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ABSTRACT

Arguments for the use of sequential ordinal scales in the observation of infants and young children are based on the tendency of traditional psychometric assessment to distract investigators from discerning structural and hierarchical aspects of development. Norm-referenced testing focuses on interindividual comparisons rather than developmental patterns. Mental age and IQ scores are often considered to be fixed quantities, and interpreted inappropriately in educational practice. Sequential ordinal scales, as originally suggested by Piaget, invite investigation of structural details. Their advantages are (1) The hypothetical sequential order permits direct testing of hypotheses of the sequential organization of development, (2) They allow for the examination of relationships between developmental patterns and environmental circumstances, (3) They provide means to test Piaget's hypothesis of six sensorimotor stages, (4) They disentangle development from the age variable, (which allows for study of the degree of plasticity in development, and relationships between cognitive competencies and affective conditions). The Uzgiris-Hunt Scales, which contain six series based on behavioral landmarks of development, are described. Research literature in which the Uzgiris-Hunt Scales have been used is reviewed to provide concrete examples of how ordinal scales facilitate investigation of early psychological development. (DP)

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UTILITY OF ORDINAL SCALES DERIVED FROM PIAGET'S OBSERVATIONS*

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The epigenesis in the structures of early psychological development is not universally recognized. Ignorance of the details of this epigenesis is profound. Very little is known of how the adaptive accommodations of the behavioral repertoires that infants and very young children bring to the situations that they encounter build one upon another to produce their cumulative effects on cognition and motivation. Little is known of the kinds of encounters, the nature of the experiences, that foster the various behavioral transformations.

Part of this ignorance undoubtedly results from the relative inaccessibility of infancy and early childhood to trained observation. What is known comes largely from the reports of parents who have had at least some training in behavioral observation and who have been on hand to note the landmarks in behavioral development and to realize their interconnections with their children's experiences. This includes what we have learned from Piaget (1936, 1937, 1945) who came to his parenthood with very special and unusual preparation from his ecological studies of molluscs, his background in embryology, and his experiences in the psychiatric clinic of Bleuler and the laboratory-school of Binet and Simon. What we think we know does not include what we have been taught by Arnold Gesell even though he fathered the methodology of longitudinal studies of behavioral development aided by motion pictures. Gesell failed to appreciate the full nature of what he made a way of observing because, I believe, he came to his observations with conceptions, such as that of genetic predeterminism and as the doctrine of recapitulation learned from his teacher (G. Stanley Hall), that blinded him in considerable part to the nature of the behavioral phenomena that he observed. The relative inaccessibility of infancy and early childhood need no longer stand in the way of investigating early psychological development even though we still lack institutional settings for observing the very young that schools have provided for observing children at later ages. If day care should become as common as schools, this lack of an institutional setting for observing the very young could no longer excuse ignorance.

A second part of the ignorance of the details of early psychological development derives from the misconceptions of development that have prevailed. Preformationism in embryology gave way to the notion of a predetermined epigenesis of anatomical structures in the latter half of the 18th century with the investigations of the details of the epigenesis of the circulatory system and of the intestine by C. F. Wolff (1759, 1768). Religious predeterminism gave way to the hereditary predeterminism of the late 19th and early 20th century. Moreover, the epistemological empiricism, stemming originally from John Locke's essay on understanding, came to be seen as an original nature consisting of a multiplicity of reflexes that could be combined through the conditioning process in an infinite variety of ways (see Hunt, 1969 in Elkind & Flavell). This provided an extreme alternative to hereditary predeterminism, and the pseudo-issue of the relative importance of heredity and environment came into being to distract observers from examining the cooperation of heredity and environment in an on-going process of interaction between the infant and his environment to produce the hierarchy of behavioral transformations with their various natures and experiential bases about which we know so little.

A third part of this ignorance derives from the lack of appropriate tools of assessment for investigation of early development. To be sure, tests of intelligence have existed for nearly three quarters of a century since Binet and Simon (1905) presented th[e] first scale. This scale was the culmination of a decade of investigation, begi[n] in 1895, during which Binet and Henri posed what became two of the main issues of traditional differential psychology, namely, the nature and extent of individual differences in psychological processes, and the interrelationships of mental processes within the individual. Binet and Simon wrote (as translated): "It seems to us that in the intelligence there is a fundamental faculty, the alteration or lack of which is of utmost importance in practical life. This faculty is judgment, otherwise called good sense, practical sense, initiative, the faculty of adapting oneself to circumstances. To judge well, to comprehend well, these are the essential activities of the intelligence . . . indeed the rest of the intellectual faculties seem to be of little importance in comparison with the intelligence . . . " (1905, p. 42).

In their search for a metric with which to quantify this "fundamental faculty," Binet and Simon hit upon "mental age" which provided what Clyde Coombs (1950), in his essay on scaling without a unit of measurement, has viewed as a kind of average in which success on each test item could substitute for every one of the others. Note that this very first choice of metric served to hide the details of the organizational structure of the activities represented in the test items.

Very early, this "fundamental faculty" of intelligence came to be viewed as innately fixed even though Binet (1909) himself deplored that ". . . some recent philosophers appear to have given their moral support to the deplorable verdict that the intelligence of an individual is a fixed quantity . . . a child's mind is like a field for which an expert farmer has advised a change in the method of cultivating, with the result that in the place of desert land, we now have a harvest. It is in this particular sense, the one which is significant, that we say that the intelligence of children may be increased. One increases that which constitutes the . . . capacity to learn with instruction" (1909, pp. 54-55). Despite such evidence of Binet's general appreciation of the interactionist's view of development, his choice of a substitutive mode of averaging the ages of achieving several landmarks of ability to obtain the metric of mental age for his "fundamental faculty" tended to distract investigators from discerning the structural aspects of psychological development. The substitutive averaging tended to hide the way in which an infant brings to each situation a ready-made organization that gets adaptively modified as he accommodates his ready-made organization to the demands of the situation encountered. The substitutive averaging also tended to hide the hierarchical nature of developing abilities. When in 1912, Wilhelm Stern hit upon the IQ-ratio of mental age to chronological age, moreover, he devised a metric that tended to make the IQ a permanent dimension of each individual indicating his intellectual power. Such static terms as dimension and scale provided a kind of semantic support for the notion that the IQ should be constant. Moreover, the idea of a power that increased with maturation served as another conceptual blanket helping to obscure the structural and hierarchical nature of developing abilities. The concern of clinicians for the phenomenon of "scatter" on the IQ-scales shows, however, that these aspects of developing abilities could not be completely obscured even by the combined metrics of mental age and IQ (see, e.g., Harris & Shakow, 1937; Wallin, 1922).

The measurement of intelligence has long been viewed as one of the major successes of psychology. Indeed, intelligence tests have had predictive value and have been highly useful for selecting individuals for functions where high levels of ability were crucial. On the other hand, these metrics of mental age and IQ have not only served to distract investigators from the structural and hierarchical aspects of abilities being developed through the cumulative effects of adaptive accommodations to the requirements of situations, they have been highly unfortunate in three ways for Binet's educational hopes. First, the idea that the IQ provides a measure of future potential as well as past achievement has provided teachers with an excuse for their failures and removed the motivation to be ingenious about instruction. Second, whenever children were informed of their own IQs, the information concerned their comparative status with that of others. All too often this concern served to diminish their self-confidence and to deprive them of hope. Third, the norm-referenced model of testing where the meaning of concrete performances derives from the individual's comparative status in a representative group got extended to the testing of educational achievement in general. This extension of the norm-referenced model served in turn to separate testing from teaching and learning. As a consequence, children are presented in schools with given curricula regardless of their individual abilities and interests. They are then examined with tests only distantly relevant to the component learning tasks in the curricula. It should come as no surprise, therefore, thatChristopher Jencks (1972) has found the schools serving chiefly a credentializing function rather than a function of socializing and teaching which appear to go on largely in home and neighborhood activities. Also, it is not surprising that with the new approach to instructional research, brought on by the advent of the teaching machines, investigators quickly discovered that norm-referenced tests designed to bring out individual differences in ability or achievement were poorly adapted to evaluate the effects of instruction (Hammock, 1960). It was Robert Glaser (1963) who elaborated the requirements for measuring the outcomes of instruction, who differentiated "criterion-referenced" tests from "norm-referenced" tests, and who coined these terms. The criteria of "criterion-referenced" tests are the items of ability, information, strategies in information processing, motivation, and motor skill that constitute the concrete goals of instruction. These concrete goals typically come from the demands of society. The task of such tests is to discover how well the student's performance on the items of instruction generalizes to other items within each criterion domain (Glaser & Nitko, 1971, p. 654ff).

It was the merit of Piaget to provide the basis for a mode of assessment very different from either the norm-referenced tests of intelligence and achievement or the criterion-referenced tests of concrete educational achievements. Early in his career, before Claparede invited him to become director of research at the Rousseau Institute, Piaget worked for a time in the schools that served as a laboratory for Binet and Simon. He notes in his autobiography (Piaget, 1952) that he concerned himself there with attempting to discover <u>why</u> the children failed various test items. Even then he educed the idea of information or skills required for success that were missing from the ready-made repertoire brought by the child to the test. This idea is much like that much later hit upon by Gagné and Paradise (1961) in their efforts to understand the problem-solving failures of members of the U. S. Air Force in World War II. It presaged the idea that intelligence or

capacity to learn consists in a hierarchical arrangement of concepts, information, and strategies for processing information (see Hunt, 1961). When Piaget turned from his investigations of language and thought (Piaget, 1923), reasoning (Piaget, 1924), physical causality (Piaget, 1927), and moral judgment (Piaget, 1932) to observing the epigenetic transformations in the behavior of his own three children in the situations he provided for them, the notion of a hierarchical arrangement of abilities emerged full blown in his hypothesis of six successive stages of sensorimotor development.

It was Piaget's marvelously clear observations of the steps in sensorimotor development that prompted the idea of sequential, ordinal scales as a basically new approach to the assessment of cognitive and motivational development. With the inspiration of Piaget's (1936, 1937) observations of his own children, Dr. Uzgiris and I (Uzgiris & Hunt, 1974) set out to devise sequential ordinal scales of sensorimotor development. When having all our behavioral landmarks grouped together proved to be both practically and theoretically clumsy, we decided to separate them into six series or branches. The separation owes something to the schemes that Piaget found ready-made at birth and something also to his distinction between coping or intelligence organizations and constructions of reality. Because we could readily find more than six behavioral "landmarks" on which observers could agree, we became dissatisfied with Piaget's six stages of sensorimotor development. One needs an instrument with more than six successive landmarks with which to validate an hypothesis of six stages. Thus, we have come up with six branches or series that we came to call scales only after we got at least cross-sectional evidence of a high level of ordinality in each. Each of these scales has more than six steps. One is concerned with visual following and permanence of objects. It has 14 steps rather than Piaget's six. The second concerns the development of means for obtaining desired environmental events. It has 13 steps. The third branch concerns imitation, and it yields two scales: one for gestural imitation with 9 steps and one with vocal imitation also with 9 steps. The fourth branch concerns the epistemological construction of operational causality and has 7 steps. The fifth branch concerns the construction of object relations in space, and has 11 steps. The sixth concerns the development of schemes for relating to objects, and has 10 steps. Although we make no claim that these scales have encapsulated the ultimate nature of sensorimotor development, they provide a set of assessment tools of considerable utility for investigating the structural aspects of psychological development which have hitherto been so well hidden by the metrics of mental age and the IQ. I should note here that others have also been inspired by Piaget's (1936, 1937) observations to devise other somewhat similar tools (see Corman & Escalona, 1969; Giblin, 1971). I should note also that these sequential-ordinal scales are rooted in the nature of the developmental process. They are neither norm-referenced nor criterion-referenced. The meaning of a child's performance comes, insofar as the tests prove to be sequentially ordinal, from its place in a universal developmental order.

The utility of such scales resides in the several modifications in the strategy for assessing development and for investigating its structure. Having the landmarks of achievement arranged in a hypothetically sequential order permits a direct test of the hypothesis of sequential organization and of how it is related to the environmental circumstances encountered. In also permitting an investigation of the

generality of developmental advance across the several branches, the scales, secondly, provide a way of testing Piaget's hypothesis of six sensorimotor stages. In making no assumption of automatic developmental progress with time, ordinal scales disentangle psychological development from age. They thereby make it feasible to use age as the dependent variable with which to assess the development-fostering impact of various kinds of independent environmental variables. This second change of strategy alone permits several new lines of investigation. First, it provides a way of investigating the degree of plasticity in each of the several lines of development by determining the ages at which infants living under diverse conditions achieve the successive landmarks on each scale. Second, by relating changes in the ages at which infants achieve landmarks on the several scales to specific and limited changes in the circumstances of rearing, the scales permit investigation of what kinds of experience are important for fostering development along each of the several lines. Third, these scales permit an investigation of the relation of cognitive and sensorimotor competencies to the emotional signs of interest, boredom, and distress evoked by various behavior models and inanimate materials. All three of these lines of investigation are highly important for any educational psychology useful for guiding development during infancy and early childhood. Finally, having a series of sequential landmarks on several lines of development invites investigations of the essential features of the various forms of transformation that are implicit in the differences between the characteristics of the observable behavior characteristic of successive levels of development. From such investigations can come corrective information about the differing kinds of learning involved with maturation in behavioral development.

What I have been saying about the utility of the sequential ordinal scales inspired by Piaget's observations is highly abstract. Let me try to be more concrete and specific with illustrations from each of the several categories indicated.

Thus far, the hypothesis of invariance in the order of achieving the steps on the several scales has held up well. When Corman and Escalona (1969) followed some of their subjects longitudinally with the Escalona scales of prehension, object permanence, and spatial relationships, they confirmed the invariance of the sequential order in achievements marking the Piaget stages, but noted also that the order observed within any one stage need not be consistent. Using all six of the Uzgiris-Hunt scales in a longitudinal study of 12 infants from predominantly middle-class families (three academic, two from families supported by welfare, and the remaining seven of typical middle-class status), Uzgiris (1973) examined them in their homes weekly from age four weeks to eight months, every other week from eight months to one year, and monthly thereafter. Two infants exhibited one inversion each on the 14 steps of the scale of object permanence derived from cross-sectional evidence. Both began to search for a desired object partially covered before they would return to the location where an activity with an object had been interrupted, and Piaget considers both of these behaviors characteristic of his Stage III. Despite the 14 steps in this scale, no other deviations occurred. No deviations occurred for the 13-step scale on the development of means for obtaining desired environmental events except that two adjacent were inverted for this sample. No deviations appeared for the sequence of seven steps of operational causality. For the scale on the construction of object relations in space, however, there were a number of deviations. The adjacent steps of grasping an object in view and

localizing the source of a sound were inverted, both signifying Piaget's Stage III, and several other deviations occurred for steps based on actions utilizing the spatial relationships between objects and compensating for the pull of gravity on objects which are characteristic of Piaget's Stage V. Dr. Uzgiris did not include the scales of gestural and vocal imitation or the scale for the development of sensorimotor schemes for relating to objects in her first report of this study. Whether the paucity of deviations from these sequences in their present form, which is based on only cross-sectional data, will be reproduced when data become available for children being reared in an Iranian orphanage and with various enrichments intended to foster their development remains to be seen.

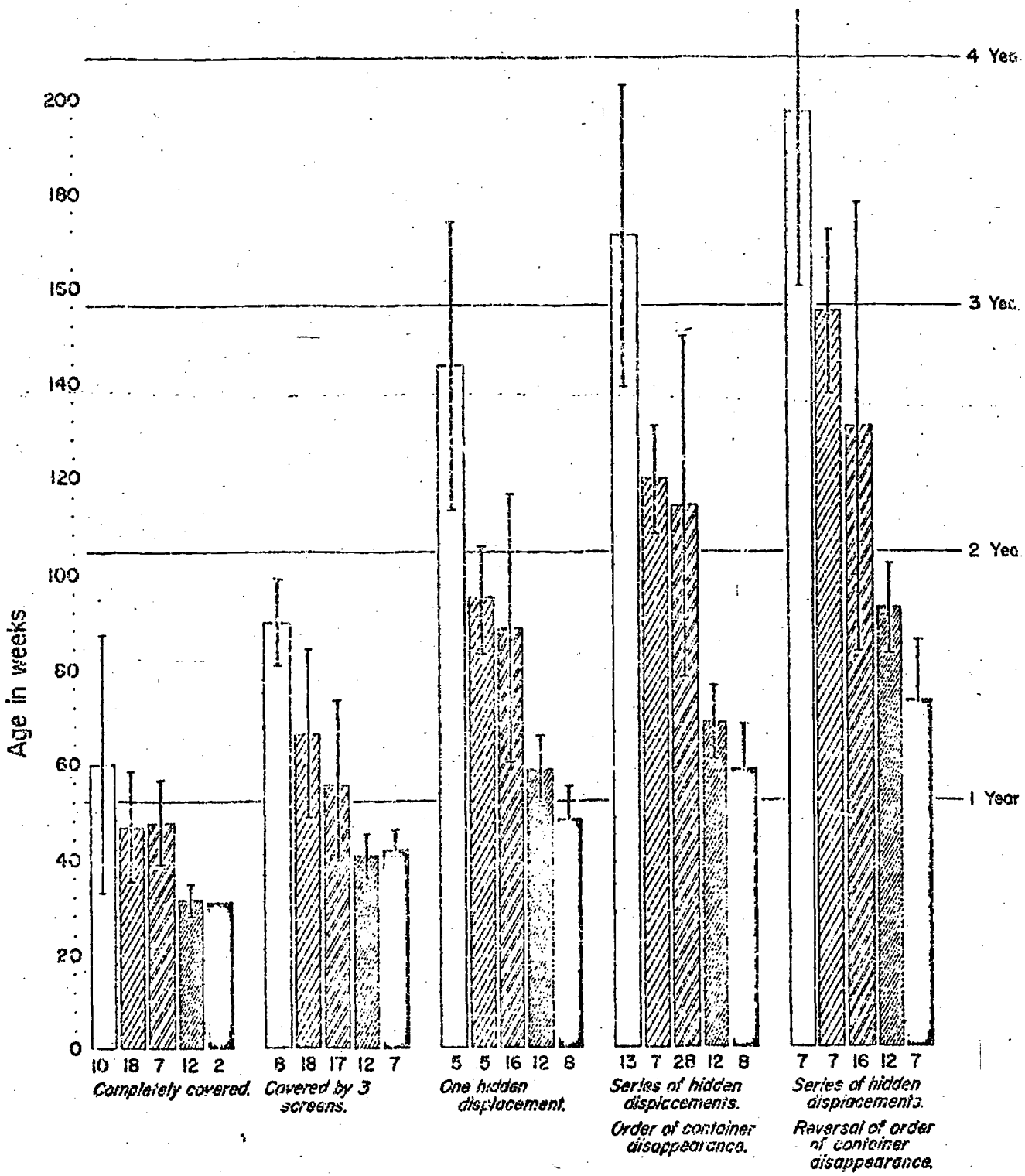
The structural relationships among achievements along the several lines, or what I have characterized above as the generality of developmental advances across the several lines, has been investigated in ingenious fashion by Professor Uzgiris (1973) with the data from her longitudinal study of development as assessed by our scales in the 12 Worcester infants. The scales concerned were those of object construction, object relations in space, development of means of obtaining desired environmental events, and operational causality. It is interesting that intercorrelations among the ranks of the various infants at each month of age on degree of advancement on each of the four scales failed to reveal anything of interest except an impression that progress in the construction of the object concept might have a leading function. I say this is interesting because our traditional correlational analyses, including factor analysis, are in essence correlations among the rankings of individuals in terms of quality of performance on the various test items. On the other hand, when she ceased to group her subjects according to chronological age, that "involves an arbitrary classification that ignores different rates of development during different time periods for individual infants," and took the steps in the construction of the object concept as her anchor points, she got evidence that advances in object construction lead those in the other lines of development. Moreover, her examination of the relationships between achievements in object construction and achievements in the other three branches suggested four distinct levels. The first parallels Piaget's Stage III and seems to reflect a minimal ability to incorporate objects and events outside perception into on-going systems of action. The second level appears to span stages both IV and V in Piaget's system and reflects an increasing differentiation of objects from the actions in which they participate, entails substantiation of objects, and contributes to their use as means for achieving desired goals. The third level seems to coincide with the beginning of Piaget's Stage VI, is marked search for an object hidden by means of an invisible displacement, appears to follow considerable exploration of relationships among objects in space, and "probably reflects the articulation of a matrix of spatial relations in which displacements of objects can be envisioned thereby permitting the exploitation of perceived relations among objects for achieving goals. The final and fourth level coincides with the culmination of the sensorimotor period and reflects the achievement of ability to represent the displacement of objects moving independently within a spatial framework," (Uzgiris, 1973, p. 200). These I consider to be very interesting structural findings from a very promising mode of investigation that I hope will be exploited by other investigators.

Consider now some of the investigations deriving from the strategy of disentangling psychological development from age that Professor Uzgiris has already found useful for the study of structural interrelationships. Paraskevopoulos and I (1971) have had an abbreviated form of the scales of object construction and imitation, both gestural and vocal, administered to all the infants aged from five months to five years who were living in the Municipal Orphanage of Athens and the Metera Baby Center in the summer and fall of 1969. We also had these scales administered to a sample of 94 home-reared children from working-class parents comparable in social, economic, and educational status to the biological parents of the illegitimate babies at the orphanages. My own investigations have emphasized the scales of object construction and vocal imitation because I am taking seriously the hypothesis that these lines of development constitute the sensorimotor roots of language. Object construction provides the knowledge that myst be symbolized in language, while vocal imitation provides the source of the vocal signs that symbolize the knowledge of objects. We first asked whether differing conditions of rearing would influence the ages at which the landmarks of object construction and vocal imitation are achieved. Thus, the independent variable consisted of the differing conditions of rearing at the Municipal Orphanage, where the infant-caretaker ratio is of the order of 10/1, at Metera Baby Center, where the infant-caretaker ratio is of the order of 3/1, and in the homes of working-class families. The results for object construction appear in the three left-hand columns of each cluster of columns in Figure. 1. (See Figure 1) Here we have used only five of the 14 levels in the scale. Since this was a cross-sectional study, moreover, the levels are defined by passing one of the lower levels and failing those above. Our dependent variable consisted of the means of the ages of the children at each of the levels. In Figure 1, the column at the left of each cluster of five represents the means of the ages of the children at the Municipal Orphanage, that second to the left represents the mean ages of the children at Metera, and the third represents the mean ages of the home-reared children. Note that the children of the Municipal Orphanage average substantially older than those of Metera who average older than those home-reared.

The infant-caretaker ratio is highly objective as an independent variable, but not very meaningful psychologically. Yet to see how much of an effect this factor has, note the three columns on the left of the cluster at the right. These represent the mean ages of those at the top level of object construction where the child retrieves an object that has been hidden in a container that has disappeared under three successive covers and goes to the place where the container disappeared last and proceeded through the series of places where the container disappeared in reverse order. At the Municipal Orphanage the mean age is 195.22 weeks, at Metera 153.51 weeks, and for those home-reared 129.86 weeks. The variation in mean ages for those living under these three sets of conditions at this level of object construction is about 65 weeks or about a year and a quarter.

But these 65 weeks do not represent the full extent of what geneticists call the "range of reaction" in the age of achieving top-level object construction. Consider next the two columns on the right of each cluster in Figure 1. That second from the right derives from the longitudinal study of development in the 12 infants of predominantly middle-class families in Worcester by Professor Uzgiris. The ones on the extreme right of each cluster come from a study planned to evaluate

OBJECT CONSTRUCTION UNDER DIFFERING CONDITIONS OF REARING



Child searches for and obtains desired object when it is: _____

Method: Cross-sectional single examination	Athens Orphanage -	*Infant / caretaker ratio: about 10:1*	from Paraskevopoulos & Hunt (1971)
	Athens Orphanage -	*Infant / caretaker ratio: about 3:1*	
	Athens -	*Home reared*	
Method: Longitudinal repeated examinations	Worcester, Mass. -	*Home reared - Middle class families*	Uzgiris (In press)
	Mt. Carmel, Ill. -	*Parent and child center - with "badger mother-training program"*	Hunt, Schickedanz, Badger & Noe

the effects of a program aimed at hastening the development of a series of 8 successive infants born to the parents from the poverty sector participating in the Parent and Child Center at Mt. Carmel, Illinois. Consider again the cluster at the right. These columns represent the mean ages at which the infants in this sample achieved top level object construction, and you can see that those at Mt. Carmel achieved this level at an average age of 73 weeks while those from predominantly middle-class families of Worcester averaged 98 weeks -- a difference of 25 weeks or nearly half a year with those from the families of poverty advanced over those from families of predominantly middle-class.

It is of interest to note the range of reaction for the age of achieving top-level object construction. If one makes an appropriate correction in the mean ages of the infants at this level in the cross-sectional study of Greek children, the estimate of the mean age at which those children of Municipal Orphanage achieved this level of object construction becomes 109 weeks or more than two years. The impact of Piaget's work on the plasticity of development is ambiguous. If one emphasizes his theory with his constructs for describing on-going infant-environment interaction which include accommodation, assimilation, and equilibration, one would expect variations in conditions of rearing to have substantial effects on the ages of achieving the various landmarks of development. On the other hand, if one emphasizes Piaget's method and age findings, each stage appears to be tied to a very limited range of ages. Clearly the finding that the range of reaction for the age of achieving top-level object construction is over two years indicates that Piaget's theory deserves more credence so far as the effects of the conditions of living on rate of development are concerned than does his method or the finds he has reported. In order to put this finding into a familiar frame of reference for purposes of dramatic impact, it may be worth transforming these findings into the terms of the IQ-ratio for object construction. The transformation, as has been done elsewhere, results in a range of reaction for means of this particular IQ-ratio from 60 to 150 (see Hunt, Paraskevopoulos, Schickedanz & Uzgiris, 1974). This 90-point range of reaction in mean IQ-ratio is equivalent to the range of variation in individual IQs for all but a minute fraction of those above the small pathological cluster at the low end of the distribution of individual IQs.

When we come to relating structural interrelationships to variations or interventions in the conditions of rearing, one gets inklings of other findings of interest that have been missed through nearly three-quarters of a century of measuring early development with standard norm-referenced scales. The intercorrelations among the scale scores for all the children in the Greek study (Paraskevopoulos & Hunt, 1971) on the scales of object construction, gestural imitation, and vocal imitation were high. They were 0.80, 0.86, and 0.88. On the other hand, those children being followed by my collaborators in Tehran appear from inspection to be much more advanced in object construction and gestural imitation than they are in vocal imitation. In fact, the only infants who have manifested even pseudo-imitation of familiar vocal patterns during their whole first year are six of the 10 in our first wave of audio-visual enrichment. These babies had speakers attached to their cribs that they could turn on by tugging at a cord attached to their wrists or other parts of their body. Each pull gave about 10 seconds of sound which consisted of either music or mother talk in Farsi, the main language of Iran. It would appear that familiarity with such sounds is important for the socialization of the vocal

system, and that parents' imitations of their infants, mentioned with derision by John B. Watson (1928), may be of considerable importance for this socialization.

Other evidence also shows clearly that interventions may hasten one line of development without hastening another. In the home-reared babies of Champaign-Urbana who served as subjects in the development of the Uzgiris-Hunt scales, pseudo-imitation appeared typically in the fourth month following birth but that eye-hand coordination which Burton White (1967) termed "top-level reaching" appeared much later at about the beginning of the sixth month. The order was entirely reversed in the institution-reared babies who experienced White's interventions. The median age for top-level reaching was 89 days, or the end of the third month, but I was unable to elicit pseudo-imitation of cooing sounds even in infants of six months who had been reared in the baby hospital where White's studies were done. The only instance of pseudo-imitation came with the sounds of saliva squirting within the mouth such as White had heard in the repertoires of certain of these infants. Yet another instance of an intervention hastening one line without hastening others has occurred at the Parent-and-Child Center of Mt. Carmel. The Mothers' Training Program developed by Mrs. Earladeen Badger is aimed chiefly at solving what I like to call "the problem of the match," but one of the inanimate materials that she has found to be of great interest to infants who can sit up is a shape box from Creative Playthings. For day after day, infants apparently take delight in inserting shapes through the holes in the top of this box. Starting earliest with a ping-pong ball through the round hole, they proceed to the round block through this same hole, then the square block through the square hole, then the rectangular block through the rectangular hole, etc. All of the eight consecutive babies born to parents of the Center at Mt. Carmel played often with this toy, and we suspect that play with this toy had a good deal to do with fostering the appearance of top-level object permanence at the early mean age of 73 weeks. On the other hand, the intervention at Mt. Carmel failed to hasten the development of vocal imitation. These infants lag behind in vocal imitation those home-reared infants in the longitudinal study by Uzgiris in Worcester. These homely instances illustrate not only how interventions can hasten one line of development without hastening others; they also bring evidence that is at least suggestive of the kinds of experience important for the various lines of development.

Another homely illustration will illustrate the relation of cognitive and sensorimotor competencies to emotion and motivation. Infants who place blocks in their correct holes in the shape box by inspection without trial and error can readily be interested in matching pictures -- or finding the picture in a 3 x 3 matrix corresponding to the one an examiner holds up. On the other hand, if a child is still using trial and error, such matching constitutes an overmatch that results in distress and withdrawal. I have been able to demonstrate this to my own satisfaction a number of times, and, in the process ruined, at least temporarily, what was blossoming as a wonderful friendship.

Investigation of the characteristics of the transformations taking place from level to level in the several lines call for an examination of the implications concerning what must be happening in the central nervous system. Object construction appears to be based on the development of representative processes which

increase in autonomy and permanence throughout the sensorimotor phase until children achieve the capacity to operate these processes backward as well as forward. In a variety of instances the behavioral transitions appear to imply a transformation consisting of the coordination of sensorimotor systems or schemes which were previously separate. One instance consists of the coordination of eye-movement with head movements in visual following; still later comes a coordination of coordinated head-and-eye movements with hand movements in top-level reaching. Other instances appear in the "primary circular reactions" of Piaget when "things grasped become something to suck," and "sounds heard become something to look for." A highly important later instance appears when object construction and vocal imitation become in the learning set or generalization that "things have names," Yet another form of the implicit nature of the transformation involved in the transition between successive behavioral landmarks appears to be motivational in character (Hunt, 1963). This is illustrated by the efforts to retain or regain perceptual contact with objects or models that have been repeatedly encountered perceptually, and where their attractiveness appears to derive from emerging recognitive familiarity. Later, with more perceptual encounters, interest shifts to what is novel in these familiar situations (see Hunt, 1970; Uzgiris & Hunt, 1970; Greenberg, Uzgiris & Hunt, 1970; Weizmann, Cohen, & Pratt, 1971). Much remains to be learned about these transitions and about the relationship between cognitive and emotional-motivational matters in development.

In summary, what I have been endeavoring to say is that we are still highly ignorant about the structural details of early psychological development. We are ignorant because the norm-referenced tools of measurement were based on the metrics of mental age and IQ which tended to hide the details in the epigenetic changes that occur in the development of behavior which are highly important both for theory and for the development of an educational psychology for the management of the learning of the young. Sequential ordinal scales provide an alternative to the traditional tools of assessment which invite and readily permit investigation of these structural details in a variety of ways that I have tried to illustrate concretely.

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