Terms and Powerful Ideas

Blue Heron, SR Sheridan good luck bird,
pen and ink drawing, 1997

Some of the terms used in this book are new; some are used in particular ways. Some information is so relevant to education that it is described as Powerful Ideas.

TERMS:

WholeBrain:

The terms "whole brain" and "whole mind" are existing terms used to describe educational strategies informed by brain science which take into account the fact that the child exhibits distinct intelligences—spatial, logical-mathematical, and so forth (Gardner, 1983), and that these intelligences are best developed in integrative, cross-disciplinary ways.

WholeBrain is a new term. WholeBrain education categorizes intelligence under two general categories: spatial and linguistic. These two broad categories are informed by a grammar of intelligent thought that is natural to the brain and also learnable. WholeBrain education focuses on the development of mental powers in the context of these two general categories in mutually reflective exercises. The goal is encouraging learning that is brain-like, or interhemispheric.

WholeBrain education begins with the fact that students have a right hemisphere and a left hemisphere—as well as other corresponding brain parts—which work together. WholeBrain education recognizes that the bihemispheric brain has evolved to make translations between systems of representation—most particularly, between the visual and the verbal. Image and text developed syncretically. Education can teach drawing and writing in the same co-creative manner.

WholeBrain education is cross-modal; it deliberately encourages an exchange of information between visual and verbal brain processes. These exchanges, or cross-translations, extend understanding. **Translation exchanges are the bihemispheric brain's particular strength.**

Educational strategies which provide training with translation exchanges are Neuroconstructivist. Constructivism is an existing term which focusses on the student as the knower and the learner. **Neuroconstructivism * (Sheridan, 1990) is a new term. Student's not only construct knowledge, but their brains.** The brain is a highly modificable, complex organ. The environment and more especially, how the learner responds to the environment, strongly influences how the brain grows and functions. The ways in which the brain learns to connect information determines the quality of its neural networks, and, by extension, the usability of that information.

The goal of WholeBrain education is well-developed, well-connected visual and verbal observational, analytical and inferential thinking skills. Brains educated in this way will be astute about meta-messages embedded in advertising—political, commercial, and otherwise—and will also be skilled at producing messages designed to communicate precisely where verbal meets visual, or where text and image intersect. These brains will be equipped to navigate effectively in an historic period described as the Age of Technology, or the Age of Information. In addition, brains trained by humanistic/Neuroconstructivist strategies like Drawing/Writing, will be adept at balancing options and accepting differences—two mandatory skills in a complex, increasingly global society. And, most importantly, such brains will be multi-lingual. They will speak the language of drawing, the language of writing, and the several languages of the classroom, from a highly examined argot to a shared, more formal language based on a classroom-generated vocabulary informed by the arts, mathematics, grammar, philosophy, science, and Latin and Greek prefixes, suffixes and roots. Such brains will be equipped to and expect to move between languages.

The brain is predisposed to think intelligently. But, like language, intelligence requires triggering and training, and, like language, intelligence is developable or retardable. Neuroconstructivist education focuses on language as central to thought and provides experiences designed to produce brains interested in and skilled with language.

Extended definitions

The cross-modal translation exchange:

A cross-modal teaching strategy requires a transfer of information from one mode of representation to another. For instance, in Drawing/Writing, a deliberate transfer of information is achieved from drawing to writing. The sentence, “My drawing tells me that my object is...because....” achieves this transfer. The goal of the transfer is inter-influence: each mode of representation intends to extend the other. The result of the transfer is a transformation, or a new kind or level of information or understanding. **The term cross-modal translation exchange is new** and describes the Drawing/Writing program in particular and Neuroconstructivist programs in general.

The terms “cross-modal,” or “cross-domain transfer” are existing terms used to describe the ways in which the spatial and linguistic capabilities of the brain cross-cue and complement each other. It is useful to appreciate the four ways in which the term cross-modal is already in use as a descriptor of brain function beyond the fifth, specialized use described above—the cross-modal translation exchange:

1. The term cross-modal means “multi-sensory.” Multi-sensory thought is intrinsic to all organisms with sensory systems. We access information about the world through our eyes, ears, noses, mouths, and fingers, as well as through the entire surface of the skin of our bodies. In addition, there is a sixth sense described as proprioception: this is our ability to know, as if we were a gyroscope, where and how and at what attitude or angle we exist physically in the world of physical phenomena. In the form of multi-sensory processing, cross-modal thought happens in the routine course of adaptive behavior in intact sensorimotor systems. “My hammer smells like dust because it looks like an old bone” combines the sense of smell with the sense of sight. “My corkscrew smells as sharp as rain because it has repeated diagonals in the screw part which remind me of driving rain” (David Belval, Drawing/Writing student, 1997) combines the sense of smell with touch and the sense of touch with sight. Multi-sensory processing enriches comparisons.

2. The term cross-modal means "inter-hemispheric," or spatial/linguistic. In the intact human central nervous system, the entire brain, including both hemispheres, contribute to thought. Brain scans clarify the fact that every act of thought is both spatial and linguistic.
   Spatial and linguistic processes are associated with one hemisphere or the other. Generally, the left hemisphere specializes in language, while the right hemisphere assumes spatial tasks. Although initially equipotential, each hemisphere eventually suppresses the other for the ability it assumes. Suppression of function, or delegation of tasks, maximizes the capability of the brain for specialized operations. Thus, brains become "lateralized." We speak about the right hemisphere as a spatial information processor and the left as a language processor, but we must keep firmly in mind that such distinctions are themselves linguistic; a spatial/visual mental operation like drawing is linguistic: it is visual language, and linguistic/verbal mental operations like writing and reading are spatial: they include and often start with a visual analysis of the patterns of marks on a page.
3. Cross-modal processing is global operations and global operations are cross-modal processing. Multiple brain scans of the same individual can be combined with averaged scans of other brains using a tracer chemical, oxygen 15. These averaged scans demonstrate metabolic activity all over the brain, as well as in both hemispheres, for either a visual or a verbal task.
4. Cross-modal thought is both concrete and abstract or practical/theoretical. As a brain's problem solving skills become more powerful, the mind is capable of thinking about things and ideas in equally rigorous ways. In fact, the brain manipulates ideas and things in similar ways (Minsky, 1988).
   Doing something to a thing, having an idea about a thing, and having an idea about an idea about a thing are so interrelated in effective problem solving that making a distinction between these ways of thinking becomes meaningless or, at least, counterproductive. The point to hold to is the enduring usefulness of the back-and-forth rhythm between concrete and abstract processes in language-based thought.
   A letter of application from my second cousin, John Bannister, written in 1996 after his sophomore year at Reed College, to Columbia University about qualifying for a summer physics program, describes such a moment of recognition about the intimate and important relationship between practical and theoretical thought:
   "During the last two years, while occasionally struggling my way through Reed's notoriously theoretical physics classes, I have asked

myself this question, 'Why am I bothering with all this theory?'
"I came to Reed College for a number of reasons, a burning desire to study physics not being one of them. I thought, at the time, that I might possibly like to become an engineer, and physics seemed a logical stepping stone.... Predictably, I began to be frustrated with the theoretical emphasis of Reed's first-year physics class. I didn't want to learn the theory. I wanted to learn how to build things!
"Working over the summer as a computer repair technician, I began to consider computers with the insight I had gained during my first year of college physics. Surprising myself, I realized that I could conceptualize a basic theory and how the various computer components worked. It gave me a thrill and boosted my confidence considerably when I did some basic research and discovered that many of my theories were more or less correct. With this small success, I began to examine other things around me and realized that I could apply the physics I had learned to many situations. This was much more fun that solving word problems in the book. Being able to apply my knowledge to real life situations was far more gratifying. Also, while I had been an able computer repairman before, able to follow installation and repair instructions well enough, I felt that I was becoming a better one; I was now able to grasp more fundamentally what I was actually doing (Before, it might have been simply, 'Don't put your disks near a magnet.' Now it was, 'Here's why you shouldn't put your disks by a magnet...').
"More importantly, at least for myself, is the fact that an understanding of the underlying physics allows me to look at things at a new level, and to see beauty and simplicity where before I saw nothing. My understanding of physics, even as rudimentary as it is at the moment, allows me to see not only the spinning top, for instance, but to understand and appreciate the forces and interactions which keep it upright. To quote Richard Feynman: 'I can appreciate the beauty of a flower. But at the same time, I can see much more of the flower. I can imagine the cells inside, which also have beauty. There's beauty not just at the dimension of one centimeter, there's also beauty at a smaller dimension.'
"I've modified my career goals; I don't see how I could ever have considered a career in engineering without wanting to learn the theory behind what I was doing. An understanding of the theoretical foundations is what makes engineering and science (especially physics in my opinion) such elegant and interesting subjects. No matter what I choose to do, I believe that I will do it better, and derive a greater

satisfaction from it because I will understand the physical principles behind it " John Bannister, 1996. John majored in physics at Reed.

5. Cross-modal operations provide cross-domain cues. Cross-domain cues are responsible for linking or integrating codes, triggering the combination of several modes of representation. Cross-domain cues also have the power to unleash additional processing capabilities for the second or subsequent mental operation. Should the second mental operation be the more difficult or challenging one, as might be the case with writing, or mathematics, that mental operation profits by this boost in processing power. This is the observed effect of the relationship of drawing to writing in a deliberate cross-domain cueing situation called Drawing/Writing.
   Cross-domain cueing happens in the course of our daily lives: we hear a dog and a mental image of a dog, or of the many dogs in our experience, are cued as well as our emotional responses to dogs, and, in addition, the word "dog" or the names of specific dogs may be cued.When language is cued, a high-level code comes into play; through this code we are able to tag and describe the barking dog through a wide range of characteristics, relationships, stories, works of art, poems, associations, emotions, allusions and inferences.
   Cross-modal, multi-sensory, interhemispheric, spatial/linguistic, globally-distributed, concrete/abstract thought is intrinsic to the human mind. It is in particular the spatial/lingusitic, or visual/verbal aspect of cross-modal thought that the Drawing/Writing process emphasizes.

Neuroconstructivism * (Sheridan, 1990):

Neuroconstructivism * (Sheridan, 1990) is a new term. Neuroconstructivism * (Sheridan, 1990) places the emphasis on the child's brain as the active agent in learning. It shares with Piagetian and Vygotskian thought the understanding that the mind of the child is qualitatively different from that of older children and adults, and that knowlege, intelligence and morality spring from the child's actions, and that this "child-action" has the quality of being playful and experimental.

Children not only construct knowledge, intelligence and morality but they construct their brains on neural levels through thought and action. The point to remember as parents and educators is that the networks children construct determine present and future capabilities for thought and action.

The brain is alone and would be very nearly inert or at least quiescent—a shut-in—were it not for its body's sensory systems. Each brain constructs its world from experience. That world may be like or very unlike other brains' constructions. The position of the atheist existentialist is relevant to neuroconstructivism * (Sheridan, 1990): all things are allowed. Still, if we accept the atheist existentialist position, each brain's moral or ethical decisions must be made in the context of the common weal, or the good of all. This paradoxical freedom is like that of the Christian existentialist who worships a god "in whose service is perfect freedom." In a society comprised of many cultures, belief systems, and codes of behavior, when it is unclear what behaviors are and are not allowable, a strategy for determining right action based on compositions in drawing provides a practical approach to ethical decision-making .

The mind might fragment in despair were it not for integrative activities. Dance and song and painting—the applied and performing arts—allow the human spirit to feel as if it were one with creation. Human interaction, on the other hand—communal worship, collaborative productions, parenting and partnering—allows the human spirit to feel as if it were at one with humanity. The brain's aloneness is its protection and its vulnerability, its joy and its sorrow, its pleasure and its pain. The more lively, the more attentive, the more efficient the brain becomes in its searches, the more expressive it becomes in its outreachings, the more integrated that brain will be within itself, and within the context of the world it constructs for itself.

"The world is infinitely complex, and an individual brain can only know the little that it can create within itself. It turns out that this view is well known to philosophers....Now neurodynamicists can show experimentally that it is true....As existentialist philosophers from Kierkegaard to Heidegger and Sartre have concluded, each of us constructs our self by our own actions, and we know our self as it is revealed to us in our actions" (Freeman, 1997, 69).

The Thinking Child:

The Thinking Child is the name of a new educational theory and practice which focus on the child as a self-constructing thinker. The program is informed by both brain science and by constructivist educational practice. Neuroconstructivist curricula are appropriate to thinking children because they are cross-modal, modeling brain processes.

Grace periods and educational lag time:

WholeBrain approaches to thinking skills take into account periods of grace. One child's brain grows differently from another child's brain. Each brain grows differently from day to day. Robert Kegan's advice—"attend upon the child"—means that educators and other caregivers must provide patient support for the child as a thinker. Some children are ready to read in the first grade. Some are not. In the meantime, students can create cognitively useful abstract drawings, like Composite Abstractions, even if they are not yet ready to read or write. The CA provides a grace period in the literacy process.

With the current overemphasis on visual stimulation and underemphasis on verbal stimulation, expectations about writing, reading and speaking skills should be flexible. In classrooms where primary languages differ, grace periods are required.

The new literacy:

The brain shunts information between systems. The shunting is so continuous that the process is best described as spatial/linguistic, or visual/verbal. Language instruction should mirror and mine this relationship. Classroom practices which disconnect drawing from writing, or writing from reading, parse brain functions, interrupting the continuum and isolating mental endeavors. Brain-like educational practices have optimal effects: efficient networking on neural levels; rich syntheses on mental levels.

The deliberately syncretic, or co-creative integration of visual and verbal modes of expression constitutes the new literacy. The new literacy is the ability to "read" and to "write" these combined, complex communications. Images developed in connection with text and text developed in connection with images, allow each mode to be read at certain levels. It is precisely "where verbal meets visual"—where two information systems converge—that the meta-message occurs. It is the combined effect of several systems that increases the possibilities for precise communication, and, for good or for ill, influence.

The new literacy takes into account the fact that students may need to be fluent in informal as well as formal versions of their mother tongue, and, for many, in a second language—the language of the classroom which, for many Americans, is English. Slang or argot as languages are not necessarily less precise than more formal language. The group that uses the argot knows exactly what is meant. Generally, argot is appreciably informed by glance, gesture, inflection, tone and particular group usage. Problems occur when one group's informal language or slang or argot is unintelligible to another group or identifies them prejudicially or simply proves inadequate socially or professionally when they move beyond the group. It is here that training in translation exchanges proves useful. Students who are used to translating between drawing and writing, and who are trained in critical yet supportive peer exchanges, and who are used to constructing and explaining drawings and writings including Composite Abstractions in group critiques, know that clear communication in any language requires work and negotiation. These students know that several languages facilitate communication. A well-placed word in argot may be effective if the group understands it. Beyond the group, additional words shared across domains may be necessary.

Balanced bilateral brain:

A brain that uses both hemispheres in a less lateralized or less specialized manner is described as balanced bilaterally. Research shows that the female brain is naturally less lateralized for some tasks than male brains, using corresponding spots on both sides to solve certain kinds of problems faster and with less expenditure of energy. The female brain also remains equipotential longer than the male brain; its capacity for recovering functions usually located on one side or the other after trauma is higher initially and remains so for a longer period. When combined image and text dominate as the favored method of communication, it makes sense to train brains for balanced bilateral processing and production.

POWERFUL IDEAS:

Redundancy:
The brain is redundant. It has more connections than it needs. Educational strategies should be redundant, too, allowing repeated practice with connected, richly experiential, reflective activities.

The Arts as knowledge informed by touch:
If the arts are redefined as knowledge informed by touch, it becomes clear that the arts are neither frills nor the pursuit of the elite nor the exclusive activity of the very young but that they are the everyday business of the body/brain.

Dynamic nonlinear system:
The human brain, the Drawing/Writing process, and the neuroconstructivist classroom are nonlinear systems. The output from each system has the possibility of being phenomenally different from the input. The child’s ability to think, as well as brain-like teaching and learning strategies and classrooms conducted in a neuroconstuctivist manner, produce unpredictable, nonlinear outcomes.

The highly variable aspects of dynamic, nonlinear systems like the brain and the classroom mean that small changes can have large effects. This is a message of hope for over-stressed school systems. The introduction of a neuroconstructivist program like Drawing/Writing and the training it provides in the new literacy have substantial, observable effects on behavior and performance in the classroom, most especially in connection with increased attention, self-direction, and visual and verbal skills.

Embeddedness:
The quality of nestedness—of being fit inside itself in increasingly small, cloned models, like Russian dolls—is responsible for the self-referential aspects of human thought, including language. In the brain, layers and columns of brain tissue interwoven like the Ardebil tapestry with hundreds of neural knots per square inch achieve parallel and simultaneously interconnected transmissions. The organization of brain tissue for feedback loops provides the physical/procedural basis for iterative, recursive human thought.

Like the relationship of energy to matter, the relationship of thought to language is reciprocal. Educational strategies which nest language activities within each other—like Drawing/Writing—mirror brain activity, encouraging cooperative, transformational exchanges between modes of representation. Cross-modal exchanges, particularly visual/verbal exchanges, can be used iteratively and recursively, calling themselves back over and over in operations described as translation exchanges. By making use of a simple command—draw and then write reflectively about the drawing—the Drawing/Writing program calls back one procedure over and over again throughout an expanding system. That iterated command models the bihemispheric brain's own command relayed by the corpus callosum: translate and extend this visual information verbally, and translate and extend this verbal information visually.

Fractals:
Fractal objects and procedures describe complicated systems. Fractals have changed the way we understand the word chaos. Complex systems whose orderly patterns repeat so infrequently that only a vast string of computations reveal the system behind the behavior is described as a chaotic system. It is only apparently indescribably messy. A single event can occasion a global change in a chaotic system. This hypersensitive perturbability is a characteristic of chaotic systems, including brains. The complexity and the modifiability of the brain make it a prime candidate for fractal models and explanations.

Holographs:
The brain also lends itself to holographic modeling and explanation. A

hologram is produced when a laser beam is split in two. One beam hits the object—say, an onion—and bounces off; the other beam collides with this bounced light. The collision creates an interference pattern. Like dropping two pebbles in a pond which send out two sets of concentric ripples which intersect, a holographic image is created by interference patterns. The complex configuration of troughs and crests from the colliding ripples creates intersecting, concentric rings. This interference pattern is recorded on a piece of film. When another laser beam is shined through the film, an image of the original object—the onion—re-appears. The observer can walk around this object but can not touch it. The object/image is perceptible but immaterial.

There are curious qualities to holographs. They are self-generative. Shine a laser on a small piece of the holographic film and the whole onion is generated. Cut off a slice of the holographic film containing the laser-imprinted image of an onion, and, planaria-like, any slice of that piece of holographic film regenerates the entire onion. Memories in the brain are stored in this overall way: they are not localized, as researchers once thought, and yet certain aspects of a memory—smell, sound—can be triggered locally via a carefully inserted electrode. Visual information is stored in the brain in overall ways, too. The wave-like connectivity between the branching dendrites of nerve cells creates wave or ripple-like electrical signals. These waves intersect, causing patterns of interference which we recognize as thoughts. On several levels, brain function is holograph-like (Talbot, 1991; Freeman, 1991; Sheridan, 1991).

According to the holographic model, not only brain function but reality is the result of waves of interference in a now-you-see-it-now-you-don't mode. The observer makes the difference. Look, and you see an onion. Look away from the onion, and the intersecting ripple pattern on the holographic film returns. When you are not looking, the interference pattern is all there is. This point of view is akin to experiments in quantum mechanics; how the observer sets up the experiment determines what happens, including the appearance and behavior of an individual photon. All that exists by itself—apart from any observer—is an unbroken wholeness (David Bohm in Zukov, 1979, 95). Holographic theory means that the world is interference patterns—unless there is an observer. The eye of the observer achieves a laser-like transformation (using, perhaps, a Fourier-like calculation: Changeux, 1985; Churchland, 1986; Talbot, 1991), which translates interference patterns into things or people, as we believe things and people exist.

For educators, the point of holographic theory, as is the point with quantum physics, is that the observer makes a difference. More particularly, the mental acuity of the observer determines how the interference patterns are translated by that particular observer, including their sharpness and completeness. Acuity is trainable—from the most direct level of looking at objects and drawing them—to writing about objects using categorized and embedded language systems. The holographic model underscores the radical individuality of perception, as well as its variability and its embeddedness. The holographic model (as does the fractal model) also emphasizes the mathematical aspects of human thought. Research with Warlpiri (contemporary seminomadic hunter/gatherer Central Australian aborigines) who create sand songs and site path designs suggest that preliterate symbolic communication has a grammar and that this iconography is a form of mathematics with visual components that interact like notational components in algebra. This field of study is described as ethnomathematics. In communications like the sand songs (marks drawn in sand like petroglyhs are carved in rocks, only sand songs, like Native American sand paintings, are evanescent: the wind blows the marks away) "mathematics provides a means for individuals to explain and control complex situations of the natural and of the artificial environment and to communicate about those situations. On the other hand, mathematics is a system of concepts, algorithms and rules, *embodied in us,* in our thinking and doing; *we are subject to* this system, it determines parts of our identity" (Roland Fischer, *Mathematics as a means and as a system in Restivo,* Sal; van Bendegem, Jean Paul; and Roland Fischer, Eds. *Math Worlds: Philosophical and Social Studies of Mathematics and Mathematics Education,* Albany: State University of New York Press, 1993, pp.113-133 cited in the article "Sand Songs: The Formal Language of the Warlpiri Iconography" by James R. Rauff, Humanistic Networks Journal #15, p.26, July 1997).

Note: Italics under "embodied in us" and "we are suject to" were added by the author to underscore the intimate relationship between our brains, our thinking, and mathematics.

If the implications of the holographic model are to be taken seriously, it is critical to train the mind to work with abstract and intangible patterns matter-of-factly and concretely. It is also extremely important educationally to make connections between mathematics and other languages, like the ones we speak and write and read.

The Form of the form

The Form of the form is a new term to describe the structure and process (fractal, holographic, and mathematical) underlying and responsible for the brain's operations. Like religious terminology or systems of geometry, the term can only be an approximation but it provides an attempt to describe hierarchically something which operates, for all intents and purposes, globally and simultaneously.

The predisposition toward language is a form of this Form. Languages—spoken, written, mathematical, musical—are specific manifestations of one—the linguistic—form of many forms of the Form. The predisposition toward language is variously called deep or innate grammar. This grammar allows very young children to construct strings of well-formed sentences. Overheard language triggers and operationalizes innate grammar. Another manifestation of the form of the Form is drawing. No trigger is necessary for children to mobilize this visual grammatical system.

The Form (fractal, holographic) organizes stimuli in waves and patterns via neural-based, mathematics-like operations. A nerve fires when there is neither too much nor too little electro-chemical energy. A wave of excitation floods the brain as a result of millions of right relationships, achieving a pattern of tightly spiraled energy recognized as a perception or a thought.

In a drawing, right relationships are felt, first, but are capable of analysis. A student who creates right relationships between line, form, and space in a CA through thoughtful, largely non-verbal contemplation of the work from all angles is able to analyze these relationships verbally, bringing them to a conscious, communicable level. Right relationships in abstract drawings depend upon something like Praxitelian symmetria—the chiastic, "crossed," asymmetrical balance expressed in the contrapposto stance of the Greek sculpture "Doryphoros." Right relationships in the brain occur neurally and globally, and are felt on some level as resolution, and may include not only perceptions and thoughts, but provide the basis for decisions and conclusions. Having come to a conclusion after struggling with a dilemma is often felt as relief, or peace. That sensation, too, can be examined verbally: why do I feel so relieved as I drive away from that situation? I feel relieved because I see that I have decided to leave that situation behind. Mathematical problems often yield to intuitive, felt solutions, first. These solutions are capable of backward analysis, providing a logical, spelt-out proof, or explanation. As we become increasingly sensitive to brain processes, the same should be true, to some extent, of our understanding of our own thinking through the use of images and words.

Bihemispheric brain processes can be described as employing three formal sub-systems:

1. a meta or over-arching rightbrain/leftbrain, spatial/linguistic system

2. a visual system
3. a verbal system.

The brain spoke the language of the senses, first, a "where is it/what's it doing?" locational language. When humans started naming, the brain added a categorical "what is it?" word-based capability. The spatial/linguistic system became visual and then it became verbal. Pictures, words, mathematical and musical notation developed as specialized sub-sub-systems.

A set of mathematical operations and/or syntactic rules organize incoming stimuli in accordance with relationships recognized in some manner by the brain as coherent or balanced or resolved. Research in neurobiology supports the existence of innate syntactic rules which operate at levels well below and above verbal language. The fact that students in group critiques agree about "too much or too little" in each other's drawings supports the existence of innate sensibilities, or spatial/syntactic rules for rightness, or pleasingness, or balance.

Drawing/Writing provides practice with right relationships. These exercises work from the simple to the complex, from the concrete to the abstract, and from the visual to the verbal. The specific instructions or rules or syntax are:

- Select visual information, express it visually, and then express it verbally.
- Combine visual information in one coherent presentation and then express it verbally.
- Take the visual statement and break it back down into parts, producing a new visual statement; then, express that new statement verbally.
- Take verbal statements about visual information in simile, metaphor, analogy, prediction and hypothesis, and translate these in visual terms.
- Include neither too much nor too little in the visual and in the verbal translations.
- After every translation exercise, explain the translation exchange using the word "because."

In Drawing/Writing, visual processing begins with the distinction between figure and ground—or what is and what is not the subject under consideration. This distinction is made by drawing the outline of the object. The informational search moves on to form, continues to value, and culminates with a wealth of additional information including texture and relevant details. This resulting drawing is optically accurate. It is followed by an abstract, recombinant drawing which no longer looks like the object but stands for it. This process of selection, accumulation and transformation of visual information provides an overall shape or form or grammar of intelligent visual thought.

In Drawing/Writing, verbal information begins with physical description and works toward analysis, then inference through the use of declarative sentences, simile, metaphor, analogy, speculation, prediction and hypothesis. This process of description, analysis and inference provides an overall shape or form or grammar of intelligent verbal thought. When used deliberately in parallel and interconnected modes, this visual grammar and this verbal grammar enhance and extend thought. This extension and enhancement demonstrate and develop human thought as naturally and optimally spatial/linguistic, or visual/verbal—as a combined, cooperative enterprise.

We inherit a mother tongue and either do or do not acquire other spoken and written languages. The specific grammars and syntaxes or rules for organizing words in strings called sentences influence how we think, as does the depth and breadth of our command of the vocabulary in that language. As the contemporary British author A.S. Byatt observed in one of her earliest books (it may be noted that she uses the language of geometry), all Western philosophical studies—as far as the philosopher Nietzsche was concerned—are variations on the same problems in recurring circles because all ideas are "unconsciously dominated and directed by simple grammatical functions which are in the end physiological" (Shadow of the Sun, 1993, 187).

This book supports the position that the grammars we use to organize spoken and written language are, at base, physiological. Great circles occur in many geometries and structure many philosophies because they are inherent in the organization of mind/body. The question is whether a syntax or grammar or form of intelligent thought can be designed and taught which takes its design cues from brain science and other disciplines within the combined field of cognitive science which will allow any mind using any mother tongue to use its brain optimally despite any peculiar grammatical constraints placed on that brain by that language's sentence structure or vocabulary. This book suggests that the answer is yes—any language can be used in optimal, brain-like ways—and a five-step program called Drawing/Writing provides one such syntax for intelligent visual and verbal thought.

A non-pharmacological approach to optimal brain performance:
The arts provide natural ways to normalize certain aspects of neurochemistry because of their high attentional, motivational, emotional and cognitive benefits. The normalization of brain function in connection with the arts is self-regulatory. Artists, writers, dancers, musicians learn how to initiate, sustain and

regulate attention. When action and attention provide a self-regulatory neurochemical feedback loop, brains produce their best work, achieving, as a dividend, states like peace, satisfaction, happiness, euphoria and joy. Since the brain requires heightened experience, it makes sense to devise methods for providing heightened experiences that do not damage brain function.

Strange Loops:
Solutions to complex problems are not strictly trackable—logically or neurally. Douglas Hofstadter used the
term "Strange Loops" in Gödel, Escher, Bach: The Eternal Golden Braid to describe the non-explainable aspects of powerful systems, including the brain. In mathematics, Strange Loops are accounted for by Gödel's Theorem as they are in physics by Heisenberg's Uncertainty Principle. In brain science, a theory like neuroconstructivism * (Sheridan, 1990) and a practice like The Thinking Child recognize and champion the nonlinear aspects of children's learning, predicting the unpredictability of WholeBrain classroom practice. Inexplicable events are inherent in complicated systems.

A unified duality:
The brain functions discretely and globally. This "right-left hemisphere complementarity" (Rucker, 1987) is like the "wave/particleness" of light described by Arthur Zajonc, Amherst College physics professor (Catching the Light, 1993), or like this book's definition of geometry as the study of shapes-in-space—another dyad—or this book's presentation of a teaching and learning strategy called Drawing/Writing. Paradoxical complementarity is a way of explaining the nature of our minds, our actions, and our realities. A unified duality describes productive classrooms in which teachers and students constitute a nonlinear, complex feedback loop.

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