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COMPARISON OF CONSERVATION PERFORMANCE OF
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THE UNIVERSITY OF OKLAHOMA
GRADUATE COLLEGE

COMPARISON OF CONSERVATION PERFORMANCE OF NORMAL AND
INSTITUTIONALIZED EMOTIONALLY DISTURBED CHILDREN

A DISSERTATION
SUBMITTED TO THE GRADUATE FACULTY
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MICHAEL LEE JEPSEN
Norman, Oklahoma
1975

COMPARISON OF CONSERVATION PERFORMANCE OF NORMAL AND
INSTITUTIONALIZED EMOTIONALLY DISTURBED CHILDREN

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To Moretia

whose love, patience and understanding
made everything worthwhile.

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COMPARISON OF CONSERVATION PERFORMANCE OF NORMAL AND INSTITUTIONALIZED EMOTIONALLY DISTURBED CHILDREN

CHAPTER I

INTRODUCTION

Piaget's theory of cognitive development has recently begun to have increased impact on educational and psychological theories of development. An essential part of that theory concerns the affective development of the child and has led to some investigation into the etiology of that affective development. Piaget views affective development as an aspect of cognitive development and holds that the two are not separate entities but are aspects of the same structure. Affectivity represents the energetic or motivational aspect of intellectual activity, and all behavior patterns, however intellectual, involve affective components in congruence with the intervention of comprehensions or perceptions which make up the cognitive components.¹ He states that the affective life and cognitive life are "not only parallel but interdependent."² They are inseparable and irreducible and there is a constant parallel between affective and intellectual (cognitive) life throughout childhood and adolescence. Affectivity

¹Jean Piaget and Barbel Inhelder, The Psychology of the Child, (New York: Basic Books, Inc., 1969), p. 158.

²Jean Piaget, Play, Dreams and Imitation in Childhood, (New York: W. W. Norton & Company, Inc., 1962), p. 205.

and intelligence are indissociable, and they constitute the two complementary aspects of all human behavior.³ At each stage of development the "affective schemas" are governed by the same laws of organization that rule the "cognitive schemas."⁴ Thus, it would seem that disturbance in one aspect of the developmental structures would necessarily imply a disturbance in the other.

This study focuses on that concomitant development of affective and cognitive thought. A most important phase in a child's development is the transition from a prelogical to a logical mode of thought. In Piagetian theory, this transition occurs with the development of the stage of concrete operations, and the concept of conservation signals this cognitive transition from preoperational to concrete operational thought. It would follow that if a disturbance occurred in the affective realm of this transition there should also be some disturbance in the cognitive aspect of the transition. Therefore, the purpose of this study is to determine whether the development of the cognitive aspect of the structures leading to concrete operational thought, as measured by conservation performance, are affected by a disturbance in the affective realm of those structures.

Statement of Problem

This investigation concerns whether or not a disturbance in the affective realm implies a disturbance in the cognitive realm of developmental structures. The focus of this study is to determine

³Jean Piaget, Six Psychological Studies, (New York: Vintage Books, 1967), p. 15.

⁴Ibid., p. XIV.

whether the performance on the conservation tasks of institutionalized emotionally disturbed children differs from the level of performance of normal children of the same chronological age. Also considered are patterns of nonconservation among emotionally disturbed children and the subject's sex. This investigation is based on the Piagetian model of cognitive development and for the purpose of this study his assumptions will be accepted.

CHAPTER II

INTRODUCTION TO PIAGET'S THEORY

Piaget has proposed a systematic stage theory of mental development in which each developmental stage constitutes a particular form of equilibrium as a function of its characteristic structures. He states that mental evolution is effectuated in the direction of an ever increasing equilibrium and that all human action consists of a continuous and perpetual mechanism of readjustment or equilibration. For this reason in the initial phases of construction, the successive mental structures that engender development can be considered as so many progressive forms of equilibrium, each of which is an advance on its predecessor, and the progressive organization of these structures of mental development appears to be an ever more precise adaptation to reality.⁵

Each stage in Piaget's theory is characterized by the appearance of original structures whose construction distinguishes it from all previous stages and in terms of which the main behavior patterns can be explained. These overall structures are integrative and are not interchangeable. Each results from the preceding one, integrating it as a subordinate structure and preparing it for the subsequent one into which it is sooner or later itself integrated. The

⁵Ibid., p. 7-8.

stages develop sequentially and their order of succession is fixed⁶ i.e., the concrete operational stage follows and is built upon the preoperational stage. Thus, each stage constitutes a particular form of equilibrium as a function of its characteristic structure, and each new behavior consists not only in reestablishing equilibrium but also in moving toward a more stable equilibrium than that which preceded.⁷

Piaget has delineated four main stages of cognitive development. As a result of the developmental process, there are particular operatory mechanisms which characterize each of these stages. The first stage is the sensori-motor period which covers approximately the first 2 years of life. During this period, the infant makes perceptual and motor adjustments to the immediate environment and moves from a primarily reflexive organism responding in an undifferentiated way to his environment to a "relatively coherent organization of sensori-motor actions vis-a-vis his immediate environment."⁸ Piaget feels that the practical knowledge which constitutes the substructure of later representational thought is developed during this period, and he studied the sensori-motor stage in detail. The sensori-motor child attains rudimentary knowledge that is the prototype of concepts, he differentiates himself from objects and localizes himself in space. He establishes a beginning awareness

⁶Op. cit., Piaget and Inhelder, The Psychology of the Child, p. 153.

⁷Op. Cit., Piaget, Six Psychological Studies, p. 7.

⁸John Flavell, The Developmental Psychology of Jean Piaget, (New York: Van Norstrand, 1963), p. 86.

of cause and effect, time, and space - in part, because he has acquired the ability to identify the permanence of objects. These accomplishments are a result of the following cognitive processes:

1. Use of reflexes (0 - 1 month);
2. Primary circular reactions and first acquired adaptations when reflexes begin to intercoordinate (1 - 4 months);
3. Secondary circular reactions and first appearance of primitive intentionality or goal directedness (4 - 8 months);
4. Coordination of secondary schemas and their applications to new situations - definite intentionality (8 - 12 months);
5. Tertiary circular reactions and discovery of new means by active experimentation (12 - 18 months);
and
6. Invention of new means through primitive mental combinations (18 - 24 months).⁹

During the early phases of the sensorimotor period, the child is in the phase of "adualism." There is no differentiation between what is internal and what is external, and there exists no consciousness of the self.¹⁰ Impressions that are experienced and perceived are not attached to a personal consciousness sensed as a

⁹Ibid., p. 87-121.

¹⁰Op. cit., Piaget and Inhelder, The Psychology of the Child, p. 22.

self, nor to objects conceived as external to the self. They exist in a dissociated block or are spread out on the same plane, which is neither internal nor external. Everything that is perceived is centered on the child's own activity, and all affectivity is centered on the child's own body and action. Only with the dissociation of the self from the non-self does decentration, affective or cognitive, become possible. The affects observable in the adualistic period are dependent upon general rhythms corresponding to the rhythms of the spontaneous global activities of the organism - alternations between tension and relaxation. These rhythms are thus differentiated into search for agreeable stimuli and a tendency to avoid disagreeable stimuli.¹¹

During the intermediary phase of the sensori-motor period the child experiences increased numbers of psychological satisfactions supplementing organic satisfactions. He also feels discomfort in presence of the unknown and in the presence of strangers to the milieu. He begins to develop increased tolerance to stress. Since tolerance to stress is greater when conflict occurs in a situation in which contact is otherwise felt as pleasant, contact with people becomes increasingly important, introducing a transition from contagion to communication. Sooner or later there becomes a causality with others as a source, as they produce pleasure, comfort, pacification, security, etc.

During the final phase of the sensorimotor period the child establishes object relations, due primarily in response to a need

¹¹Ibid., p. 23.

for security. When the child ceases to relate everything to his states and his own actions and begins to substitute for a world of fluctuating representations a universe of permanent objects structured according to objectified and spatialized causality, then his affectivity will also be attached to these localizable permanent objects and sources of external causality which persons come to be.¹² This decentering of affectivity gives rise to the establishment of object relations. Since both occur as a result of a single integral process, affective decentering is a correlative of cognitive decentering, and the formation of object relations occurs concomitant with the scheme of object permanency.¹³

Piaget views the sensorimotor stage as very important since sensorimotor intelligence leads to construction of an objective universe in which the child's body is an element among others and with which the internal life, localized in his body, is contrasted.¹⁴ In the beginning the self is the center of reality because it is not aware of itself, and the external world will become objectified to the degree that the self builds itself as a function of subjective or internal activity. During these first months of life the child constructs all the cognitive substructures that will serve as a point of departure for his later perceptual and intellectual development and a number of elementary affective reactions that will

¹²Ibid., p. 26.

¹³Ibid.

¹⁴Op. cit., Piaget, Six Psychological Studies, p. 13.

partly determine subsequent affectivity.¹⁵

Piaget's second stage of cognitive development is the pre-operational stage which covers approximately age 2-7 years. During this period the child is transformed from an organism whose most intelligent functions are sensory-motor, overt acts to one whose upper-limit cognitions are inner, symbolic manipulations of reality.¹⁶ The beginnings of language, symbolic function, and representational thought develop during this stage. At the level of representational thought, there must be a reconstruction of all that was developed on the sensory-motor level since the sensory-motor actions are not immediately translated into operations.¹⁷ The structures formed at this stage are rigid and irreversible, and the child reasons intuitively and transductively. The mechanism of intuition, simple internalization of percepts and movements in the form of representational images and "mental experiences," inherits some of the characteristics of sensory-motor schema but yet prepares for reversibility and operational thought.¹⁸ Thus, this stage provides the intermediary step for the development of true operational thought to come.

Five basic properties characteristic of the thought of the preoperational child are as follows:

¹⁵Op. Cit., Piaget and Inhelder, The Psychology of the Child, p. 3.

¹⁶Op. cit., Flavell, The Developmental Psychology of Jean Piaget, p. 151.

¹⁷Jean Piaget, "Development and Learning," Journal of Research in Science Teaching, 1964, No. 3, p. 177.

¹⁸Op. cit., Piaget, Six Psychological Studies, p. 32.

1. Egocentrism;
2. Centering;
3. States in a Transformation;
4. Irreversibility;
5. Transductive reasoning.¹⁹

The preoperational child is egocentric with respect to representations, just as the infant was egocentric with respect to sensory motor actions.²⁰ The child is unable to take the role of the other person and to see his viewpoint as one of many possible. As a result of lacking other-role orientation, the preoperational child feels neither the compunction to justify his reasonings to others nor to look for contradictions in his logic. The function of his thought is to satisfy the self by transforming what is real into what is desired and, as a result, compensates for and completes reality by means of a fiction.²¹ All reality is construed with the self as the model.²²

An important characteristic of the preoperational thought is its tendency to "center" attention on a single, striking feature of the object of its reasoning to the neglect of other important aspects, and by doing so, to distort the reasoning. The pre-operational child is unable to "decenter" and to account for features

¹⁹John W. Renner, Don G. Stafford and William B. Ragan, Teaching Science in the Elementary School, (New York: Harper & Row, 1973), p. 72.

²⁰Op. cit., Flavell, The Developmental Psychology of Jean Piaget, p. 156.

²¹Op. cit., Piaget, Six Psychological Studies, p. 23.

²²Ibid., p. 28.

which could balance and compensate for the distorting and biasing effects of the single centration. He is confined to the surface of the phenomena he tries to think about, assimilating only those superficial features which clamor loudest for his attention.²³

Since the preoperational child reasons on the basis of single characteristics and is unable to reason with multi-faceted aspects of stimuli simultaneously, his conceptualization is perceptually dominant and he operates on preconcepts.

Closely related to centering of preoperational thought is the lack of awareness of states in a transformation. Preoperational thought is static and immobile and can focus impressionistically and sporadically on a random, momentary, static condition but cannot adequately link a whole set of successive conditions into an integrated totality by taking account of the transformations which unify them and render them logically coherent.²⁴ The preoperational child focuses his attention upon each successive state or configuration of a display rather than upon the transformations by which one state is changed into another. He simply runs off reality sequences in his head just as he might do in overt action and views transformations as independent, unrelated "slides" of reality.

Perhaps the most important single characteristic of preoperational thought is its irreversibility.²⁵ Thought is reversible

²³Op. cit., Flavell, The Developmental Psychology of Jean Piaget, p. 157.

²⁴Ibid., p. 157.

²⁵Ibid., p. 159.

if it can travel along a cognitive route and then reverse direction to return to its unchanged beginning; that is, it is reversible if it can compose into a single organized system the various compensating changes which result from a transformation, and by seeing how each change is annulled by its inverse, insure constancy or invariance for the total system. Thus, reversible thought is flexible and mobile and able to correct for distorting superficials by means of successive, quick-moving decenterings. However, preoperational thought is not reversible, but imitates irreversible events in reality. The preoperational child is constantly embroiled in contradictions because he is unable to keep premises unaltered during a reasoning sequence, and his thought is irreversible in that the permanent possibility of returning by the inverse operation to the unchanged beginning premise or identity element of the system is denied him.²⁶

"Transduction is a combination of elementary relations but without reciprocity of these relations amongst each other, and consequently without the element of necessity that would lead to generalization."²⁷ Transductive reasoning proceeds from particular to particular. The preoperational child centers on one compelling aspect of an event and then irreversibly draws a conclusion from another interesting event. Transductive reasoning is distorting

²⁶Ibid.

²⁷Jean Piaget, Judgment and Reasoning in the Child, (New Jersey: Littlefield, Adams, & Company, 1972), p. 198.

and irreversible because it is centered.²⁸

Literally, preoperational thought produces a distorted reality based on superficial features which are each isolated from others and not coordinated into a coherent whole. The preoperational child is unable to separate cause from effect and his lack of perceptual differentiation and dissociation affects his thought, self-awareness, and social relations. He is perceptually bound affectively and cognitively. His cognitive life and his affective life tend to be unstable, discontinuous, and moment-to-moment.²⁹ For the preoperational child all reality is construed with the self as a model.³⁰

The third stage of cognitive development is the concrete operational stage which lasts from about age 7 to 11 years. At this stage the first true operations appear, and Piaget calls these "concrete operations" since they operate on objects and not yet on verbally expressed hypotheses.³¹ The appearance of conservation occurs during this stage, which signals the arrival of reversible operations and the first true beginnings of logical thought. The concepts of causality, mastery of time, rate, and space become general schemata of thought rather than schemata of action or

²⁸Op. cit., Piaget, Play, Dreams, and Imitation in Childhood, p. 235.

²⁹Op. cit., Flavell, The Developmental Psychology of Jean Piaget, p. 158.

³⁰Op. cit., Piaget, Six Psychological Studies, p. 28.

³¹Op. cit., Piaget, "Development and Learning," p. 177.

intuition.³² Concepts and relations are organized into sets in which all the elements are interdependent and in equilibrium, and these "groupings" attain a state of coherence and non-contradiction paralleled by cooperation on the affective plane. As the process of "decentering" occurs on both the cognitive and affective level, the self becomes subordinated to the laws of reciprocity.³³

For Piaget, an operation is the essence of knowledge as it allows the subject to get at the way the object is constructed. Operations are particular types of actions which comprise logical structures. They are reversible, internal, never isolated, and always capable of being linked to other operations to form overall systems or groups.³⁴ Operations consist of reversible transformations which allow for the possibility of a return to the point of departure in thought. The reversibility may be of two kinds, inversion and reciprocity. Inversion reversibility occurs when an inverse operation combines with the corresponding direct operation and cancels the whole operation ($+A -A = 0$). Reversibility by reciprocity occurs when the original operation combines with its reciprocal resulting in an equivalence ($A < B$ reciprocated by $B < A$).³⁵ This attained reversibility is a manifestation of a

³²Op. cit., Piaget, Six Psychological Studies, p. 46.

³³Ibid., p. 54.

³⁴Op. cit., Piaget, "Development and Learning," p. 176.

³⁵Op. cit., Piaget and Inhelder, The Psychology of the Child, p. 97.

permanent equilibrium between assimilation of things to the mind and accomodation of the mind to things, and, as a result, the mind may go beyond its immediate point of view.³⁶

An operatory transformation always leaves some feature of the system constant; otherwise it would be irreversible. The constant invariant in a system of transformations is what Piaget calls the scheme of conservation, and the notions of conservation are the psychological indications of reversible operatory structures.³⁷ Conservation is the indication of a correction of perceptual illusion and a decentering of egocentricity so as to transform transitory relationships into a coherent system of objective, permanent relations. Thus, the concrete operational child may be identified by his ability to conserve, and his development within the stage may be identified by his mastery of areas of conservation since the child is not always at the same stage of development with regard to different areas of conservation.

Operations provide the possibility for exchange of interpersonal as well as personal coordination and this cooperation constitutes an indispensable condition for the objectivity, internal coherence and universality of the operations. The decentering of the cognitive constructions which result in the development of operations leads to the same decentering of affective constructions. The child can dissociate his point of view from that of others and

³⁶Op. cit., Piaget, Six Psychological Studies, p. 54.

³⁷Op. cit., Piaget and Inhelder, The Psychology of the Child, p. 97.

can coordinate these different points of view. The need for justification and proof arises. Instead of impulsive behavior, unquestioned beliefs, and intellectual egocentricity of the preoperational child, the concrete operational child thinks before acting and begins the difficult process of reflection.³⁸ He can decenter, do mental reversals, equilibrate, begin to reason deductively and inductively, see relationships between transformations and conserve, which culminates in a better integration of the self and a more effective regulation of affective life.³⁹

The last stage of cognitive development is that of formal operations which is capable of beginning at about age 11.⁴⁰ The formal child attains new structures which are on one hand combinatorial corresponding to lattices, and on the other hand, more complicated group structures. Formal operations provide thought with an entirely new ability that detaches and liberates thought from concrete reality and permits it to build its own reflections and theories. Formal thought is hypothetico-deductive in that it permits drawing conclusions from pure hypothesis and not merely from actual observations, and these conclusions even have a validity independent of their factual truth. Formal thought is the representation of a representation of possible action.⁴¹ Reality no longer is limited

³⁸Op. cit., Piaget, Six Psychological Studies, p. 40.

³⁹Ibid., p. 55.

⁴⁰Although the child is capable of, he usually does not become fully formal operational until about 14-15 years of age. Barbel Inhelder and Jean Piaget, The Growth of Logical Thinking From Childhood to Adolescence, (New York: Basic Books, Inc., 1958), p. 335.

⁴¹Op. cit., Piaget, Six Psychological Studies, p. 63.

to its concrete aspects. The essential difference between formal thought and concrete operational thought is that concrete thought is centered on reality, while formal thought grasps possible transformations and assimilates reality in terms of imagined or deduced events. The change in perspective is as important for affective as for cognitive development, for affectivity can remain bound by concrete and perceptible reality, or it can encompass many interpersonal and intrapersonal possibilities.⁴²

Piaget assigns four factors which promote mental development. The first factor is maturation, especially of the nervous system and the endocrine systems. Heredity provides the child with the equipment to function and respond. Organic maturation plays an indispensable role in the unvarying order of succession of the stages of the child's development as he can operate only if he has the physical means to do so.⁴³

The second factor in mental development is exercise and acquired experience in contact with objects. There are two kinds of experience which are psychologically very different. The first is physical experience which involves acting upon objects and deriving some knowledge about the objects directly from the objects themselves.⁴⁴ This experience is an active structuration. The

⁴²Op. cit., Piaget and Inhelder, The Psychology of the Child, p. 149.

⁴³Ibid., p. 154.

⁴⁴Op. cit., Piaget, "Development and Learning," p. 179.

second is logico-mathematical experience which involves interacting with objects so as to learn the result of the coordination of the actions, and knowledge is derived from the actions which are organized or combined rather than from the objects themselves. It is an experience of the actions of the subject upon the external object.⁴⁵

The third factor in mental development is social transmission. Socialization is a structuration to which the child contributes as much as he receives, thus the interdependence and isomorphism of "operation" and "cooperation."⁴⁶ Social interaction corresponds to two very distinct realities in the affective sense. First, there is the relationship between the child and the adult which is the source of educational and verbal transmissions of cultural elements cognitively and of moral sentiments affectively. Second, there are social relations among children themselves, and in part between children and adults, as a continuous and constructive process of reciprocal socialization rather than unilateral transmission.⁴⁷

The fourth factor in mental development is equilibration or self-regulation. It is a series of active compensations by the subject in response to external disturbances and is an adjustment that is both retroactive and anticipatory, constituting a permanent system of compensations.⁴⁸ A structure is in equilibrium to the

⁴⁵Op. cit., Piaget and Inhelder, The Psychology of the Child, p. 155.

⁴⁶Ibid., p. 156.

⁴⁷Ibid., p. 116.

⁴⁸Ibid., p. 157.

extent that the individual is sufficiently active to be able to counter all intrusions with compensations.⁴⁹ The child receives information from the environment, and, in an attempt to understand it, he assimilates the event into already existing structures and/or accommodates his current structures to fit the new situation, thus bringing coherence and stability to his world. Equilibrium is the end which is sought in each developmental period and which is progressively improved during each period so as to allow the individual to make a more precise adaptation to reality.

Piaget feels that this mental development determines the entire course of psychological evolution and that affective development is concomitant with cognitive development. There is no behavior pattern which does not involve affective factors, and there can be no affective states without the intervention of perceptions or comprehensions which constitute their cognitive structure. The two aspects, affective and cognitive are at the same time inseparable and irreducible. Just as the cognitive structures are formed and modified in search of a progressively more effective equilibration, so too is the formation of personality dominated by structure formation in search of a coherence and organization that will prevent internal conflicts.⁵⁰ Thus, in reality, the most profound tendency of all human activity is the progression toward equilibrium, and reason, which expresses the highest forms of equilibrium, unites intelligence and affectivity.⁵¹

⁴⁹Ibid., p. 151.

⁵⁰Ibid., p. 158.

⁵¹Op. cit., Piaget, Six Psychological Studies, p. 70.

CHAPTER III

REVIEW OF LITERATURE

There has been a vast number of validation studies of cognitive development done with Piaget's conservation tasks.⁵² However, there are very few research studies investigating the relationship between cognitive development and affective development using the conservation tasks.

One of the validation studies of particular relevance is that done by Renner et al⁵³ in which the six conservation tasks - number, solid amount, liquid amount, weight, length, and area - were administered to 252 public school children ranging in age from 60 - 144 months. He found that conservation of number was achieved by 84 months, conservation of solid amount and liquid amount by 88 months, conservation of weight by 120 months, conservation of length by 128 months, and conservation of area by 132 months. These ages and sequences of cognitive development essentially correspond to those found by Piaget in his original studies.⁵⁴

⁵²Paul H. Mussen (ed.) Carmichael's Manual of Child Psychology (3rd.; New York: Wiley and Sons, Inc., 1970), Vol. I, p. 991-1043.

Op. cit., Flavell, The Developmental Psychology of Jean Piaget, p. 379-398.

⁵³John W. Renner et al., "Piaget is Practical," Science and Children, (October, 1971), p. 23.

⁵⁴Op. cit., Piaget and Inhelder, The Psychology of the Child, p. 99.

Goldschmid⁵⁵ investigated the levels of difficulty of ten conservation tasks including the six used in Renner's study. He ranked the conservation tasks from least difficult to most difficult based on the performance of 102 urban school children. His data ranked the tasks in the same order that Renner found with the exception that Goldschmid found conservation of length more difficult than conservation of area.

Conservation-related studies in which comparisons of performance between emotionally disturbed children and normal children are quite limited. Halpern⁵⁶ periodically tested a single 17 year old schizophrenic boy from 1963 - 1964 with Piagetian tasks. Although the standardized IQ measure revealed no developmental lag, the Piagetian tasks did.

Neale⁵⁷ investigated egocentrism in institutionalized emotionally disturbed children and normal children. He compared their performance on a Piaget task consisting of a mountain scene presented from various perspectives. Using 20 institutionalized emotionally disturbed children and 20 public school children, Neale found the emotionally disturbed children to be significantly more egocentric than their normal peers.

⁵⁵M. L. Goldschmid, "Different Types of Conservation and Nonconservation and Their Relation to Age, Sex, IQ, MA, and Vocabulary," Journal of Child Development, 1967, 38, p. 1229-1246.

⁵⁶E. Halpern, "Conceptual Development in a Schizophrenic Boy," Journal of American Academy of Child Psychiatry, 1966.

⁵⁷John M. Neale, "Egocentrism in Institutionalized and Non-institutionalized children," Journal of Child Development, 1966, 37, p. 97-101.

Goldschmid⁵⁸ compared conservation performances of 102 children in the first and second grades in (1) a public school, (2) a private school, and (3) a day school for emotionally disturbed children. Although the emotionally disturbed children were two years older than the children in the other two schools, their level of conservation performance was not higher than that of normal children. Goldschmid felt that his results suggested that disruptive personality characteristics might delay cognitive development.

Lerner, Bie, and Lehrer⁵⁹ administered conservation tasks of amount, weight and volume to 35 hospitalized mentally ill adolescents ranging in age from 15-23 (mean 18-8) years. They found that most of the adolescents gave concrete responses to the amount and weight tasks and that 50% gave preoperational responses on the volume displacement task.

Filer⁶⁰ compared performances of 29 emotionally disturbed children ranging in age from 6-13 years with 2 groups of normal children one matched for chronological age and one matched for mental age. She administered concrete operational tasks and some tasks modified to apply Piagetian concepts to social-interpersonal development. The emotionally disturbed children performed the

⁵⁸Op. cit., Goldschmid, "Different Types of Conservation and Nonconservation and Their Relation to Age, Sex, IQ, MA, and Vocabulary."

⁵⁹Sandra Lerner, Ildri Bie, and Paul Lehrer, "Concrete Operational Thinking in Mentally Ill Adolescents," Merrill-Palmer Quarterly, Vol. 18, No. 3, (July 1972), p. 287-291.

⁶⁰A. A. Filer, "Piagetian Cognitive Development in Normal and Emotionally Disturbed Children," Unpublished Doctoral Dissertation, University of Rochester, 1972.

same as their matched controls on traditional cognitive measures, but demonstrated less mature understanding on social-cognitive measures than normal children. The data were consistent with, but hardly confirmed, the hypothesis that normal children would show more "consistent" developmental abilities across areas of performance than would emotionally disturbed children. The normal children also manifest an orthogonal "social understanding" factor which did not appear for the emotionally disturbed children.

Gambini⁶¹ compared conservation performance among other types of performances between 26 diagnosed emotionally disturbed public school males and 26 normal public school males ranging in age from 8 - 11 years (mean 10.3 years). She found that the emotionally disturbed males were more preoperational and egocentric than normal males, and felt that there was a significant relationship between affective development and cognitive development.

This research investigates the relationship between affective and cognitive development to determine whether or not they are interdependent, and if a disturbance in one aspect implies a concomitant disturbance in the other.

⁶¹Josephine Gambini, "Piaget's Theory: Conceptual Development and Affective Development in Diagnosed Emotionally Disturbed Public School Males," Unpublished Doctoral Dissertation, Wayne State University, 1973.

CHAPTER IV

METHOD AND DESIGN

Subjects

A sample of 40 children of approximately 12 years of age was chosen as subjects for this investigation. No child over 12 years 11 months nor under 11 years 6 months was used. This age was chosen since all levels of conservation used should have essentially been achieved. Socio-economic background was considered in the selection to provide some control for past experiences of the subjects.

Normal Group - 10 boys and 10 girls considered to be normal were chosen at random from one middle school in the Norman Public School System in Norman, Oklahoma. A child was defined as normal if he was making satisfactory progress in regular public school classes and had no history of emotional disturbance. The mean age of this group was 12 years 0 months.

Emotionally Disturbed Group - 10 boys and 10 girls considered to be emotionally disturbed were chosen from three residential treatment centers for emotionally disturbed children; Children's Medical Center, Tulsa, Oklahoma, Phil Smalley Children's Center, Norman, Oklahoma, and Children's Unit, Wichita Falls State

Hospital, Wichita Falls, Texas.⁶² A child was included if he had or was having emotional problems severe enough to necessitate institutionalization. No child with suspected primary organic pathology nor any child whose I.Q. level was below the dull normal range was used. I.Q. was determined by performance on the Stanford-Binet or WISC taken from each patient's record. The mean age of this group was 12 years 2 months.

The investigator recognizes fully that there is no consistency in the severity of the emotional disturbance that would necessitate institutionalization of a child. For instance, the varying ability and desire of each family to stand by and maintain the disturbed child in the home would influence the necessity for institutionalization. However, many of the children were in such condition that no family could provide the resources needed to keep the child at home. All children used in this study for the emotionally disturbed group experienced, at some time, sufficient emotional problems in getting along in their life space to be institutionalized.

All of the children in the emotionally disturbed group at the time of testing met the following criteria:

- (1) They were all oriented to time and space. That is, they were all in good enough contact with reality to maintain orientation and know who they were, where they were, the day of the week, the month, and the year.

⁶²Due to the difficulty in finding sufficient numbers of institutionalized emotionally disturbed children to fit the criteria for selection, the use of institutionalized emotionally disturbed children from three residential treatment centers for emotionally disturbed children was necessitated.

- (2) They were all in such condition that they could relate to the investigator as a person. They could maintain interpersonal contact throughout the testing period.
- (3) They were all able to understand, not the details, but the fact that this was an examining situation in which they were expected to respond to a series of stimuli. All the subjects were able to maintain this relationship with the investigator throughout the examination period. Children who were so uncooperative or unresponsive that they could not attend to the tasks were not used.
- (4) In the opinion of the investigator, none of the subjects had deteriorated materially by reason of long confinement to an institution.

Instrument

The conservation tasks modeled after Piaget were used to determine the level of conservation performance of each child in 6 areas; number, solid amount, liquid amount, weight, length, and area. The original Piagetian tasks as modified by Renner were used.⁶³

Task 1: Conservation of Number

Six black checkers are lined up in one row and six red checkers are lined up in a parallel row.

⁶³John W. Renner, University of Oklahoma, Norman, 1973.



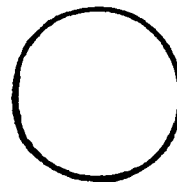
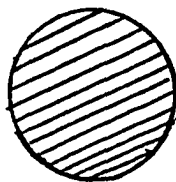
Once the child confirms that there are as many red as black checkers, the red checkers are stacked into one stack.



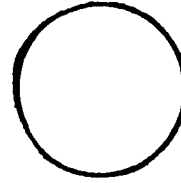
The child is then asked whether there are as many red checkers as black checkers. If he answers "yes," the child is asked how he knew that. If he answers "no" he is unable to conserve number.

Task 2: Conservation of Solid Amount

Two pieces of clay of the same amount are rolled into balls of equal size. For convenience two colors are used, green and red. Once the child confirms that there is the same amount of green clay

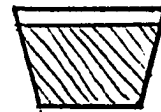
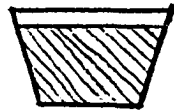


as red clay, the red clay is deformed by rolling it into a "snake." The child is then asked whether there is as much red clay as green clay. If he answers "yes," the child is asked how he knew that. If he answers "no," he is unable to conserve solid amount.

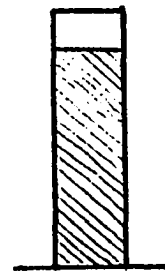
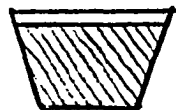


Task 3: Conservation of Liquid Amount

An equal amount of water is poured into two containers of equal size and shape. After the child confirms that the containers

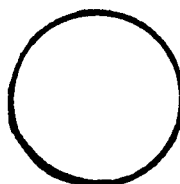
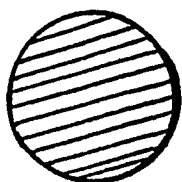


are the same size and that they contain the same amount of water, the water in one of the containers is poured into a taller, thinner container. The child is then asked whether there is as much water in the taller container as in one of the original containers. If he answers "yes," the child is asked how he knew that. If he answers "no," he is unable to conserve liquid amount.

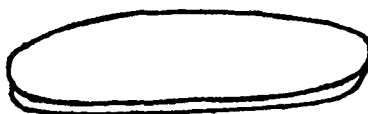
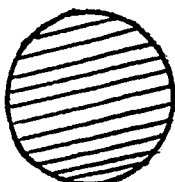


Task 4: Conservation of Weight

Two balls of clay of equal size and weight are given to the child. For convenience two colors are used, red and green. When



he confirms that each weighs the same, one of the balls is deformed into a pancake. Without being allowed to touch the clay the child



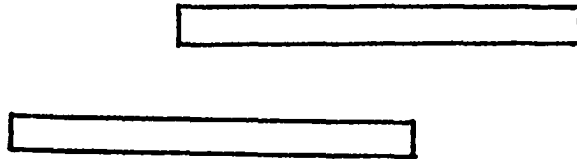
is asked if the pancake would weigh the same as the ball of clay. If he answers "yes," the child is asked how he knew that. If he answers "no," he is unable to conserve weight.

Task 5: Conservation of Length

Two rods of identical length are laid side by side so that their ends correspond. When the child confirms that each is the



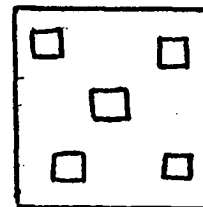
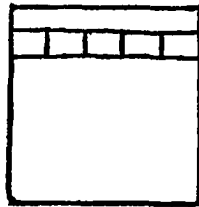
same length, one of the rods is moved so that their ends no longer correspond. The child is then asked if the two rods are the same



length. If he answers "yes," the child is then asked how he knew that. If he answers "no," he is unable to conserve length.

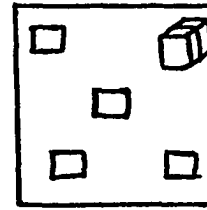
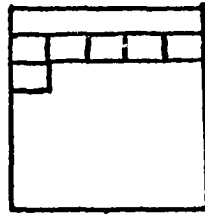
Task 6: Conservation of Area

Two pieces of construction paper of the same shape and area are presented to the child. Also, a number of "barns" of equal shape and size are shown him. When the child confirms the equality of the papers and the "barns," an equal number of "barns" are placed on each paper. On one paper they are placed side by side, on the



other the barns are scattered around the paper. The child is asked if there is the same amount of paper showing on each piece of construction paper. If he answers "yes," the child is asked how he knew that. If he answers "no," he is unable to conserve area. If the child should count the "barns" when asked about the equality of the areas he is probably conserving number and not area. To compensate for that, another "barn" is placed on the side by side sheet

and on the scattered sheet a barn is placed on top of one to make a



two story barn. The question of equality is repeated. The child who confirms that more area is showing on the paper with the two story building conserves area.

Procedure

Each subject was administered all of the conservation tasks individually in a private room by the investigator. The following four steps were used in the presentation of each task: first, the child was given an opportunity to familiarize himself with the materials; second, it was ascertained that the child perceived the initial equality of the objects he was asked to compare; third, after each manipulation of one of the two objects, the child was again asked to judge the objects' equality or inequality; and fourth, the subject was asked to explain why the two objects are equal or unequal (depending on his response) with respect to a given area of conservation.

The instructions given to each subject at the start of testing were as follows:

I will ask you to do some things for me and answer some questions about them. Some of them may be easy and some may be a little harder. Do the best you can on each of them.

The scoring of the data was simple and objective. A possible score of 2 points may have been given for each conservation task with a possible total score of 12 points for level of performance over all the conservation tasks. Within each task 1 point was given for a correct judgment after manipulation of one of the two objects, and 1 point for an explanation that noted reversibility, compensation or invariant quantity.

Hypotheses

The following hypotheses, stated in the null form, were investigated.

Hypothesis 1: Within the samples investigated, there is no significant difference between the levels of conservation performance of normal children and institutionalized emotionally disturbed children.

Hypothesis 2: Within the samples investigated, there is no significant difference between the levels of conservation performance of normal males and institutionalized emotionally disturbed males.

Hypothesis 3: Within the samples investigated, there is no significant difference between the levels of conservation performance of normal females and institutionalized emotionally disturbed females.

Hypothesis 4: Within the samples investigated, there is no significant difference between the levels of conservation performance of institutionalized emotionally disturbed males and institutionalized emotionally disturbed females.

Hypothesis 5: Within the samples investigated, there is no significant difference between the levels of conservation performance of normal males and normal females.

CHAPTER V

RESULTS

A t-test was used to compare the mean levels of conservation performance of normal and institutionalized emotionally disturbed children. The following results were obtained.

Hypothesis 1 states that within the samples investigated, there is no significant difference between the levels of conservation performance of normal children and institutionalized emotionally disturbed children. At the .01 level of confidence, a t-test score of 4.56 indicates a statistically significant difference between mean levels of performance of normal and institutionalized emotionally disturbed children. Thus, Hypothesis 1 is rejected.

Hypothesis 2 states that within the samples investigated, there is no significant difference between the levels of conservation performance of normal males and institutionalized emotionally disturbed males. At the .01 level of confidence, a t-test score of 3.18 indicates a statistically significant difference between mean levels of performance of normal males and emotionally disturbed males. Thus, Hypothesis 2 is rejected.

Hypothesis 3 states that within the samples investigated, there is no significant difference between the levels of conservation performance of normal females and institutionalized emotionally disturbed females. At the .01 level of confidence, a t-test score of

3.15 indicates a statistically significant difference between mean levels of performance of normal females and emotionally disturbed females. Thus, Hypothesis 3 is rejected.

Hypothesis 4 states that within the samples investigated, there is no significant difference between the levels of conservation performance of institutionalized emotionally disturbed males and institutionalized emotionally disturbed females. At the .01 level of confidence, a t-test score of $-.24$ indicates no statistically significant difference between mean levels of performance of emotionally disturbed males and emotionally disturbed females. Thus, Hypothesis 4 is supported and accepted.

Hypothesis 5 states that within the samples investigated, there is no significant difference between the levels of conservation performance of normal males and normal females. At the .01 level of confidence, a t-test score of $.44$ indicates no statistically significant difference between mean levels of performance of normal males and normal females. Thus, Hypothesis 5 is supported and accepted.

CHAPTER VI

DISCUSSION AND CONCLUSIONS

The hypothesis that the level of conservation performance of institutionalized emotionally disturbed children significantly differs from that of normal children of the same chronological age was supported by this research. The results of this study seem to be consistent with previous research⁶⁴ in that emotionally disturbed children operate at a lower cognitive level than their normal peers. The emotional disturbance appears to inhibit their ability to de-center, reverse their thinking, and comprehend states in a transformation as required by the conservation tasks. Thus, the emotionally disturbed children tend to rely on those functions more characteristic of the preoperational child, i.e. they are perception bound.

Most of the institutionalized emotionally disturbed children were only able to master the first three conservation tasks; conservation of number, conservation of solid amount, and conservation of liquid amount. This level of conservation performance is usually achieved by normal children by approximately 88 months of age

⁶⁴Op. cit., Gambini, "Piaget's Theory: Conceptual Development and Affective Development in Diagnosed Emotionally Disturbed Public School Males."

Op. cit., Neale, "Egocentrism in Institutionalized and Noninstitutionalized Children."

as demonstrated by Renner.⁶⁵ Although the institutionalized emotionally disturbed children used in this research had a mean age of 146 months (12 years, 2 months), they were cognitively functioning at a much younger level as compared with the normal children used.

The conservation performance of the female children in each group did not significantly differ from that of the male children in their corresponding group. That is, the performance on the conservation tasks of institutionalized emotionally disturbed females did not significantly differ from that of institutionalized emotionally disturbed males, and the performance on the conservation tasks of normal females did not significantly differ from that of normal males. It would appear that sex has little, if any, effect upon cognitive development as measured by conservation performance.

This investigation supports the hypothesis that a disturbance in the affective realm does result in a concomitant disturbance in the cognitive aspect of the developmental structures. It supports Piaget's belief that affective development and cognitive development are both parallel and interdependent.⁶⁶ Since a disturbance in the affective development seems to have delayed the development of the conservation schema, it would seem that this delay in the development of cognitive structures would at the same time, conversely limit the affective development of the child. Piaget has proposed that at each stage of development the affective schema are

⁶⁵Op. Cit., Renner et al., "Piaget is Practical," p. 23.

⁶⁶Op. cit., Piaget, Play Dreams and Imitation in Childhood, p. 205.

governed by the same laws of organization that rule the cognitive schema.⁶⁷ Since the emotionally disturbed child has difficulty in being able to decenter, reverse his thinking, and comprehend states in a transformation, his reality would be distorted and based upon superficial and unpredictable features which are isolated and never coordinated into a coherent whole. The emotionally disturbed child would also have difficulty distinguishing cause from effect, and his lack of perceptual differentiation would affect both his self perception and his social relations. This cognitive limitation is also his affective limitation, and it would seem that to make progress in affective development, the child would have to make progress in cognitive development. Since his perception of reality and his ability to deal with reality is a product of the cognitive structures at his disposal, and his affects are governed by these same structures, it would seem most important that cognitive development in emotionally disturbed children be evaluated and promoted. For the emotionally disturbed child to develop or improve affectively, he must have the structures available to evaluate, reason, and respond to reality in the most effective and equilibrating manner possible. In his attempts to make an ever more precise adaptation to reality,⁶⁸ the child's affective life and cognitive life truly must be indissociable and interdependent.⁶⁹

⁶⁷Op. cit., Piaget, Six Psychological Studies, p. XIV.

⁶⁸Ibid., p. 8.

⁶⁹Ibid., p. 15.

CHAPTER VII

SUMMARY AND RECOMMENDATIONS

The purpose of this investigation was to determine whether the performance of institutionalized emotionally disturbed children on Piagetian conservation tasks differs from the level of performance of normal children of the same chronological age. Also considered was the effect of sex difference upon conservation performance of both groups. This investigation was based on the Piagetian model of cognitive development in which affective development is held as an aspect of cognitive development and both are governed by the same laws of organization at each stage of development. This research investigated whether or not a disturbance in the affective realm results in a disturbance in the cognitive realm of the developmental structures.

An experimental group of 20 institutionalized emotionally disturbed children, 10 boys and 10 girls, and a control group of 20 normal children, 10 boys and 10 girls, of approximately 12 years of age were given 6 conservation tasks modeled after Piaget. The level of conservation performance was determined in 6 areas; number, solid amount, liquid amount, weight, length, and area.

The results of this investigation are as follows:

I - A t-test between the conservation scores of the normal children and the institutionalized emotionally disturbed children

indicated a significant statistical difference in performance. The emotionally disturbed children scored significantly lower.

II - A t-test between the conservation scores of normal males and institutionalized emotionally disturbed males indicated a significant statistical difference in performance. The emotionally disturbed males scored significantly lower.

III - A t-test between the conservation scores of normal females and institutionalized emotionally disturbed females indicated a significant statistical difference in performance. The emotionally disturbed females scored significantly lower.

IV - A t-test between the conservation scores of institutionalized emotionally disturbed males and institutionalized emotionally disturbed females indicated no significant statistical difference in performance.

V - A t-test between the conservation scores of normal males and normal females indicated no significant statistical difference in performance.

These results indicate that the level of conservation performance of institutionalized emotionally disturbed children is lower than that of normal children of the same chronological age. Sex difference had no significant effect on the conservation performance of either group. This research supports the hypothesis that a disturbance in the affective aspect of the developmental structures results in a disturbance in the cognitive aspect of those structures.

This investigation has implications for further research

in this area, as well as for the education and psychotherapy for emotionally disturbed children. If the emotionally disturbed child has a cognitive developmental lag, as supported by this research, and the affective structures are limited by those same laws of cognitive organization, it would follow that promotion of the cognitive development would be essential for the affective development of that child. The behavior which has usually been attributed to the affective disturbance in the emotionally disturbed child may be a product of his cognitive disturbance, and its successful resolution may depend on his cognitive development. The distorted reality of the emotionally disturbed child due to cognitive inabilities, such as lack of perceptual differentiation and inability to separate cause from effect, should be particularly responsive to educational and psychotherapeutic interventions which not only implement the child's available cognitive abilities, but also promote his further cognitive development. As the structures which rule the whole of mental life come into increasing equilibrium with reality, the affective equilibrium should also be enhanced.

Since this study was limited to one age group, it might be useful to compare conservation performance between emotionally disturbed children and normal children at other chronological ages to determine other developmental lags.

Further study might be useful utilizing other Piagetian tasks such as conservation of volume, proportional reasoning, separation of variables, and exclusion of variables to compare formal operational performance of emotionally disturbed adolescents

with normal adolescents.

The implications for the education and psychotherapy of emotionally disturbed children need further investigation. It has been shown that experiences made possible by the first grade program of Science Curriculum Improvement Study significantly enhances the rate of attainment of conservation skills in normal children.⁷⁰ Investigation into whether the SCIS program, as well as other curriculum programs, would also enhance the attainment of conservation skills in emotionally disturbed children is needed.

Further research is needed to support an implication of this investigation that the cognitive development of the child is necessary for the affective development of that child. An investigation in which a program to enhance the cognitive development of emotionally disturbed children and its effects upon their affective development would have major implications for education and therapy of emotionally disturbed children. For example, would there be an improvement in the affective realm of emotionally disturbed children if a program such as the SCIS program were implemented to facilitate their cognitive development? This would have special significance in curriculum planning and implementation for classes for emotionally disturbed children.

⁷⁰John W. Renner et al., "An Evaluation of the Science Curriculum Improvement Study," School Science and Mathematics, April, 1973, pp. 291-318.

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APPENDIX I

DEFINITIONS

Accommodation - Accommodation is the modification of internal structures to fit reality.¹

Assimilation - Assimilation is modification of reality to fit the existing structures of the organism.²

Centering - Centering is focusing attention on one compelling feature of the object of thought to the neglect of other important aspects.³

Circular Reaction - Circular reaction is a repetitive gesture whose interesting result motivates repetition in sensorimotor development.⁴

Conservation - Conservation is the comprehension that certain aspects of an object remain constant while other aspects of the object are changed. It is the psychological implication of reversibility.⁵

¹Jean Piaget and Barbel Inhelder, The Psychology of the Child, (New York: Basic Books, Inc., 1969), p. 6.

²Ibid.

³John Flavell, The Developmental Psychology of Jean Piaget, (New York: Van Nostrand, 1963), p. 157.

⁴Op cit., Piaget and Inhelder, The Psychology of the Child, p. 10.

⁵Jean Piaget, "Development and Learning," Journal of Research in Science Teaching, 1964, No. 3, p. 177.

Egocentrism - Egocentrism is a child's inability to take another's point of view.⁶

Equilibration - Equilibration is the overriding principle of mental development in the sense that all mental growth progresses toward ever more complex and stable levels of organization.⁷

Group - A group is a set of operations that can be composed so that any two operations will produce a third belonging to the same set, and the set contains the inverse of each of the operations composing it.⁸

Intuition - Intuition is a form of thought in which judgments regarding physical reality are made on the basis of perception rather than reason.⁹

Operation - An operation is an internalized action which becomes reversible and is coordinated with other operations into an integrated operational grouping.¹⁰ It is a means for mentally transforming data about reality so that they can be organized and used selectively in the solution of problems.¹¹

⁶Jean Piaget, Six Psychological Studies, (New York: Vintage Books, 1967), p.xxii.

⁷Ibid.

⁸Jean Piaget, Play, Dreams, and Imitation in Childhood, (New York: W. W. Norton & Co., Inc., 1962), p. VI.

⁹Op. cit., Piaget, Six Psychological Studies, p. xxii.

¹⁰Ibid., p. 78.

¹¹Barbell Inhelder and Jean Piaget, The Growth of Logical Thinking From Childhood to Adolescence, (New York: Basic Books, Inc., 1958), p. xiii.

Reversibility - Reversibility is the permanent possibility of returning to the starting point of an operation in thought.¹²

Schema - Schema are structures of thought at any level of mental development.¹³

States in a Transformation - States in transformation are transformations of the object of thought by which one state or property is altered or changed into another and each state is integrated into the total transformation.

Structure - A structure is a mental system or totality whose principles of activity are different from those of the parts which make it up.¹⁴ They are organizational properties of intelligence that are created through functioning and inferable from behavior of the individual.¹⁵

Transductive Reasoning - Transductive reasoning is reasoning that proceeds from particular to particular as opposed to inductive or deductive reasoning.

¹²Ibid., p. 272.

¹³Op. cit., Piaget, Six Psychological Studies, p. xxii.

¹⁴Ibid.

¹⁵Op. cit., Flavell, The Developmental Psychology of Jean Piaget, p. 17.

APPENDIX II

TABLE 1

T-TEST RESULTS BETWEEN NORMAL AND INSTITUTIONALIZED EMOTIONALLY DISTURBED CHILDREN

Group	N	\bar{X} score	Var.	S.D.	t-ratio	Level of Significance
Normal	20	10.9	.08	.99	4.56	$p < .01$
Emotionally Disturbed	20	7.1	12.18	3.49		df = 38

TABLE 2

T-TEST RESULTS BETWEEN NORMAL MALES AND EMOTIONALLY DISTURBED MALES

Group	N	\bar{X} score	Var.	S.D.	t-ratio	Level of Significance
Normal	10	11	1.0	1.0	3.18	$p < .01$
Emotionally Disturbed	10	6.9	14.12	3.76		df = 18

TABLE 3

T-TEST RESULTS BETWEEN NORMAL FEMALES AND EMOTIONALLY DISTURBED FEMALES

Group	N	\bar{X} score	Var.	S.D.	t-ratio	Level of Significance
Normal	10	10.8	.96	.98	3.15	$p < .01$
Emotionally Disturbed	10	7.3	10.24	3.20		df = 18

TABLE 4

T-TEST RESULTS BETWEEN EMOTIONALLY DISTURBED MALES AND EMOTIONALLY DISTURBED FEMALES

Group	N	\bar{X} score	Var.	S.D.	t-ratio	Level of Significance
Male	10	6.9	14.12	3.76	-.24	$p < .01$
Female	10	7.3	10.24	3.20		df = 18

TABLE 5

T-TEST RESULTS BETWEEN NORMAL MALES AND NORMAL FEMALES

Group	N	\bar{X} score	Var.	S.D.	t-ratio	Level of Significance
Male	10	11	1.0	1.0	.44	p < .01 df = 18
Female	10	10.8	.96	.98		

TABLE 6

DISTRIBUTION OF CONSERVATION SCORES FOR EMOTIONALLY DISTURBED MALES

Subject	CA (months)	Conservation Tasks												Score
		Number		Solid Amount		Liquid Amount		Weight		Length		Area		
		J	E	J	E	J	E	J	E	J	E	J	E	
1	145	1	1	1	1	1	1	1	1	1	1	1	1	11
2	151	1	1	1	1	1	1	1	1			1		9
3	149	1												1
4	154	1	1	1	1	1	1	1		1				8
5	152	1	1											2
6	149	1	1	1	1	1	1	1	1	1	1			10
7	141	1	1	1	1	1	1			1	1			8
8	138									1				1
9	148	1	1	1	1	1	1	1	1	1				9
10	142	1	1	1	1	1	1	1	1	1	1			10

J = Judgment
E = Explanation

\bar{X} age = 146.9 months
 \bar{X} score = 6.9

TABLE 7

DISTRIBUTION OF CONSERVATION SCORES FOR EMOTIONALLY DISTURBED FEMALES

Subject	CA (months)	Number		Solid Amount		Liquid Amount		Weight		Length		Area		Score
		J	E	J	E	J	E	J	E	J	E	J	E	
1	153	1	1	1	1	1	1	1	1	1	1	1	1	12
2	155									1		1	1	3
3	143	1	1	1	1	1	1	1	1	1	1	1	1	12
4	155	1	1	1	1	1	1			1	1			8
5	146	1	1	1	1	1				1	1			7
6	146	1	1	1	1									4
7	138	1	1	1	1	1	1			1	1			8
8	141	1	1	1	1	1	1			1	1			10
9	144	1	1							1				3
10	138	1	1	1	1	1				1				6

J = Judgment
E = Explanation

\bar{X} age = 145.9
 \bar{X} score = 7.3

TABLE 8

DISTRIBUTION OF CONSERVATION SCORES FOR NORMAL MALES

Subject	CA (months)	Number		Solid Amount		Liquid Amount		Weight		Length		Area		Score
		J	E	J	E	J	E	J	E	J	E	J	E	
1	144	1	1	1	1	1	1	1	1	1	1	1	1	12
2	144	1	1	1	1	1	1	1	1	1	1			10
3	144	1	1	1	1	1	1	1	1	1	1	1	1	12
4	144	1	1	1	1	1	1	1	1	1	1	1	1	12
5	144	1	1	1	1	1	1	1	1	1	1			10
6	144	1	1	1	1	1	1	1	1	1	1			10
7	144	1	1	1	1	1	1	1	1	1	1			10
8	144	1	1	1	1	1	1	1	1	1	1	1	1	12
9	143	1	1	1	1	1	1	1	1	1	1			10
10	143	1	1	1	1	1	1	1	1	1	1	1	1	12

J = Judgment
E = Explanation

\bar{X} age = 143.8
 \bar{X} score = 11.0

TABLE 9

DISTRIBUTION OF CONSERVATION SCORES FOR NORMAL FEMALES

Subject	CA (months)	Conservation Tasks												Score
		Number		Solid Amount		Liquid Amount		Weight		Length		Area		
		J	E	J	E	J	E	J	E	J	E	J	E	
1	144	1	1	1	1	1	1	1	1	1	1	1	1	12
2	144	1	1	1	1	1	1	1	1	1	1			10
3	144	1	1	1	1	1	1			1	1	1	1	10
4	144	1	1	1	1	1	1			1	1	1	1	10
5	144	1	1	1	1	1	1	1	1	1	1	1	1	12
6	144	1	1	1	1	1	1	1	1	1	1			10
7	144	1	1	1	1	1	1	1	1	1	1	1	1	12
8	143	1	1	1	1	1	1	1	1	1	1			10
9	143	1	1	1	1	1	1	1	1	1	1	1	1	12
10	145	1	1	1	1	1	1	1	1	1	1			10

J = Judgment
E = Explanation

\bar{X} age = 143.9
 \bar{X} score = 10.8