MEASUREMENT OF BRAIN DOMINANCE

by Ned Herrmann

An early version of this paper was delivered to the *International Congress on Cerebral Dominances* Munich, 1988

Although I started out as a scientist, my interest in the brain came from a fascination with the creative aspects of art rather than a purely scientific pursuit. At the same time, as Manager of Management Education at General Electric, I was searching for ways to inspire creativity in a broad spectrum of company employees. My exploration of the nature and source of creativity led to a personal 'rediscovery' of the brain, which, in turn, impacted my life and my career. I spent the final 12 of my 35 years with GE largely focused on brain research, and have devoted the past seven years entirely to the advancement of brain dominance technology. Though trained as a physicist many years ago, in the highly technical arena of brain research, I am rather an innocent lay person pursuing something of enormous interest to me. It is perhaps that very innocence coupled with my experimental physics background that allowed me to develop my four-quadrant model of brain dominance, because I started not with metaphor in mind but physical reality. Had I been an expert in physiology, I may never have tackled this formidable task. But to understand why I designed the Herrmann Brain Dominance Instrument and how I have approached the validation process, it's important that you understand the premise upon which I engaged in my initial research.

Early Research

In the 1970's research into hemispheric specialisation was producing new and very exciting data. As head of management education at General Electric, I became interested in it as soon as I learned that it might apply to learners.

I immediately began exploring hemispheric specialisation myself, with a special electroencephalograph (EEG) setup designed and operated by Tod Mikuriya, M.D., Ph.D., of Berkeley, California, and with myself as the subject. My objective in arranging these tests was to satisfy myself that there was hard data available to support my understanding of left and right hemisphere dominance. During the test session, with the collaboration of Dr. Mikuriya, I developed four tests that differentiated left hemisphere and right hemisphere activity. The EEG apparatus consisted of two identical Autogen biofeedback units, one for each hemisphere. The numbers in the chart to the right represent the percent that a particular hemisphere was in either alpha or beta for at least a ten-second sustained period during the task activity.

Ned Herrmann's Personal EEG Biofeedback Experiment Conducted by Tod Mikuriya, M.D. Berkeley, California

Activity	Left Brain Alpha	Left Brain Beta	Right Brain Alpha	Right Brain Beta
Draw Graphic Symbol	90	10	0	100
Add numbers	0	100	20	80
Sketch a scene	100	0	0	100
Solve math problem	10	90	20	80

(Numbers represent percent of activity in specified wave form.)

The conclusions from this experiment are as follows: In the performance of right-brain tasks, such as drawing a graphic symbol or sketching a nature scene, the right brain was in a beta (active) state to perform the task, and the left brain was in an alpha (idling) state and therefore disengaged from the task. When performing left brain tasks, such as adding a column of numbers or solving an algebra problem, the left brain was in a strong beta state in order to perform the task while the right brain was in a lower beta state, which indicated involvement but to a lesser degree than the left hemisphere. This meant to me that the left brain situationally responded to tasks by switching quickly to a full beta state when the task called for it, and the right brain, though also situational, was

less so in that it was essentially turned on all the time. I felt that this experiment confirmed Ornstein's work as reported by Carl Sagan in *The Dragons of Eden.* The experiment also helped to explain how I functioned in my own bi-modal occupations: artist and business manager.

This experiment was followed by a much more extensive one involving a similar bi-modal EEG apparatus supplemented by a Mind Mirror and involving some 50 activities equally distributed between left brain and right brain functions. While these experiments were encouraging and in some instances confirmed left and right hemisphere selective responses to differentiated tasks, it became very clear that wiring people to an EEG apparatus would be too awkward, difficult to replicate, and time consuming for the business populations with which I worked. It was therefore imperative that I find an instrument that did not have such an elaborate apparatus or complicated setup requirements.

Even without a convenient measuring instrument I was able to incorporate some brain-related techniques to improve the design and delivery of a number of management courses. Applying the early brain dominance concepts, I made adjustments and modifications in the learning designs that ultimately became the basis for my whole-brain teaching and learning model. Even the early rudimentary attempts produced almost immediate improvements in course effectiveness.

From my early brain dominance research I discovered an interesting characteristic of GE (which I later found to be true of all large corporations). Most of the employees in each primary function (e.g. engineering) had similar brain dominance patterns. They seemed to be homogeneous in thinking style, and therefore in group situations they tended to jump to a consensus much too quickly. They were often ready to settle for the first convenient answer without searching for better alternatives. To make significant improvements in the learning, we somehow needed to develop a more diverse student body or a different process of design and delivery. So I felt a pressing need to find a way of measuring the mental characteristics of the people coming to the GE Management Institute. In the context of my knowledge of brain function at that time, my mission was to find an instrument that measured brain dominance. I was convinced that with our specialised brains, each of us would have developed different specialised brain functions to different degrees. Thus, I reasoned, people will have a variety of preferred ways of understanding things. After all, it seemed unlikely that one individual would be equally developed in all mental possibilities. Therefore, I felt that most individuals would have a distribution of dominances across the brain dominance spectrum. (Subsequent data have corroborated that opinion.)

Development of the Instrument

I went to a number of neuropsychologists and other brain specialists (including Richard Restak, one of the chairmen at the present Congress) in search of an instrument to accurately measure what I was calling 'brain dominance'. In fact, using the power of General Electric's name, I went as far as I could in the United States and the world at large to find such an instrument, but was unable to locate one.

While continuing to search for an available tool, I felt the need to share with a rapidly growing number of professional associates what I was discovering about the brain and myself. To do so, I designed and offered a series of one-day 'brain update' seminars in which I brought about 50 people into the GE Management Institute to present to them what I had learned. As the ticket of admission, they completed what I called the 'participant survey form', in which I asked them standard questions such as name, occupation, educational background, work liked best, descriptions of self, hobbies, handedness, etc. In each of ten workshops, at intervals during the experiential unfolding of my brain dominance concept, I asked the participants to indicate on a form where they felt they belonged in a left-to-right continuum.

In this way I collected data on 500 people, which sat in two piles on my desk for a year without being processed. Meanwhile, the desire to accelerate my research intensified my need for a measurement instrument. Finally, intuition persuaded me that there

was something of potential value in all that survey data. So I arranged for the Opinion Research Corporation to study the possible correlation between the questions I had asked and the positions of the respondents on the left/right continuum. The correlations were striking. For example, engineers described themselves as logical and analytical, performed well on technical tasks, excelled in math and placed themselves on the far left end of the continuum. In contrast, artists described themselves as artistic, aesthetic and emotional, they performed well on visual and spatial tasks, excelled in English rather than math and placed themselves on the right end of the continuum. With this encouragement I revised the survey form to provide additional and more accurate data and applied it to as many seminars and workshop groups as I could work into my schedule.

Using this improved questionnaire as a preliminary measuring tool, I deliberately brought students into my seminars whose data suggested that they repre-

sented positions across the entire left brain / right brain continuum (a composite whole brain group) rather than just the left brain segment. This challenged the traditional teaching process by introducing mental diversity into the classroom with the objective of having all these students become not only active learners but, because of their individual differences, part of the learning resource. Everything changed as a result.

The Metaphor

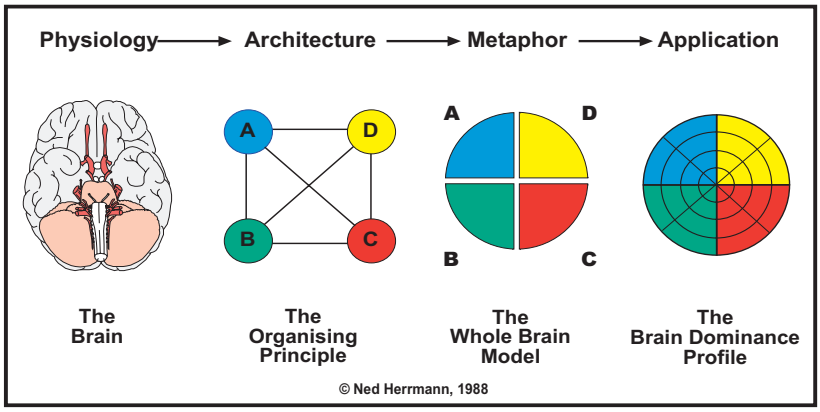
Though founded on physiological evidence in the 1970's, the behavioural qualities the Herrmann Brain Dominance Instrument measures do not depend upon the precise location of any particular physiological substrates. Therefore, from a design standpoint, the physiological nomenclature of the present whole brain model is purely metaphorical. While we continue to study research reports and hear presentations with respect to EEG's, blood flow measurement, PET scans, doppler effects and all manner of different ways of measuring brain activity, I have found nothing that contradicts my metaphorical model. Future research may establish that some of my dominance descriptors are off the mark, or even reversed. When, and if, that happens, I'll modify the model and the profile as the evidence indicates. However, no significant conflicting evidence has emerged in the past 10 years.

To optimise the usefulness of my work, my motivation has been to move from physiology to architecture, to descriptive metaphor, to useful application as quickly as validation evidence appropriately allowed. My feeling of confidence about the opportunities for application of the model stems from overwhelming empirical evidence: Countless people have declared, "This profile feels right!"

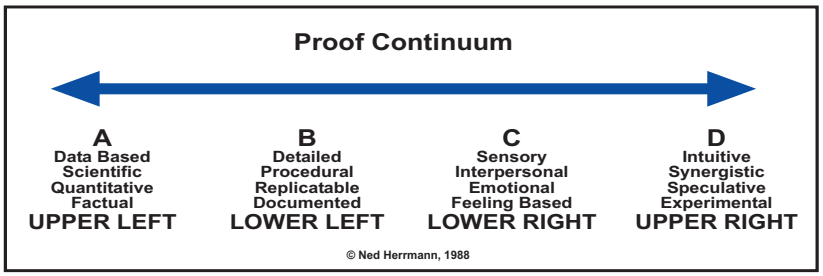
Validation

In spite of good results, I have been cautious of overly simplistic conclusions, so I have continually sought validation of my brain dominance concept.

Just as a continuum exists from left to right in brain dominance, so does a continuum occur in types of proof of validity. On one end of this proof continuum,



which can be described as 'soft', are personal experiences leading to feelings of 'rightness' and an-



ecdotal observations. The other end contains hard scientific data and statistical dissertations. Somewhere between are detailed observations and informal studies. (See the diagrams on this and the next page.) Studies performed on the HBDI also range from physiological to behavioural, some treating the instrument as a physiological measure, as I started out doing, and some treating it as an indicator of behaviour, as the metaphor approach does. I consider all forms of validation evidence worthy of consideration and incrementally contributory to the validity of the whole brain model. In fact I waited ten years to write my book, *The Creative Brain*, in order to accumulate sufficient data and experience to be confident in the work's credibility. During those ten years hundreds of studies, in the full continuum from hard to soft, have been conducted on the HBDI. I will share with you now some of that validation evidence, across the entire proof continuum.

The first formal validation study I will describe here is entitled, "Cognitive style, EEG waveforms, and brain levels" by Lawrence L. Schkade, Chairman, Systems Analysis Department, and Alvin Potvin, Chairman, Biomedical Engineering Department, both of the University of Texas at Arlington, Arlington, Texas 76019, U.S.A.

Using an early version of the instrument, available in 1980, Schkade and Potvin studied a group of 12 accountants and 12 art students using EEG biofeedback techniques. They concluded that indeed the instrument measured left and right cerebral hemispheric dominance:

> The experimental results indicate that accountants and artists have very different cognitive styles that are manifested physiologically. In terms of the ratio of the power of the hemispheres, a value of 1.0 would indicate no dominance (equal uses of each hemisphere), a ratio of

less than one indicates dominant use of the left hemisphere, while a ratio greater than one indicates dominant use of the right hemisphere. In this study, the mean power ratio for accounting students was 0.77 while the corresponding ratio for art students was 1.2 a statistically significant result that is expected to result randomly with a probability less than 0.001.

[Schkade and Potvin, 1981, p.330]

The results of this study indicate that the sampled persons in each of these two career areas processed information very differently and have chosen career fields that reflect their hemispheric dominance. I would position this validation study toward the 'hard' and physiological end of the proof continuum.

My book, *The Creative Brain*, contains a 41-page appendix chapter written by the head of research management for Educational Testing Services (ETS), C. Victor Bunderson, a well-known authority in the field of psychometrics. In this comprehensive paper, Bunderson describes four forms of validity - content based, criterion based, construct based and face validity, all of which he analyses thoroughly. His positive conclusions on the validity of the HBDI are based on three studies he personally conducted as well as the doctoral dissertation of Kevin T. Ho, Ph.D. [Ho, 1988.]

Evidence for the internal and external construct validity of the HBDI has been presented in this appendix. The following statements can be made with confidence that they are supportable by replicable validation studies.

Internal Construct Validation.

1. There are four distinct clusters of preference and avoidance measured by the HBDI.
2. The four clusters are consistent with the descriptions given in this book of the quadrant model of brain processing.
3. The scores derived from the instrument are reliable.
4. The internal factor structure consists of two bipolar 2nd order factors (A vs. C and D vs. B) and a single bipolar third order factor (Left vs. Right Dominance).
5. Avoidance is most often found in the end opposite to a preferred end of one of the bipolar factors.

External Construct Validation

1. The Left vs. Right Score and the four quadrant scores were involved in a pervasive and a predictable way with the mental processes involved in measures of other constructs:
   - personality type
   - cognitive style/cognitive abilities
   - learning style
2. The bipolar factors internal

Distribution of Proof in the Whole Brain Model

A
UPPER LEFT
Physiological Measurements
EEG, PETT, Blood Flow Data
Split Brain Tests
Tachistoscopic and Dichotic Listening Tests
Brain Dominance Demonstrations
Doctoral Dissertations

D
UPPER RIGHT
Intuitive Understandings
Observed Accomplishments
Personal Experiences
Specific Affirmations
Drawing
Sculpting
Imaging

B
LOWER LEFT
Documented Accomplishments
Participant Evaluations
Longitudinal Studies
Published Articles/Studies
Testing Protocols
Validation Studies

C
LOWER RIGHT
Personal Testimonials
Feelings of Rightness
Ability to Teach Others
Understanding of Self/Others
Soul

to the HBDI are also found in first, second, and third-order factors in batteries of instruments that cut across these different instrument types. The quadrant constructs thus have explanatory and predictive power well beyond the HBDI item types.

3. While the HBDI scores share variance in predictable ways with speeded cognitive ability factors, introversion/extroversion and the tendency to use different learning strategies, these are all different factors which separate as distinct factors in properly constructed test batteries.

4. By contrast, the Myers-Briggs Type Indicator and other high-order measures of pervasive personal styles load on the same bipolar factors with the HBDI scores. They appear to be different rotations of item clusters which, while developed based on different theoretical models, may ultimately be explainable by a common set of constructs.

In addition to Ho's work, there are 55 other doctoral dissertations based on the instrument.

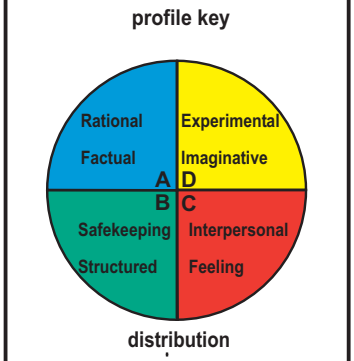
Toward the soft end of the proof continuum is an exercise I use in the five-day ACT I workshop, in which participants create a 'personal logo'. They do not know their brain dominance profiles at the time they create this logo, but the concept, design, and materials selected consistently corroborate their profiles.

On the bottom of this page are five examples of profiles and corresponding personal logos.

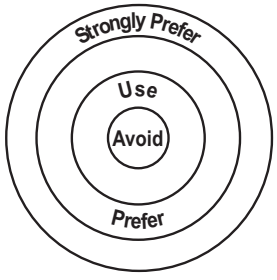
This type of strongly correlated data is an important part of the validation process for me. It demonstrates the relationship between mental preferences and behaviour, and I believe these mental preferences are a direct result of differing brain dominances.

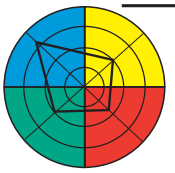
Another form of validation re-

Herrmann Brain Dominance Instrument



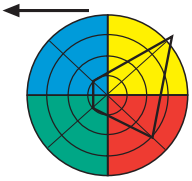
The HBDI profile indicates the distribution and degree of an individual's mental preferences in four quadrants





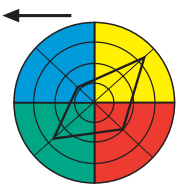
A collection of tools (pliers, ruler, screw driver, tape measure) arranged in a structured display

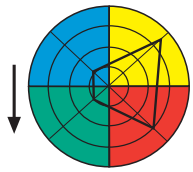
A vivid tropical 'bird' constructed of multi-coloured cotton balls



Lengths of ribbons hung from a rod equally spaced along its length and symmetrical in length

Two large red arrows side-by-side pointed in the opposite direction with metaphors of fun/pleasure in one direction and business/home responsibilities in the other direction





A model of a hot-air balloon made of multi-coloured yarn with two friends in the basket

This text describes personal logos made from available creative materials in the ACTI Workshop. The HBDI Profiles represent the thinking style preferences of the individuals who created the logos.

sults from diagnosing the prework for the Applied Creative Thinking workshop. In this exercise I ask participants to describe the "most creative person" they know. Virtually every aspect of the response reflects the respondent's profile, though he or she has not yet seen the profile. From the hundreds submitted, I have selected four representative examples of profiles and responses.

1.0 Who

The person I am describing… I know… only as a casual friend; hence, I cannot relate to her regarding all of the points outlined in exercise 1-B

2.0 Points from Exercise 1-A

2.1 Imagination

Sam's imagination is best exemplified by her quick and cunning wit…

2.2 Drive & Logical Thinking

Sam was secretary to the owner and manager of a… cleaning franchise… She borrowed the money and bought the franchise… [and] the business has been successful for approximately ten years.

3.0 Productivity

I believe that Sam's productivity is also explained in paragraph 2.2 above.

4.0 Creativeness

Over the past ten years, she has hosted many parties. These parties are usually organised around a central theme or idea…

A Creative Person I know

Pre-conscious musings register,
Sensory inputs high noon,
Expanding wealth of experience,
With body and mind in tune.

Heart and mind working together,
In the midst of the marketplace roar,
Seeing and feeling relations,
Where none existed before.

Visualising what she is thinking,
Believing in what she feels,
Happy examining pieces,
Before the bell finally peals.

Dresses as comfort demands,
With fixins' that take little time,

Smiling, straight talk and humour,
Articulates ideas in rhyme.

Behaves as if hard work is fun,
Listens to what people say,
Knows that success is subjective,
But people are vital today.

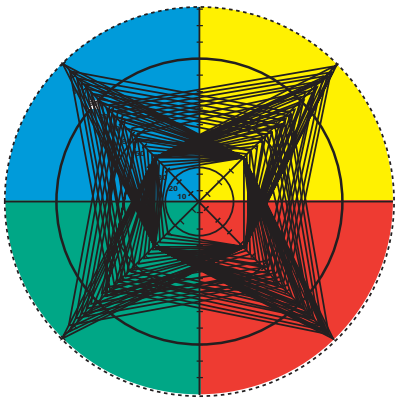
Produces by standards she sets,
Keeping her eyes on the dream,
Remembers that life is for living,
And doing, not having the cream.

Confident walking in darkness,
Before the sun's brilliant roar,
Playfully understanding,
That life is a green metaphor.

I cannot say I have met what I consider a creative person in my working career. My perception of a creative person is best depicted by some college professors I have had.

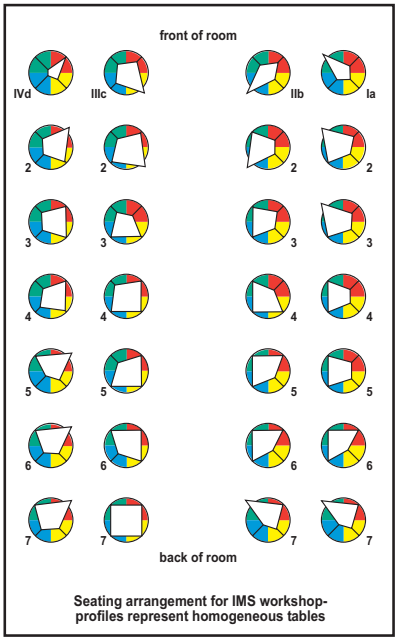
This exercise required little time, only a quick hand to capture all the thoughts that flowed. A close friend, Susan… surely is my creative individual. This unique lady has eyes that can see art in a seed pod and draw it, can capture love from the canvas in the exposed ceiling of a room and paint it, see a man in a block of clay, glass, oils, water colour, ink, paper, cloth, wood, even useless junk, and I am sure that with a little time, the results will be either useful, artistic, clever, silly, odd, innovative, etc. But most important, it will happen, and will be created at that moment and it will never happen again with the same impact. She can listen to Bach, Beethoven, the Black Sabbath, Styx, or a preschooler sing and find some value and beauty in each. Being at the right place at the right time is not enough, but being at the right place at the right time and hearing the music is what Susan is all about.

From a dominance point of view, I believe that the world as a whole is a composite whole brain. Diverse groups of 100 people or more routinely display this relatively uniform four-quadrant distribution.



Composite Profiles of Management Group (Chicago IMS)

In working with such a group I arrange the seating in the auditorium so that people are positioned on the basis of their mental preference.



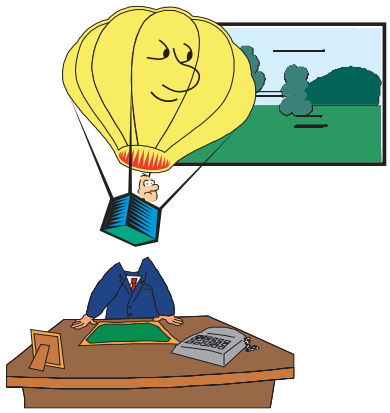
Seating arrangement for IMS workshop- profiles represent homogeneous tables

A typical exercise conducted with groups seated on this basis asks homogeneous groups to reach a consensus about what work "turns them on". The results of over 100 of these public demonstrations are strikingly consistent. Homogeneous groups at the left end of the brain dominance continuum (A quadrant, on the left side of the room) uniformly identify work requiring logical, analytical, quantitative, and fact based processing, while homogeneous groups at the far right end of the spectrum (D quadrant) identify work requiring synthesis and intuitive, holistic, conceptual modes of processing. The B quadrant people strongly prefer work requiring planned, organised, detailed and structured activities, while the C quadrant people uniformly require people-oriented, interpersonal, feeling oriented work. As the profiles become more multidominant, the work preferences become more blended and evenly distributed, which occurs most frequently in the centre of the room.

In this type of seating arrangement, the participants have the opportunity to witness brain dominance distinctions directly. For example, in several of my workshops I show a number of cartoons, some of which appeal specifically to left-dominant individuals and some to right-dominant people. Inevitably, one cartoon will set the right side of the room rolling with laughter while the left side looks on in astonishment, wondering what is so funny. Another cartoon will set the left side off but leave the right side exclaiming, "dumb!"

As my workshops are designed specifically for the brain dominance continuum, such seating arrangements offer graphic and immediate face validation to the participants.

I regularly perform other demonstrations of the face validity of the instrument in seminar groups of 20 to over 100 participants. For example, after they have received and understood their profiles, I ask the participants whether they believe that their profiles represent an accu-



"Honestly, Ellen, you're SO organised!"

rate description of the distribution of their mental preferences.

On the average, about 90 percent raise their hands. Though these exercises are relatively close to the 'soft' end of the proof continuum, they nevertheless provide a powerful affirmation of the face validity of the instrument.

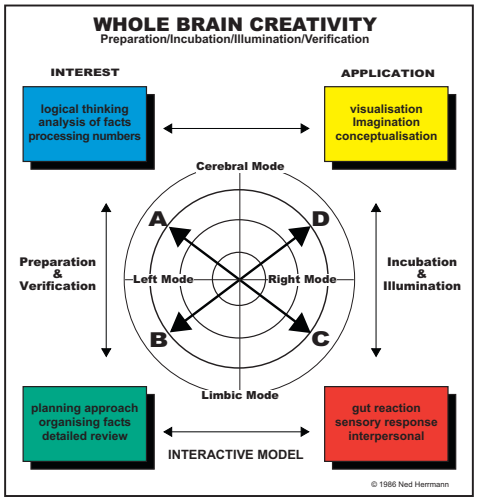
Whole Brain Models

The organising principal of the whole brain model contains four different selves, characterised by the following descriptive concepts: rational, safekeeping, feeling, and experimental. (Other words can replace these - the concepts are broad).

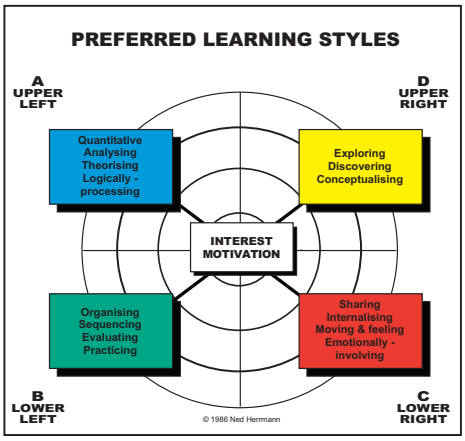
This organising principle is also the basis for the instrument and an array of other models, one of which is whole brain creativity. Using the idea of the specialised, iterative nature of the brain, it is possible to teach people not only creative techniques and skills, but also to access their latent creative potential.

The model provides a process and a direction, and it can be further expanded to include not just the personal aspects of creativity, but also the culture in which a creative experience takes place, because the culture and environment can influence everything that takes place.

Preference and competence are not the same thing. Preference can lead to a competence in that we will gain the competence at a higher level, faster, and with less pain in our areas of preference. Our capacities for achieving competence are also influenced by our interests and motivation, for which there is absolutely no substitute. For example, the 12 years that I have spent engaged eight to 10 hours a day studying the brain have been effortless, because I've been interested and motivated. That has led me to do more in that 12 year period than I did in the previous 35.



OUR FOUR DIFFERENT SELVES



My decision model shows how sensitivity to one's profile can help in developing and using competencies. Having achieved competencies, one can go to work applying them.

Approaches are different for each quadrant. Questions are different, and strategies are different. The organising principle helps us understand that we are not single individuals but rather a coalition. We are a combination of the A, B, C and D quadrants in the model. As we go through a decision-making process we apply the approaches and strategies of each quadrant to the degree of our preferences.

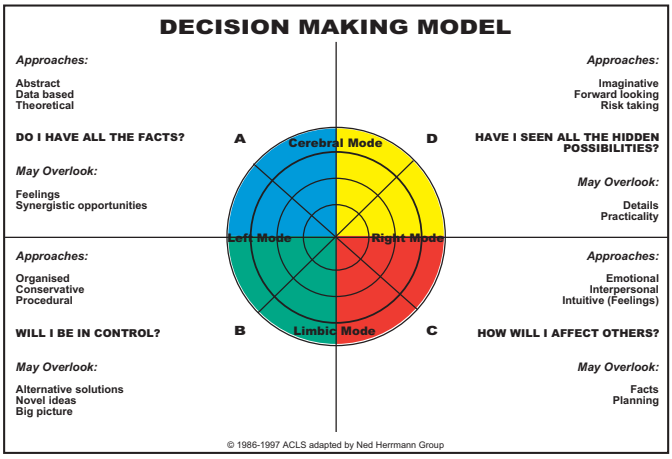
Coming out of the development of the instrument was the complimentary and parallel development of an array of models around which I developed seminars and workshops. The workshops deal with specific issues such as creativity, teaching and learning, management development, team building, leadership, problem solving, etc. Applications include: marriage counselling, family counselling, career counselling, etc.

For example, we have considerable data on recovering alcoholics. One important finding is if the therapy does not match the preference of the individual, the chances of success are greatly reduced.

No matter what a person's brain dominance is, the degree of wholeness is the degree to which the person can use any quadrant situationally. We must maintain competencies even in our least preferred quadrants so that when a situation demands it we can respond appropriately. We

can develop competencies even in mental areas where our preference isn't at the primary level, particularly if we know about our profile and thus, our array of preferences. An effective strategy of management education and development is to facilitate a person's ability to be more situationally whole.

In summary, I have here presented information and data describing a variety of validation studies and activities that have involved the HBDI over the past 10 years. These validations range from hard to soft across the proof continuum. Taken together, I believe they represent far more effort and scientific commitment than most instruments with which I am familiar. From a financial standpoint, the investment in validation and reliability of the HBDI exceeds $500,000 and between 18 and 20 person-years of effort. More importantly, the validation process is a continuing commitment - it is ongoing. I am confident that the validity and reliability of the HBDI will be increasingly confirmed by current and future research.



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