
MLE and IE as a Basis of the Education of the Blind

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Structural Cognitive Modifiability (SCM)

Human beings are viewed by us as having a unique propensity to change or be modified in the structure of their cognitive functioning, as they respond to changing demands of life situations. Changes occur in response to external stimuli and internal conditions. Change is structural when (a) Change in a part affects the whole to which the changed part belongs; (b) When the very process of change is transformed in its rhythm, amplitude, and direction; and (c) When the produced change is self-perpetuating, reflecting an autonomous, self-regulatory nature. SCM is assumed to occur when the changes are characterized by a certain degree of permanence, pervasiveness, and when they are generalizable. Human beings are viewed as open systems, accessible to change throughout their life spans, and responsive to conditions of remediation, providing that the intervention is appropriately directed (in quantity and quality) to the individual's need.

Mediated Learning Experience (MLE) – Dimensions and Quality of Interaction

Cognitive development occurs through an individual-environment interaction. This interaction is affected by certain characteristics of the organism (including those of heredity, maturation, and the like) and qualities of the environment (education opportunities, socio-economic status, cultural experience, emotional contacts with significant others). Interaction between the organism and environment may occur: (a) as a *direct* learning experience, immediately consequent to direct exposure to stimulation, and (b) through a *mediated* learning experience that requires the presence and activity of a human being to filter, select, interpret, and elaborate that which has been experienced. MLE theory holds that the organismic and environmental facts are *distal* determinants of cognitive development (causing differential responses to the environment), whereas MLE constitutes the *proximal* determinant that influences structural cognitive development and the potential for being adaptive to and modified by experience.

For MLE to occur, an *intentional* human being must interpose him- or herself between the stimuli and the learner's response, with the intention of mediating the stimuli or the response to the learner. This is mediational in the sense that the situation (stimuli and responses) are modified by affecting qualities of intensity, context, frequency, and order, while at the same time arousing the individual's vigilance, awareness, and sensitivity. The interactional experience

may have the quality of repeating or eliminating various stimuli, relating events in time or space, or imbuing experience with meaning (see Figure 1). MLE requires the presence of three parameters that are the object of deliberate attention on the part of the mediator: Intentionality and Reciprocity, Transcendence, and Meaning. In addition, situational variables in the encounter present opportunities to mediate for other important parameters of the experience.

Regulation and control of behavior, feelings of competence, psychological differentiation and individuation, sharing behavior, goal seeking, goal planning, and goal achieving behavior, competence/novelty/complexity, self-change, optimistic choice of alternatives, and feelings of belonging. Each of these parameters offers opportunities for the mediator to make planned and systematic choices to exploit the mediational potential of the situation to encourage cognitive functioning and stimulate modifiability.

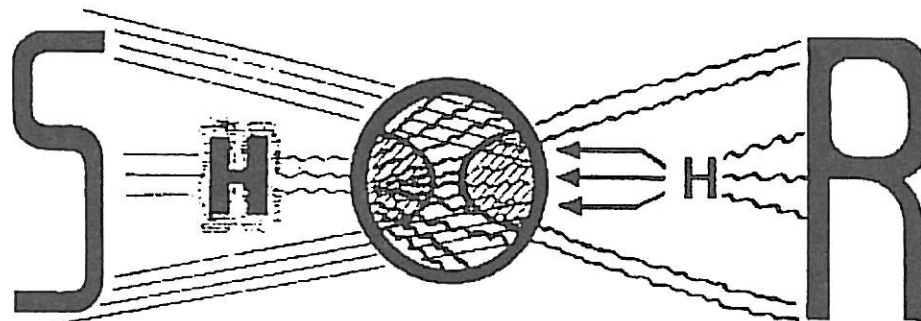


Figure 1. Mediated Learning Experience (MLE) Model
SOURCE: Feuerstein, 1979, 1980; Feuerstein & Feuerstein, 1991.

The mediational process extends beyond a simple, task-oriented, product-oriented, coaching/teaching objective toward making the individual able to function independently of specific situations, and it renders the learner able to adapt to the new dimensions that he or she will confront.

MLE significantly affects the individual's capacity to become modified structurally through direct exposure to stimuli. The more MLE acquired by the individual, the more benefit that person derives from direct exposure to learning; the less MLE received, the less a person is able to learn from direct exposure, and the less adaptive the individual will be. This is a central construct for the structure and application of the LPAD as an assessment methodology.

Deficient Cognitive Functions

Inadequate MLE leads to cognitive functions at the input, elaboration, or output phases of the mental act that are undeveloped, impaired, or fragile in their presence and contribution to learning and cognitive behavior.

These deficiencies do not necessarily appear in toto as a complete repertoire of the cognitive characteristics of the low-functioning individual (e.g., the culturally deprived, the learning disabled, etc.). Certain deficiencies may appear in a given individual whereas others may be absent. Accordingly,

different individuals will need more or less investment in one function rather than another and be more or less resistant to change, according to the profile of modifiability that emerges from the assessment process. The presence of a deficient cognitive function, the balance between deficiencies and well-established and/or modifiable functions, and their saliency in the profile of the individual will determine the nature of the intervention, according to the amount of resistance encountered and the extent of the investment required to overcome it.

The deficient cognitive functions can be analyzed as they manifest themselves in the three phases of the mental act: the input phase, the elaboration phase, and the output phase. The input and output phases can be described as peripheral compared to the elaboration phase, which is the core of the mental act. This orientation links deficient functions to the phases of the mental act and helps define the specific factors impairing successful mastery of the task, suggesting types of strategies for their correction. Although this division is somewhat artificial (in the sense that the mental activity within these phases indivisible), it helps in both diagnosis and prescription. The interactions occurring between and among the phases are of vital significance in understanding the extent and pervasiveness of cognitive impairment. An additional dimension, the affective-motivational factor, has a significant effect on the three phases of the mental act.

The Input Phase: Deficiencies at the input phase include all those impairments concerned with the quantity and quality of data gathered by the individual in the process of solving a given problem or at early levels of appreciation of the nature of the problem. Some impairments at this phase include:

- Blurred and sweeping perception
- Unplanned, impulsive, and unsystematic exploratory behavior
- Lack, or impairment, of receptive verbal tools that affect discrimination (e.g., objects, events, and relationships are not appropriately labeled)
- Lack, or impairment, of spatial orientation and lack of stable systems of reference by which to establish organization in space
- Lack, or impairment, of conservation of constancies (e.g., size, shape, quantity, color, orientation) across variation in one or more dimensions
- Lack of, or deficient need for, precision and accuracy in data gathering
- Lack of capacity for considering two or more sources of information at one. This is reflected in dealing with data in a piecemeal fashion rather than as a unit of facts that are organized.

The Elaboration Phase: Deficiencies at the elaboration phase include those factors that impede the individual's efficient transformation of the available data. In addition to impairments in data gathering, which may or may not have occurred at the input phase, these deficiencies operate to obstruct proper elaboration of whatever cues do exist:

- Inadequacy in the perception of the existence of a problem and its definition
- Inability to select relevant as opposed to irrelevant cues in defining a problem
- Lack of spontaneous comparative behavior or the limitation of its application by a restricted need system
- Narrowness of the mental field
- Episodic grasp of reality

- Lack of need for the education or establishment of relationships
- Lack of need for an/or exercise of summative behavior
- Lack, or impairment, of need for pursuing logical evidence
- Lack, or impairment, of inferential, hypothetical (“iffy”) thinking
- Lack, or impairment, of strategies for hypothesis testing
- Lack, or impairment, of planning behavior
- Lack, or impairment, of interiorization

The Output Phase: Deficiencies at the output phase include those that result in inadequate communication of final solutions. Even adequately gathered data and appropriate elaboration can result in inappropriate expression if difficulties exist for the individual at this phase. Specific difficulties include:

- Egocentric communication modalities
- Difficulty in projecting virtual relationships
- Blocking
- Trial and error responses
- Lack, or impairment, of verbal or other tools for communication adequately elaborated responses
- Lack, or impairment, of need for precision and accuracy in the communication of one’s responses
- Deficiency in visual transport
- Impulsive, random, unplanned behavior

The Cognitive Map

To understand sources of cognitive impairment, it is necessary to analyze the characteristics of the task to which the individual is required to respond. The analysis is done with the help of the cognitive map, wherein critical elements require the individual to generate responses relevant to the demands of the tasks. These components of the task interact with the cognitive functions in the formulation and production of responses, which may be adequate, appropriate, and facilitative of learning and problem solving, or may combine to generate failing, inadequate, and inefficient performance.

The cognitive map includes seven parameters by which a task can be analyzed: content, modality, phase, operation, level of complexity, level of abstraction, and level of efficiency. Tasks thus require mastery of elements that in turn require adequate cognitive functions for efficient thinking to occur in a process-oriented approach.

Content: Each mental act can be described according to the subject matter with which it deals and the universe of content on which it operates. Experiential and educational background (e.g., prior learning that has been assimilated) and culturally determined saliency (the importance and value as a factor of an individual’s cultural experience) lead to differential levels of competency in individuals.

If the content of the task is strange to the learner – and indeed, people differ greatly as to the specific content they are exposed to and familiar with – or if facts, events, or details of the required performance are not within the individual’s experiential repertoire, there will need to be an investment in

acquiring mastery of this content before the learner can be expected to focus on the cognitive operations that are the target of the assessment. Failure to respond therefore, must be considered in light of the presence of absence of relevant content dimensions embedded in the task, any attempt to evaluate the intelligence of the individual without considering content as a source of success or failure is doomed to do injustice to the individual.

Modality: Tasks may be presented in a variety of language: verbal, pictorial, numerical, figural, or a combination of these other codes, which range from mimicry and paralinguistic communication to conventional signs that are detached from the content they signify. Efficiency in use of specific modalities may differ among individuals because of their preferential modes or because of their differing saliency for particular socioeconomic, ethnic, or cultural groups. It is also a function of specific distal factors (such as neurological or sensory deficits, lack of exposure to specific teaching, etc.).

Functional impairment must be considered in light of the modality required by the task, as well as the range of cognitive functions present in the learner to make possible the reception of stimuli. Inadequate responding can be changed by shifting the modality of presentation of the task and its required expression of solutions. One cannot conclude that an operation is inaccessible to a learner simply on the basis of an inability to perform it in a specific modality. On the other hand, difficulty involved in using a particular modality must be understood in order to be bypassed or challenged, depending upon the goal.

The Phase of the Mental Act: the three phases of the mental act – input, elaboration, and output – may be differentially represented in a given task. When functioning is appropriate, it is difficult to clearly identify the contribution of each specific phase. With failure, however, it is necessary to isolate the responsible phase and understand its role in interfering with performance, as a basis for assessment and intervention. A task that places too much emphasis on input from the individual may disadvantage that individual in subsequent performance. For example, an individual's response may be inadequate because of incomplete, imprecise data gathering, which, even if elaborated properly, would lead to failure at the output phase.

As a dimension of task, examiners must analyze the specific phase requirements or emphases embedded within it to understand failures in performance, and then link them more specifically to the cognitive dysfunction that may be present in the individual. If, for example, the task requires primarily input or output phase functions, performance on the task may be more resistant to change than if elaboration is emphasized, and this may require more investment of time and energy or focus on structural interventions. The analysis of impaired performance in terms of phase helps to locate deficient cognitive functions and the source of difficulties and attribute a differential weight to success or failure. Thus, an arithmetical problem requiring the computation of 100 additions is measurably less difficult than one requiring four types of operations ordered in a given sequence.

Operations: A mental act may be analyzed according to the operations that are required for its accomplishment. An operation may be understood as a group of activities that enable information derived from internal and external sources to be organized, transformed, manipulated, and acted upon in a way that generates new information. In defining the nature of an operation, it is important to identify the prerequisites necessary for its generation and application. For example, classification, seriation, logical multiplication, or analogical, syllogistic, or inferential thinking are more complex in the demands they place upon the individual to use cognitive functions than recognition or comparison.

When the examinee's performance is impaired, the examiner must determine the component elements in the task necessary for the acquisition and/or application of the required elements and assess the presence or level of impairment in the related cognitive functions required to achieve the operation.

Level of Complexity: The level of complexity of a task may be understood as the quantity and quality of units of information required to be handled for its solution. However, this in turn is contingent on the quality of the information, its degree of novelty for the individual, and the level of conceptual organization. The more familiar the units, and the more organized, even if they are multiple, the less complex the act; the less familiar, or organized, the more complex the mental act. It is thus necessary to analyze the task from three perspectives: (a) The number of units of information contained in the task; (b) The degree of familiarity the subject has with the task and its component elements; and (c) The degree of organization, grouping, and categories that allows a reduction of the complexity of the task. Intervention and mediation is then directed toward these dimensions. As these elements are modified by mediation of organization, levels of complexity change, both within tasks and across tasks with similar structures or modalities.

Level of Abstraction: The level of abstraction is defined as a distance between a given mental act and the object or event upon which it operates. Thus, a mental act may involve operations on the objects themselves, as in sorting, or it may involve relationships between hypothetical propositions without direct reference to real or imagined objects and events. The level of abstraction as here defined becomes a source of interpretation of the difficulties the examinee has in acceding to higher levels of functioning, as well as the modification that occurs when such levels become accessible as a result of MLE.

Level of Efficiency: This parameter is qualitatively and quantitatively different than the other six, although it is determined or affected by them, singly or in combination. It is defined as the structure of the task requiring a certain degree of rapidity and precision in order to be solved. A third dimension is the level of effort experienced by the subject as needed to generate or sustain a given performance.

The relationship of level of efficiency to the other parameters may be observed, for instance, where a high level of complexity, attributable to a lack of

familiarity, may lead to inefficient handling of a task. The inability to differentiate efficiency from capacity is an important potential source of error in assessment, resulting in faulty labeling and erroneous prognosis. The lack of efficiency, defined as slowness in response generation, reduced production, or imprecision (lack of accuracy), may be totally irrelevant to the propensity of the individual to grasp and elaborate a particular problem and may need to be analyzed from the perspective of other parameters of the cognitive map. Indeed, tasks may differ widely as to the efficiency they require from the performer.

With regard to the dimension of perceived level of difficulty, a variety of task-intrinsic and/or task-extrinsic factors may be present. These can be categorized as *affective-energetic* factors in performance, and they need to be carefully considered in the analysis of results. Fatigue, anxiety, lack of motivation, and the amount of required investment may all affect the individual in the performance of a task. In addition, the recentness of acquisition of a pattern of behavior must be considered, as behavior not yet automatized or crystallized is more vulnerable to the impact of interfering factors and can thus be described as fragile.

Goals of the Instrumental Enrichment Program

A number of goals can serve as guidelines in the selection and production of tasks to include in programs designed to develop cognitive processes, problem-solving behavior, creative thinking, critical thinking, philosophical modes of thinking, or even lateral thinking (such as is present in the De Bono Program). In order to benefit from any program, students must have the capacity to learn from experiences, whether those experiences are intentionally produced for developing thinking or emerge from informal circumstances that individuals may be exposed to in their daily life. The capacity to learn cannot be considered as universally and equally present in all individuals. Some people benefit from each exposure, be it accidental or incidental, no matter how organized the experience is or whether or not it meant to be a learning situation. Others have an extremely limited capacity to benefit from such learning opportunities. These individuals are exposed to experiences, are confronted with many and often powerful sources of stimuli, and yet are affected by them very little. For disadvantaged learners, it is sufficient to make these stimuli available; they need to help in rendering stimuli accessible to them.

These individuals need to enhance their propensity to use their encounters with stimuli in order to become modified and more experienced by this exposure. They must be rendered more flexible so that their previous ways of thinking and the established schemata can interact with the new data by new ways of perceiving them, new modes of elaborating them, and new and more adequate ways of responding to them. Through this process of assimilating the novel and the more complex and becoming modified by this very process of assimilation in the direction of a better accommodation to the new situation, they will become better able to benefit from experience.

Without this process of enhanced assimilation and accommodation, the simple presentation of data will affect the population of low-functioning individuals very little, if at all.

In other words, the major goal of a program that aims at enriching low-functioning individuals will be to render them permeable to the program by creating in them the prerequisites for learning, that is by increasing their modifiability. To this end, a number of sub-goals are necessary. These sub-goals must guide the construction of the program and the selection of its materials and content. Even more, they must be considered in determining the program's presentation, didactics, and techniques that shape the interaction between the teacher (turned mediator) and the learner (turned mediatee). In the following sub-section, we present the six sub-goals that we chose as the basis for the Instrumental Enrichment program whose major goal is to enable individuals to better learn what is being offered them by life or by education.

Sub-goals of the IE Program

Correction of Deficient Cognitive Functions

The first sub-goal is to correct the deficient cognitive functions referred to previously. What we presented as prerequisites of learning we now define as goals. The over-arching goal aims at correcting the deficient functions that characterize the individual with learning problems and reduced modifiability. This goal requires that the program be designed and applied both implicitly, in the way that tasks are structured, and explicitly, in the way the tasks are presented. The program is, therefore, designed to correct those deficient cognitive functions that are responsible for the reduced learning propensity of the individual.

Thus, in the Instrumental Enrichment program, tasks are shaped so as to compel the learner to invest much more meaningfully in their perception. For instance, the learner is compelled to search at great length for a given figure in a cloud of dots in which the figure is superimposed among others. The act of segregating a given shape in a cloud of dots requires that the perceptual activity be regulated, that impulsivity be inhibited, and the number of dots identified as belonging to the sought-after shape be kept constant until the other dots that belong to it are found. Learners will have to look for strategies to facilitate their search, such as keeping their fingers on two of the dots while looking for the other two missing dots of the square, or finding certain systems of references that facilitate greater efficiency in the process of searching. Perception must be much more accurate than when it is confronted with unequivocal stimuli. Furthermore, by making the task require more than sheer perceptual processes, the learner must actively use cognitive processes to solve the problem.

Thus, in the search for the hidden square, individuals will have to gather more precise data about the model figure. The square's attributes will have to be compared with the attributes of a triangle or quadrangle. For this end, learners will have to use numerical criteria, such as four sides and four angles. The

concept of equilaterality will have to be applied, as opposed to the differences in size of the sides of the rectangle. They will have to use the concepts of distance, length, and size. The constancy of the object across changes in its orientation will have to be maintained. From the presence of a given set of dots, the presence of another set must be inferred. From the absence of one particular dot, conclusions will be reached as to the inadequacy of the set under consideration (see Figure 2).

The elaborational process is initiated by confrontation with incompatibilities inherent in the task, which are intended to produce a state of disequilibrium. The immediate feedback of the outcome of their activities will correct may deficiencies on the output level and will create a greater readiness in individuals to control their impulsivity and to check on their hypotheses, restructuring them according to the outcomes of previous trials. Instrumental Enrichment has been shaped by this need to confront the learners with stimuli, experiences, and tasks that correct their specific deficient functions.

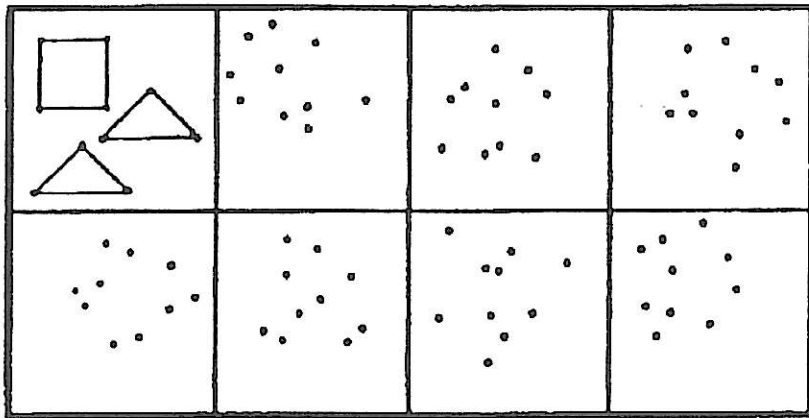


Figure 2. Selected tasks from *Organization of Dots*, page 2.

The individual must seek the necessary dots in an irregular, amorphous cloud so as to project figures identical in size and form to the given model. Successful completion involves segregation of the dots and articulation of the field. Tasks of *Organization of Dots* become more difficult with increased density of dots, complexity of figures, overlapping and changes in orientation.

Acquisition of Prerequisite Repertoire

The second sub-goal is to equip learners systematically and intentionally with the prerequisite information, verbal labels, types of relationships, and modes of operation that they need to do the exercises. Terms such as *square*, *triangle*, *parallel*, *equilateral*, *central*, *peripheral*, *before*, *after*, *simultaneous*, *identical*, *similar*, and *opposite* are necessary prerequisites whose presence in the individual's repertoire should not be taken for granted, even though, in practice, there may be evidence of their application even by the most low-functioning individual. For purposes of learning and generalizing, however, the explicit meaning of such terms is a precondition for adequate learning. Similarly, operations such as analogical reasoning, logical multiplication, permutations, substitutions, and elisions will have to become active and explicit components of the repertoire of the individual's mental functioning.

This second sub-goal is achieved mostly through the active intervention of teachers/mediators who interpose themselves between the learner and the task and, according to their knowledge of the individual's need, introduce the vocabulary, operations, and strategies necessary for the mastery of the tasks. This sub-goal should not be seen as the specific content of learning, even though it represents the content aspect of the program, which itself is not content-oriented.

Production of Generalization and Transfer

The third sub-goal is to build into the program itself a propensity for generalization and transfer as a dimension of the learning process. This sub-goal, the most neglected in many other programs, is mainly achieved through the creation of insight and opportunities to activate this propensity immediately. Teachers/mediators interpose themselves between the learners and the tasks and help in the analysis of the processes involved in solving a specific task. The mediator interprets to the learners the meaning of these processes and the way such processes can be applied in a variety of situations. Insight enables the learner to recognize that the functions that have been applied in a given task are relevant and applicable in others. Insight is also oriented towards discovering (through a self-reflective process) the kinds of changes produced in one's own cognitive structure by exposure to given experiences. These will be the source of new strategies applicable to other situations. Thus, insight will become an effective and powerful tool in producing transfer of the acquired elements and their generalization over situations differing from those to which the individual has been exposed.

Insightful learning, leading to generalization and transfer, relies heavily on the concept of transcendence, taken from the mediated learning experience. Mediators do not interact with the learner only to the extent that the current task requires; they go beyond the immediacy of the needs of the current situation into other areas of functioning that the individual may be called upon to fulfill. Many of the programs that fail to generalize and transfer to other tasks have failed because there was no provision for those elements that would ensure that such generalization and transfer would occur; they relied heavily on what the processes themselves would do. It was supposed individuals who were given a set of principles would apply them spontaneously, by themselves, because development was assumed to be spontaneous and from within, outwards. The social origins of generalization and transfer have been neglected very badly. They originate in a mediated orientation toward such processes. Through the transcendent nature of their interactions, the mediators orient individuals toward a process of generalization.

In Instrumental Enrichment, for instance the passage from learned rules, principles, strategies, and habits to other areas that are unrelated to the initial task is accomplished through what we refer to as *bridging*. The process of bridging consists in creating a certain orientation of the individual's mental activities. The individual is constantly oriented to seek areas of affinity between situations that warrant the application of the same principle. Transfer is ensured by the individual's acquired propensity toward comparing situations

in terms of their commonality and difference; by an orientation toward facilitating problem-solving behavior by referring to previous experiences; by the use of the solutions of previous experiences; and by the selection of specific strategies, or modes, or styles (see Fig.3).

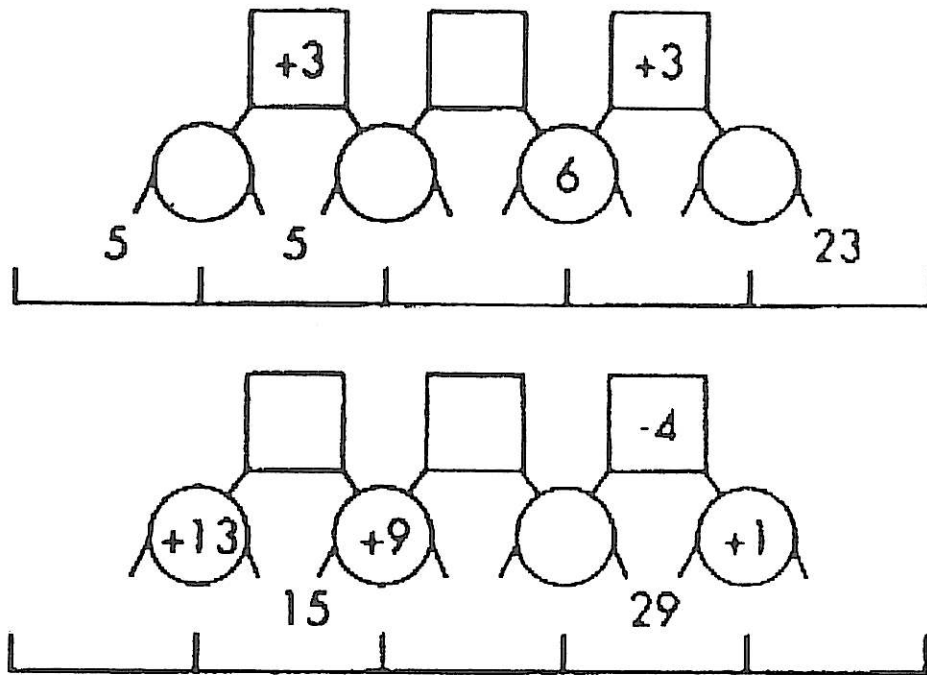


Figure 3. Selected tasks from *Numerical Progressions*, page 21.

The tasks of *Numerical Progressions*, presented in a numerical and graphic modality, deal with establishing the rule governing the relationship between objects and events and using that rule to explain the past and anticipate the future. The preceding tasks illustrate higher order relationships that are not readily discerned. The principle that is revealed is readily bridged to family relationships, or divisions of the atom, or the phenomenon of chain letters.

The teacher as mediator not only activates one particular individual in the classroom, but enriches that person's propensity to generalize through the participation of the whole group, which offers the variety and diversity of its particular experiences, thus fostering divergent thinking. Insight, defined here largely as metacognition, orients the individual toward the search for the mental process to master a given task. This metacognitive activity, involving self-reflection control, leads to activating a variety of cognitive processes that will enhance meaningfully the structural nature of the changes produced by learning. For example, the current task may be compared to a past task in which difficulty was experienced. Following this comparative behavior, the current task will be solved more easily by application of a strategy that was found to be efficient in the previous situation.

Development of Intrinsic Motivation

The development of an intrinsic motivational system is the fourth sub-goal that must be kept in mind in developing programs for the disadvantaged learner. This intrinsic motivation is necessary in order to ensure that the learner will apply those learned rules, principles, sets, strategies, and problem-solving behaviors to situations in which there is not explicit demand to do so, as in the

classroom (in particular), or in life situations (in general), it is not enough to know that there is a strategy. In order for it to be applied, one must also be motivated to use it. Such motivation may be extrinsic, as when one is specifically asked to implement the strategy; but such situations are rarely present in the life of disadvantaged individuals, whose encounters with situations that demand higher order thinking may be very limited (at least as long as they function as disadvantaged, both in school and at home).

The motivation to use adequate cognitive processes may become possible through an internalization and intrinsically determined activation of part of the repertoire of functioning. One disadvantage of many available programs is that intrinsic motivation, as a determinant of behavior is not addressed. Producing intrinsic motivation is especially important for disadvantaged learners. The great problem is how intrinsic motivation can be produced where it does not exist. The disadvantaged learner is often very much of a “realist”, seeking types of skills or information that can best serve in immediate encounters with situations. When it comes to intellectual higher order mental processes, internal needs rarely animate. There is a pragmatism in grasping the easiest way to perform and achieve immediate goals.

How, then, can we produce intrinsic motivation towards types of functioning that are not always needed and not necessarily economical? What types of investment are required in order to endow the low-functioning individual with a motivation that is detached from the immediately experienced, extrinsically generated need? To deal directly with low-functioning individuals, we must confront this question. Our answer is that intrinsic motivation can be equated with habit formation. A habit is an intrinsic way of determining behavior. In certain cases, the habit is not contingent on any situational constraints. In some extreme cases, it is even incompatible with extrinsic needs. When we are habituated to do something, we do not do it because it is necessary, but because we have the habit of doing it. The habit itself makes it necessary that act be performed in a specific way.

Habit formation has been badly neglected in an era when everything has had to rely on internal reconstruction, on discovery learning, and on a spontaneous and fluid kind of approach. Many educators have fought against habit formation, which has been considered – and rightly so – as too mechanical, less thought-through, and as having no requirement for the fluid intelligence that is applied in operational thinking. Habit formation, therefore, has been totally neglected in programs in which thinking rules and problem solving are the major goals. Principles that are taught are applied to a situation in the immediate experience episodically and spuriously, leaving place for another principle to be taught. All that is taught remains on the level of fluid intelligence. There is no purposeful, intentional way of producing a crystallized form of thinking in the learner.

Habit formation usually relies heavily on a repetitive, rote type of learning. It requires repeating the same thing until it gets applied mechanically. The question, therefore, is to what extent should rote, mechanical learning be used

in order to form habits of thinking and functioning? The damage that may be produced in the motivation of individuals (in having them do things they do not like to do), and to the fluidity of their thinking (by making them do things without having to think) may be greater than the benefit derived from forming habits of cognitive functioning.

In attempting to solve this problem, which sounds very much like “squaring the circle,” we have used a Piagetian concept initially termed by J.M. Baldwin as the “circular reactions.” We have made sure that habit formation through repetition of the same principle will never become purely mechanical. We achieved this by designing tasks that repeat themselves in one or two of the parameters they have in common but change in other parameters. A need has always been created to rediscover the familiar, the mastered part of certain skills in situations that constantly become different, more complex, more novel. Even when the same rule is applied, it will always be done with the help of more fluid types of thinking, by rediscovery, and by shaping the known element so it will fit the situation that was previously unknown. This need to create habits is addressed in Instrumental Enrichment by producing numerous repetitions of the same principle, but never applying it mechanically or blindly nor using exactly the same situation. The repetitive tasks require a great effort of discovery and restructuring. The goal of producing intrinsic motivation through habit formation makes the program require more time than does a usual enrichment program in which principles and rules are taught in a hit-and-run fashion, with hopes that by hitting and running the goal will be attained (see Figure 4).

The need to crystallize the acquired cognitive processes is felt mostly in the input and output phases of the mental act, which are more resistant to change than the elaboration phase and, therefore, require much more investment in order to reach higher levels so automatization and efficiency. Thus, in order to make individuals with blurred, sweeping perception invest more and focus longer in order to reach a greater level of clarity and accuracy in the perceived, many situations must be created in which this will be imposed by the nature of the task. The same is true in the output phase. Inhibiting impulsivity in the output level is not achieved by imparting to the individual the meaning of control of impulsivity. It will require a neutralization of the original determinant of impulsivity and then the undoing of the habit that has become established through long years of practice. Undoing a habit is best achieved by substituting another and more desirable one for it. Formation of a new habit requires more effort and is spread over longer periods of time.

Fill in what is missing:

Position	Object	Direction in Relation to the Boy
1	The tree	
4		right
2		back
	The house	front
3	The bench	
2	The house	
	The tree	left
4		back
	The bench	
		left
3		back
4	The tree	
		right

Figure 4. Orientation in Space I, page 5.

The preceding task illustrates the controlled repetition of the same principle. The field must be constantly restructured for mastery. The instrument, Orientation in Space I, introduces a personal, stable system of reference by which to describe spatial relationships. It also seeks to develop and enhance the use of representation and the ability "to put oneself in the shoes of the other". A transcendent goal of the instrument is to develop an understanding and tolerance for ideas and attitudes that stem from perspectives different from one's own.

Follow-up research (Rand, Mintzker, Miller, and Hoffman, 1981) found an increase in the effects of Instrumental Enrichment with time elapsed after cessation of the program, a fact at least partially explained by the process of consolidation and crystallization of the cognitive habits. Time has thus acted as a reinforcer rather than as a weakening determinant of the acquired cognitive functions (see Figure 5).

Habit formation adds the dimension of efficiency to the mental act. Efficiency (defined later as the "rapidity-precision" complex and feeling of ease by which a given task is performed) is strongly dependent on whether the program allows for habit formation. The more habit formation, the greater the efficiency. The greater the efficiency, the more chances that the individual will use the acquired

cognitive functions, because it will be easier, require less investment, and hence be more economical.

Instrumental Enrichment: Follow-Up Study

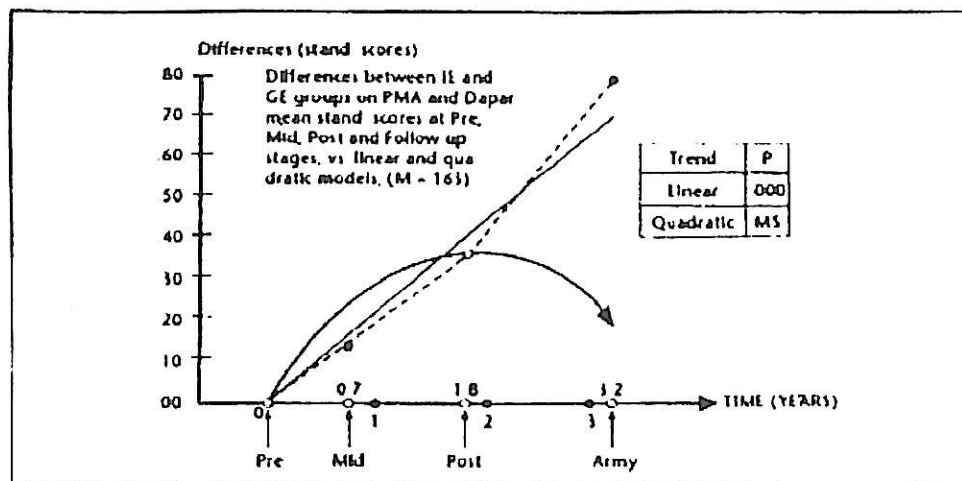


Figure 5. Divergent Effects of Instrumental Enrichment

Differences between Instrumental Enrichment and general enrichment groups on PMA and Army "Dapar" mean standard scores at pre, mid, post, and follow-up stages indicate that nearly 2 years after the cessation of intervention, the positive effects of IE intervention continue to grow. Differences between the two groups closely resemble a linear, rather than a quadratic, model.

Development of Task-Intrinsic Motivation

The fifth sub-goal is the creation of task-intrinsic motivation. This requires producing types of tasks that will entice the disadvantaged learner and stimulate a readiness to act in response to the appeal of the task itself. To be stimulating, Instrumental Enrichment makes these tasks accessible to learners by offering them the necessary mediation, carefully gauged to individual needs, to help them succeed. Once the learners are successful, the mediator leaves them to work independently. The task may be complex, but the learners' competency is not based on their previous experiences. We have carefully avoided making success contingent on previously known units of information. The complexity of the task relates only to the mental act that the individual will have to perform to solve the problem, with very little reference to previous experiences. Of course, some individuals will be more advantaged when confronted with these tasks because of their greater generalized or specific experience. However, even the advantaged must invest again and again when they are confronted with the same task. Teachers themselves must invest and make an effort when presented with our materials. In certain cases, their effort is even accompanied by their feeling, "How is it possible that I cannot do what the children are supposed to learn, and I must make an effort to do what the children will have to learn with ease?" Usually, the training problems aimed at problem-solving are easily mastered by the teachers. By its very nature, the complexity of its tasks, and its independence from demands for previous learning, the IE program is a target worthy of mastery by individuals with a proficient education, as well as being interesting and appealing to the disadvantaged who have had very little or very inefficient modes of learning.

This task-intrinsic motivation, which is produced by the very nature of the tasks, has both a substantive and a social aspect. The substantive aspect is, of course, the nature of the mental operation in which the individual becomes engaged while doing the tasks, which tends to become “addictive” because it is both challenging and a source of success. Some of the children cannot stop doing the exercises. Some adults, as well, experience this because of the challenge of the exercise and the prospects of success. In many instances, low-functioning individuals may initially be frustrated when they see themselves caught in a task in which they have to invest, because they have never done anything requiring from them more than a very fleeting, sweeping kind of perception and attention. They may actually tear up the page of exercises. But if the mediator has enabled them to experience a first success, they come back slowly, so that what was initially a source of frustration becomes enticing. Then the task-intrinsic motivation and curiosity emerge, not only about the task but also about themselves (“How will I be able to do it?”, “How much better will I be able to do it at a later stage?”, “How much more difficult will the tasks be that I will be able to do later?”). Indeed, some of the learners, having once experienced success, request more difficult tasks. This kind of task-intrinsic motivation is very seldom experienced with disadvantaged, dysfunctional learners. They usually avoid learning. They also avoid anything that is new because of the difficulties it presents to them. This behavior is followed by the evasion and lack of persistence that so strongly mark the disabled learner.

Another positive aspect of task-intrinsic motivation is the social meaning that the mastery of such tasks bears for the learner. The learner – child or adult – learns the worth of this type of activity as a socially valued and appreciated experience. Many of the children in the classroom situation who have experienced constant failure learn through Instrumental Enrichment for the first time that they can do as well as the more successful students do in subject-matter areas. Furthermore, the nature of the tasks is such that they require a constant rediscovery even when they are presented to initiated, experienced learners, including the teacher, who have performed the tasks before. A constant need exists for investment each time they are confronted with similar tasks. Even if, admittedly, they will need less investment, nevertheless they will not be able to perform just by looking at the task. Learners cannot solve the problem by simple recognition, they must restructure and rediscover the problem. The tasks have been shaped in a way that will make such discovery possible, but it requires a reinvestment. Teachers and students then realize that they are very close to each other in doing these tasks and that the relationship in the teacher/mediator-task-student triangle is much more equilateral than in any other instructional experience (see Figure 6).

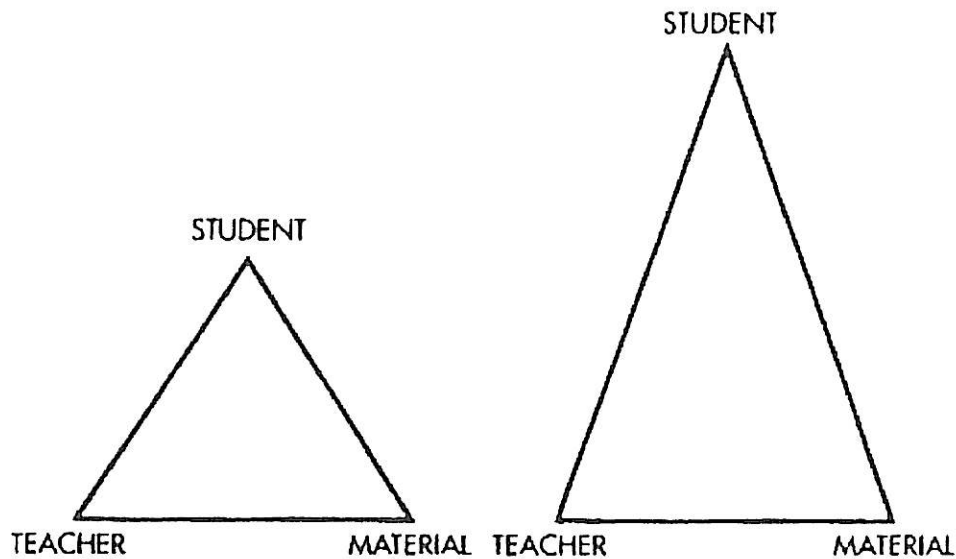


Figure 6. Teacher-Student-Material Relationship.

In teaching curriculum material, the teacher is usually very familiar with the lesson's content. Students perceive the teacher and material as a unit and feel very distant from both. In Instrumental Enrichment, however, the teacher-mediator and student confront the tasks together. This cooperative relationship makes the distance from the material the same for both. The teacher-student-material interactions more closely resemble an equilateral triangle.

Changing the Role of the Learner

The sixth sub-goal, probably the most important in dealing with the disadvantaged students, is to create a feeling of not being just passive reproducers of units of information offered to them ready-made, but as people who are called upon to generate new information that would not come into existence without their direct contribution. In many instances, deficiencies in the functioning of the disadvantaged, deficiencies in their learning process, are the direct result of a view of themselves as the recipients of information and, at best, the reproducers of the received information, without any pretense or even readiness to see themselves in the role of those who are called on able to produce information. In many instances, programs designed to create higher mental processes offer the learner problems that are matched to the presumed repertoire of prerequisites of thinking, the componential skills, and the motivation to solve them.

Success in such programs is built on the conditions for solving the tasks, which presuppose certain prerequisites. However, low-functioning learners do not possess these prerequisites. They will not be able to solve such problems unless they are properly and systematically prepared for them and unless they are equipped, through previous focused intervention, with the necessary conditions for such problem-solving behavior. Presenting tasks that require the production of new modes of thinking, new strategies, and the discovery of rules in situations not previously experienced leads toward their perception and awareness of themselves as generators and creators of new information, which is essential in solving problems. Many of the individuals experience this change as having a significant impact on their lives.

Low-functioning students often attribute their failure to that to which they have not been exposed. If they do not function properly, they comment “I have never learned it. Nobody taught me. I have never been told to learn it,” as if everything one knows depends on external sources information. This affects the output phase of the mental act, turning even a properly elaborated problem into a failing response, just because the students do not dare think they will ever be able to respond to something about which they have never been told. Programs addressing themselves to low-functioning learners have to create the situations, the modes of presentation, and the interpretation that will convey to that learner, “Yes, you are the generator of information and thereby can be engaged in the processes of discovery and creativity, and in more efficient learning.”

The Relevance of the IE Program for Blind Learners

There are two major reasons for the application of the IE program with a broad range of the blind learners. First, the IE program can substantially enhance their mental imagery and mental representations; second, the Braille IE program amplifies the blind learners’ exploratory skills and makes them more sensitive to perceptual experience.

By its very nature blindness imposes serious limitations on the learners’ mental imagery. This, in turn, may influence such mental operations as comparisons, categorization, encoding and decoding of information, and symbolic representation of objects and processes. The absence of the above mentioned cognitive prerequisites may negatively affect the learner’s ability to benefit from formal education and spontaneous learning experiences. Two predominant forms of perception used by the blind learners, auditory and tactile, both have a successive character. While the sighted person simultaneously perceives the entire scene complete with many objects and details, the blind learners are forced to use tactile exploration successively moving from one element to another.

We believe that the Braille version of the Instrumental Enrichment program is capable of providing an answer to both of the above mentioned problems, the cognitive prerequisites of learning and the creation of quasi- simultaneous tactile perception of images and schematic representations.

The specific technique for adapting the Instrumental Enrichment program to the needs of the blind learners is described in Roman Gouzman’s chapter. We would just like to mention here that the support of the Emouna Foundation was essential in the development of the first IE instruments in Braille, while a grant from the Arison Foundation allowed us to continue this project.

Enhancing Cognitive Skills in Blind Learners

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Introduction

By its very nature blindness modifies the ways in which blind learners receive, evaluate and respond to information. The major channel of information for a blind learner is auditory, followed by tactile and kinesthetic. In this paper we will examine the cognitive aspects of the blind learners' experience with two-dimensional materials accessible for tactile examination.

The prevailing educational approach places major emphasis on the integration of the blind learners into the regular classroom on the basis of the auditory channel of learning supported by learning materials in Braille. As a rule students do not have much experience with tactile materials beyond the Braille pages. Until recently the quality of these materials embossed on plastic sheets was not high. The current technology of tactile imaging on micro-capsule paper allows the blind learner to gain access to highly accurate graphic images including pictures, diagrams, plans, maps, etc. The mastery of these images is associated with several cognitive problems faced by the blind learner.

The first of them is related to the difference between the simultaneous character of visual perception and the successive character of tactile perception. The second problem stems from the fact that the process of concept formation in blind learners is dominated by two extremes: extremely abstract verbal notions that have little support in the learners' experience, and extremely concrete tactile images of every-day life objects that possess little potential for generalization. As a result, the middle ground, i.e. everyday concepts that possess a certain degree of generality are under-represented in the blind learners' cognitive repertoire. The third cognitive problem is directly related to the predominant methods of education for the blind that almost completely exclude two-dimensional schematic representations of objects and processes

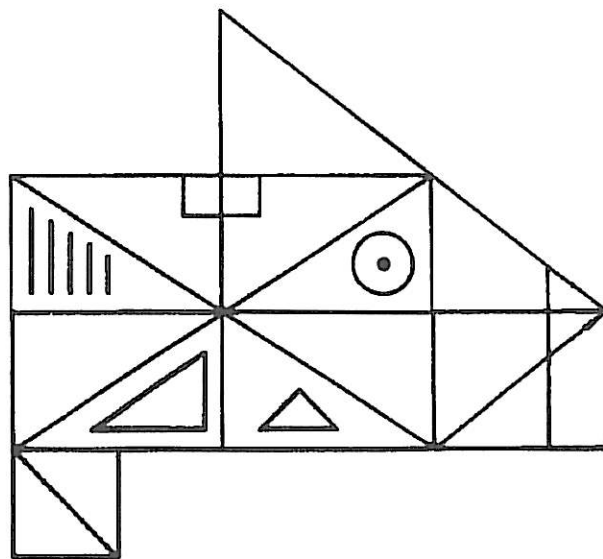
such as diagrams, charts, plans and maps. As a result many of the cognitive tools used by regular students remain underdeveloped in the blind learners.

Cognitive Functions

The cognitive problems facing the blind learners can be described more specifically by using the nomenclature of deficient cognitive functions suggested by Feuerstein et al (1979). Following the information processing model the deficient cognitive functions are considered at the Input, Elaboration, and Output phases of the mental act.

Input

At the Input phase one of the most prominent functions observed in the blind learners is the narrowness of their perceptual field. The linear successive method of tactile exploration is confined to one specific line or element at a time. The whole tactile picture thus remains beyond the spontaneous grasp of the learner. As a result, while exploring and reproducing complex graphic material, like the Rey Osterreith Figure (Fig 1), blind learners tend to repeat the same line twice because it "reappears" in two separate exploratory movements.



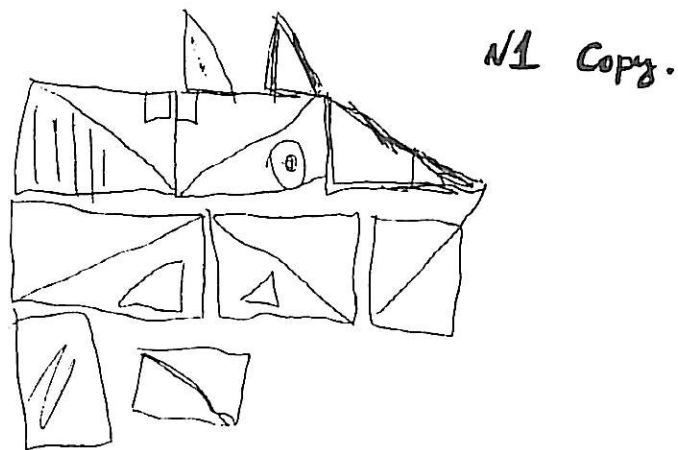


Figure 1

Another of the Input phase functions is the blurred and sweeping perception especially concerning size, directionality, and proportions of the two-dimensional tactile images. For example, our students could briefly explore two circles of a very different size and declare that "they are identical". Similarly, some of them would pronounce identical two L-shaped figures one of which is a mirror image of the other. The issue of proportion between different parts of the whole, e.g. human body, also poses serious problem for the blind learners. They often have a very imprecise impression of the proportion between the parts in the objects beyond their daily experience. In this respect it seems significant that many of our students did not know their own height and the relationship between their height and that of surrounding objects.

Yet another cognitive function at the Input phase is that of spontaneous exploratory behavior. The major difficulty in carrying out a spontaneous exploration of tactile material stems from the lack of proper methods of exploration. Often the only experience that students have with two-dimensional tactile materials is that of reading Braille pages, as a result their spontaneous exploration of a page with tactile images repeats the technique of scanning the horizontal Braille lines using one finger. Such a method is absolutely inadequate for the exploration of tactile images, producing poor results and impairing spontaneous exploration as a whole. Sometimes this reductive method of exploration is applied to the three-dimensional objects as well. One

of our students who was asked to explore a sculpture approached this task by moving one finger along the sculpture's surface.

Elaboration

Apparently the lack of appropriate experience and technique leads to the underdevelopment of functions such as a spontaneous comparative behavior directed at tactile images. We observed spontaneous comparison only with such well-trained objects as pages of the Braille text. However, when confronted with new tactile images our students initially failed to produce comparative activity necessary for appropriate exploration of these images.

Another problematic function is that of integration of several sources of information. It should be mentioned here that such integration poses problem for all students not only those with special needs. However, the severity of the problem is, of course, greater in blind learners who initially lack integration techniques. For example, when asked to find a tactile image by form, size and location parameters, our students easily identified the form, with a certain amount of difficulty they added the size parameter, but the parameter of location was often neglected.

In general, cognitive functioning at the Elaboration phase suffered from the episodic grasp of reality. Separate experiences, tactile images, and verbal concepts often remained disconnected in our students' minds.

Output

In the absence of the well-integrated mental picture our students' responses were often characterized by a certain egocentrism. For example, when working with the issue of direction our students could not resist seeing their own position as a privileged one. For example, when, upon completing a task on the sheet of micro-capsule paper, the students were asked to exchange sheets with their peers, they rarely took into account the peers' position. As a result the sheets were incorrectly oriented when exchanged and the students were unable to understand the tactile images that suddenly appeared as completely different.

Without special training our students also demonstrated considerable difficulty in performing the perceptual transport necessary to solve certain tactile tasks. For example, the two-dimensional orientation in space tasks that include position, context, and varying instructions require (see Fig 2a&b in Gouzman's chapter) transporting the image representing position into the center of the field, then consulting the table with instructions and then tracing the direction from the central point to one of the objects. All these perceptual transport activities had to be established in our students because they failed to emerge spontaneously.

Instrumental Enrichment for Blind Learners

Instrumental Enrichment (IE) is a cognitive education program developed by Feuerstein et al (1980) (See also Feuerstein's chapter in this issue). IE materials are organized into instruments aimed at such specific cognitive domains as analytic perception, orientation in space and time, comparative behavior, classification and more. The program has been successfully used as a tool for the enhancement of learning potential in learning disabled, educationally deprived and underachieving students. For many years the IE program remained inaccessible to blind learners because of the pictorial nature of IE tasks. Recently created tactile version of IE materials printed on micro-capsule paper helped to overcome this limitation. (See Gouzman's chapter in this issue).

The use of the IE program with blind learners allowed us to develop in them the following cognitive abilities:

- 1) Symbolic and schematic representations of objects and processes that previously existed only as abstract verbal labels;
- 2) Strategies of tactile exploratory activity that lead to the formation of a mental image of a structured and differentiated space;
- 3) Integration of verbal labels and schematic images leading to the ability to use mental models in problem solving;
- 4) Development of quasi-simultaneous images of situations that were previously only represented successively.

The blind learners' new abilities can be described using the above mentioned nomenclature of cognitive functions at Input, Elaboration, and Output phases of the mental act.

Development of Input functions

IE program, particularly the *Organization of Dots* instrument allowed us to develop in blind learners special methods of accurate perception and sustained attention using the tactile modality. Our students learned, for example, how to use fingers of both hands for scanning, parallel exploration of two figures, measurement of segments and angles, fixation of positions, and other tactile operations. As a result, if previously the task of distinguishing between a two-dimensional image of a square and a rectangle was very difficult for them, at the post-IE stage this perceptual operation became almost routine.

The *Orientation in Space* instrument helped to develop non-egocentric special representations. If previously the factor of orientation or directionality of two-dimensional images was mostly ignored by our students, at the post-IE stage they confidently included this parameter in their descriptions of the tactile images. Through group activities (e.g. a game - "in which hand is there a coin") it became possible to ascertain that the principles of spatial perception became transferred from the domain of tactile perception to that of the auditory one.

Spontaneous exploratory behavior improved significantly with the help of the IE instrument of *Comparisons*. Using two hands in a parallel examination of two different tactile images students learned strategies of exploration. It is significant that these strategies were spontaneously applied by our students to new unfamiliar objects such as a Braille page that contained some schematic images.

Development of Elaboration functions

One of the major gains at the Elaboration phase was the enhancement of spontaneous comparative behavior. Using some preparatory tasks, as well as *Organization of Dots* and *Comparisons* we were able to develop in our students

the ability to properly compare two sets of tactile data. An important step in this direction was made when students learned to distinguish between the lines constituting a frame of the micro-capsule page and the content images. Then students learned to explore, compare and name the totality of images on the page.

The naming progressed from the inarticulate stage of "there is a line here" to "there is a straight line that starts in the lower left corner of the page and goes diagonally to the upper left corner".

The technique of the parallel exploration of two images or two pages allowed our students to progress from the stage when they expected to receive instructions or a question, to the stage when they were able to formulate the possible task or a question themselves.

Orientation in Space proved to be effective in helping our students develop the function of integration of several sources of information. This was achieved by introducing both a general cognitive strategy and specific tactile techniques, such as fixing and preserving the position at the center of the page.

Once the students became familiar with the general principles of work with two-dimensional tactile images, it became possible to develop in them the function of planning. Through the work with the *Comparisons* instrument our students learned how to plan copying a given geometric figure. For example, in order to copy an isosceles triangle the student should first determine the number of angles and sides, the orientation of a base relative to a page frame, the position of the top relative to a base, etc. Only after these planning steps are taken and a mental image of a copy is constructed may the student start actual copying on braille paper (Fig 2).

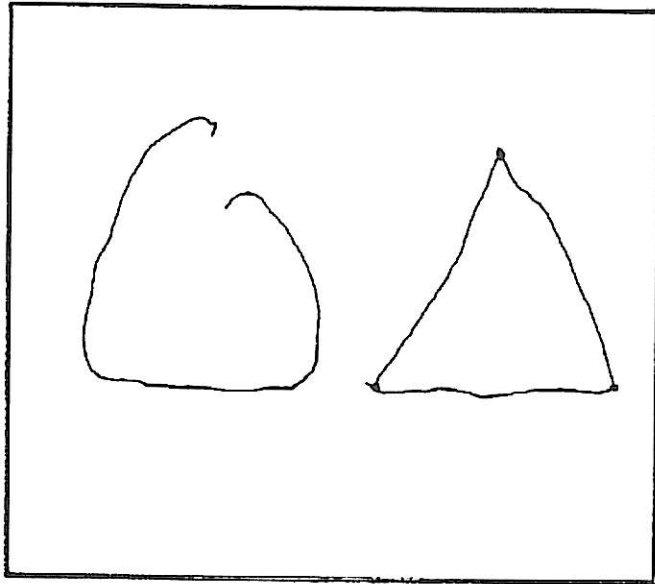


Figure 2

An episodic grasp of reality that was so characteristic of the students' pre-IE performance was remediated on the basis of the above mentioned representational, integrative, and planning techniques. If, for example, at the pre-IE stage our students reproduced the Rey-Osterreith figure in a fragmentary and episodic way, after IE training the reproduction acquired a quality of well organized, planned and integrated whole (Fig 3).

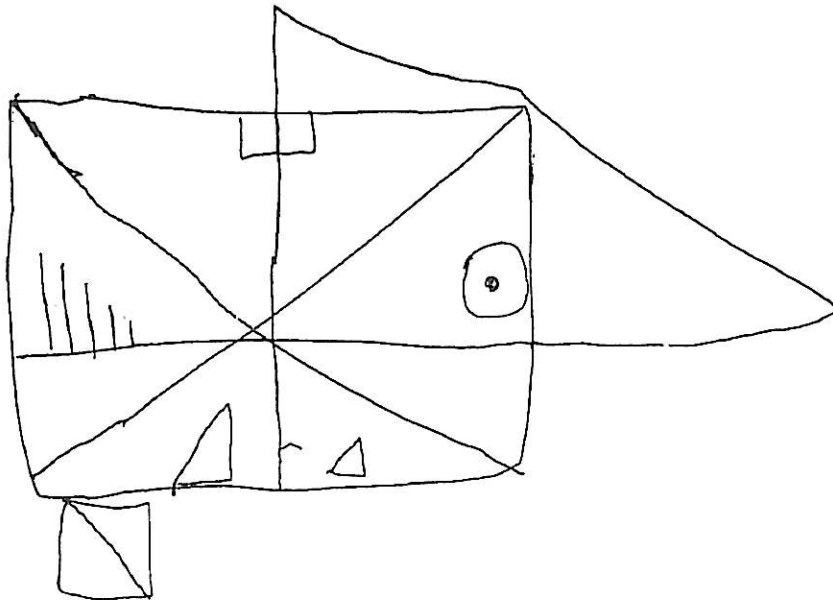


Figure 3

Special techniques for integration of separate tactile experiences were developed with the help of *Analytic Perception*. The *Analytic Perception* tasks enhanced our students' ability to work with circumscribed surfaces rather than individual lines. With this new technique lines appeared as borders of certain figures and not as isolated elements

Development of Output functions

One of the major advances in the functions related to the Output phase was the reduction of egocentric responses. This was achieved both through teaching the general strategies of taking the addressee into account, e.g. while handing a sheet of micro-capsule paper or a magnetic board to a partner, and through special IE instruments such as *Instructions*. The tasks of *Instructions* taught students how to convey to a partner all the necessary information. Thus students who started with highly egocentric descriptions like "there is a line here" mastered the skills of evaluating all the information that has to be conveyed to a partner so that he or she can identify the target image.

The quality of perceptual transfer was improved primarily with the help of *Analytic Perception*. The students became capable of abstracting the design that should be transferred from its initial context and finding its proper place in a new context.

Conclusion

On the basis of the above experiences some conclusions can be drawn regarding the cognitive advancement of blind learners:

- 1) Introduction of schematic images of objects and processes helped to link in the students' mind verbal concepts with schematic perceptual images.
- 2) On the basis of this integrative schema the teacher became capable of conducting a functional analysis of different objects.
- 3) Schematic images open a way to using modeling in all content subjects from math and science to English.

- 4) Modeling promoted the development of system of concepts that can then be applied "back" to perceptual images of objects and their representations (e.g. city maps).
- 5) Students' learning motivation improved because they obtained a sharper image of things that was a step toward such perception of objects that can be shared with sighted peers.

Acknowledgments

The Braille version of IE tools has been developed with the help of generous support provided by the EMOUNA Foundation and Arison Foundation.

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The Instrumental Enrichment Program for the Blind Learners

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The Instrumental Enrichment (IE) is a cognitive intervention program developed by Reuven Feuerstein et al (1980) as a tool for the enhancement of learning potential of children, adolescents, and adults. The major goal of IE is to enhance the students' cognitive modifiability and provide them with cognitive tools necessary for them becoming independent learners. Regular IE program includes 14 booklets of paper-and-pencil tasks aimed at such domains as analytic perception, orientation in space and time, comparisons, classification, and so on.

For many years IE program the IE program remained inaccessible to blind learners because of the pictorial nature of IE tasks. The developer of a tactile version of this program was confronted with a major task of transforming the successive tactile perception into the quasi-simultaneous mental image (Gouzman, 1997).

The Problem of Input and Response

The first problem is how to make IE material accessible to the blind learners and how to provide them with relevant response modalities. Blind individuals cannot use the graphic input of the regular IE material, and, as a rule, cannot respond by drawing figures or signs. The problem of input was resolved by using micro-capsule paper sheets. IE pages containing drawings, text in Braille and other graphic elements were printed on this paper and in this way became accessible for tactile examination.

The problem of response has been resolved by placing micro-capsule paper sheets on magnetic boards and providing students with ferromagnetic response tokens. The blind learner explores the task using a tactile modality,

selects an appropriate token from the case, and then places it in the correct position on the page. Different combinations of boards and tokens are used depending on the specific needs of a given IE instrument. Tokens are available in different shapes and sizes, some of them bearing symbolic information or a short text in Braille. In addition, the blind learners working with IE pages were taught to respond to the task by making drawings on the braillon sheets. The combination of magnetic boards, response tokens, and braillon drawing allowed us to resolve the following problems:

- To create a common input and response field for the blind learner;
- To achieve considerable flexibility in representation of information (verbal, pictorial, symbolic, etc.);
- To achieve greater simplicity and precision in presenting information to the blind learner.

The IE Page Design

A number of methodological principles have been developed that allowed us to revise the entire graphic material of IE pages thereby making them attuned to special needs of the blind learners.

These principles include:

- One) Identifying the most essential pictorial elements of the IE material and retaining only these elements in the Braille version of IE;
- Two) Selecting the optimal sizes of graphic representations;
- Three) Finding a proper balance between schematic and realistic styles in pictorial representations.

The point (a) was achieved by:

1. Analyzing the depicted object in terms of its essential , constituent characteristics directly related to its conceptual meaning;
2. Selecting the most efficient and expressive means of graphic representation;
3. Reducing the number of pictorial elements on the page to 3 or 4;
4. Replacing the excessively complex means of pictorial representation used in the regular IE instruments by those means accessible in the tactile modality. For example, instead of the $\frac{3}{4}$ view of the face, the frontal or a profile view; instead of a picture with linear perspective, a frontal view or a a view from above.

5. Reduction and schematization of separate details and a pictures as a whole;
6. Piloting the newly designed graphic material in different learning contexts.

The optimal size (b) was determent by the following way:

1. Elements of the design should not overlap each other;
2. Elements should be spread in such way that one may discriminate between them by tactical analysis;
3. The blind learner should be able to explore the design as a whole using all fingers of both hands. As a result a quasi-visual simultaneous image of the objects should appear in the learner's mind.

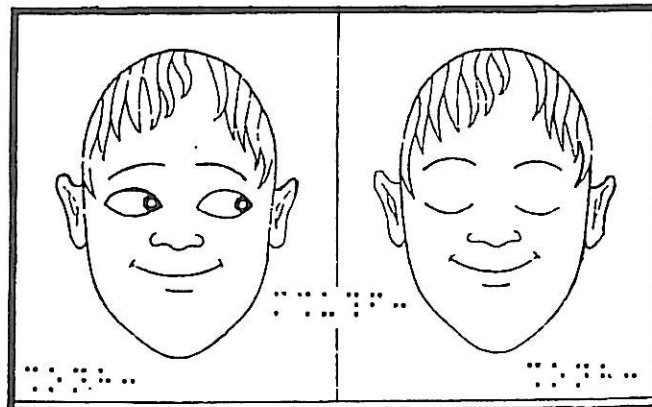
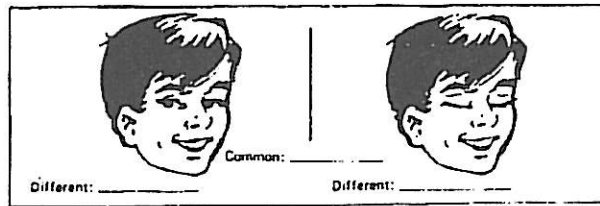
A proper balance between schematic and realistic representation of objects (c) was achieved through the development in the blind learners of the special cognitive functions of symbolic representation. Symbolization is related to the realistic image by retaining some of its concrete features, but it is also related to an abstract schema of the object by focusing on essential, conceptual elements of the object.

For example, in one of the tasks of the IE instrument *Comparisons* students are supposed to compare two pictures of the child's face. In developing the tactile version of this page (see Fig. 1 A&B) we followed the above rules and retained the following most essential elements of the original picture: Outline of the face; elements responsible for facial expression such as eyes, brows, mouth; major parts that allow one to recognize the image as a human face such as hair, ears, nose, and chin. The shades on boy's head and cheeks were excluded from the tactile version, the $\frac{3}{4}$ view was replaced by the frontal view and the symmetry of the face was emphasized. The size of the face was selected as to be equal to a half of the student's palm. This size is sufficient for simultaneous examination of the image by all five fingers, and it is big enough for examination of separate elements of the image by individual fingers. For example, the student should be able to identify the position of pupils in the corner of boy's eyes. Reduction and schematization of the image included the change of the graphic style in the depiction of hair, brows, and mouth into a more plane

one. Emphasis is added to those elements such as mouth and brows that convey the expression of a smile.

Sometimes the IE page should be completely redesigned in order to respond to special needs of the blind learners. For example in the *Orientation in Space I* instrument (Fig. 2 A&B) a “three-dimensional” picture of a square with house, bench, flowers, and a tree shown in perspective had to be replaced by a “flat” semi-schematic view. All depicted objects became represented by the relevant schematic images that express the most basic function meaning of each one of them. The four positions of the boy that in the original version were represented by the four full size images of his body see from the left, right, front and back were reduced in the tactile version to the four positions of the pair of shoes. We literally realized here the saying about “putting on somebody else’s shoes” in a sense of assuming the position of another person.

Indicate what is common to each pair of pictures and the differences between them



Instructional Methods

Figure 1 A&B

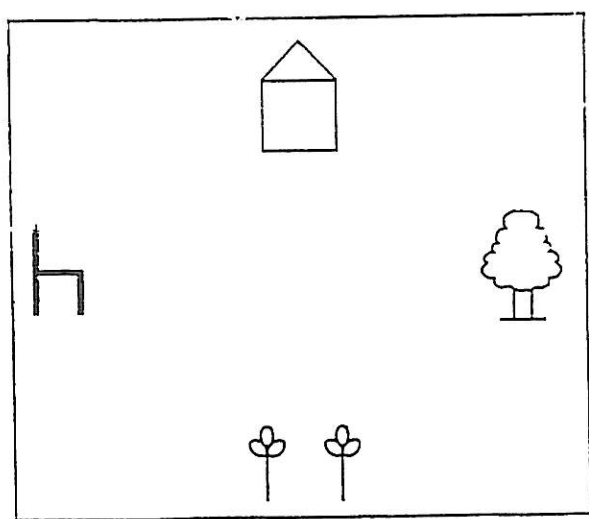
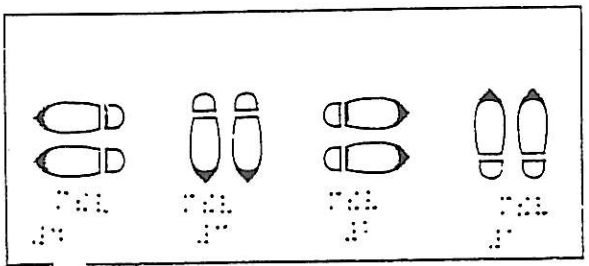
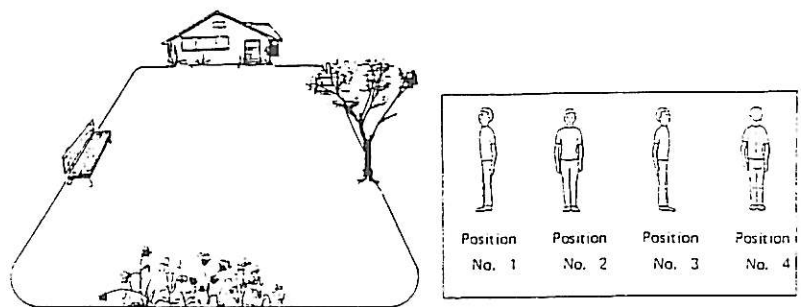


Fig. 2a&b

Figure 2 A&B

The underlying principle of the IE instruction is that of mediated learning experience (see the paper of Feuerstein in this issue). Mediation of IE material to the blind learners should take into account their special needs and first of all the fact that material that is perceived by a sighted learner simultaneously is accessible to the blind learner only successively. In order to turn the product of successive tactile exploration into a quasi-simultaneous mental image the following approaches should be used:

1. Creating a system of reference.

The majority of blind learners do not know how to explore pictorial information appearing on a sheet of micro-capsule paper. Their experience is often limited to examination of Braille texts that have a fixed linear organization from left to right and from top to bottom of the page. Thus one of the first tasks is to teach blind learners how to organize their exploratory activity when confronted with unfamiliar material printed on micro-capsule page. Such an exploration includes the analysis of the page layout, the distinctive parts and segments of the page and their relationships. Our students were taught how to use the frame of the page and horizontal and vertical lines dividing it as a basic system of reference. Additional emphasis was placed on identification of right angles and intersections of lines. As a result our students formed a basic reference system to which they systematically returned in the process of problem solving.

2. The measurement system.

The analysis and comparison of complex tactile images is greatly facilitated by the presence of measuring devices. Our students learned how to use their hands as such devices and how to measure the length of line segments, angles, areas and so on. They also learned how to check whether the given lines are overlapping, orthogonal, or parallel.

3. Sensory-motor coordination.

To achieve satisfactory exploratory behavior blind learners should be able to coordinate their sensory-motor activity. One of the important achievements of our students was the development of coordinated activity involving all their fingers. The tactile analysis of images combined the periods of narrow-range exploration performed by 2-3 fingers and the periods of wide-range scanning of the page performed by all fingers of both hands.

4. From successive to quasi-simultaneous perception.

All of the above described approaches were integrated into a coherent system of mediated activities that allowed the blind learners to identify the difference between successive and simultaneous perception. The awareness of simultaneous perception was created in the students and the resultant

quasi-simultaneous images were transferred from the IE tasks to other learning and everyday life material.

Recipients of the IE Program

The IE program was implemented with different groups of students in different contexts.

- Blind students with multiple problems (ages 10-18) studying in a specialized Jewish Institute for the Blind in Jerusalem;
- Blind students without additional problems integrated into various regular schools (ages 10-18);
- Children attending special summer camp for the blind learners (ages 12-18);
- Students at the special pre-academic program for the blind learners at Hebrew University of Jerusalem (ages 19-30);
- Elderly new immigrants attending Hebrew courses (ages 55-70).

Program Outcomes

The outcome of the implementation of the IE program includes changes in the behavior, cognition, and the self-image of the blind learners. In the field of behavior the students demonstrated greater alertness and involvement during lessons. Some of them for the first time started actively interacting with their sighted peers. The self-image of the blind learners improved significantly. Students started setting for themselves much higher educational and career goals. Cognitively a very significant change has occurred associated with acquisition of “quasi-visual” representations of objects and processes, learning to use schematic representations and models, developing learning strategies and expanding the area of cognitive activity.

References

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