

## **Educational Implications of Cerebral Lateralization: A Neurosociological Perspective**

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Modern society is composed of a complex institutional order that emerged from the traditional solidarities such as tribe and family that constituted pre-modern society. The moral costs and benefits of this process have been the subject of social scientific discourse and artistic creation. Politics in modern society became the principal activity for integrating the modern institutional order, after the eclipse of traditional forms of social authority. The educational institution developed to provide the social space in which political socialization could occur. It seems impossible to conceive the modern nation state without the educational institution; and nations committed to modernization initiate the process with a system of mass education. As Silvert and Reissman (1976:7) propose in their cross-national study of the effects of education:

Formal educational in national societies is the institution fundamental to preparing persons for autonomous participation in secular and relativistic politics. The effect of education makes possible individual democratic activity in national societies. In such societies formal education is a crucial element in creating both the grounds of the conflict and the ability to perceive it.

The location of the educational institution at the heart of modern society suggests the problematic of how educational systems function to produce practices that contribute to societal integration. The educational system reproduces and legitimates the division of labor in economies stratified by class divisions and class politics (Bourdeau and Passeron, 1977; Habermas, 1970; Bernstein, 1975).

Less understood is how the educational system affects the interior life of the individual—how the body as well as the body politic are fashioned by educational institutions. As Freud first pointed out, and Deleuze and Guattari (1975) recently elaborated, socialization always involves the interior territory as well as the territory of the class domain; socialization entails intervention of society upon the physiological functioning of the body—such as, the mouth, the anus, and the genitals. This “primitive” socialization has been historically and remains largely the function of the family. However, the educational institution in modern society has moved toward socializing the “highest” and most distinctively human organ, the brain. The marking and conditioning of the brain in modern society by the educational institution, and the individual effects of such conditioning, constitute the subject of this paper. It is argued that education provides not only the ground for integration of society by political activity, but the ground for the integration of the individual with his or her body, with the health and effective neurophysiological functioning of the individual.

## **The Brain and Modes of Thought**

Recent advances in the understanding of higher brain functions can be seen to have far reaching implications for an understanding of the educational process. The brain monitors and controls all aspects of cognitive functioning. Schematically the brain can be viewed as multi-dimensional. A "vertical" view of the brain reveals that it is organized structurally in three layers—the brain stem, the mid-brain, and the cerebral cortex. This vertical organization contains a complex feedback structure such that "Just as surgical intervention into the brain produces alterations in psychological functioning, the feedback structure of the brain suggests that psychological states such as extreme emotional states also affect brain structures." (Pelletier, 1977: 49).

A "horizontal" view of the cerebral cortex reveals a highly specialized structure. The cortex governs higher-order intellectual functions and exercises control over the lower level brain structures. The relationship between the levels of the hierarchy is one of constant interaction in which the commands of the cortex exercise a profound influence over the hierarchy and eventually over muscular activity and bodily movements.

The cerebral cortex is divided into left and right hemispheres, each specialized for a distinct group of higher cognitive functions or "mode of thought." According to the theory of cerebral lateralization and hemispheric specialization, in right-handed persons without a history of left-handedness in the family, the specializations of the left and right hemispheres are called, respectively, "logical-analytic" vs. "gestalt-synthetic" (Levy Agresti and Sperry, 1968), "propositional" vs. "appositional" (Bogen, 1969 b), or "propositional" vs. "compositional" (TenHouten, 1978-9).

Language is associated with the functioning of the left hemisphere, but there is also evidence that the right hemisphere is not devoid of language processing functions (Albert, Sparks and Aittelm, 1973; Blumstein and Cooper, 1974). Patients with unilateral brain damage and injury have greater losses of linguistic capability—both in the comprehension and production of speech—if damage is to the left hemisphere rather than bilateral or to the right hemisphere. The right hemisphere—while minor for linguistic function, and more generally for the propositional mode of thought—dominates visuoconstructive activities, such as drawing, copying, and assembling; perceiving and mentally manipulating objects in space; and constructive activities in the arts, such as music, painting, and the plastic and neolithic arts (Bever and Chiarello, 1974; Gordon, 1970; Nebes, 1971). The right hemisphere's compositional mode of thought is also evident in archaic and traditional knowledge practices, which can be described as "synthetic inquiries" (TenHouten and Kaplan, 1973).

The relations between the hemispheres have been shown by a wide variety of studies to include mutual antagonism or "contradiction." Galin and Ornsetin argue that the split-brain studies show that each hemisphere possesses its own consciousness, such that relations between the hemispheres are ordinarily antagonistic with persons "switching" from one mode to the other (1972).

Levy et al. write that the split-brain studies show that the disconnected

hemispheres, working the same test, are apt to process the same sensory information in distinctly different ways, and that the modes of mental operation of the two hemispheres, spatial synthesis for the right and temporal analysis for the left, show indications of mutual antagonism (Levy, Trevarthen and Sperry, 1972). They see an "interference effect" that has contributed to the evolution of laterality of function in the human brain. The propensity of the left hemisphere to note analytic details and describe in language is seen to interfere with the perception of an overall gestalt, leaving the left hemisphere "unable to see the woods for the trees."

Nebes (1971) demonstrated a superiority in the right hemisphere of the split-brain patient for the perception of part-whole relations, and suggests that the dominance of the left hemisphere is a relative contingency. Similarly, Bogen and Bogen maintain that "certain kinds of left hemisphere activity may directly suppress certain kinds of right hemisphere action" (1969: 201), or may prevent the products of the right hemisphere's activity from gaining access to the left.

The idea that thought contains a dialectical mode implies that thought which is fragmented and dualistic is pathological. Also, thought too one-sided can be pathological. The left hemisphere is capable of inhibiting the primary spontaneous compositions of the right hemisphere (Galín, Diamond & Braff, 1977; Zangwill, 1974). The tendency of the left hemisphere to inhibit the right can have the effect of inducing a state of mental depression. It has been suggested that the left hemisphere becomes over-activated in depression, while the functions of the right hemisphere become suppressed (d'Elia & Perris, 1973; Flor-Henry, 1969).

Kaplan and Wogan (1978) found that a high level of left hemisphere activation in the presence of pain stimuli resulted in higher levels of subjective pain being reported. On the other hand, right hemisphere activation during pain stimuli (involving the mobilization of fantasy processes following instruction, e.g., to think of the hand to which a painful stimulus was applied as made of rubber) resulted in a comparatively lower level of experienced pain. This outcome suggests a lack of right hemisphere processing of painful stimuli may contribute to the psychosomatic patient's preoccupation with pain.

Hoppe (1972; 1976) in psychiatric interviews with split-brain patients, found a quantitative as well as qualitative paucity of dreams, fantasies, and symbolizations. This phenomenon, described as "*pensee opératoire*" (Marty & de M'Uzan, 1963 or alexithymia (Sifneos, 1973) is hypothesized to involve the blocking of all emotions and gestalt perceptions of the right hemisphere from being verbalized by the left. Hoppe and Bogen (1979) scored twelve split-brain patients, using Sifneos' measure of alexithymia and found them all to be alexithymic. The patients experienced loss of libido, a lack of investment in interpersonal relationships, and a reduced capacity to engage in productive work. The phenomena of functional commissurotomy associated with operational thinking in non-damaged persons, and alexithymia in split-brain patients, suggest that participation in social, cultural, and economic practices requires hemispheric interaction.

Bogen (1969) contends that the split-brain experiments show that a duality of mind resides in the normal person as well, such that this duality of mind is not created but rather revealed by the surgery. At the same time, he does not claim that the propositional and compositional thought of the two hemispheres are exhaustive of modes of conscious awareness; instead, Bogen and Bogen (1969) argue that creative thinking depends on hemispheric interactions made possible by the cerebral commissures connecting the two hemispheres, and that the split-brain operation would have the side effect of reducing the creative thought of an initially highly creative person.

The notion of dialectical reason has been developed in life-span developmental psychology as a critique of Piaget's developmental theory (Reigel, 1973; 1976). According to Piaget early cognitive development has a dialectical character. For example, this is found in the child's fluid ability to switch attention in the initial sensory-motor phase of development; and, the ability to attend to both concepts at once in the pre-operational stage (Piaget, 1962; 1964). But, as cognition develops through concrete operations and arrives at formal operations, thought is seen as noncontradictory and the primitive dialectic of the first two stages is lost. Reigel contends that dialectical operations represent a still higher level of mental development, characterizing the most productive thinking of the mature mind. In dialectical thinking the emphasis is not on equilibration, but rather on conflict and contradiction as fundamental to thought. Contradiction contributes to change, to the resolution of old contradictions and the production of new ones.

To argue that dialectical thinking is both compositional and propositional does not mean that mere proficiency is developed in both modes so that a person can carry out tasks in one and tasks in the other. The latter reflects not dialectical thinking but the extent of laterality or lateral differentiation. Dialectical thinking means rather that both compositional and propositional thought are brought to bear interactively on one problem, in a dialectical moment.

If consciousness is to be studied in relation to its physiological basis in the systems of the brain, then it must be considered not only synchronically, in examining the specialization of function in the two sides of the brain, but diachronically, viewing cognitive structure as revealed in its neurophysiological artifacts of thought. Furthermore, the interaction of the hemispheres is apparently required not only for extraordinary abilities, the highest levels of individual expression, but also in the creativity of the everyday world - including the often unnoticed dialectics of participating in human relationships, in discourse, in productive work and in effective physiological functioning.

### **Modes of Thought and Education**

Given the inference from lateralization of hemispheric function of three modes of thought, a theory of cognitive functioning becomes available for use in analyzing educational systems. Since the educational system is explicitly designed to promote cognitive development, and cognition is a function of the brain, a neurosociological analysis makes

it possible to connect social structure and the brain. Two areas of interest to this analysis are: 1) the effects of the educational process, and 2) the effects of social organization on cognitive function.

Modern society has developed structurally through the organization of productive relations in accordance with the abstract and universalizing effects of market supply and demand and the accumulation of capital on an expanded scale. The re-creation of society in the form of economy required the re-organization of social relationships on rational, scientific, and technically efficient bases. The growth of industry on an expanded scale freed propositional thought from its auxiliary social functions and raised it to a dominant position. Compositional thought became devalued in the process. The third mode of thought, the dialectical—which has traditionally been associated with the most refined human activities—was reduced to the residual interests of academic specialists and the dialogues of revolutionaries. The devaluation of modes of thought other than the practicality of propositional thinking was resisted in many forms. As early as 1802, Schiller, in his **Lectures on the Method of Academic Study**, had criticized this devaluation of dialectical and non-practical thought.

The economic organization of modern society has required a work force trained in scientific and technical thought. This requirement has been met by the expansion and development of a number of social institutions. The factory became the model of the organization of social institutions. Sartre (1976) describes in detail the resistance that occurred in France in the attempt to establish the factory system and to inculcate its supporting mode of thinking. Foucault (1973; 1975; 1979) provides a parallel description of the historical development of the clinic, prison, and mental asylum for the control of deviants in accordance with the requirements of practical rationality. But the most essential institutional form contributing to the primacy of a propositional habitus of mind in modern society was that of mass education. Education came to mean the full-time training of children in a highly formalized and systematic form of language use (Bourdieu and Passeron, 1977). New social categories, such as that of the adolescent, were developed to legitimate the full-time attendance of children in schools with the explicit purpose of developing their cognitive capacities. As Musgrove (1964) notes, it was no accident that the introduction of the concept of the adolescent by Rousseau in 1762 corresponded with Watts' invention of the steam engine in 1765.

### **Education, Propositional Thought, and Social Dominance**

It has been amply demonstrated (Jencks, 1972) that students who are disadvantaged on the basis of subdominance in class, socioeconomic status, race, sex, and so forth, will be in a different position with respect to learning within an educational system than those not so disadvantaged. The theoretical problematic relating social dominance, manual asymmetry, and cerebral lateralization was first explored by Durkheim's student Hertz in his study of "lefthanded practices" and dual symbol classification in primitive societies. Hertz (1960: 3) wrote:

"What resemblance more perfect than between our two hands!  
Any yet what a striking inequality there is!

"To the right hand go honors, flattering designations, prerogatives: it acts, orders, and takes. The left hand, on the contrary, is despised and reduced to the rule of a humble auxiliary: by itself it can do nothing; it helps, it supports, it holds."

"The right hand is the symbol and model of all aristocrats, the left hand of all plebians."

Hertz's inquiry led him to a consideration of cerebral laterality and the contralateral control of the hands by the two hemispheres. He cited Broca to the effect that we are predominantly right handed because our left hemispheres are dominant. What Hertz observed in his study of the Maori and other groups in what was then Dutch Indonesia was an attempt to control left-handed practices—sorcery, witchcraft, and other occult practices—by inhibiting the left hand of children, even binding it to the body, to teach them not to use it.

The problem of dominant and subdominant forms of knowledge practices, with scientific practices dominant and non-scientific practices subdominant, also required consideration of dominant and subdominant social groups. Dominant groups and classes appropriate the propositional mode of thought, with subdominant groups functioning in a relatively more compositional mode. For example, in a probability survey of adults in one urban and two rural sites in the United States, it was found that performance on a "right-hemisphere task," the Street (1931) Gestalt Completion Test (A) and a "left-hemisphere task," the WAIS (Wechsler, 1958) Similarities Subtest (P), compared by A/P ratios, showed differences in test performance by social group. The results, based on multi-group discriminant function analysis, indicated that samples of Hopi Indians, rural white farmers and their wives, urban black males and females, and urban white males and females, could be discriminated on the basis of these ratios: it was found that the A/P (appositional/propositional) ratios were higher for nonwhites than for whites, with Hopis higher than blacks among the nonwhites. Within racial groups, rural dwellers had higher A/P ratios than did urban residents (TenHouten, Thompson and Walter, 1976). A further analysis of the urban sample (TenHouten, 1978) showed that when race and sex are controlled, lower socioeconomic status adults perform better in appositional relative to propositional tasks than do higher socioeconomic status respondents.

These investigations show that relative superiority of appositional functioning is concentrated among the least modern groups (Hopi Indians, rural white farmers) and subdominant groups (nonwhites, lower socioeconomic status), and (among blacks only) females. Since educational systems in modern societies stress the propositional, subdominant groups are placed at a disadvantage in the educational system. The disadvantage of the subdominant and nonmodern groups and classes in the educational systems is due to the compositional habitus of mind that they are apt to bring to the school setting as their resource. The demands placed on students to master a propositional habitus, not by embedding the propositional in forms that are sensible to the compositional mode of

thought of the right hemisphere, but by learning the propositional mode from the very beginning puts them at a disadvantage. The situation is analogous to natural left-handers being required to learn a physical practice not by beginning activities that require the coordinated action of the two hands, but by beginning practice with only the right hand. Hunter (1976), in this connection, has referred to "right-brained" children in "left-brained" schools.

The disadvantage of the non-modern and subdominant groups of youth in educational systems, which goes so far to reproduce social and class divisions, does not follow from modern and advantaged group having greater access to language *per se*. Rather they have a greater access to a propositional habitus—scholarly mastery of scholarly language, which Bourdeau and Passeron (1977) refer to as "linguistic capital".

### **Dialectical Education**

Bruner (1962: 200) argues that intuition and the mode of thought associated with the left hand is not best suppressed, but is essential to the production of knowledge. He writes:

The right hand is order and lawfulness, **le droit** . . . Reaching for knowledge with the right hand is science.

Yet to say only that much of a science is to overlook one of its excitements, for the great hypotheses of science are gifts carried in the left hand . . .

Educational systems in modernizing and modern societies tend to function as the creators of propositional thinking at the expense of "non-practical" modes of thinking. Students are not tested in, not taught in, and are not apt to be rewarded for either compositional or dialectical performances. The student produced by such a system can be described as "one dimensional," making extensive use of propositional thinking to the neglect of other modes. Such educational systems influence the quality of life of both the society and the individual. Two of these consequences become critical: the decline of the capacity to creatively solve job and life problems, and the emergence of new forms of physical distress.

The tendency for problems to be solved by a single strategy, rather than the cognitive flexibility of using more than one mode of thought is apt to encourage the search for an authority of a single selected strategy rather than experimentation with multiple strategies. Trained cognitive inflexibility has provided a legitimation of the labor process whereby work becomes increasingly rationalized and "de-skilled" and decision making is controlled by ever-fewer numbers of "experts" (Braverman, 1974). The interaction of a school system that produces "lopsided" individuals with restricted cognitive competencies and an economy that creates jobs that are less demanding of creative intellectual input creates a closed feedback loop in society. The result is what Marcuse (1964: 79) describes as ". . . the atrophy of the mental organs for grasping the contradictions and the alternatives and, in the one remaining dimension of technological rationality, the **Happy Consciousness** comes to prevail," i.e., a non-dialectical, nonholistic type of consciousness.

The atrophy of mental organs suggested by Marcuse may have negative consequences for the health of the individual educated in non-dialectical institutions as well as a general decline in the creative intelligence distributed in society. The distinctive kind of thinking associated with psychosomatic patients—alexithymia or *pensee operateire*—parallels in perhaps an acute and extreme form the operational and non-dialectical “one-dimensional” thinking Marcuse has posited to be characteristic in modern societies (Marty and de M’Uzan, 1963; Nemiah and Sifneos, 1970). A theory for the emergence of this mode of consciousness in the psychosomatic patient has been offered by Mitscherlich (1969) who outlines a biphasic defense model in which psychosomatic patients first suffer from a neurotic conflict; and, in a second phase of defense, regress further by resomatizing the affect arising from the neurotic conflict. Shands and Meltzer (1975) have demonstrated that these symptoms are associated with patients of the working class who are not able to abstract sufficiently enough to avert this regressive resomatization of affect. An inference to be drawn here is that an educational system that does not provide the student a means of solving conflicts, and does not value the solving of problems by means of both hemispheres in their dialectical interaction, produces a mild “functional commissurotomy” that prevents intra-psychic conflict resolution and initiates organic symptoms.

It is well known that diseases vary under historical and social conditions (Dubos, 1977; Polgar, 1964). Pelletier (1977: 157) argues that the excessive, free floating stress that characterizes modern society “eventually induces psychological, and endocrine disruption. This state, which is characterized by excessive activity of the entire mind and body, leads to mental depression and an increased susceptibility to infection, and appears to be a precursor of the major afflictions of modern civilization—cardiovascular disorders, cancer, arthritis, and respiratory disease.”

The association between the theory of “functional commissurotomy” and the etiology of modern society’s major diseases has yet to be empirically demonstrated. However, research on heart patients suggests that their physiological imbalances have higher cortical associations. A number of these studies show that these patients may be described as cognitively dualistic—that is, suffering from an atrophy in the ability to integrate their cognitive experience holistically, and to affect functional interhemispheric communication. For example, Friedman and Rosenman (1974) have isolated a “Type A Personality” that characterizes patients with cardiovascular disorders. Two traits emerge in Type A people: an excessive competitive drive and a continual time urgency expressed in a feeling of always having to meet deadlines. The type B person, in contrast, takes time to think, daydream and meditate, and is not “polyphasic”—trying to do several things at the same time. For example, one type B patient said that when standing in line, he welcomed it as, “good a time as any other to daydream or meditate” (p. 95), and described his philosophy of life as half pragmatic and half metaphysical. The type B personality seems to be able to balance between time and “time independence”. In contrast, Type A patients can be seen as giving their

cognitive life to the left hemisphere.

A number of studies of cancer patients have linked long-term depression and recurrent pessimistic fantasy to an outward behavioral attitude that is "too good to be true" (e.g., descriptions by friends and relatives of these persons as being exceptionally fine, thoughtful, and gentle (Le Shan and Worthington, 1956; Lansky et al, 1976). The cycle of existence for the patient before onset of cancer is one of "hoplessness and helplessness". Many researchers maintain that the disease finally occurs with a breakdown of the surveillance system of the body. Simonton and Simonton (1975), in their study of spontaneous remission of cancer, concluded that positive imagery and visualization increases the probability of arresting the cancer process. These studies seem to point to a role of the right hemisphere in conditioning the disease. Unable to talk about negative affect, an individual can be given over to a right-hemisphere mode of thinking that is timeless in that the future has lost meaning, and in which it is most difficult to communicate with others in a way that breaks down negative fantasies (e.g., through psychotherapy). Under such conditions, the surveillance system of the body is apt to atrophy.

The connection between hemisphere functional imbalance and the functional imbalance of other organs is still largely speculative. However, if this hypothesis has validity, then the influence of the educational system on the physical health of the individual as mediated by the brain must be taken into account in the evaluation of educational programs and structures. When we realize that educational systems in modern societies have effects apart from their functional articulation with the occupational and class structure of society, and effects on the political and organic well-being of the individual, then the re-design of education must take into account the total structure of the brain—the organ for whose development it now takes primary responsibility.

### **Re-Designing Education in Modern Society**

Our discussion of education in modern society has outlined certain social and individual effects that emerge from an educational system structured to develop the left hemisphere of the brain and to neglect the development of the right hemisphere and the development of hemispheric interaction. On the level of modes of thought, we contend that these educational systems emphasize the propositional at the expense of the appositional and the dialectical. Re-designing education in modern society from our viewpoint would be the establishment of learning with the whole brain, with the flexible use of the available methods of thought.

Pre-modern societies were apt to reproduce their knowledge systems through educational systems that aim at the discipline of the right hemisphere. The stability of such societies is reinforced by an education that values the eternal (externally time-independent) and internal (affective) orientation functions of the right hemisphere. For example, whereas many American Indian tribes have not been able to maintain their culture forms, the Hopi have been able to continue their cognitive life relatively unchanged. This in part is due to their isolation, but one must also consider the effect of the highly articulated system

of cultural transmission that works in a structure of clans and secret societies. The features of this "educational system" include a lifetime program of ritual, ordeal, and story-telling which function to consciously inculcate a particular affective state that supports a cognitive style emphasizing the scenic understanding of a Hopi that he or she is interdependent with both nature and society. In traditional Hopi culture there was no reading, writing, or linguistic analysis, but rather an elaborate program of physical exploration of both the body and the world of appearance in which the existential sense of being Hopi is established (Waters, 1964). The success of this educational system in inculcating a compositional, right-hemisphere competence has been measured by standard cognitive tests, where Hopi subjects have been found to perform significantly better than other rural and urban cultural groups (Bogen, De Jure, TenHouten and Marsh, 1972; TenHouten et al., 1976).

The medieval university is an historic example of a dialectically oriented system of education. Here scholarly activity involving the left hemisphere was combined dialectically with meditation, prayer, artistic creativity, and physical tasks. The ratio of classroom time to "free" time outside of the classroom was relatively low, with more time in the world than in the classroom.

Bernstein's (1975) theory of educational transmission is useful for locating the places where education could be redesigned in the context of modern society. He contends that mental structures are in part determined by certain dominant principles of interpretation that he calls codes. These codes are differentially distributed in society. Class and other levels of dominance relations are transmitted through the codes by means of definite "preparing" agencies. One of the most important of these are the schools. Bernstein argues that educational institutions involve two practices—classification practices and framing practices. Classification practices are those involved with the establishment of the contents of curricula, including the subjects to be taught, the boundaries to be drawn around areas of knowledge, and the schools of thought to be considered. Framing practices involve control of the content—the authority relationships that exist between students and teachers. The overall organization of educational systems takes place by the code that dictates how classifications and frames are to be formally defined and related. Bernstein suggests that there are two types of codes—collection codes and integrated codes. In collection codes the boundaries between contents is strong and the boundaries between students and teachers is also strong. We interpret this educational system to be one that aims at the development of the left hemisphere and its propositional mode of thought. An integrated code, in contrast, is an organization of educational knowledge involving a marked attempt to reduce the strength of classification and framing practices. This integration code aims at the development of the right hemisphere and its appositional mode of thought.

The realities of collection and integrated codes also pertain to the problem of social dominance structure, i.e., social order. When knowledge is produced and distributed in educational systems with collection codes,

“. . . authority relations are hierarchical, and knowledge systematically ordered in time and space, out of an explicit and usually predictable examining process (Bernstein, 1975: 106).” In such institutions control requires ideological consensus on the part of the staff, boundaries are strongly maintained across the roles and fields of knowledge, and efforts are made to reduce the dimensionality of assessment criteria. This type of educational system emphasises the hierarchical ordering of what is learned, with the effectiveness of the pedagogical process measured in a quantitative way. It is this form of educational system that is most appropriate for the learning of scientific and technical materials in the modern world. Its weakness is that it is not set up to reward the creative, unusual, perceptually complex, and embodied cognitive activities of students.

In the integrated code, weak frames made possible creative, diverse, and original student accomplishment. The weakness of this code is that it results merely in “progressive” education, which, while it fosters creativity, fails to transmit the scientific and technical training necessary if modern society is to survive. Education involving a dialectical code would permit the operation of both integrated and collection codes in dynamic interaction. The acceptance of a dialectical code means recognizing that education should focus on the process of change, rather than on the end-products resulting from change. As Riegel (1976) suggests, change, far from being undesirable, is both inevitable and constructive. Change in this view arises through the interaction of the person with the world. Riegel analyzes this interaction into biological, psychological, cultural-social, and physical levels of analysis. Change in any of these systems requires adaptive change from the individual. Although change is often seen as a disaster, it need not be. For example, uncontrolled changes in the biological realm lead to epidemic outbreak of disease, but controlled changes lead to productive cultivation. Although current educational systems are focused on the desirable end-products of change—conditions of equilibrium, absence of tension, problem solutions—dialectical development suggest that development only comes about through change. That is, disequilibrium produced either through intra-individual or inter-individual changes leads to adaptive coping behaviors and further growth. Promoting development, as education seeks to do, means promoting change and the means of dealing with it. The critical issue then becomes, not avoidance or control of change, but codes for synchronizing changes occurring in two different time sequences. These predictive schema can be referred to as dialectical codes. Dialectical codes anticipate development and prepare in advance for it.

In the case of hemispheric lateralization, the issue is not one of training either hemisphere to perform a particular task, but promoting a synchronized code that facilitates interaction between them. In this case, the goal is not in the end state (e.g., “adulthood”) or skill (“becoming a veterinarian”) but in the process by which changes in any area of specialization may be dealt with.

Rigid content boundaries and authoritarian frames within an educational system are attempts to exclude change from the educational system. At a minimum, a system of education designed to promote

dialectical development would use both weak and strong frames and both rigid and permeable content boundaries. To facilitate the development of both hemispheric modes, and to avoid the pitfalls of either traditional or progressive education requires a flexible use of both types of organization. For example, learning writing might require a strong frame, fostering a left hemisphere mode, learning a second language might require a weak frame and weak boundaries, which would foster a right hemisphere mode (Scott, Hynd, Hunt and Weed, 1979).

If the dialectical viewpoint is assumed, change is expected, and the participants therefore become willing to switch from one system to another, as appropriate. While dialectical interaction might be taught explicitly in such an educational system, it would also be implicitly conveyed by the flexibility and change-orientation of the system itself. A system which makes flexible use of different types of classifications and frames should also maximize the opportunities for the development and transmission of the dialectical mode of thought, which will ramify both to the exterior organization of society and to the interior life of the individual.

The objective of this paper has been to present a macrolevel analysis of educational systems and their effects on the cognitive functioning and physical well-being of pupils and students in these systems. The theory of cerebral lateralization and hemispheric interaction is used to develop a model of the modes of thought associated with the highest cognitive functions. The propositional and compositional modes of thought of the left and right cerebral hemispheres, and the dialectical mode of thought that is argued to have as its neurophysiological basis the interactions of the two hemispheres, are analyzed diachronically. It is argued that the right hemisphere and the compositional mode of thought is most evident in the traditional solidarities, where members gain a sense of totality in a manner consistent with comprehensive systems of thought and ideologies. It is hypothesized that, with the development of the modern world, with its emphasis on science and technology, the dominant form of human reasoning underwent a transformation, from the primacy of the compositional mode of the right hemisphere to the propositional mode of the left. Propositional thinking not only became dominant, but was historically appropriated by dominant groups and classes, insofar as the modes of economic production required a work force educated in a scientific and technical mode of thought. Creativity and praxis always require cognitive flexibility and a dialectical basis, so an optimally designed educational system must provide the collection codes that contribute to the mastery of propositional symbolization, integrated codes that contribute to the re-emergence of compositionality, and dialectical codes that provide for dynamic development, creativity, and change.

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