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ABSTRACT

"Psychological Assessment in Education and Social Class," a paper presented at the University of Missouri conference on the "Legal and Educational Consequences of the Intelligence Testing Movement: Handicapped and Minority Group Children," is provided. The historical origins of the scheme of norm-referenced testing and the evidence questioning its assumptions are summarized. The implications of the interactionist's view of heredity and environment are examined. Alternative schemes for psychological assessment are outlined which, if developed, could guide the teaching process and encourage rather than discourage ingenuity in teaching. Specific topics include revisions in the conception of intelligence and their sources (achievement and motivational autonomy, maturation and experience, and spurious factors in the longitudinal validity of the IQ) and race and social class differences in IQ. (KM)

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FROM

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THE LEGAL AND EDUCATIONAL CONSEQUENCES
OF THE INTELLIGENCE TESTING MOVEMENT:
HANDICAPPED CHILDREN AND
MINORITY GROUP CHILDREN

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FOREWORD

On April 13-14, 1972, University of Missouri-Columbia sponsored a conference on the "Legal and Educational Consequences of the Intelligence Testing Movement: Handicapped and Minority Group Children." This conference was the second in what is anticipated to be a series of annual conferences focusing upon critical issues relative to the education of exceptional children. The first conference was held in 1971 and dealt with the "Categorical/Non-Categorical Issue in Special Education." The topic of the 1972 Missouri Conference seemed an obvious choice in view of the emphasis in the literature and the significant court decisions which have been rendered in recent years relative to psychological testing, special education placement, and the rights of all children to appropriate educational services.

The planners of this conference made every effort to include as presentors individuals with experience and expertise appropriate to the issues involved; to this end, their efforts were highly successful. Most certainly, in the months and years ahead, there will be ever-increasing activity in the field of special education relative to the legal and educational implications of intelligence testing; hopefully, this second Missouri Conference will contribute to the initial thinking on the topic.

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PSYCHOLOGICAL ASSESSMENT IN EDUCATION
AND SOCIAL CLASS¹

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Psychological assessment should guide teaching. It should tell a teacher what kinds of assignments and curricular materials a given child can utilize profitably to foster his psychological development and to pick up the knowledge and skills which he must acquire in order to adapt to his culture. The form of psychological assessment now most prevalent in education fails utterly to do this.

Psychological assessment as we know it is based almost exclusively on norm-referenced tests where the meaning of an individual child's performance comes from its position (percentile rank or standard score) among those in the group on which the test was standardized, or from the modal age of the children in the standardization group for which such performance is typical.

Recent years have brought social rebellion against such assessment practices and habit of thought upon which they are based. People in various minority groups have objected strenuously to the idea that an hour of performance in what they regard as an artificial testing situation can demonstrate and prove the inevitable and permanent inferiority of their children. They have objected loudly enough to be heard. Within the educational and psychological professions, moreover, these habits of thought about the IQ have led both to disappointment and confusion when gains in IQ from special educational programs disappeared shortly after the gainers were returned to the home and school environments from whence they came.

This scheme of assessment, with its unfortunate educational consequences and professional disappointments, is based, I believe, on serious misconceptions about the nature of psychological development and its causes. First of all, the scheme assumes that intelligence is a kind of learning power or capacity for adaptation (e.g., Spearman's--1904, 1923, 1927--g). It is this power which is presumed to be measured by the IQ tests. It is supposed to increase in essentially automatic fashion at an approximately constant rate with age. This rate is given by the IQ. Second, this rate is presumed to predict the ultimate level of competence which the individual can expect to achieve because the scheme assumes that the measured individual differences in this hypothetical power are essentially fixed by the individual's heredity. Third, it follows, as an automatic corollary, that the differences between the average IQs for races and social classes are biologically inevitable. So dogmatically strong have these habits of thought in this scheme become in many people that they serve to motivate questioning the validity of any evidence dissonant with them, and, for many years, they discouraged even the investigation of alternative conceptions of psychological development and of the

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achievement of the cognitive abilities and motivations which would lead to a scheme of assessment which could, at least potentially, serve to guide the teaching process (See Hunt, 1961).

What I wish to do today is to outline the historical origins of the scheme of norm-referenced testing, to synopsise the evidence which calls most convincingly into question the assumptions upon which the scheme is based, to look briefly at the implications of the interactionist's view of heredity and environment, and to outline alternative schemes for psychological assessment which, if developed, could serve to guide the teaching process and would encourage rather than discourage ingenuity in teaching.

Historical Origins

Inasmuch as Binet and Simon (1905) developed the prototype for the IQ test in the course of studying the problem of mental retardation among children in the public schools of Paris in order to determine how "the intelligence of children may be increased . . . with instruction" (Binet, 1909, pp. 54-55), the purpose to which the tests have been put is ironic. Unfortunately, Francis Galton had already taken what he considered to be, but were not, implications from his Darwin's survival theory of species evolution to see the conceptual trend with his book on Hereditary Genius (1869). Galton had also launched the measurement of individual differences in his anthropometric laboratory and published his Inquiries into Human Faculty (1883). Although the many simple tests of sensory and motor functions that Galton devised failed to show any appreciable relationship to the criteria of genius in which he was interested, his preconceptions about the role of heredity were quickly applied to variations in the measures of the more complex functions of "judgment, otherwise called good sense, practical sense, initiative, the faculty of adapting one's self to circumstances" devised by Binet and Simon (1916) and found to be roughly correlated with age. The IQ emerged when Wilhelm Stern (1912) suggested dividing mental age (MA) by chronological age (CA) to get the intelligence quotient (IQ) which more or less following the thought of the day, he considered to be a fundamental trait in which individuals differ.

Such a view was greatly reinforced by the influence of G. Stanley Hall whose ambition it was to become "the Darwin of the mind," and whose faith in the doctrine of recapitulation led to the assumption of predetermined development. Although Hall wrote much, it is likely that his influence endured more through the profound effect he had upon his students than through any direct effects from his writings. Hall's students include a majority of those names associated with the early development of intelligence tests in America. They are H. H. Goddard (Ph.D., Clark University, 1899), F. Kuhlman (Ph.D., Clark University, 1903), and L. M. Terman (Ph.D., Clark University, 1905). His students also include Arnold Gesell (Ph.D., Clark University, 1906) who exploited the normative approach to child development on the assumption that "the basic configurations, correlations, and successions of behavior patterns are determined by the innate processes of growth called maturation" (1945).

Such are the historical origins of the assumptions on which our dominant scheme of psychological assessment in education are based. They are the teachings of our teachers. They grew out of but were not necessarily implied by Darwin's survival theory of the evolution of species. They are correct for the evolution of species, but, as I shall show below (Plasticity and Heredity: Implications of Interactionism), it is a serious mistake to apply the principles of species evolution to the development of individuals.

Revisions in the Conception of Intelligence and Their Sources

Although I have never denied a primary role to heredity, I have been in the business of revising these conceptions of intelligence and of its origins for some time. A decade ago, in Intelligence and Experience (Hunt, 1961), I tried to alter our habits of thought about intelligence and the nature of cognitive development with both evidence and argument. On the side of evidence, I found and summarized a substantial list of studies which indicate that early and prolonged encounters with differing environments can have tremendous effects. In other words, development is not predetermined in rate and order. It is quite plastic. On the side of argument, I contended, in view of this plasticity, that IQs from tests of intelligence are valid only as a way of assessing the rate of past acquisitions, and that they have very little validity as predictors of future IQs or the ultimate level of competence to be achieved without knowledge of the circumstances to be encountered. I suggested also that we should think of intelligence as a hierarchy of learning sets, strategies of information processing, concepts, and motivational systems and skills which are acquired in the course of each child's ongoing informational interaction with his environmental circumstances. From the several lines of evidence and argument, I suggested that readiness is no mere matter of maturation that takes place automatically. Rather, it is a matter of information-getting strategies, of concepts and motivational systems achieved, and of skills acquired. There I also introduced what I like to call "the problem of the match" which I later elaborated (Hunt, 1963a, 1965, 1966). This is a problem especially for parents and teachers and for all those who would prepare circumstances to foster psychological development in the young. The nature of this problem is based upon the view that adaptive growth takes place in, and only, or at least chiefly, situations which contain for any given infant or child information, models, and challenges just discrepant enough from those already stored and mastered to produce interest and to call for adaptive modification in the structure of his intellectual coping, his beliefs about the world, and his motor patterns which are not beyond his accommodative capacity at the time.

Despite the highly publicized arguments of Jensen (1969) and Herrnstein (1971) to the contrary, a major share of the theorizing and investigating relevant to these views coming during the past decade have served both to strengthen them and to suggest

elaborations. An exception is Head Start which did fail to achieve the highly unrealistic goals set for it in large part because the kind of curriculum deployed in Head Start was unfitted for the compensatory task set. Let me mention a few of these newer theoretical developments and bits of evidence. The decade brought Humphreys' (1962a) demonstrative argument that tests of intelligence are basically like tests of achievement. Both call upon previously acquired percepts, concepts, motives, and skills. The fact that tests of intelligence call for older acquisitions for which the learning situations are more difficult to specify than do achievement tests fails to destroy their basic similarity. Moreover, Humphreys (1962b) has extended Ferguson's (1956, 1959) explanation of the abilities derived from factor-analysis in terms of positive transfer of training by showing how the various experimental manipulations which have traditionally been used to study the transfer of training can account for the obtained nodes of intercorrelation among test scores. Such analyses provide a clear theoretical basis for an important role of experience in the development of intelligence as it has been traditionally measured and statistically analyzed, but they provide parents and teachers with little in the way of guidance concerning how abilities and interests build dynamically one upon another. In fact, the statistical factors (Thurstone, 1935; Guilford, 1967) are of relatively little use in choosing the circumstances best calculated to foster the development of new abilities and motivation systems in children.

My notion of the "problem of the match" and its later elaborations (Hunt, 1963a, 1965, 1966) gives central importance to cognitive acquisitions in other domains, and especially in those of emotion and motivation. This notion has received considerable empirical support. Several studies of attentional preference in very young infants, done by my own group, lend support to the idea that emerging cognitive familiarity motivates the maintenance of perceptual contact with whatever is becoming recognizable (Hunt, 1970; Uzgiris & Hunt, 1970; Greenberg, Uzgiris & Hunt, 1970; Weizmann, Cohen & Pratt, 1971). Moreover, the motivational importance of what is becoming recognizable is less a stage of psychological development than it is a phase in the course of information processing. This is suggested by a still tentative finding that when infants nearly a year old are presented regularly in tests of four minutes with pairs of patterns, one of which is presented regularly test after test and the other intermittently every seventh presentation, they come to look longer at the regularly presented patterns before they come to look longer at the intermittently presented ones (Hunt & Paraskevopoulos, in preparation). In the course of developing our ordinal scale of imitation, Uzgiris and I (1966, 1968) observed that infants regularly show pseudo-imitation of highly familiar gestural and vocal patterns before they imitate unfamiliar ones. Moreover, our observations indicate a great motivational significance for the match between the model presented and previous acquisitions. Infants are strongly motivated to imitate only models which challenge to a proper degree their perceptual and cognitive grasp or their motor skills. They become distressed and angry with models which call

for either cognitive or motor adaptations beyond them. They withdraw in boredom from models which have become too familiar or too simple to be challenging. An infant will imitate only what interests him and only what he can understand. Thus, what he imitates of a given model typically serves to show what he understands of that model.

Other bits of evidence supporting this view that cognitive developments are of importance in other domains such as emotion and motivation have come from investigations in other laboratories. The role of cognitive achievement in emotion has been illustrated in a very recent study by Schultz and Zigler (1971). On the assumption that a clown presented on a stationary condition would be easier to accommodate perceptually than the same clown in motion due to a difficulty in following contours, these investigators predicted that such expressions of pleasure as visual fixation, smiling, and non-stressful vocalizing would occur earlier for the stationary than for the moving condition. Their findings clearly confirmed this prediction.

The role of cognitive achievement in motivation has been illustrated in the findings of Zigler, Levine, and Gould (1967), that children of school age appreciate and prefer cartoons near the upper limit of their comprehension. In my own theorizing, (Hunt, 1965) I have suggested that the self concept may well be the most important of cognitive constructs for the motivation of achievement in school and in social behavior. It was especially interesting to me, therefore, to find Katz and Zigler (1967) suggesting that the disparity between the concepts of self and ideal self should be related to developmental maturity. The finding of positive associations of both chronological age and IQ with the size of the disparities between self and ideal self lend support to this contention that cognitive development is especially important in motivation. In this same vein, Kohlberg and Zigler (1967) have suggested that a child's concept of his sex role results largely from having categorized himself as either male or female early in development. Inasmuch as cognitive development involves transformations of the mental constructions of a child's environment, they have reasoned that both mental age and IQ should be positively correlated with maturity of social development. Moreover, they have found mature trends in social development coming early in children with IQs above average than in children of average IQ.

Achievement and Motivational Autonomy

While such findings lend support to the theoretical contention that developments within the cognitive domain are of importance for development in emotion and motivation, they also raise questions. All too seldom have the gains on tests of intelligence and achievement from various systems of compensatory education persisted after the children returned to the environments of their homes and standard schools. Recent experiences with the evanescence of the effects of compensatory education are a case in point. One might argue from the traditional view that these gains have been obtained only in limited cognitive skills, and that their persistence awaits

maturation of the organism as a whole. I question seriously such an explanation because evidence which I shall synopsise shortly suggests that anatomical maturation itself shows considerable plasticity. I suspect that the failure of gains from many of the prevalent systems of compensatory education to persist resides rather in their failure to provide experiences which inculcate ideal self-concepts that include professed ability to learn readily along with pride in such learning. Such self concepts might well yield autonomous striving.

It is very likely that autonomous striving has roots in very early experience. Burton White (1971) has found the behavioral patterns marking outstanding overall competence already present in children by age three. Despite the evidences of greatest plasticity during the first year (Greenberg, Uzgiris & Hunt, 1968; White, 1967), his observations have led him to emphasize importance of the home-based education that occurs in the period between the ages 10 months and three years. During the period from ages 10 months to three years, White notes, the burgeoning capacity for infants' manipulation and locomotion puts stress on mothers, and mothers differ in their means of coping sufficiently to make the effects show prominently in the competence of their babies by age three. Moreover, our own observations of the joy which infants of only two or three months show in connection with making a mobile sway by shaking themselves (Hunt & Uzgiris, 1964; Uzgiris & Hunt, 1970) and similar observations by Watson (1966, 1967) suggest that the beginnings of the motivation to act upon the world to achieve ends anticipated by the infant come very early indeed. Robert White (1959) has characterized such motivation by the term "competence" and contended that it is associated with an emotion which he terms "effectance." I have described a mechanism for such motivation which is inherent in information processing and action (Hunt, 1960, 1963b, 1965, 1971a, 1971b).

The importance of perceptual feedback to self-initiated action in such early development was illustrated in a study reported last March by Yarrow, Rubenstein, and Pedersen (1971) at the Society for Research in Child Development. This system of motivation, which they termed "goal orientation" was assessed in infants at six months of age by a cluster of items on the Bayley Scales. Prominent among these were persistent and purposeful attempts to secure objects out of reach. Their measure of goal orientation correlated approximately +.4 with mothers' responsiveness to their infants' expressions of distress. According to standard operant theory, with its emphasis upon overt behavior, this contingency of maternal response to such indicators of distress as crying should reinforce the crying and make cry-babies. It did not. In such young infants, apparently the contingency of maternal response to crying reinforces not the crying, but a hope of change in the circumstances. It thereby contributes to the development of confidence on the part of the infant that he can control his circumstances. Such may well be the origins of that trust emphasized by Erikson (1950). Out of such experiences of being able to change conditions in anticipated ways through one's own action comes gradually, I suspect, a kind of learning set which we (not the infant) might verbalize as: "If I

act, I can get what I want and make interesting things happen." I contend that this learning set is basically cognitive in character. It is a piece of knowledge about the relationship between an infant's self-initiated efforts and what comes to him from his world. If a child has tried and tried to no avail, he derives another kind of learning set which we might verbalize as: "Struggling is useless." Such a set must be corrected if the infant who has acquired it is ever to achieve confidence and trust that he can achieve his ends. Such confidence, I suspect, is an important precursor of developing that pride in achievement which motivates competence.

We know exceedingly little about the successive landmarks in the development of these learning sets and concepts with motivational significance. Because we have thought of cognition largely in terms of such school skills as language, or reading, or numbering, our various systems of compensatory education have omitted any attempt to provide corrective experiences designed to inculcate autonomous competence motivation. Years ago, Andreas Angyal (1941) emphasized in psychological development a general dynamic trend toward increasing autonomy. We need to know more about the kinds of experience which foster and hamper such motivational autonomy.

Maturation and Experience

In the various conceptions of development which have prevailed during the last half century, learning and maturation have been domains as separate as Kipling's East and West (and never the twain shall meet). Since World War II, however, clear evidence has come that informational interaction, especially with information through the eyes, influences maturation within the central nervous system. Most of these studies have been inspired by the neuropsychological theorizing of Donald Hebb (1949) or the neurobiochemical theorizing of Helgar Hydén (see 1959). Riesen (1947, 1958) inspired by the former, reported that rearing chimpanzees in the dark resulted not only in behavioral deficiencies but also to diminish the number of nerve cells and glial cells developing in their retinal ganglia by adulthood. Then Brattgård (1952), inspired by the latter, reported that rearing rabbits in the dark caused a paucity of RNA production in their retinal ganglia as adults. Since then, a California group has reported that thickness of the cerebral cortex and the level of total acetylcholinesterase activity of the cortex, as well as rate of adult maze-learning, are a function of the complexity of the environment during early life (Bennett, Diamond, Krech & Rosenzweig, 1964; Krech, Rosenzweig & Bennett, 1966). More recently, studies of the effects of dark-rearing during early life have been extended through the visual system. Such dark-rearing produces a paucity of both cells and glial fibers in the lateral geniculate body of the thalamus (Wiesel & Hubel, 1963). Moreover, as a Spanish investigator, Valverde, and his collaborators have shown, dark-rearing also decreases both dendritic branching and the number of spines which develop on dendritic processes of the large apical cells of the striate area in the occipital lobes in mice (Valverde, 1967, 1968; Valverde & Esteban, 1968). In a still unpublished study,

Fred Volkmar, one of my own students, and William Greenough, have demonstrated that low-level complexity in the circumstances encountered rather than the absence of light is responsible for very substantial decreases in the branching of the dendrites of the large apical cells in the striate area in the occipital lobes of rats. Such evidence indicates that there is considerable plasticity in the maturation of the neuroatomical equipment for information processing, and that variations in the maturation are associated with variations in the environmental circumstances encountered during development.

Spurious Factors in the Longitudinal Validity of the IQ

The evidences of plasticity in early development which I described in Intelligence and Experience were sufficient to compel me to relinquish all faith in the longitudinal validity coefficients for the IQ. It has not been sufficient for others. In Intelligence and Experience, I distinguished criterion validity (correspondence of the rank of an individual's score on an intelligence test with his rank in that group in performance in school or on a variety of jobs) from longitudinal validity (correspondence between an individual's IQ from an early testing with his IQ from a later testing) which I called their "predictive validity" (Hunt, 1961, p. 312). Moreover, I have said elsewhere that "the plasticity which appears to exist in the rate at which human organisms develop renders longitudinal prediction basically impossible unless one specifies the circumstances under which this development is to take place" (Hunt, 1969, p. 128). Yet, both psychologists and educators ask almost routinely about the longitudinal predictive value of those measures of development from our ordinal scales (Uzgiris & Hunt, 1966). It seems likely that the failure of the evidence for plasticity to be more widely convincing resides in the fact that substantial correlations are regularly observed between IQs based upon early testings and those based on later testings widely separated in time. Bloom (1964) based much of his discussion of stability and change in various traits on such evidence. It has been presumed generally that the basis for the existence of such correlations resides within the differing natures of individuals and within their predetermined rates of development. This, to be sure, is one source of the obtained correlations, but I contend that there are at least two other sources of such correlation which are spurious for any such interpretation.

If the scores on tests of intelligence are based on past achievements, as I believe Humphreys (1962a) has demonstrated, then the correlation between successive testings must involve a part-whole relationship in which the size of the part from the first testing approaches the size of the whole from the latter testing as the time between testings decreases (Humphreys, 1962b). The portion of any longitudinal validity-coefficient deriving from this part-whole relationship is completely irrelevant to any assumption of inherent stability in rate of individual development. It is, therefore, spurious as an indicator of an inherent rate of psychological development.

The second spurious factor in these longitudinal coefficients is to be found in the consistency of the developmental impact of home and neighborhood environment. The recent investigation by Yarrow, et al. (1971) is relevant here. Pedersen, one member of this team, reports that measures of home environments--social and inanimate--which were based on merely two three-hour time samplings taken a week apart showed correlations with various measures of performance on the Bayley Scales ranging to above .5. The coefficient of .5 accounts for 25 percent of the variance in the measures of infant performance at six months of age. If merely two three-hour samples a week apart can represent the variations of impact of environmental circumstances in the homes for the first half year of the lives of infants sufficiently well to account for 25 percent of the variance in their test performances at six months, then the consistency in the developmental impact of home environments is much greater than we have ever conceived such consistency to be. Whatever portion of longitudinal validity coefficients derives from such consistency in the impact of home environment is also entirely spurious as an indicator of the variations in the inherent rates of maturation for individuals. These two spurious contributions, one from the part-whole relationship and the other from the consistency of the developmental impact in the environment, subtract substantially from the traditionally accepted import of these observed longitudinal validity coefficients for the IQ. Moreover, the existence of such spurious components of these coefficients renders more credible some of the investigative examples of variations in the IQ associated with encountering differing sets of environmental circumstances.

Especially interesting is an example from a still unpublished program of investigations under the direction of Professor R. F. Heber of the University of Wisconsin. The first step in this program was a survey of tested intelligence in the poorest census district in the city of Milwaukee. In this survey, both the mothers and the children of five or six in 500 families were tested. The results show that 80 percent of the children with IQs under 80 came from mothers with IQs under 80. Such a finding is precisely what would be expected from the assumption that heredity predetermines intelligence. But Heber and his collaborators did not stop there. Instead, they selected a sample of 40 mothers with IQs under 75 who also had infants aged under six months at the time this portion of the program began. The 22 infants of a randomly selected half of these 40 mothers served as controls who had been tested repeatedly at the corresponding ages of the children in a treated group. The 25 children of the other 20 mothers were given educational treatments by home visitors until they were six months old. At this point, they were taken to a day-care center where each child was cared for by verbally articulate women who had been trained to administer an educational program which was designed to foster the development of confidence and of cognitive and language skills. Heber and his collaborators have not described the nature of this program in detail. The mothers of these children in the treated group also got some attention and training, but it was not they who taught their children. The results of the treatment show in a comparison of the IQs based on

Stanford-Binet tests given when the children in the control and treatment groups were 45 months old. Those in the control group had an average IQ of 92, which shows in comparison with the mother's IQ of 75 or less an unlikely degree of regression toward the mean which may well have been based in part upon repeated testing. Those in the treatment group averaged 128. However evanescent this result may turn out to be, this difference of 36 points indicates that those receiving the day-care with educational treatment have developed much more rapidly during their first 45 months than did those in the control group.

Another example which shows how large the environmental influence on the IQ from at least one kind of test can be appears in a cross-cultural study by Wayne Dennis (1966). Dennis got the Goodenough Draw-a-Man test given to samples of typical children, aged between six and nine years, who were living in normal family environments in some 50 cultures over the world. The variations in mean Draw-a-Man IQs for these samples ranged from a high of 124 to a low of 52. Mean IQs of 124 were found for suburban children in America and England, for children of a Japanese fishing village, and for Hopi Indian children. In all of these four cultures, the children grow up in almost continuous contact with representative, graphic art. The low mean IQ of 52 came from a sample of children in a nomadic Bedouin tribe of Syria, and the mean IQ of 53 from a nomadic tribe in the Sudan. It should be noticed that the Moslem religion has been more effective in prohibiting contact with graphic art than either Judaism or Christianity. Yet, even among groups of Arab Moslem children, the mean IQs for the Draw-a-Man test range from 52 for the Syrian Bedouin, who had almost no contact with graphic art, to 94 for the children of Lebanese Arabs in Beirut who see television and have considerable contact with the graphic art of Western civilization. The Draw-a-Man IQ probably calls for a less complex set of abilities as these are determined by factor analysis than does an IQ derived from either the Stanford-Binet battery or the Wechsler-Bellevue battery. For American children, however, IQs from the Draw-a-Man test correspond about as well with IQs from either of these two standard measures of intelligence while IQs from the two standards correspond with each other. It should be noted that the variation of 72 points in mean Draw-a-Man IQs holds for children reared in environmental circumstances which are typical for their various cultures. Moreover, these 72 points of variation in mean IQs from such typical groups of children fall only about 18 points short of the range of individual IQs (that between 60 and 150) which includes all but a small fraction of 1 percent of those individuals above the pathological bulge at the low end of the IQ distribution. Thus, variation in the mean Draw-a-Man IQ associated with circumstances of rearing have a "range of reaction" nearly equal to the variation of individual IQs. Where the variation in individual IQs is commonly attributed largely to genetic variation, this variation in mean IQ must be attributed to the differences in the cultural environments.

Highly significant even yet is the pioneering study in this domain by Skeels and Dye (1939). This study, to which Florence Goodenough (1939) referred with derision, came about as the

consequence of a "clinical surprise." Two residents of a state orphanage in Iowa, one aged 13 months with a Kuhlman IQ of 46 and the other of 16 months with an IQ of 35, were committed to an institution for the feeble-minded. They were committed not only because of their low scores on the test; at 13 months the younger one had made no attempt to stand even with assistance and he displayed no manipulative or vocal play, and the older at 16 months could not walk even with help and could not vocalize or play with materials. Both, therefore, appeared obviously feeble-minded. At the institution, they were placed on a ward with moron girls who ranged in age from 18 to 50 years and in mental age from 5 to 9 years. Some six months after this transfer Skeels, visiting the wards, noted with surprise that these two children had shown a remarkable degree of development. When they were tested again with the Kuhlman scale, the younger one had an IQ of 77, and the older one an IQ of 87. At the end of a year on the ward, the younger one had attained an IQ of 100, while the older one remained at 88. From a discovery that the older and brighter girls on the ward became very much attached to the children and would play with them during most of their waking hours, and that attendants took great fancy to the babies, brought them toys, picture books, and play materials, came the fantastic plan of transferring mentally retarded children from the orphanage nursery to an institution for the feeble-minded in order to foster their development. A group of 13 with an average IQ of 64.3 and a range between 36 and 89, with chronological ages ranging from 7 to 30 months, were actually transferred to such wards. After periods ranging between six months for the youngest and 52 months for the 30-month-old youngster, these children were retested. All 13 showed a gain. The gains ranged from a minimum of seven points to a maximum of 58 points. All but four showed gains of over 20 points. On the other hand, 12 other babies with a mean IQ of 87, an IQ range from 50 to 103, and an age range from 12 to 22 months were allowed to remain in the orphanage. When these children were retested after approximately corresponding periods, all but one showed a decrease in IQ. One decrease was of only eight points, but the remaining ten showed decreases ranging from 18 to 45 points, with five exceeding 35 points. So long as the conditions that fail to foster psychological development persist for but a short time, the essential plasticity characteristic of infancy permits considerable improvement when development-fostering circumstances are provided.

Recently, after 25 years, Skeels (1966) has looked up the individuals who composed these groups. Those who were transferred from the orphanage to the ward for moron women in the institution for the mentally retarded he found to be average citizens in their communities. Their children had an average IQ of 105 and were doing satisfactorily in school. These 13 individuals actually had a median educational attainment of 12th grade, four had one or more years of college work; one had received a bachelor's degree and gone on to graduate school. At the time of follow-up, one of those who remained in the orphanage had died in adolescence following continued residence in a state institution for the mentally retarded; five continued as wards of state institutions; all but one of the remaining six were employed in work calling only for

the lowest of skills. One gleans from these studies that environmental circumstances which persist over time can make a tremendous difference. The effects of circumstances are fairly readily reversible early in life, but as circumstances of a given kind endure, their effects become more and more difficult to alter.

Race and Social Class Differences in IQ

Such evidences of large cumulative effects of prolonged encounters with environments of differing development-fostering qualities have clear implications for the inevitability of race and class differences. The mean IQs of children of unskilled laborers typically fall about 20 points below the mean IQs of children of professional men (Anastasi, 1958, p. 517). Moreover, the mean IQs for samples of Black children have typically been found to fall about 15 points (one standard deviation) below the means for white children (Shuey, 1966). These are descriptive facts. Yet, as Anastasi has pointed out, they provide "no information regarding the cause of these observed behavioral differences" (1958, p. 598). The existence of a 72 point range in mean Draw-a-Man IQs associated with development in differing cultures suggests that class differences and race differences in mean IQ could readily be accounted for through class variations in the development-fostering quality of the environments encountered.

Intelligence testing, in fact, has always assumed approximately equal opportunity for learning, at least in typical families. This past decade, however, has brought evidences of large variations in the basic nutritional requirements, in opportunities to acquire cognitive skills, in opportunities to develop the motivational systems required for competence, and in the opportunities to acquire those values and standards of conduct required for life in the mainstream of a complex organized society (See Hunt, 1969, pp. 202-214). The fact that such opportunities are lacking most often for children of the poor argues strongly against the biological inevitability of class and race differences. Moreover, inasmuch as higher proportions of the various racial and ethnic groups than of native white people are poor, one would expect to be able to explain at least a major share of the failure of children from these groups to perform at the standard level in terms of the factors associated with poverty.

I have made this last statement repeatedly. I have based it on the evidence and inferences I have been describing. Recently, however, it has received stronger empirical support than anyone has had any right to expect. In a study reported at the meetings of the American Psychological Association, George W. Mayske (1971) described a special analysis of the data in the report on Equality of Educational Opportunity by Coleman, et al. (1966) in order to determine the degree to which these differences among racial-ethnic groups could be explained. Of the total variance among students in their academic achievement, 24 percent was associated with membership in one of six racial-ethnic groups (Indian, Mexican, Puerto Rican, Negro, Oriental, or native White). From regression equations, he took into account the socioeconomic status of each family, the presence or absence of key members of each family, assessments

of the aspirations for schooling by students and parents, beliefs about how students might benefit from an education, the region of residence, and the achievement and motivational levels of the students attending the school. These are all environmental circumstances associated in varying degrees with membership in these various racial and ethnic groups. When they were taken into account in his statistical analysis this percentage of variance dropped down to 1.2. This analysis was based on the achievement scores for sixth-grade students, but similar results were obtained for other grade levels and for each region of the country. Thus, the effects of racial-ethnic group membership on the academic achievement is almost completely confounded with a variety of conditions in the past or present circumstances of the students. Once these are taken statistically into account, race and ethnic differences become miniscule.

It should be noted that such considerations detract nothing from the cross-sectional validity of the IQ in terms of its capacity to predict the performance of children in standard schools. In the terms of what I call "the problem of the match," standard schools will achieve their educational purpose only in so far as children bring to the school those concepts, motivational systems, and skills for information processing which standard schools take for granted. This is another statement which I have been making on the basis of the evidence and inferences which I have been describing. It too gets strong empirical support from recent evidence reported by Jane Mercer (1971) at the American Psychological Association. She found that Chicano children with high IQs tend to (1) come from less crowded homes, (2) have mothers who expect them to have education through high school or beyond, (3) have fathers who were reared in an urban environment and who have had at least a ninth-grade education, (4) live in a family which speaks English much of the time, and (5) come from families who are buying their own homes; and that Black children with high IQs also come from families that have characteristics similar to those of the modal configuration for the white community of Riverside, California, where the study was done. She then used the findings from a multiple regression equation to group each Black and Chicano child of the elementary school within the city of Riverside, California, according to the degree to which his family conformed to the modal configuration of the total community. Each child got one point for each way in which his family background was like that of the modal configuration. If his family had all five of the modal characteristics, the child received a social background score of 5, and correspondingly for 4, 3, 2, 1, and none of these characteristics of the modal configuration. The IQs of Black children with scores of 5 averaged 99.5 and 104.4. Those from both ethnic groups with four points in common with the modal configuration averaged 95.5. As the social background scores decrease, the average IQ also decreased. Of those with no points in common with the modal configuration, the Black children averaged 82.7 and the Chicano children 84.5. From these latter come a major share of those who get into special education for the mentally handicapped. Jane Mercer suggests an improvement in this standard scheme of diagnosis which would take into account both IQ and the

degree to which the characteristics of a child's family fail to correspond with those of families typical of the dominant culture. Most of such children who get into special education encounter curricula geared merely to slowed rates of acquisition. What they need is help in the acquisition of those "entry skills" and motives taken for granted in standard schools. This term "entry skills" I have learned from my collaborator, Girvin E. Kirk, who is expert in such analyses.

Plasticity and Heredity: Implications of Interactionism

In presenting the results of the cross cultural study of the Draw-a-Man IQ by Wayne Dennis, I suggested that the 72-point range in mean IQs is the best indication that we have of what geneticists, since the days of Walterreack (see Dunn, 1965), have termed the "range of reaction" or the "norm of reaction." This is the distribution or range in measures of any phenotypic characteristic from a given genotype which results from developing through interaction with diverse environments. It is a concept which should be much more familiar to educators and psychologists. In their concern with the relative importance of heredity and environment, they typically concern themselves rather with indices of heritability. Heritability is defined as the proportion of trait variance within a given population which is determined by the genotypic variation in that population. If one assumes additivity, the variation in a population is the sum of the variances due to heredity, to environmental variation, and to the interaction between these. In human investigation, all these must be estimated indirectly, and they are typically estimated from the correlations between the IQs of individuals with varying degrees of kinship ranging from identical twins reared together and apart, fraternal twins, siblings, half-siblings, parents and children, cousins and unrelated individuals (see e.g., Burt, 1957, 1966; Cattell, 1960; Fuller & Thompson, 1960, Ch. 7; Huntley, 1966; Vandenberg, 1968; Woodworth, 1941). These statistical estimates of heritability are typically based on groups of individuals living within the range of environmental variation of a given race and class who are tested at a single time of their lives. Even though such estimates are averages which hold only for the population sampled, they often are used as if they applied generally. The primary importance of the heritability of any trait is to provide an estimate of the rate of gain in measures of that trait from selective breeding, yet they get used to make inferences about the educability of individuals. The educability of an individual, in so far as it is dependent on the IQ, calls for solid evidence about the norm of reaction for the IQ. But a statistical index of heritability, to quote Hirsch (1970, p. 101), "provides no information about the norm of reaction."

Those who find and point out the evidences of plasticity in phenotypic measures of intellectual and motivational development typically get tarred environmentalism. I wish to point out, however, that evidences of plasticity are not dissonant with a primary role for heredity. Heredity is always primary. The genotype in the fertilized ovum constitutes the starting point for any individual organism. The DNA in the genes contains the information which

sets the main lines of development throughout life. Yet, this information serves to determine nothing in an environmental vacuum. Moreover, the information gets modified by variations in the environmental conditions encountered. The DNA is far from totally predetermining. Development comes dynamically in the course of a continuing process of interaction between the individual at any given time and its environmental circumstances at that given time. This is the interactionist's theme song. The theme originated with Johanssen, the Danish investigator, whose name is now paired with that of Gregor Mendel as fathers of scientific genetics. The norm or range of reaction is a product of interacting in the course of development with different circumstances. For many of the traits in which educators and psychologists are interested, the range of reaction is great. Even so, heredity remains primary in determining the size of the differences between phenotypic measures which will derive from a given genotype developing in any two sets of differing environmental circumstances. One may put this principle more simply by saying that the genotype determines the norm or range of reaction.

Unfortunately, the statement in this form is scientifically meaningless because neither the genotype nor the ultimate norm of reaction is directly measurable and knowable. One can probably best illustrate this principle concretely. Suppose, for example, the existence of two pairs of identical twins, one pair typical, or without pathology, the other mongoloid. Suppose that one twin of each of these pairs were reared from birth in the Syrian tribe of nomadic Bedouins for which Dennis found the mean Draw-a-Man IQ to be 52. Suppose the other of each pair were reared in one of the best suburban American homes where Dennis found the Draw-a-Man IQ to average 124. Which pair of twins, the mongoloid or the normal, would show the greater difference in IQ on the Goodenough Draw-a-Man test at age 3, 8, or 12? I believe you will see immediately that the difference to be expected for the normal pair will be considerably greater than that for the mongoloid pair. I have designated one pair as mongoloid here only in order to permit recognition at birth of a pathological limitation on genotypic potential. In principle, the same prediction should hold for pairs which differ in potential within the normal range. Thus, hypothetically at least, the genotype determines the amount of effect on phenotypic measures which ongoing interaction in two differing environments can have.

Despite the primary importance of heredity, the concern of parents and educators is to utilize to the full advantage of children their individual norms of reaction. The heritability coefficients are significant chiefly for those in animal husbandry concerned with selective breeding. There is also a growing place for genetic counseling in human meeting, but as educators we are concerned with utilizing the norm of reaction which is substantial in the case of human competence.

Toward a Revision of the Strategy of Assessment

The tests of intelligence are generally regarded as one of the great monuments of achievement by modern psychology. Their

widespread use so continually reinforces the conception of intelligence on which they are based that it adds to the difficulty of revising that conception with any combination of dissonant evidence and new conceptual alternatives. Yet, as I have already indicated, intelligence testing has left many problems in psychological development and education completely unsolved, and it has even distracted attention from them. For three quarters of a century these tests have focused attention on comparative assessments of individual differences in a power (the IQ or Spearman's *g*) or a multiplicity or factored abilities (Thurstone, 1938; Guilford, 1967). This focus, I believe, has distracted investigators from attempting to see how in the various lines of psychological development the actual landmarks of ability and of motivation build one upon another. I believe this focus has also distracted investigators from examining the nature of the successive learning sets which enable and motivate a child to process information and to solve problems at successive levels of complexity. Instead of helping to tell teachers how to prepare the curricular environment to foster the development of any given child, the scores from the tests have tended to destroy even the motivation for ingenuity in teaching. The saddest words in education, when applied to student performance, are "as well as can be expected." Fortunately, at least the beginnings of new strategies for the measurement of learning and development are appearing.

One of these new strategies consists of criterion-referenced tests described by Robert Glaser (1963) of Pittsburgh. This strategy derives from the hierarchical conception of intelligence as it was suggested by Gagné's studies of adult problem-solving (Gagné & Paradise, 1961). Criterion-referencing may be contrasted with the norm-referencing which is characteristic of the standard test-batteries for both intelligence and achievement (Glaser, 1963; Glaser & Nitki, 1971). In the traditional norm-referenced test, the performance of an individual acquires its meaning from some index of its comparative rank among the scores describing the performances of the various individuals in the representative group on which the norms for the test are based. In the case of criterion-referenced tests, on the other hand, the meaning of any individual's performance derives directly from the behavioral goal of the educational experience which has been provided for him. It is this behavioral goal which defines performance desired of the tested subject. His performance, in turn, determines the criteria of success for the educational effort. This strategy of criterion-referencing gives new meaning to the standard concepts of reliability and validity for test scores (Popham & Husek, 1969). Reliability derives from examiner agreement, and validity is inherent in the relationship between the examinee's performance and the educational goal. Thus, this strategy also has the very considerable advantage of focusing the attention and effort of both teacher and student on the educational goal and of avoiding the distraction which is almost inevitable from the interpersonal comparisons involved in norm-referencing. It should be noted that age and time figure not at all in this strategy of assessment. Missing from such a strategy, however, is any developmental or educational frame of reference which can help guide the choice

of learning experiences. One must wait for failure and then search backward for its basis. This leaves teaching based too completely upon clinical or intuitive skills.

A second new strategy consists of ordinal scales of psychological development. This strategy is at least illustrated by our own ordinal scales of sensorimotor development in infancy (Uzgiris & Hunt, 1966, 1968). These scales were inspired by Piaget's (1936, 1937) observations of his own three children. They consist of items based on sequential landmarks for six overlapping lines of development through what Piaget has termed the sensorimotor phase. Each of these landmarks consists of a specified behavior elicited by a specified situation. Inter-observer agreement on the criterion behaviors is typically above 95 percent. Test-retest consistency for examinations conducted within 48 hours is typically above 85 percent, and the great majority of changes which do occur are upward on the scales.

Theoretically when a child shows the behavioral criterion for one of these landmarks, it implies that he has achieved all of those steps below it on that scale. Empirically, for the sample investigated, the ordinality of the steps on the various scales as indicated by Green's (1956) index of consistency range from a low of .802, for the scale on the development of relating to objects, to a high of .991, for the scale on the construction of operational causality. For all but two of our six scales, Green's index of consistency is well above .9. These findings are based, however, on only one cross-sectionally studied sample. The issue calls for longitudinal studies² and, ideally, for longitudinal studies of infants developing under environments which differ as radically as possible. In some instances, the invariance of sequence implied in ordinality is logically built in and is of trivial significance, but in others its basis is not obvious. Contrary to the argument of Mary Shirley (1931), however, such invariance of sequence need logically imply no predetermined rate or even order of maturation. It can just as readily derive from transformations of cognitive structure which are a function of the infant's informational interaction with his environmental circumstances. Presumably these interactions produce developmental transformations which in turn permit other, higher-order forms of informational interaction.

The sequential ordinality of steps in these scales provides a novel strategy for the measurement of psychological development. One can compare the development of two infants, regardless of their ages, in terms of their positions on each of the scales. This permits one to reverse the traditional strategy of measuring psychological development. It permits making age the dependent variable, which varies as a function of the kind of experience,

²Such a longitudinal study has recently been described by Uzgiris (1972). Moreover, the use of these scales in various orphanages and Parent-and-Child Centers for purposes of evaluation of programs of experiential enrichment will yield data of relevance to this issue of sequential invariance.

instead of the independent variable implied in our traditional concept of the IQ and of the normative descriptions of Arnold Gesell, et al. (1940). These sequentially ordinal steps permit one to define successive levels of development in terms of success on lower steps on the scale and failure on those above. One can then compare the means and variances of age for infants who have lived from birth under differing kinds of circumstances. The variations in age permit one to compare the educational or development-fostering quality of these differing circumstances. Measures based on ordinal scales may have the additional value of referring only to past experience and making no claims of persistence in the rate of development.

Let me illustrate these points. Paraskevopoulos and I have recently had examined with the scales of object permanence and of both gestural and vocal imitation, all the children aged between five months and five years who have lived from birth in one of two Athenian orphanages with differing regimes of child rearing (Paraskevopoulos & Hunt, 1971). The differing nature of these regimes can most easily be specified in terms of the child-care taker ratio. In the Municipal Orphanage, this ratio is of the order of 10/1. At the Metera Baby Center, which attempts to be a model institution for children, this ratio averages approximately 3/1 through the day. We also had examined some 94 home-reared children from working-class families. The mean ages for the children of the Municipal Orphanage lagged progressively for those at successive levels of object permanence. Let me take, for example, that level at which children follow an object through one hidden displacement, but not through a series of such displacements. The mean ages of the children at this level was 33.2 months at the Municipal Orphanage, 21.8 months at Metera (note a difference between mean ages of approximately a year), and 20.3 months for those home-reared. David Schickedanz has been following the development of infants in a Parent-and-Child Center at Mt. Carmel, Illinois. There the mothers of poverty, who are also the caretakers, have been taught how to foster early sensorimotor development. Six successive infants from these parents of poverty who have been developing under this regime have now achieved this level of following an object through one hidden displacement before they were a year old. Their average age approximated 11.5 months. Here the differing regimes of child rearing constitute the independent variable, and the ages of children at a functionally specified level of development constitute the dependent variable. The norm of reaction in age for this level of object construction must be at least of the order of 21 months.

Ordinal landmarks in development need imply no position on the issue of whether psychological development is continuous or step-wise. We have identified more landmarks than the six sensorimotor stages described by Piaget. Our scale of object permanence, for instance, consists of 14 sequentially ordinal landmarks. From the evidence with which I am now acquainted, I believe that psychological development is continuous, and that the degree of consistency for measures of sequential ordinality are a function of the range of landmarks employed and of the developmental

distances between them. This domain is wide open for investigation. The landmarks which we have selected are little more than first approximations of what can ultimately derive from exploring behavioral development with such a strategy. Our ignorance of development from the standpoint of this hierarchical conception is immense. Yet, if we are even to have a basis for guiding and learning of the young in what Piaget has termed the preconceptual phase, I believe such a strategy must be extended upward from the sensorimotor phase through the preconceptual phase.

It should be noted that the examining operations which define the sequentially achieved landmarks in development resemble criterion-referenced tests. In neither case does the meaning of an individual child's performance derive from comparison with the performance of others. In ordinal scales of psychological development, however, there is no educational experience with a behavioral goal to give meaning to the performance. Once the sequentially achieved landmarks have been identified, the meaning of any child's performance derives from where that performance places him along the sequentially ordinal scale. From the educational standpoint, what is still missing from this strategy is solid knowledge of the kinds of experience which promote the acquisition of each consecutive behavioral landmark. Moreover, there is little experience to guide us in uncovering landmarks through the preconceptual phase. In the course of her own teaching of mothers and observing of children, however, my colleague, Mrs. Earladeen Badger, is gleaning a number of clinical suggestions which are helpful. For instance, once infants in their play with a shape-box have achieved the level where they put the blocks of varying shapes into holes with appropriate shapes without active experimentation but merely from visual inspection, they can be happily interested in picture-matching games. On the other hand, while they are still struggling with a rectangular block in a square hole or a square block in a circular hole, any attempt to introduce picture-matching games becomes a source of threat and distress. You can readily see how such procedures can be helpful in both devising and testing educational strategies for fostering the psychological development of children with atypical backgrounds.

Potentially, there is at least a third strategy which might yield information to use in the guidance of the teaching process. It would consist in asking and determining what understandings, what strategies of information processing, what motor habits, and what motivational interests are required before a child can respond with productive accommodations to a given curriculum or teaching situation. To make this potential strategy concrete, let me ask what background acquisitions do kindergarten teachers implicitly take for granted in those children coming to kindergarten? Let me answer this question with some of the items which I suspect they take for granted. I suspect they take for granted that children can process information about color, can understand color names, and can use these names in their own speech. I suspect the same for information about place which is typically couched in prepositional terms, and for shape with the names of shapes and for size with comparative terms. If we once knew what was taken

for granted, it would not be difficult to design criterion-referenced tests with which to determine whether a child has or has not the expected skill in information processing. With respect to color information, let me note that well over 90 percent of four-year-olds from middle-class homes can both identify the main primary colors when they are named, and about 80 percent can name them when they are pointed to. Yet, less than 20 percent of the four-year-old Head Start children from families of poverty have such mastery of the linguistic processing of color information. This is a finding from a study which my colleague, Girvin Kirk, and I now have underway.

Suppose we extend this strategy by asking yet other questions. What motor abilities, symbolic linguistic skills, cognitive abilities, and interests are required before a child can learn to read, or can learn to read by each of the methods of teaching reading? Let us repeat this question for numerical counting, for addition and subtraction, and for multiplication. Do we have systematic information on such matters that we can teach to prospective teachers?

Although I am confident that the answer is negative, skillful teachers have always made such diagnostic assessments of their pupils intuitively. One has only to observe a master teacher, such as Max Bieberman in mathematics, to glean that each pupil's response to a problem is for the master a kind of diagnostic test. The pupil's response serves him as a guide to the kind of illustration or new question which can provoke understanding. Such teaching is beautiful to watch, but it is now so completely an intuitive art that it is impossible to communicate and teach to those who would become master teachers. It is interesting to note in passing that Bieberman's methods of teaching, as they are now canned in textbooks, are less successful than he was as a teacher.

With the information required for these three new strategies of psychological assessment, and with appropriate tests of the criterion-referenced rather than the norm-referenced sort, we could have a form of psychological assessment which would be teachable and which could guide the teaching process. Getting the information about cognitive and motivational development, constructing the appropriate tests, and learning how best to teach--how to provide experiences which foster each kind of development--these are large tasks. Until we do them, however, assessment will do little to guide the teaching process, and teaching will remain an intuitive art. Moreover, in continuing as we are, what we teach in colleges of education is about as likely to damage as to improve the lot of socially atypical children in our standard schools.

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