

EFFECTS OF IMAGERY AND SENSORIMOTOR REPRESENTATION  
ON A PERCEPTUAL INFERENCE TASK:  
A DEVELOPMENTAL STUDY

by 557

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B. A., State University of New York, 1969

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A MASTER'S THESIS

submitted in partial fulfillment of the  
requirements for the degree

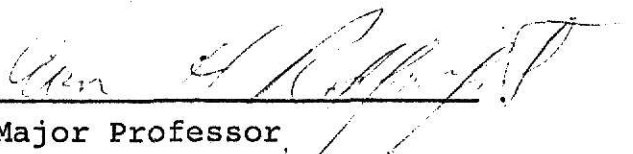
MASTER OF SCIENCE

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Manhattan, Kansas

1971

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## Chapter I

### Statement of the Problem

The general purpose of this research is to compare the effects of sensorimotor and perceptual forms of active involvement on different aged children's performance on a perceptual inference task.

### Background and Theory

Problems concerning the role of sensorimotor activity and concrete imagery in the cognitive functioning of the child have long been of interest in developmental psychology (e.g. Werner, 1948; Bruner, Olver, & Greenfield, 1966). The idea that action and imagery are very important in the child's attempt to order and integrate experience, predict and control outcomes, or otherwise conceptualize his environment has been examined in many studies (cf. Werner, 1948; Flavell, 1963).

Werner (1948, 1957) and Kaplan (1959, 1967) consider the action-oriented, or "things-of-action" behavior of the child to be the earliest form of thought displayed by humans. Using comparative methods to examine similar action patterns in young children, phylogenetically lower species, as well as adults in less advanced cultures, Werner clearly ties the primitive, undifferentiated cognitive functioning of the child to the "signal qualities," or kinaesthetic properties of objects. A thing is "known" insofar as it conveys information of an affective-motoric nature through the child's sensorimotor apparatus.

In general, Werner (1957) states: "There appears to be an early sensorimotor stage of spatial orientation, succeeded by one in which objects emerge in terms of 'things-of-action,' where perceptual qualities of things are determined by the specific way these things are handled [p. 129]."

In a systematic investigation of Piaget's work on cognitive development, Bruner and his colleagues (1966) also consider the child's first attempts at organization as highly motoric, or "enactive." Summarizing a series of experiments concerning delayed-reaction motor learning in young children, he argues that: "The degree to which the child, even after action-free imagery is well developed, continues to depend on some form of enactive representation, is striking (Bruner et al., 1966, p. 19). Moreover, according to Drake (1964) the young child's enactive mode of learning can be disrupted by such interferences as intervening motor activity, angular displacement, and temporal delay.

The child's enactive, or sensorimotor pattern of learning reaches its peak during the first two years of life (Flavell, 1963) but it is carried over in a subordinated form for some time after (Werner, 1948). By the age of four or five, schematic action patterns, which serve the functions of integrating experience and producing reciprocal effects on the environment (cf. White, 1959), become abstracted from their basic motor movements via the perceptual apparatus. This stage of action-free imaginal representation is termed "ikonic" by the Bruner group (1966); "concrete imagery" by Piaget (cf. Flavell, 1963); and "concrete perceptual" by Werner (1948).



It should be noted, however, that progressively higher stages do not supplant each other--a higher stage represents a reorganization of a lower. Lower stages are found to be hierarchically integrated with more advanced ones. Kohlberg (1968) states this argument as follows: "Accordingly, higher stages displace (or rather reintegrate) the structures found at lower stages. As an example, formal operational thought includes all the structural features of concrete operational thought but at a new level of organization [p. 1021]." The most salient characteristics of an earlier stage of development, however, are greatly altered by the process of cognitive growth. For example, although children up to the age of seven years are found to organize experience in a spatial-imaginal way, Kuhlman (1960) demonstrated that the vividness of imagery decreases directly with age. The child is dealing with increasingly more abstract qualities of a concrete conceptual nature that cause him to "decenter" from the salient visual-motoric dimensions of a stimulus configuration. This decentering allows him to categorize common properties, but he apparently does this at the price of his earlier sensitivity to sensory experience.

Werner (1948) summarizes this issue as follows: "The image, so we may suppose, originally rooted in the sensuous sphere of feeling and fantasy, is gradually changed in functional character. It becomes essentially subject to the exigencies of abstract thought [p. 152]." Werner goes on to state that imagery and sensorimotor functioning in general undergo structural (organizational) changes, and that these changes are necessary for the

development of abstract thinking. The faintness of sensuality and the lack of vividness in imagery are seen as positive changes toward directed thought.

Piaget (1962) as well as Mehrabian (1968) in attempting a theoretical synthesis of Piaget and Werner, argue strongly that cognitive learning in children is best facilitated when the child's own "spontaneous" intellectual resources are utilized. Piaget (1962, p. 11) states:

"I do not believe, as Vygotsky seems to do, that new concepts, even at school level, are always acquired through adult didactic intervention. This may occur, but there is a much more productive form of instruction: The so-called 'active' schools endeavor to create situations that, while not 'spontaneous' in themselves, evoke spontaneous elaboration on the part of the child, if one manages to both spark his interest and to present the problem in such a way that it corresponds to the structures he had already formed himself."

Piaget clearly believes that "passive" or didactic conceptual instruction is a hindrance to, and potentially harmful to the child. "Active" or spontaneously oriented instruction, exemplified by the Montessori approach, and Synectics training (Gordon, 1961) implies subject-object involvement, ongoing utilization of sensorimotor and imaginal processes, and a degree of affective excitement in conceptual attainment. The child is presented with a cognitive challenge--the extent to which he adapts or "accommodates" by restructuring his way of thinking is dependent on: (a) his existing cognitive skills; and (b) the extent to which situational demands tax these skills. The relationship between (a) and (b) is best stated by Mehrabian (1968), who in a theoretical synthesis arrived at "corollary 1" as a rule for the facilitation of conceptual accommodation, or restructuring on lower

developmental levels. Mehrabian states: "The lower the level of conceptual development of an individual, the greater is the facilitative effect of learning at the sensorimotor and perceptual levels in a given content area on the acquisition of conceptual objects in the same content area [p. 14]."

Cognitive development is generally believed to represent situations where the child must utilize his ongoing organizational tendencies to their fullest extent. Implied in the statements of Piaget and Mehrabian is the notion that educators should gear learning tasks to the cognitive capacity of the child. To superimpose a passive, disengaged mode of instruction on the child is seen as a poor means of maximizing cognitive learning. Various researchers note the child's inability to logically integrate disparate information (cf. Draguns & Multari, 1961; Potter, 1966; Westcott, 1968). The above mentioned researchers have employed the "microgenetic" paradigm (Sander, 1930; Flavell & Draguns, 1957), to be described in the following section, and have concluded, for varying reasons, that efficiency of attainment on this cognitive-inferential task rises as a direct function of age. More interesting, however, is the fact that younger children often display stereotypic, impulsive, or otherwise inefficient orientations to the microgenetic task (Draguns & Multari, 1961; Potter, 1966; Westcott, 1968).

### Microgenetic Development

Microgenesis, a term first used by Sander (1930) as "aktual-genese," translated as "microgenesis" by Werner (1948) refers to

the development of discrete perceptual configurations over time. By presenting a stimulus in an initial state of vagueness, ambiguity, or short exposure-time, it is possible to chart the growth of a percept or thought through successive stages of clarity, articulation, and completedness. Brunswik (1956) summarizes as follows: "Sander distinguishes a series of organizational stages in the brief genesis of any single full-blown perceptual act (or perceptual actuality); this so-called 'actualgenesis' is set in parallism to the phylogenesis and ontogenesis of perception in an overall theory of development. A most primordial, feeling-like stage is said to be followed by a second, 'geometric-ornamental' stage and eventually by a third, 'realistically meaningful' stage [p. 133]."

Stimulus materials used to construct tasks for the study of microgenesis include successive degrees of picture blurredness (Bruner & Potter, 1964; Draguns & Multari, 1961), degrees of picture completedness (Gollin, 1961; Westcott, 1968), high contrast photographs (Mooney & Ferguson, 1951), and increasing levels of tachistoscopic exposure-time (Hemmingdinger, 1951).

As mentioned above, such tasks have been applied developmentally, consistently demonstrating that efficiency of cognitive activity, as defined by successful object inference relative to the degree of information (number of stages) necessary to elicit a "realistically meaningful" inference, rises steadily as a function of age (Flavell & Draguns, 1957).

In general the various researchers cited above all indicate that the young child is unable to adequately integrate the

disparate information presented microgenetically (cf. Bruner et al., 1966). Two prevalent explanations concern (a) the young child's inability to withhold an initial, impulsive guess (Westcott, 1968; Potter, 1966), and (b) the "centeredness" of the young child's cognitive activity (Bruner & Potter, 1964). The impulsiveness of the young child, termed "nonreflective attitude" (Kagan, Rosman, Day, Albert, & Phillips, 1964) reflects the inability of the sensorimotor-imaginal child to differentiate, or break up a field to its components. On the other hand, centeredness reflects the child's stereotypy of responding--his susceptibility to "tying" himself to a salient part, or attribute, overlooking the relation between parts, or attributes.

The aim of the present study is to produce an "experimental decentering" on the part of the child, by requiring him to: (a) deal with the total stimulus configuration as a connected unit; and (b) impose a form of reflectiveness, or delay, by virtue of a motoric interaction with the stimulus, thereby minimizing impulsiveness.

### Specific Aims and Rationale

Given that the young child is greatly dependent on enactive-motoric and perceptual-imaginal cues for cognitive learning, and that all of the previously cited microgenetic research emphasizes the importance of such cues, the present study is designed to study the effects of a sensorimotor (finger-tracking) and an imaginal orientation on the child's ability to elicit cognitive inferences.

Finger-tracking of two dimensional representations as a means of facilitating decentering has been used in nonmicrogenetic settings (cf. Bruner et al., 1966, p. 24; Gellerman, 1933). Gardiner (1970) points to some experimental evidence demonstrating that the young child in effect makes little or no distinction between two and three dimensional representation, and that there is complete transfer of training across dimensional modes. Acceptance of this conclusion implies that the utilization of a standard microgenetic task, involving successive stages of picture completedness (Westcott, 1968) on a two dimensional level, may in fact be conducive to simple motoric representation.

The utilization of imaginal, concrete representation has been shown to be of varying benefit in the attainment of simple conceptual tasks. For example, Kuhlman (1960) conducted a study in which children were required to reproduce ambiguous drawings that were individually paired with names of common objects. Children who made use of a "high-imagery" mode of representation showed less convergence to the object denoted by the familiar name, than did children using a non-visual mode, in their reproductions of the drawings.

Specifically, the implementation of finger-tracking and concrete imagery training on a version of the Westcott microgenetic task, "perceptual inference" (Westcott, 1968) may produce an increment in cognitive efficiency by: (a) maximizing the utilization of the child's ongoing cognitive organizing tendencies; (b) imposing a temporal delay between stimulus presentation and

cognitive inference; and (c) encouraging the child to account for the total stimulus configuration, thereby minimizing centeredness.

It is predicted that: (1) Overall efficiency, as defined by the degree of successful object inference relative to the degree of information necessary to elicit an inference over a series of post-training trials, will show a reliable increment; (2) A younger age group (six years) will show a larger increment from pre-training to post-training than will an older group (nine years), as an abstract-symbolic mode should be at least partially available to the older group (i.e., they should be somewhat efficient at the onset); (3) Age will interact with training technique used (tracking and imagery) as younger, more "enactive" children should benefit more from finger-tracking; whereas the older, more perceptually oriented group should benefit more from imaginal representation; and (4) Children exposed to either technique will prefer that technique more than the traditional passive (visual-verbal) orientation utilized in the pretraining sequence. This follows from the premise that children enjoy making use of their 'natural' mode of organization, or way of thinking.



## Chapter II

### Design and Procedure

The present research plan involves the application of two prevalent forms of cognitive representation among children (imagery and sensorimotor activity) to a microgenetic task. A task which lends itself to these forms of organization is "perceptual inference" (Westcott, 1968). Other forms of microgenetic stimulus material, by virtue of the method of stimulus presentation (e.g. tachistoscopic exposures) or method of integration of components in a temporal sequence (e.g. blurred pictures) are not applicable to the above stated training techniques (i.e. not directly amenable to enactive or imaginal representation).

#### Perceptual Inference Task

Westcott's microgenetic task consists of a series of incomplete picture sequences, where each succeeding stage within a sequence provides a greater degree of completedness, information, and certainty. The subject tries to identify the developing object at the earliest stage that he can. Figure 1 represents an example of Westcott's microgenetic task, perceptual inference. This sequence contains a series of eight stages of a schematic bird drawing. The stages appear to range from an initial global stage to a stage of vague differentiation (stage 4), to a stage of objective clarity (stage 8).

Stimulus material for the present study consists of a standardized version of Westcott's perceptual inference task (West-



**THIS BOOK  
CONTAINS  
NUMEROUS PAGES  
WITH DIAGRAMS  
THAT ARE CROOKED  
COMPARED TO THE  
REST OF THE  
INFORMATION ON  
THE PAGE.**

**THIS IS AS  
RECEIVED FROM  
CUSTOMER.**



Fig. 1. An example of a perceptual inference sequence.\*

\*From Westcott (1968), size reduced.

cott, 1968). This task contains twenty different picture sequences selected from children's coloring books. Each sequence presents a given object in eight stages of completion, ranging from an initial stage comprising a few scattered lines through succeeding stages of "closure" and figural clarity. The final stage represents a comparatively veridical representation of an object common to all children within our culture. Succeeding stages contain all information present in preceding stages, each successive stage adding a significant degree of additional information.

The pictures were arranged on 8" X 5" cards and the 20 sequences combined to form a booklet such that E could control the rate of presentation of successive stages in a sequence.

Westcott (1968) reports split-half reliability data for the age levels selected in the present study. Coefficients for success scores range from .81 to .89 (corrected by Spearman-Brown).

### Subjects

The subjects tested were 30 male and female children in kindergarten and 30 male and female children in the third grade. Mean ages for the two groups were 6:1 and 9:2 respectively. These ages were selected primarily because of their approximate correspondence to the midpoints of two basic developmental stages described by Piaget and Inhelder (1969), and Bruner et al. (1966). The two stages and their reported range of ages (Piaget & Inhelder, 1969) are the sensorimotor (2-7) and that of concrete operations (7-11).

## Procedure

Subjects were tested on the Westcott task individually in a separate room. Standard instructions, appropriate to the child's age level, were given to all children for the initial example and pretraining phase. This consisted of a brief explanation of the nature of the task, with a corresponding requirement to indicate to E "what you think the picture is as soon as you think that you know." Children were asked not to guess out loud until they felt confident or "pretty sure" of their guess. It might be added that the entire procedure was carried out to promote a game-like atmosphere. Children occasionally expressed a great deal of enthusiasm over the task, often grabbing at the task booklet in attempts to look ahead or turn the pages by themselves. An initial, unscored example was utilized to familiarize S with the task, and to assure E that the instructions were understood. For example, several children had to be reassured by E that it was 'safe' to guess at an object before the final stage of completion, and that a degree of uncertainty was 'natural' to the task.

During presentation of the task, E recorded the number of stages required for an object inference for each of 16 test trials (information demand), and the total number of successful object identifications over the 16 trials. Each S was scored for a mean "information demand" measure and a "total success" measure. A time limit of 5 seconds was placed on the presentation of each stage of picture completion throughout the task.

Following the initial presentation of eight baseline sequences, the independent variables, finger-tracking and imagery, along with a control procedure, were introduced. E randomly selected 10 Ss for finger-tracking, 10 Ss for imagery instructions, and 10 Ss for control purposes from the kindergarten population. An identical, randomized procedure was implemented for the third grade population, producing a total of six experimental groups of 10 Ss each.

Two examples were used to explain the training instructions to the finger-tracking and imaginal Ss. Finger-tracking instructions consisted of requiring S to trace the outline of the fragmented picture in a way in which S could best "fill in the gaps." S was asked to make believe that he was touching the "real thing," and that he could actually make "all the lines come together, forming a thing that you know." E did not score S's behavior over the two training examples. All children in the finger-tracking condition understood the instructions and were able to trace the outlines accordingly.

Imagery instructions consisted of asking S to "imagine the lines growing together," and to "picture this in your head"-- "making believe that it is real, and right here!" During the course of the training phase of the two examples, Ss were asked if they were in fact able to imagine the lines growing to completion, and if they could, in effect, represent this process internally. E was assured by all imagery Ss that they were able to do so. Ss in the training groups were instructed to continue using these techniques for the remaining eight trials,

and to continue guessing at the earliest point of confidence.

Children in the control conditions were given identical "training examples," with the exception that they were not given specific imaginal or enactive instructions. Instead, these Ss were given a basic repetition of the initial instructions, and told to continue on as before. In this respect, verbal interaction between E and S was controlled.

As stated above, during the course of the 16 test trials, E recorded individual "information demand" scores and a total success measure for each S. Cognitive efficiency, defined as the ratio of success to information demand (output/input), constituted one of two dependent variables. A second dependent variable consisted of a yes-no answer to a question posed by E to all Ss exposed to a training technique. The question posed was whether the second, post-training phase was preferred to the initial pretraining phase of the "game." The wording of the question was reversed for one-half of the Ss, as an attempt to control for acquiescent response bias (e.g., "yea-saying"). These Ss were asked whether the first, pretraining phase was preferred to the second, post-training phase of the "game."

### Design Summary

To recapitulate, the experimental procedure consisted of (a) pretraining instructions and example; (b) pretraining phase of eight baseline sequences; (c) two training examples, or identical control sequences; (d) eight post-training sequences, or eight identical control sequences; and (e) training preference question.

Experimental procedure (imagery versus finger-tracking versus control) and two age levels (6 years versus 9 years) defined a 3 X 2 factorial design. The dependent variable was the difference between efficiency scores across pretraining and post-training phases. Accordingly, an analysis was to be subsequently applied to these difference scores.

To summarize the specific experimental hypotheses, it is expected that: (a) Ss in both experimental training conditions will exhibit a reliable overall increment in cognitive-inferential efficiency, defined as the ratio of success to information demand, across a post-training series of eight sequences; (b) the group with a mean age of 6:1 years will show a larger overall increment than the older (9:2) group; (c) age will interact with training technique. Younger Ss will show a relatively greater benefit from sensorimotor training than the older Ss, while the reverse will be true for imaginal training, with the older Ss generating a larger increment; (d) children exposed to either technique will express a preference for that technique to pretraining in response to a post-experimental question posed by E.

## Chapter III

### Results

#### Cognitive Efficiency

Cognitive efficiency was measured in terms of the number of successful inferential attainments generated by each S, divided by the mean number of stages required by each S, across a series of eight pretraining and eight post-training sequences. Each score was multiplied by a constant of ten for computational purposes. These efficiency scores were then averaged for each of the six experimental groups.

An analysis of variance was applied to difference scores across pretraining and post-training phases. Table 1 represents a summary of this analysis, which shows a reliable main effect for the two training techniques, summed across both age levels ( $F = 12.91$ ,  $p < .001$ ). There is, however, no reliable effect for differential increments between age levels, nor an age by training technique interaction, as predicted.

Table 2 summarizes mean efficiency scores and mean efficiency increments for the six experimental groups. Nine year olds show an overall higher level of efficiency throughout the task. They also showed a larger, though non-reliable mean training increment (.51 vs. .35).

The reliable main treatment effect for training procedure, collapsed over age, was broken into its three components: en-active training vs. control procedure ( $t = 2.57$ ,  $p < .01$ );



Table 1

## Analysis of Variance of Efficiency Difference Scores

Source	SS	df	MS	F	P
Between Groups	3.36	5			
Age (A)	0.05	1	0.05	< 1	NS*
Treatments (B)	2.83	2	1.42	12.91	< .001
A x B	0.48	2	0.24	2.18	< .20*
Within Groups	6.08	54	0.11		
Total	9.44	59			

\*Not significant

Table 2

## Mean Efficiency Scores and Training Increments

Group	Kindergarten (6:1)		Third grade (9:2)	
	pretraining	post-training	pretraining	post-training
Enactive	1.66	1.93 (+. <u>27</u> )	1.62	2.19 (+. <u>57</u> )
Imagery	1.53	2.11 (+. <u>425</u> )	1.73	2.18 (+. <u>45</u> )
Control	1.71	1.72 (+. <u>01</u> )	1.79	1.81 (+. <u>02</u> )

imagery training vs. control procedure ( $t = 2.82$ ,  $p < .005$ ); and enactive training vs. imagery training ( $t = 0.03$ , NS).

It appears, from these analyses, that active involvement training, though highly reliable as an overall homogeneous effect, fails to yield differential increments between ages, nor between ages by specific technique employed. Six year olds, though reliably influenced by training, failed to produce a larger training increment than the nine year old group. Neither did they benefit more from enactive training than imagery, as expected.

#### Preference Measure

Preference for active involvement (imagery and finger-tracking) was measured as a response to the question: "Did you prefer the first (second) part more than the second (first)?" Table 3 summarizes the responses of the 40 trained Ss. Thirty-three of the 38 children expressing a preference favored the active forms of training ( $p < .001$ ).

Table 3

Children's Preferences for Task Procedures, Stated as  
a Response to the Question, "Did you prefer the  
first (second) part more than the second (first)?"

	Pretraining	Active training	No preference
Kindergarten (6:1) N = 20	3	16	1
Third grade (9:2) N = 20	2	17	1
Totals N = 40	5	33	2
Binomial probability < .001			

## Chapter IV

### Discussion

#### General Findings

The present study produced two important findings: (a) A general facilitation of cognitive-inferential efficiency on the Westcott microgenetic task, across two developmental age levels; and (b) An overwhelming preference amongst the children in the sample for the two training techniques employed in the task.

While the training effects did not discriminate between age levels (i.e., did not yield differential increments), it appears that active training, directed toward maximization of the use of ongoing organizational tendencies, has an appreciable effect on cognitive achievement within the age levels employed. The children, by virtue of their responses to the preference question posed by E, along with a good deal of visible excitement and anticipation over training as observed by E, thoroughly enjoyed the opportunity to make use of nonverbal (enactive and imaginal) processes. With respect to the aims of the study, the facilitation of cognitive learning found here is basically consistent with "corollary 1" (Mehrabian, 1968), and with Piaget's (1962) statements on the development of spontaneous conceptual functioning through "active" education, and the capturing of the child's attention with a "spark of interest" (p. 11).

Possibly a prime factor involved in facilitation may well have been the capturing of the child's attentional process, as

a means toward cognitive decentering. This is not meant to de-emphasize the efficacy of utilizing nonverbal processes within the age levels found in grade school settings, for the triggering of a spark of interest, and subsequent attentiveness on the part of the experimental Ss in all likelihood hinged on the orientation to the task (i.e., the cognitive encounter) afforded by the active training techniques.

It might be added that the lack of differential increments in cognitive efficiency between age levels may have been a function of discriminative insensitivity of the Westcott measure. This question was not dealt with in the present study, as only one microgenetic measure was utilized. The application of active training techniques on a variety of cognitive-inferential tasks, such as the Street Gestalt completion test (1931) will best resolve this problem.

Children in the kindergarten group often responded in terms of the activity of a given object, as opposed to the generally applied name, or salient property of a given object. For example, one child (6:2) responded to a half-completed puppy with the statement, "It goes bowwow." Another child (6:1) stated, "Drink from it," in response to a vaguely integrated milk bottle. While no analysis was performed on these data, as no predictions were posited, there appeared to be a large amount of activity-oriented responding amongst the younger children, while none of the third graders responded in this fashion. In addition, E was impressed by the prevalence of an affective quality in the inferential behavior within the younger group, and the total absence of

affectivity within the older sample. Within the Wernerian framework (Werner, 1948; Kaplan, 1959), the introduction of an affective element is a function of the lack of differentiation between self and object encountered in younger children. This "dynamization" or "physiognomic" quality (Werner, 1948) decreases as a function of age. An example of this phenomenon, which was found almost exclusively at the earliest stages of completion (i.e., highly ambiguous stages), was the response of a six year old to the second stage of the bird sequence (see Figure 1), as "A sad cloud." Responses such as these were not found among the older, presumably more differentiated and socialized group. This is basically consistent with micro-genetic theory as outlined by Sander (1930), and Flavell and Draguns (1957).

### Implications

The results of the present study, insofar as they shed light on the pivotal function of nonverbal processes on a cognitive-inferential task, are consistent with ideas about early education stated by Bruner (1963, 1966) and Jones (1968). According to these writers, early educational learning should be geared toward integrating the child's organizing schemas, factual background, and belief systems, with tasks directed at producing "optimal matches," or optimal disequilibrium. An optimal match implies situations in which the child's internal organizing tendencies are not deemed "useless" or primitive by virtue of task demands. In this respect, a learning situation comes to

represent a satisfying cognitive challenge, instead of a source of frustration.

An integrated approach to early education, as outlined above, concerns itself with offering the child the opportunity to utilize and co-develop his nonverbal "intuitive" processes along with symbolic "analytic" processes. This approach is implied in Werner's (1948) theory of "analogous functioning," and Brunswik's (1956) notion of analytic "certainty-gear" and intuitive "uncertainty-gear" functioning. Within these frameworks, it is implied that a balanced and integrated approach to early education, where perceptual, affective, and physiognomic orientations are nurtured along with symbolic-analytic orientations, will lead to a better adapted organism, one who possesses both alternative paths to cognitive attainments and problem solving, and a "set-lifting," or insight capacity.

In this connection, there appears to be a relationship between nonverbal, or intuitive-perceptual processes, and creative behavior. In a recent study by Gittins (1969), this hypothesized relationship is explored in depth, within the context of demonstrable differences in the perceptual-ordering, and aesthetic-creativity capacities of a group of writers and scientists. It is possible that differential educative and learning experiences bring about the dominance of one category (e.g., analytic, or geometric-technical) over another. Werner (1948), however, believes otherwise. He states: "As a rule the lower level is not lost, in many instances it develops as an integral part of a more complex organization in which the higher level dominates



the lower [p. 216]." Werner (1957) sees integrated growth as the development of cognitive flexibility, "The flexibility of a person to operate at different levels depending on the requirements of a situation [p. 145]." Werner goes on to state the hypothesis that "The more creative the person, the wider his range of operations in terms of developmental level, or in other words, the greater his capacity to utilize primitive as well as advanced operations [p. 145]."

In a discussion of the problem of over-intellectualization in "certainty-gearred" early education, Jones (1968), stresses the notion that the "denaturing process" whereby the child's ongoing capacity for imagery and enactive organization are substituted for, or displaced by "higher-order" processes, results from classroom settings that discourage the richly creative but variable and uncertain processes of imagery and perception.

The present study provides supporting evidence for the notion that cognitive learning can be facilitated by an approach that maximizes the utilization of developmental processes in an integrated manner. The relationships between these processes and other tasks, such as creativity, role taking, and problem solving are open to exploration. Long-term follow-up studies of integrated, or "confluent" approaches to early education (cf. Montessori) may shed light on the potential relationships between these practices and adult flexibility, creativity, and cognitive level of integration.

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### Acknowledgements

Sincere gratitude is expressed to my thesis committee, Richard Wampler and William Griffitt, for their many helpful comments and concern. Special thanks to C. K. Garhart, Educational Center, Manhattan, Kansas, for gratefully appreciated assistance in obtaining the sample of grade school children from District 383.

Beyond all, I am indebted to Leon Rappoport, thesis advisor, for his encouragement, benevolent criticism and "active involvement."

EFFECTS OF SENSORIMOTOR AND IMAGINAL REPRESENTATION  
ON A PERCEPTUAL INFERENCE TASK:  
A DEVELOPMENTAL STUDY

by

GARY SCOTT GILBERT

B. A., State University of New York, 1969

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AN ABSTRACT OF A THESIS

submitted in partial fulfillment of the  
requirements for the degree

MASTER OF SCIENCE

Department of Psychology

KANSAS STATE UNIVERSITY  
Manhattan, Kansas

1971

The present study represents an experimental attempt at facilitating cognitive-inferential efficiency within two developmental age levels. Following from a large body of empirical evidence demonstrating the younger child's dependence on sensorimotor and imaginal forms of cognitive representation, and corresponding evidence for the efficacy of utilizing these schemas in a maximal manner, as aids in cognitive learning, it was hypothesized that the specific implementation of enactive and imaginal forms of organization on a basic cognitive-inferential task would lead to a post-training increment in cognitive-inferential efficiency.

30 male and female children in a kindergarten population (mean age = 6:1), and 30 male and female children in a third grade population (mean age = 9:2) were tested individually on the Westcott perceptual inference task, a microgenetic task consisting of picture incompleteness sequences of eight stages each. Following an initial pretraining series of eight baseline sequences, ten Ss from each age sample were randomly selected for enactive training (finger-tracking), ten Ss from each age sample were randomly selected for imagery instructions, and ten Ss from each age sample were selected for control purposes.

Following a short series of training examples, a post-training measure of cognitive-inferential efficiency, based on a series of eight post-training sequences was taken.

Results of an analysis of variance on efficiency difference scores showed a sizable training increment in cognitive efficiency ( $F = 12.91$ ,  $p < .001$ ) across both age levels. There were no differential increments for the two age levels employed, nor an interaction for developmental level by specific technique employed. These results, along with implications for further research and educative practice, are discussed.