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ABSTRACT

The longitudinal child development study involved a cohort of 1008 infants, born in 1966 and constituted as a non-random sample in order to include a substantial number of biological risk cases. Simultaneously considered were perinatal biological and social adversity and measures of attainment in three domains (physical, motoric, and cognitive) at the end of the preschool years. Experimental subjects were divided into one of four biological risk groups, based upon whether they had experienced disorders of pregnancy and gestation, disorders of delivery, neonatal disorders, or multiple complications. Subjects were tested at 36, 42, 48, and 54 months for motoric skills, cognitive skills, and physical height and weight. The effects of prenatal, perinatal, neonatal, and multiple complications, and social class in the three domains evaluated at the different ages were summarized in 45 tables. Discussion gave attention to the nature of the deficits present at age 4 years. (KW)

THE NATURAL HISTORY OF 1008 INFANTS

PHASE III

FINAL REPORT

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and
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Part One

PART ONE

INTRODUCTION

At the time of writing there is a good deal of interest in the welfare of children. It has two aspects of particular interest for this report. First, there is widespread concern in the effects of poverty and limited social opportunity on children's growth and development. Second, there is an emerging interest in the identification and remediation of instructional difficulties.

Both expressions of concern are purposive in their intent; they express a desire to see the earliest years of life structured so that all children reach their potentials for growth as learners and as human beings. Fulfullment of promise is still not automatic, however. The strategies of organization and instruction are dependent on a data base which has not yet matched our lofty goals in concreteness.

This report emerges from work begun in the late nineteen-fifties. It is one in a series of products designed to provide an inferential base for planning instructural stategies. The mechanism this report represents is a simultaneous consideration of perinatal biological and social adversity and measures of attainment in three domains at the end of the preschool years. Also, there is explicit attention to the nature of deficits when encountered at age four.

I wish to express my thanks to the following people who have assisted with the difficult task of taking data in a non-captive population. My thanks go to Dr. Claire B. Ernhart, Dr. Steven D. Spaner, Dr. James Owens, Mrs. Ellen Brasunas, Mrs. Muriel Aronberg, Mrs. Edith Greenfield, Mrs. Lois

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Thomas E. Jordan
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Part Two

PART TWO

EARLY DEVELOPMENT

In recent years there has been a revival of interest in young children. To some the earliest years represent an opportunity to intervene in the cycle of deprivation; to others young children represent a vital stage in the cognitive development of the species (Tizard, 1970). To another group the early years present an opportunity to study and identify the origins of learning problems. For all points of view the common point of reference is the presence of a body of empirical knowledge on the course of early growth. The St. Louis Baby Study is an attempt to understand the processes of cognitive and physical maturation from birth into the school years. The studies have emerged from a rational committment more than a decade ago to conduct a prospective longitudinal inquiry covering the preschool years. The program is broadly conceived in the hope of shedding light on both focal and peripheral matters. The basic theme of the inquiry is acquisition of materials which will contribute to an understanding of learning style in middle childhood. More particularly, it is an attempt to build a body of knowledge of use in explaining the cognitive skills particularly relevant to classroom experiences.

The nexus of biological familial and social influences on growth presents some challenges to inquiry. The methodology of child study in the very young is invariably a process of individual case studies. Family cooperation requires that data collection be conducted under careful supervision. The interrelation of these premises is delicate, leading to serious committments by all concerned.

The appropiate information is quite diverse, with biological data being needed. This concern for the biological domain, in addition to seeing relevance in behavioral data, arises from a conservative position on the role of environment in early childhood and a critical poistion on the adequacy of current formulations of nature and nurture. Too often what is not clearly environment is rashly construed as heredity (Mittler, 1969). More reasonably one can posit an external environment, man-made events impinging on the growing child, together with a biological environment of prenatal and postnatal nutrition. The biological order in gestation is open to influence for good and ill by the external environment. Conversely, human environments are mediated in their effects by the presence of physiological realities.

The preceding remarks are little more than restatements of the obvious. Yet, they precipitate a series of unanswered questions about the relative influence of the several vectors of change. The extent to which human influences affect cognitive status in the presence of biological influences is a preoccupying question. A further elaboration, the extent to which such influences rise and fall in salience, is equally unclear. Our age has based public planning for the education of the young on a predilection for environmentalism. It seems only reasonable to inquire into the magnitude of effects and the relevant covariants to environmental manipulation. To do so is to seek optimal use of environmental strategies for helping young children. Recently, Shulman (1970) has called for reconstruction of strategies for advancing the efficiency of educational planning. One of his exhortations is that decisions be based on comprehensive pictures of development in the school-age years.

The Early Developmental Adversity studies take their place alongside a number of attempts to understand the characteristics of children by means of study over an extended period of time. At the moment, there are several investigations under way, each of which is attempting to understand the growth of children in terms of past, present, and future. In 1969 the Office of Economic Opportunity sponsored an Educational Testing Services (ETS) study of growth in the preschool years. The goal of the study was to understand how the preschool years contribute the cognitive attainment in poor children entering school. The project gathered data in several settings, rural and urban, and in eastern, midwestern and southern regions of the United States. Unfortunately, the ETS study was drastically cut back in 1970. In the United Kingdom Tizard (1966) began study of a large population of children living on the Isle of Wight. Tizard's 1970 (Rutter, Tizard, & Whitmore) report has revealed a number of interesting findings in twenty two hundred children at ages nine and ten, for the most part. One major finding is that the connection between cognitive retardation and low social class is not confined to large urban slums. The problem can arise in small towns as well as large. Tizard and associates have shown that the situational antecedents to childhood problems can be quite circumscribed; child delinquency and emotional disorders are related to broken homes. Intellectual retardation and under-achievement are related to social class. The incidence of disability states in this well-favored population is remarkably high. Using four categories, *intellectual retardation, educational backwardness, psychi-*

atric disorder, and *physical handicap*, Tizard and associates identified problems in one child out of six; and one quarter of the handicapped had two problems. These figures may be usefully contrasted with those given in Part Six, Tables 42 and 43.

The preceding studies have in common the fact that they are recent and were intended to produce significant educational and psychological data over a period of time. Two rather different studies had their origins well over a decade ago. In the late 1950's the National Institutes of Health began the Collaborative Perinatal Study (Berendes, 1966), an analysis of the outcomes of 50,000 pregnancies. According to Fox (1971) the useable cohort is somewhat more than 35,000 cases, and there are two thousand variables available for analysis. The study conducted on a largely decentralized basis, has persisted in the face of many problems. It has produced a number of useful accounts of biological growth (Chung and Myrianthopoulos, 1969). A British investigation with similar intentions was launched about the same time. The National Child Development Study began with identification of 17,000 deliveries. In 1967 Kellmer Pringle, Butler, & Davie reported the developmental status of 11,000 of the children at age seven.

Another British study, The National Survey of Health and Development, started even sooner. In 1946 the Population Investigation Committee began study of five thousand families who had babies delivered in one week in the month of March. Studies by Douglas (1967), and Douglas & Ross (1964), and Ross & Simpson (1971), have reported the development of the children up to adolescence. The subjects born in 1946 are, of course, young adults at the time of writing.

It can be seen that there are several quite active studies of children using large populations and following them over time. In this regard they are similar to studies begun in previous generations. Perhaps Terman's work (Oden, 1968) stands as the classic, following gifted children for several decades. Similarly, the Berkley Growth Study, now in its fourth decade (Eichorn, 1969) has studied several groups of individuals up to the present time. Such studies should not be confused with "follow-up" studies, investigations in which subjects of completed studies are investigated once more. In such studies cooperation of subjects is often fortuitous and the opportunity for distortions in results due to sampling problems is considerable.

In recent years studies of lesser magnitude than the U. S. and U. K. studies of very large populations have appeared. They are based on recognition of the value of developmental data in studies of cognitive development. In Scotland, Drillien's program of study has examined the effects of prematurity on the growth of children from birth into the elementary school years (Drillien, 1963, 1964, 1968, 1969). The Washington University studies on anoxia (Graham, et al., 1962; Ernhart, Graham, & Thurston, 1960; Corah, 1965) have maintained a theme of concern for the effects of perinatal oxygen deprivation. Jordan's St. Louis Baby Study (Jordan, 1971a) is an attempt to relate social and biological data to sequential stages of development in the preschool and elementary school years. At the time of reporting the Early Developmental Adversity studies (EDAP) have entered a fourth phase after a decade of work. A 1966 cohort of one thousand infants, and the subject of this report has been followed for several years. Finally, it is helpful to consider a fourth study of medium size. For the past several years a group of scientists in Baltimore (Hardy, 1966) have been studying the effects of an epidemic of rubella on a cohort. This work is interesting because of the cyclic nature of rubella and the probability of the problem recurring in the next few years.

In addition to programmatic inquiries there has been a growing series of studies directed at studying the connection between stages of development. Versacci's (1966) dissertation related a series of paranatal factors to reading skills for two hundred children in the fifth grade. Similarly, Balow's (1969) work has examined the educational outcomes of development in children originally enrolled in the Collaborative Perinatal Study. Phase I of the Early Developmental Adversity Program (Jordan, 1964) found an educationally significant relationship between paranatal data and educational data in elementary school children. Similarly, Edwards (1966) was able to relate birthweight and Apgar scores to mental and motor performance at age four. In perhaps the most extensive study of early developmental stages Bell, Weller, & Waldrop (1971) have found that high intensity behavior in infancy is related to low intensity of behavior at nursery school age.

An aspect of these studies is their explicit orientation to the value of data from the earliest stages of development. Further, there emerges an interest in the study of characteristics without the kind of manipulation of events stereotyped as the only kind of worthwhile research. The relationship of this trend to naturalistic research is not clear. In part the machinery of Government interest in early development provided an impetus to study of children in the preschool period. That progress had antecedents in the work of Pasamanick and Knobloch (1960) and others (Anderson, 1955) who had identified a number of illuminating elements in child development. In most cases findings emerged from non-manipulative inquiries, investigations in which nature rather than science assigned experiences to children.

A highly related aspect of the interest in correlating child development at various stages between infancy and adolescence has been the implicit use of large populations. Some of the more important influences on child development are quite rare, for example, the toxemias. Investigators have monitored large populations with two particular considerations in mind. First, the identification of rare conditions, and second, preservation of samples of adequate size over periods of time. From these two observations other insights into strategy may be elucidated. First, relatively little work exists to guide investigators in the selection of conceptual models for studying populations of children (Blum, 1962; Heinrich, 1964; Schaie, 1965). Second, equally scarce have been statistical models for evaluating data in a fashion fully responsive to the passage of time as a critical dimension (Gottman, McFall, and Barnett, 1969; Werts and Linn, 1970). Third, few investigations have emerged to assist with crucial problems of manipulating phenomena in diverse realms, e.g., neurological data as predictors, and educational data as criteria. All too often rigorous data in the investigator's own domain is related to less than best data in another domain. Fourth, the procedural aspects of developing data in different realms and at different times (Hoffman, 1969) has been rarely discussed (Huessy, 1967).

From the preceding observations it can be seen that the context for connecting development of children at different stages consists of a varied assortment of procedures, ideas, and analyses. The alternatives tend to present themselves to investigators in the order of problems about (1) procedure and data gathering, (2) formal experimental design, and (3) statistical manipulation. In fact, this is an unfortunate arrangement; all three topics are reciprocal in their implications, and the nexus they form may be glimpsed in the commentaries of Kodlin & Thompson, (1958); Thomas, et al., (1960), and Schaie and Strother (1968). For the purposes of this discussion it is helpful to begin with (1) formal experimental design, considering next (2) statistical manipulation, and then (3) procedures and data gathering.

(1) Experimental Design: There are three general approaches to the study of children's development over a period of time. The first and most appealing is the retrospective approach, which has been analyzed elsewhere (Jordan, 1967, 1971). The basic strategy is identification of a group of individuals with a characteristic of particular salience, e.g., mongolism (Ingalls, Babbott, and Philbrook, 1957; Chen, 1969, behavior problems (Wolff, 1967) and cerebral palsy (Eastman, et al., 1962). The previous histories of the probands are traced and the cause of their condition is thereby discovered. Procedurally, reconstruction of events between the early state, *ad hoc*, becomes a very uncertain enterprise. Wenar (1963), and Neligan and Prudham (1969) have demonstrated that mothers' memories of early development are selective, and generally

unreliable in cases of abnormal development. At a more basic level the retrospective inquiry starts with dependent variables and then searches for independent variables. The probability is high that a Type I error will occur. In that process a correct hypothesis of no difference will be rejected (Bailey, 1958). Yarrow (1970), Jordan (1967), and Klemmetti and Saxen (1967) have shown that outcomes of retrospective technique are not the same as those reached prospectively. Despite its problems the retrospective approach to studying human characteristics over time is attractive and individuals still propose to conduct them (Silver, 1970). The economics of money, time, and energy it proffers are very appealing (Jones, 1967). Taulse and Headman (1969) have suggested that the use of multiple contrast groups can increase the probability of avoiding errors when making conclusions from retrospective data.

The second type of design is the *prospective* study. In such quasi-experimental designs (Campbell & Stanley, 1966) probands are identified by means of the independent variable and followed, together with contrast cases, through a period of natural time in a series of dependent samples (Thomas, et al., 1960; Baltes, 1968). Drillien's studies of Scottish premature babies have yielded a picture of development from birth to school age (Drillien, 1964, 1969, 1970). Moore's (1967, 1968) investigation has reported development in a group of London boys and girls up to age eight years. The program from which this report emerges has examined two birth cohorts (Jordan, 1964). The second cohort, one thousand babies, has been examined at intervals of six months for several years. The advantages of the approach are considerable. Questions may be refined with the passage of time, and data of a sort not necessarily available in existing records or through testing on a single occasion may be generated. The hazards are formidable. Gross outlays of money, energy, and time are called for. The entire enterprise may be compromised before completion by a variety of events. Sample shrinkage may be unmanageable and fiscal crises unavoidable. Very large prospective studies are particularly susceptible to such hazards, the ETS 1969 and Collaborative studies to previously being prime examples. Nevertheless, prospective studies are undertaken from time to time, despite the hazards (Butcher, 1970).

A third approach is to view the span of development, that is, time as a dimension manageable by simultaneous and independent sampling at various ages or strata (Baltes, 1968). The technique is appealing when contact with a population cannot be sustained through natural time. Cederblad's (1968) demonstration of intellectual decline in Sudanese children was possible because she studied children from ages seven to fifteen years simultaneously. Disadvantages lie in the need to have all questions formulated before data gathering. In addition, subjects born at different times may not have the same developmental baseline (Schaie and Strother, 1968). That is, they may have been exposed to highly dissimilar and transient experiences such as epidemics and social disturbances. Baltes and Nesselroade (1970), and Hilton and Patrick (1970) have recently offered highly technical criticisms of this approach.

(2) Statistical Considerations: One of the realities of child behavior is that it is complex, arising from multiple causes, and occasionally, without cause or purpose. A description of behavioral status, accordingly, rests on a mass of information drawn from many

sources. The basic information may, in turn, be manipulable in other forms as measures are segmented and combined, e.g., dichotomized and used to create cell contingencies. Analysis of variance has proved to be a powerful tool for analysis of data; however, a more flexible technique for studying large amounts of data in numerous independent categories is multiple linear regression. Introduced by Bottenberg and Ward (1963) the technique has been elaborated by a series of commentaries (Cohen, 1968, 1969; Darlington, 1968; Kelly, Beggs, & McNeil, 1969). A statistical requirement met by the technique is the need to manipulate many variables simultaneously. A further advantage is that non-linear relationships among independent variables may be explored (Jordan, 1971g). A basic justification for use of linear models to study developmental data has been presented by Werts and Linn (1970), while Cohen's (1968) commentary points to the wider applicability of the multilinear approach. An example of applying multiple regression to developmental data may be found in Wilson, Parmelee and Huggins' (1963) analysis of low birth weight, and in Blatt and Garfunkel's (1969) analysis of intelligence test scores of poor children.

(3) Data Gathering: To some extent the options for considering data have been considered in the immediately preceding sections on design and statistics. However, those observations touched on information as formal data, and left unconsidered the strategies for gathering information and using it.

In research on development the process of gathering information too often begins with searching clinical records (Burt, 1968; Spitzer & Cohen, 1968). Two problems which immediately appear are first, the value of information in records. The expression "file drawer" research is invidious, and with reason. However good case records may be, they were generated for specific purposes and to answer specific questions. It is unlikely that they can help answer all inquiries. Second, an orientation to clinical records tends to modify questions into propositions which are answerable with the data on hand. It follows that information which is available may take priority over the intellectual substance of a question; the result is first-rate data for second-rate questions.

Virtually all styles of inquiry contain the option to gather data from subjects. Common to all is the need to gather the best data. With captive populations such as students continuous access to subjects is feasible. With non-captive populations, that is people who volunteer or move to another city, acquisition of data is more difficult. Personal interviews and individual testing may be possible, but use of mailed questionnaires and telephone calls may also be needed (Droege, 1971). Hochstim's (1967) analysis suggests that the three methods are practically interchangeable in terms of validity and utility. Less manageable is the matter of public attitudes. Testing of all kinds is viewed with suspicion in some quarters. Entire segments of the population may decline to cooperate in periods of social unrest and strife. At a more sustained level a lack of interest on the part of parents and suspicions of possible interference are encountered (Moore, Hindley, & Faulkner, 1954). Such attitudes can lead to withdrawal of cooperation and an end to data gathering. A sampling bias is easily produced since withdrawing subjects are often quite different from those who continue to provide information. Equally, people who agreed initially to cooperate may be very different from those who declined at the time a study population is formed (Baltes, 1971).

Ecological Aspects of Development: To some extent consideration of child development in the contexts of nativism and the family can be considered traditional and tidy. While key concepts are related to other concepts they tend to be not unmanageable. On the other hand appreciation of child development tends to become more diffuse and uncertain when the matter is pursued in the larger context of society. To some extent the ambiguity is due to complexity; however, it is also due to haziness in some of the concepts. The matter is well illustrated in the matters of race, social class, and poverty, a nidus whose consideration while popular tends to be clouded.

There are a few subjects as likely to evoke a loss of objectivity in both the man in the street and the social scientist as the topics race and ethnicity. At one end there arises a perception that race is biology, pure and simple, while at the other a tendency to collapse all differences into "culture" is equally misleading. People can be markedly different in ways that are obvious, such as color, and in ways which are more clear to themselves, such as speaking a minority language. In such cases the differences, self-perceived and perceived by others, tend to be associated with differences in performance measured against a conventional standard (Dreger and Miller, 1960; Jenson, 1961; Rieber and Womack, 1968). In the United States the most common form is the academic performance of black children, a condition in which low attainment is commonly encountered. However, the earliest years of such children tend not to reveal basic differences. Cross cultural study indicates that children of wholly black ancestry, urban Bantu infants, tend to be ahead rather than behind urban white children (Griffiths, 1969; Liddicoats, 1969). Black immigrants in Britain are typically a year retarded in language development (Seidel, 1967) and do poorly on standardized tests (Payne, 1969). The social antecedents to these findings are not surprising. Hood et al. (1970) found that one year-olds in the London inner district of Paddington lived under conditions of considerable family adversity. Their parents were originally rural in background, for the most part. The children lived in crowded conditions averaging 3·3 persons per room. Pless and Hood (1967) have shown that black West Indian immigrants tend to experience unstable marriages. Oppé's (1964) analysis showed widespread anemia and rickets in the same population; Stroud (1964) has reported a high incidence of West Indian children among burn cases. Maternal prenatal health tends to be poor (Hood et al., 1970), although there is an interesting lowered incidence of pre-eclamptic toxemia, according to Barron and Vessey (1968).

The situation of West Indian blacks and Pakistani immigrants is the same. Their social and educational maladaptation in cities such as the industrial city of Bradford, Yorkshire, is clear. In many respects the condition of Pakistanis in Bradford is like that of Irish immigrants in the same city one hundred years earlier. Richardson (1968) has shown that among the Irish nineteenth century rates of illiteracy, infant mortality, tuberculosis, drunkenness, and crime were very high. Today, the same group shows these traits no longer, occupying essentially the same social strata as the general population of Yorkshire towns, that is, working class (Jackson & Marsden, 1966). Biology does not change, leaving social factors as the explanatory mechanism. In the case of non-anglo immigrants in Britain the social factors probably have special effects unlike those in North America. Mittler and Ward (1971) have concluded that negative social factors have an earlier and stronger effect on child development in Britain, a finding the writer's experience is inclined to confirm.

In the United States it is the case that social factors operate to the detriment of blacks, primarily. Robinson (1967) has reported that negro women account for 11.3% of live births, but 17.4% of fetal deaths. The preponderance of lower social class membership affects the health of black women and their babies. Hendricks (1967) has reported that reproductive accidents decline among black women as social class level rises. Scottish data provided by Baird and Illsley (1953), and Drillien (1968) demonstrate that low social class membership increases the incidence of true- and prematures and small-for-date infants. Even so, Naylor and Myrianthopoulos (1967) were led to believe that white babies may be heavier than black babies for unknown reasons.

In recent years Jensen's (1969) remarks have raised once more perennial questions about the basis of observed differences between ethnic groups. The matter seems no better comprehended than in previous considerations. A basic flaw is the reductionist error of labelling all processes which are not responses elicited by environment as heredity. A more profitable alternative is to consider them *native* tendencies, vectors of developmental behavior which may or may not be completely autonomous. By that label the relatively obscure processes of prenatal growth may be treated with respect. That is, the early processes of growth involving genetic materials may be acknowledged; the environmental-hereditary basis of those processes then emerges as a question of substance rather than disappearing in the swift and erroneous conclusion that genetic mechanisms are immune to environmental influences. Prenatal growth retardation cannot be defined as genetic although it occurs in the absence of the normal range of environmental influences. The uterine environment provides hazards to development as well as constituting the optimal site. The placenta (Gruenwald, 1963) is a biological support to life, but it is also environmental. The effects of late-pregnancy growth failure (Warkany, Monroe, & Sutherland, 1960; Dignam, 1967) are seen in mental retardation post-natally. Equally opaque are the effects of early pregnancy complications in the form of viruses (Monif, Hardy & Sever, 1966; Gitnick, Fuccillo & Sever, 1968) although the effects are clear several years after delivery (*N.Y. Times*, 1969). An increasing body of information in the school years (Lytton, 1968) points to the contribution of biological factors to learning disorders in children. The relationship, as explored by McNeill and Wiegerink (1971) tends to be generalized, although the antecedent factors to children's problems are becoming clearer (Rossi, 1964).

<u>Biological Aspects of Development</u>: To some extent learning problems are predictable in the preschool years. Neligan and Prudham (1969) have shown that ages for walking and talking in sentences are useful prediction of cognitive ability at school entry age. At an earlier age anoxia associated with delivery tends to produce lower cognitive

attainment in subsequent years (Graham et al., 1962; Ernhart et al., 1963).

Measures of blood oxygenation are not automatic indices of trauma in the case of anoxia (Caldwell et al., 1957). A broader picture of early damage is available through use of Apgar's (Apgar, 1953; Apgar & James, 1962) system for evaluating the physiological state of infants. Five physiological signs rated in the first few minutes of life post partum yield a score of ten for babies in optimal condition. Scores of six or less are usually indicative of a clinically poor state (Gleiss & Holderburg, 1963; Klatskin, McGarry & Steward, 1966; Shipe, Vandenburg and Brooke Williams, 1968). Apgar (1958) has reported a mortality rate of 15% in babies with scores of two or less.

Low birthweight has emerged as a significant indicator of development in children. Eaves (1970) identified depressed scores on the Griffiths scale of intelligence at eighteen months. At four years, however, the effects were less clear, a finding corroborated by Babson and Kangas (1969), and to a lesser extent in a recent British study (Report..., 1971). At seven and eight years of age normal intelligence was the rule for just over one thousand prematures studied by McDonald (1967); however, she found an abnormal incidence of low intelligence. At eight to ten years of age Wiener et al., (1968) found that intelligence test performance was generally satisfactory, although the Bender-Gestalt test revealed some differences. Lubchenco et al., (1963) analyzed development at age ten of a group of babies under 1500 gm. Two thirds were found to have neuropsychiatric problems associated with their small birthweight. Drillien's (1969) prematures under 2,000 gm. showed tendencies to disturbed behavior and lowered academic competence. Of course, prematurity does not operate in a cultural vacuum. A variety of studies (Drillien, 1963; Wortis, 1963; Wiener, Rider & Oppel, 1963) have related prematurity to development by means of social class. The effect is largely to depress levels of attainment. This is particularly the case among the smallest premature infants whose postnatal course is adversely affected by growing up in lower social class homes. In recent years birthweight above the optimum, which Rantakallio (1968) has put at 3200-4700 gm. for deliveries in the fortieth week of gestation, leads to adverse effects. Babson, Henderson, & Clark, (1969) have found an above average incidence of low intelligence in children with birthweights above 4250 gm. Large babies were more like small babies than average size babies in the distribution of Binet IQ's at age four years. It seems likely that the relationship between birthweight and development is curvilinear (Jordan, 1969); low birthweight leads to poor cognitive attainment in a disproportionate number of children, average birthweights leading to no effects, and high birthweights depressing performance once more.

It is probable that we will see an alternative to birthweight as a measure of neonatal development. In theory, gestational age is more accurate, but it is not always easy to calculate. Recent French research suggests that it may be possible to establish gestational age by studying reflexes and muscle tone, and Italian research (Petrussa, 1971) suggests there are developmental indices of gestational age. Weight has proved useful, however, and will probably continue to be employed on pragmatic grounds.

A broad picture of perinatal status and its meaning for subsequent growth has been provided by Jordan (1971b). A series of categorically defined abnormal states were related to growth in the first two years of life. Multiple complications prove most likely to affect physical and cognitive development.

Family Aspects of Development: A part of the complex of growth is the matter of nurture. Life style is altered by extreme income limitations; concern for the future and the corresponding broader notion of a rationally controlled way of life is not possible when the press of circumstance is felt immediately. The result is a life style oriented to the moment, with the demands of the future being remote. Patterns of nutrition are radically altered by poverty, with poor food selection and unwise expenditure of money as the chief causes. The effects of malnutrition are particularly critical among the very young, where irreversible damage may be produced. Winick & Rosso (1969) have reported significant brain weight reduction and protein supply in Chilean children succumbing to malnourishment. Rosenbaum et al., (1969) have reported that proteinuria among pregnant women produced lowered intelligence at age four years in fifty-three children. At a less critical level poor eating patterns such as missing breakfast have an obvious effect on the responsiveness of children; their powers of concentration are reduced and they are less capable of sustained interest.

Another of poverty's effects on children is the simple matter of inadequate clothing. Wet, cold feet, together with a degree of malnourishment can lead to poor school work among even the brightest children. North (1970) has reported that eighty percent of the health problems discovered in Headstart children were not previously known or treated.

Within the last year there has arisen a degree of attention to a problem which illustrates the interaction of social and biological problems. Metal poisoning is on the rise (Hicks, 1970; Lyons, 1970; Chisolm, 1970; Becker, 1970). Plumbism, lead poisoning, is particulary attracting attention since it is a danger to many children. Chisolm (1970) has estimated that ten to twenty five percent of children who live in older, deteriorated housing are susceptible, with two to five percent probably showing "...manifestations compatible with intoxication" (p. 598). The research program which is the topic of this proposal has discovered several cases of apparently toxic levels of plumbism in the 1966 birth cohort at age three.

Still another byproduct of poverty is its effects on the structure of the family. Poor black and Puerto Rican families have been characterized as matriarchies. Their instability and poor nurturance compound the effects of other problems. Bandler (Pavenstedt, 1967) has drawn a picture of families in which children's needs are less important than parents' needs, and in which parents' roles have not become stabilized. Maternal health is often not good in poor families. Children suffer in several way . First, they are born to mothers who tend to conceive earlier, a finding documented in England (Fitzherbert, 1967), Scotland (Baird & Illsley, 1953), and in the United States by the writer. As a group they have a higher incidence of pregnancy complications and premature births (Fairweather and Illsley, 1960). As issue of lower class mothers, their biological adversity is compounded by social adversity (Wortis et al., 1963; Drillien, 1970; Jordan, 1972).

Lower class mothers tend to act in consistent ways, with results that are not always beneficial. Hess and Shipman (1965) have listed the ways in which four year old children of lower class mothers are affected by maternal life style. They state that such children tend to respond to status rather than to logical strategies when coping with problems; they are compliant and non-reflective, and see matters in a greatly fore-shortened time perspective. Summarizing five major longitudinal studies Rees and Palmer (1971) emphasize the role of parent's occupational and educational level in the attainment of children on standardized tests of intellectual development.

The age at which the range of hypothetical influences impinge on child growth in the first four years is the subjects of a series of reports by the writer, (Jordan, 1971e, Jordan & Spaner, 1971) and is extended in the substance of this document, which studies growth at ages three and four. Being very young does not preclude infants from responding to opportunities. Moffitt's (1971) babies were quite capable of subtle discrimination of speech sounds at age six months. Work on infants conducted by Hansen (1971) in Norway shows that qualitative deprivation in the form of institutional rearing continues to present a picture of delayed development. The findings are consistent with those presented three decades ago in the Iowa studies on differential effects of institutional living. In such cases the absence of warm, sustained relationships and stimulation retard human development. On the other hand, the presence of stimulation is not always beneficial; it depends on the nature of the stimulation and on its style. Klaus and Gray (1968) have shown that there is no shortage of stimulation in poor homes; the difficulty is that it is on the order of noise rather than signal, i.e., it is not constructive stimulation. Finally, poverty's heritage of disorganization leads to patterns of neglect. It is clear from a large amount of research (Aserlind, 1963; Bing, 1963; Marge, 1967; Honzek, 1967) that a home which is child-centered and stimulating plays a vital role in helping young children reach their potentials for cognitive attainment and language skills. The earlier children are exposed to benign stimulation and develop a sophisticated life-style, the better the course of their cognitive growth (McFie & Thompson, 1971).

Social class differences in levels of child development are well known. The term itself is not without ambiguities, but it tends to consistency. Most techniques for measuring SES level incorporate the level of education and the occupation of the breadwinner. In some contexts, particularly those where social class is unusually significant, an old name and family connections may lead to under-assessment of life-style. The reverse can occur, and there are families known to social agencies as multiproblem families. For such groups, for example the North Point families described by Pavenstedt (1967), social mobility often means a downward drift, to the detriment of the children. It seems to be the case that the social class level of families influences young children largely in the negative, (Jordan, 1971e) producing inhibitions in attainment. Such overt influences are not always present in the first year of life (Jordan & Spaner, 1970), but they seem to be clearly established by the end of the preschool years. To some extent social class influences operate more powerfully than ethnic group. Stodolsky & Lesser's (1967) research shows that differences in social class level persist within a variety of ethnic groups, Chinese, Negro, etc. Freeberg and Payne (1967) believe that social class differences tend to express themselves through parental language stimulation. In addition to parental language behavior social class differences are exhibited in styles of control exerted over children. Authoritarian patterns of interaction with children tend to be inhibiting. Jordan's (1970) research and that of Ernhart and Loevinger (1969) shows that authoritarianism is quite related to social class; as social class level rises authoritarianism declines, providing a less inhibiting atmosphere for childrens' explorations of the world.

From the preceding discussion it can be seen that study of child development in the preschool years suggests that answers may be available to questions about the course of growth. When children are afflicted with learning problems the value of tracing patterns of growth is increased. A full picture of the antecedents to disability status provides a basis for understanding strengths and weaknesses which children show. Equally significant is the opportunity to relate intervention strategies to differential patterns of growth. Jordan and Spaner (1970) have shown that development at age one year is not particulary influenced by ecological data. At two years Spaner (1970) has shown that environmental variables have a modest role in cognitive attainment. At age three Palmer (1970) has shown that social class is not as great an influence on development as is commonly believed. Yet, it is well known that Headstart youngsters, e.g. kindergarten age children, differ in cognitive attainment, physical state, and academic readiness (North, 1970). Only data covering the full spectrum of preschool growth offers an opportunity to grasp how (e.g.) environmental influences exert their control on developing children. Implicit in this observation is the idea that the process of differentiation among preschoolers leads to various patterns of aptitude. It does so by eliciting different cognitive styles from cultural contexts (Stodolsky and Lesser, 1967) and also by elaborating biological propensities. In the latter instance sensory problems leading to special class placement may be increased, and minor problems of central dysfunction (Haring, 1969) may be elaborated.

In the case of emerging patterns of strength and weakness for learning the matter of time applies. Some children will appear to fall behind or move ahead in development earlier and later than others. Study of the full span of early development can identify the patterns of attainment for various groups of children. To some extent the St. Louis Baby Study EDAP inquiry is doing this. The writer (Jordan, 1971) has developed a picture of growth in several groups of children from birth to age four and a half. The relative points of difference in patterns of growth show the way in which forms of physical and cognitive growth advance and decline over time. Presumably a picture of development in several special populations through the full span from birth to school age would indicate the point in time at which inflections in growth curves would emerge. Intervention strategies could then be timed rationally; that is, treatments could be initiated at several different points in time as different groups of children, biological states, social groups, etc., begin to exhibit the deviations towards which special education programs are directed.

The substance of this report is a contribution to that end. In this document evidence is presented on the comparative influence of biological risk and the social circumstances of life at ages three and four. The influence of these elements on three aspects of development, physical growth, motoric growth, and cognitive growth will be presented and discussed. In addition, an appraisal of the nature and extent of disability states at age four will be presented, together with an analysis of correlated and antecedent factors.

Part Three

PART THREE

PROCEDURES

INTRODUCTION. The procedures of the investigation arise from the larger context of longitudinal study, and the data of this report are continuous with preceding studies. Over a decade ago the writer began studies of the role of early biological and social data on the learning styles and capacities of elementary school children. More recently, a study cohort of 1008 newborns was established in 1966 after several years of prior analyses of issues and procedures. They have been described elsewhere (Jordan, 1963, 1964, 1967, 1971), and are discussed in Part Two, Early Development. The 1966 cohort was constituted as a non-random sample of births, in order to make sure that a substantial amount of biological *risk* cases could be assembled. Study of the issues of this report, but at an earlier age, have been reported elsewhere (Jordan, 1971b).

PROCEDURES. For each of four ages, 36 - 54 months after delivery, a criterion series of measures was established, *first*, by domains of child development, and *second*, by means of specific and appropriate measures within domains. Training procedures were established to bring caseworkers to a criterion level of competence and consistency within formalized procedures. Practice testing drew on children in private preschool agencies who represented the range of social characteristics in the cohort. Simultaneously, a process of searching addresses began, and all addresses in the study population were subjected to validation. This aspect of study is important; the 1966 cohort is a non-captive population, and negotiations with subjects' families are complex and repetitive. For example, about fifty percent of the black families studied in the summer of 1971 changed their addresses. The waves of urban migration are generally not this intense, but the summer 1971 experience illustrates how difficult and taxing the procedural aspect of longitudinal study can be. In virtually all instances the summer 1971 black migrants moved a short distance. The dynamics of research among lower class black and white families begin with acceptance of the fact that migration is frequent, and is often undertaken to suppress knowledge of families' whereabouts.

After practice-testing and preliminary tracing were completed caseworkers began the process of final tracing and making appointments. In addition, selection of examiners for out-of-town cases began. In some cases children were tested by examiners who had seen them in their homes on several previous occasions. In other instances examiners met families for the first time, due to changes of caseworkers. We have developed a pool of experienced examiners in urban centers, largely in the United States, but overseas in a few cases, in the course of a dozen testing periods. Tests were administered in homes, with test administration monitored by supervisors and by means of weekly staff conferences. Test results were monitored for completeness of detail, and prepared for data processing. At the time of writing the research program has accumulated one hundred and fifty items of information on the 1966 cohort; the information is available on magnetic tape and is stored in a 360/70 computer, together with standard statistical analytic packages.

SUBJECTS. The preschooler examined in this report are the traced, cooperative portion of the 1966 cohort at either one of two half year anniversaries of birth. The 1966 cohort of 1008 infants was not random, but contrived, in order to guarantee selected perinatal risk cases. Accordingly, the 1966 cohort of 1008 was fifty percent biological risk, and fifty percent non-risk, i.e. the next *seriatim* case in the same hospital[1] and meeting the criterion series given in Table 1. The criterion series is noteworthy because it is categorical; that is, risk status is not completely defined by degree of insult. Current factors which are either in the child or in the mother were employed. Some were very clearly related to insult, e.g. low Apgar (Apgar, 1953; Apgar and James, 1962; Apgar et al., 1958) or low birthweight (Drillien, 1963, 1964, 1968, 1969, 1970; McDonald, 1967). Others were contextual, i.e. being born to a very young woman, or to a woman at the end of the childbearing period. Still other factors were predisposing, as in the case of issue born to women with a history of pre-eclamptic toxemia.

Use of a categorical predictor series is a rational choice over degree of insult as an index of *risk*; there are two reasons. One is the need to test hypotheses which incorporate both mild and severe risk since consequence of severe risk are relatively well grasped. The second arises from the decade-long purposes of the investigation, which transcend the confines of a given stage of preschool development, looking to relate early development with and without biosocial *risk* to school status. In this connection it is likely that the optimal value of *risk* data for educational purposes will arise from development of a set of *educational risk* factors. They should be discrete rather than continuous variables, which can be related at some future date to indices of school readiness and, hopefully, school achievement. In that context early developmental data need to be manipulated as relatively discrete items of information in order to be of use in planning instruction.

[1]Five hospitals used in 1966 to obtain a range of social class and race.

TABLE 1

CRITERIA FOR SELECTION OF EXPERIMENTAL SUBJECTS IN 1966 COHORT

Factor I	Disorders of Pregnancy and Gestation
	Anemia of pregnancy, toxemia, pyelonephritis, diabetes, miscarriages, eclampsia, pre-eclampsia, serious infections, over-and under-age, developmental anomalies, hypertension, hemorrhages
Factor II	Disorders of Delivery
	Cord complications, delivery complications
Factor III	Neonatal Disorders
	Low birth weight, immaturity, hemolytic disease, low Apgar, anoxia, multiple birth (not twins), traumatic defect.
Factor IV	Multiple Complications
	Factors I + II, I + III, II + III, I + II + III

The number of subjects in prospective study is a topic whose complexity is generally underestimated. The 1966 cohort contained 1008 subjects, and the subjects of this study are the available subjects at four study periods. The general stereotype is that the number of subjects in a prospective study declines in proportion to the passage of time. In the case of the 1966 cohort the picture is not that simple. The explanations are as follows. Prospective longitudinal study, by definition, covers a span of time. Within the period there may be rises and falls in availability of probands. One source of reduction is the death of children. There have been about a dozen deaths in the 1966 cohort, most due to accidents, and occuring in lower class children, black for the most part. Another source of variability in study populations followed for a period of years is public opinion. Prospective longitudinal research is affected by the socio-political state of affairs. Dr. Martin Luther King's death drastically reduced cooperation in black families. Since that time there has been a restoration of emotional tone and, further, there has been a rise in popular interest in child study. An additional element is that there is a critical number of study contacts between caseworkers and families which, once reached, facilitates subsequent contacts. A rise in the competence of research staff at tracing elusive-but rarely uncooperative families occurs. This is a matter of skill at interviewing neighbors, developing cooperative relationships with community agencies, and establishing a sense of trust in a network of third-parties, relatives for the most part. Another point is the variation in patterns of mobility. Distance in the form of moves over long distances has not generally been a source of attrition. There are currently about forty families living in various parts of the country, and a few abroad who still provide data. Some families have remained at a distance, and have been tested in their own homes by local testers, typically graduate students. Others have returned to the community on visits and have been tested in the metropolitan area. Generally, long-distance moves have been made by middle-class employees of large corporations. These people tend to volunteer new addresses and to keep in close touch.

The result of all these influences has been to refute the stereotype of prospective longitudinal study as a process of cohort attrition, with consequent sampling distortions. Table 2 shows that the number of cases examined has been quite substantial, even at the ninth study period. Actually, there has been a rise in the number of four-year olds tested, when compared with the three-year olds. The four-year olds' total of about eighty three percent of the birth cohort is actually slightly higher when expressed as a proportion of live, cooperative cases. However, the numbers in Table 2 use the birth cohort (N = 1008) since that figure is more fundamental. A minor reason is that any other smaller, more recent figure, e.g. the number of cases at six months, would be invalid. There is the occasional experience that a child is found after several years who has not been seen since birth; such a child was traced at age four and a half (For an extended review of the procedural aspects of longitudinal study see Jordan, 1971f).

The procedural aspects of tracing and testing are considerable. The 54 month data in this report constituted the tenth contact with the population, and there have been over four thousand data taking sessions. At the time of writing an eleventh data-taking period is under way.

At thirty six months, the first data-taking period of this report, a reorganization of the cohort by experimental factor groupings was undertaken in order to increase the proportion of workers applied to the target population for tracing and testing. Cases were reviewed by factor groupings,

TABLE 2

NUMBER OF CASES STUDIED AT BIRTH

AND AT AGES 36 - 54 MONTHS

Birth	(T_6) 36 Mos.	(T_7) 42 Mos.	(T_6 & T_7)	(T_8) 48 Mos.	(T_9) 54 Mos.	(T_8 & T_9)
N 1008	380	376	756	421	404	825

Controls and *risk* cases, and assigned according to the size of the predictor status groups to winter or summer testing populations. Table 3 shows the assignment of the large groups, Controls and Factor III cases, to both testing groups on the basis of a random assignment. Factor II cases were few, and they were assigned entirely to the winter testing group. Factor IV cases were assigned entirely to the summer group.

It is now appropriate to consider the *risk* factor groups in Table *1* which are, in fact, the independent variable of this investigation[1]. The first experimental category, Factor I, *risk*, covers the gestational states of *risk*. Some of them are manifestly biological aberrations while others reflect predisposition to reproductive inefficiency. The second category is complications of delivery, Factor II. In this group are disorders of presentation and expulsion of the fetus. Factor III describes adverse perinatal states in the infant. Factor IV is the presence of multiple *risk*, i.e. aggregates of Factor I, II, or III. In the 1966 birth cohort at six months most Factor IV cases were combinations of Factors I and III combinations of prenatal complications with attendant complications in the child. Almost as many were instances of delivery and child complications. The control cases were the aggregate of next cooperating cases, *seriatim*, in the hospitals where experimental cases were delivered. Knowledge of the risk status of probands is not included in the information given to caseworkers since it might well provide a source of examiner bias when testing. An additional safeguard against distorted test results was the matching of examiner and child by race (Sattler, 1970).

<u>TESTS</u>. The indices of development used at thirty six and forty two months of age with cohorts T_6 and T_7 were a continuation of those used at earlier stages

[1]It is helpful to point out that a series of studies using a different, larger predictor model has been conducted parallel to the studies reported here and in Jordan (1971e).

TABLE 3

WINTER AND SUMMER STUDY GROUPS

GROUP	T_6 and T_8 WINTER 36 and 48 Mos.	T_7 and T_9 SUMMER 42 and 54 Mos.
Controls	50%	50%
Factor I *(Gestational Risk)*	all	none
Factor II *(Delivery Risk)*	none	all
Factor III *(Neonatal Risk)*	50%	50%
Factor IV *(multiple Risk)*	none	all

of development.

Physical Domain: Height in inches and weight in pounds were obtained by direct measurement of the children under standardized procedures.

Motor Domain: Two subtests of the *Preschool Attainment Record* (Doll, 1966) (PAR) were employed. They were the Par *Ambulation, Manipulation* sections which when summed yield a third, *Physical,* score,

Cognitive Domain: Two measures were employed, the PAR *Communication* subtest and the Peabody Picture Vocabulary Test, Form A (Dunn, 1965).

At forty eight and fifty four months the same three domains of attainment were studied.

Physical Domain: Height in inches and weight in pounds were obtained by direct measurement of children under standardized procedures.

Motor Domain: The Ernhart (Graham et al., 1960) *Copy Forms Test* was employed in order to assess psychomotor proficiency. The test consist of eighteen pictures composed of line drawings ranging in complexity from straight lines to geometric figures.

Cognitive Domain: *The Boehm Test of Basic Concepts* (Boehm, 1969) and Caldwell's (1970) *Preschool Inventory* were administered. The latter consists of four subtests, (1) *Personal-Social Responsiveness,* (2) *Associative Vocabulary,* (3) *Concept Activation-Numerical,* and (4) *Concept Activation-Sensory.* A fifth score obtained *(Total)* is the sum of the subscale scores.

Two procedural points may be noted about testing. The Preschool Attainment Record is basically a Vineland-like structured interview. In the present investigation every effort was made to turn inquiry items into performance items. For example, inquiry into *hopping* was pursued by having the children hop. This procedure was applied to several items. Another point arises from the

Ernhart Copy Forms. Scoring this test is a delicate task, and raises serious problems of reliability, scoring was performed by one person[1]. All tests were administered close to the half year anniversary of birth, but not necessarily on the exact day. By ages three and four birthdays can be quite exciting, and visits by examiners may be both unwise and unwelcome. The average delay in testing was only two or three days, while testing preceded the anniversary slightly in a number of cases.

The criterion measures just described are summarized in Table 4, by study group and by domain. This table also lists the number of cases tested at each study period. One measure which remains to be described is the social class score. The occupation, level of education, and income source of the head of the household was scored in the manner developed by McGuire and White (1955). In this system a theoretical range of scores exists from 14 - 84. The scores are so arranged that a low McGuire and White score means *high* SES level. This fact should be kept in mind because a number of correlation coefficients in Tables 35, 37, 38, and 41, show significant *negative* associations. The negative signs reflect the McGuire and White scoring system, not the relationship between the constructs under consideration. The mean McGuire and White scores and standard deviations are presented in Table 7; review of those data over the postnatal period of development is presented in Part Four, RESULTS. For the purpose of reviewing procedures it is helpful to consider the mean SES scores and their significance. The grand mean for all subjects at all periods is 55.42. A child with a mean social class scores of 55 is lower middle class, blue collar in social class. Such

[1] I wish to express my thanks to Mrs. Ellen Brasunas, Senior Research Assistant, who scored all Copy Form responses under the direction of Dr. Claire Ernhart.

TABLE 4

MEASURES USED IN THREE DOMAINS AT FOUR AGES

		DOMAINS			
		Physical		*Motoric*	*Cognitive*
Cohort	N	Height	Weight		
T_6 (36 months)	380	Inches	Pounds	Preschool Attainment Record (PAR) PAR *Ambulation* PAR *Manipulation* PAR *Physical*	Peabody Picture Vocabulary Test (PPVT) PAR *Communication*
T_7 (42 months)	359	Inches	Pounds	Preschool Attainment Record (PAR) PAR *Ambulation* PAR *Manipulation* PAR *Physical*	Peabody Picture Vocabulary Test (PPVT) PAR *Communication*
T_8 (48 months)	415	Inches	Pounds	Ernhart-Graham Copy Forms	Preschool Inventory (PI) Boehm Test of Basic Concepts
T_9 (54 months)	404	Inches	Pounds	Ernhart-Graham Copy Forms	Preschool Inventory (PI) Boehm Test of Basic Concepts

a child and family are described later.

HYPOTHESES. The hypotheses of the study are essentially null propositions that four categories of early developmental risk, and social class are significant influences on child growth as measured in three domains at four ages. The hypothesis of significant influence is examined in a context of children with and without perinatal risk status using the thirty two measures of attainment given in Table 4.

The statistical model employed was multiple linear regression (Bottenberg & Ward, 1963; Kelly et al., 1969; Cohen, 1969). A regression equation is developed in order to predict a criterion. A critical element is deleted or collapsed and the resulting equation is designated as an alternate or restricted model. The full model is compared with the alternate model, and a F-value is computed for the loss of predictive efficiency traceable to the altered vector. The basic model may be illustrated as:

$$Y_{1-32} = a_o u + a_1 x_1 + a_2 x_2 \;\ldots\; a_n x_n + e$$

where Y_{1-32} = criteria of continuous or discrete data

u = a unit vector which when multiplied by the weight a_o yields the regression constant

$a_1 x_2 \ldots a_n$ = partial regression weights arrive at by multiple linear regression techniques and calculated to minimize the error sums of squares of prediction (Σe^2)

$x_1 x_2 \ldots x_n$ = variables in continuous or discrete form

e = error in predicting a criterion

The basic regression models are presented in Table 18, 22, 26, and 30. The variations seen represent variations of two kinds. First, is the use of two vectors representing experimental status Factor I, *prenatal complications,* and Factor III, *neonatal complications,* at cohort ages 36 months and 48 months. These two experimental factors were replaced at 42 months and 54 months by the experimental risk categories Factor II, *delivery complications,* Factor III, *neonatal risk,* and Factor IV, *multiple complications*. The second form of change was the introduction of vectors representing testing delay at 48 months and 54 months. It is important to note that the hypothetical effects are discussed within regression models which contain a maximum of eight predictive vectors. The critical vectors are the four perinatal risk vectors, the control status vector, and the social class vector. In the case of the experimental vectors all subjects are classified as members of one status group and non-members of all other status groups. Comparisons consist of deleting critical vectors, e.g. social class or test delay in order to test effects, and of collapsing membership vectors, in the case of risk status. All models are linear, since methodological studies by the investigator have shown that nonlinear regression models add little to prediction of early developmental criteria. Attention is also called to the fact that the statistical significance of regression models is provided against a theoretical value of zero in all cases. The regression models employed as basic or *full* models are listed in all Tables as model one. In virtually all instances statistical significance from zero is clearly established, despite the limitations imposed on the information in the regression models by the use of mutually exclusive membership status categories.

Part Four

PART FOUR

RESULTS

[Introduction. The data presented and discussed in this report are numerous and extensive, emerging from several domains of child growth at several stages of development. The principle of organization which underlies the material to be presented is developmental; materials from the several stages of child attainment will be presented consecutively. The same arrangement applies to the Inferential Analysis and Discussion sections of this report.]

DESCRIPTIVE FINDINGS

SAMPLING. A practical and theoretical question in longitudinal studies is the extent to which sampling error creeps in with the passage of time (Baltes, 1971). In the present investigation data were taken on four occasions at intervals of six months. The total span of development reported began at age 36 months and lasted to age fifty four months. The child study periods are, however, labelled in the larger context of data taking which began at birth and continues at criterion age 60 months at the time of writing. The data-taking periods of the investigation reported here are labelled (T_6) .... (T_9), and cover the period of contractual funding. At each of the criterion ages the possibility of distortions arises due to subjects dropping out, being untraceable at any or all ages, or being untestable due to family and health crises.

The materials in Tables 5, 6, and 7 are presented in order to discuss the validity of the filial cohorts $T_{(2)}$ . . . $T_{(n)}$. The materials in the tables describe the pattern of weight, height, and McGuire and White social scores from birth to the end of the period covered by this report, ages

TABLE 5

NEONATAL COHORT: WEIGHT AT BIRTH (T_1), SIX MONTHS (T_2), TWELVE MONTHS (T_3), TWENTY FOUR MONTHS (T_4)
THIRTY MONTHS (T_5), THIRTY SIX MONTHS (T_6), FORTY TWO MONTHS (T_7), FORTY EIGHT MONTHS (T_8), AND FIFTY FOUR MONTHS (T_9)

SUBJECTS		T_1 Birth	T_2 6th Month	T_3 12th Month	T_4 24th Month	T_5 30th Month	T_6 36th Month	T_7 42nd Month	T_8 48th Month	T_9 54th Month
CONTROLS	Range	5.50-9.80	9.62-26.06	15.87-30.80	21.00-37.00	23.00-27.00	22.50-45.00	25.00-64.50	24.00-51.00	26.00-72.00
	Mean	7.25	17.18	22.50	27.87	29.37	33.89	33.89	36.11	38.88
	Sigma	.98	2.34	2.60	3.27	2.62	4.73	4.73	4.35	5.80
	N	497	337	281	351	98	*179	*179	*176	*189
EXPERIMENTALS										
(Factor I)	Range	5.50-10.56	11.77-22.39	17.00-29.06	21.00-36.00	23.00-33.00	24.00-41.00		25.00-50.00	
	Mean	7.09	17.09	22.12	27.87	29.06	34.50		35.50	
	Sigma	.98	2.77	2.81	3.51	2.50	4.42		4.25	
	N	128	92	58	78	24	*91		*88	
(Factor II)	Range	2.37-8.67	11.83-22.37	16.62-30.00	22.00-32.00	23.00-29.00		25.00-39.00		5.60-8.60
	Mean	7.03	17.06	22.75	25.80	25.37		31.88		7.11
	Sigma	.83	2.87	3.62	3.45	2.20		3.76		.73
	N	18	11	11	10	4		*13		*13
(Factor III)	Range	2.37-9.75	9.68-23.12	15.35-30.01	19.00-43.00	20.00-43.00	24.00-51.00	22.00-32.00	23.00-50.00	2.50-9.70
	Mean	6.75	16.75	22.18	27.69	29.25	32.79	28.46	35.48	6.68
	Sigma	1.62	2.37	2.80	3.81	3.50	4.82	2.72	4.67	1.50
	N	258	186	171	193	59	*101	*87	*95	*105
(Factor IV)	Range	1.99-11.50	8.98-22.17	16.50-27.75	21.12-40.00	24.00-35.00		26.00-60.00		1.90-11.50
	Mean	6.37	16.56	21.12	28.00	27.99		33.61		6.34
	Sigma	1.84	3.50	2.31	4.31	2.75		5.40		1.82
	N	99	62	54	69	26		*68		*76

* = Half-year study group

TABLE 6

NEONATAL COHORT: LENGTH AT BIRTH (T_1), SIX MONTHS (T_2), TWELVE MONTHS (T_3), TWENTY FOUR MONTHS (T_4), THIRTY MONTHS (T_5), THIRTY SIX MONTHS (T_6), FORTY TWO MONTHS (T_7), FORTY EIGHT MONTHS (T_8), AND FIFTY FOUR MONTHS (T_9)

SUBJECTS		T_1 Birth	T_2 6th Month	T_3 12th Month	T_4 24th Month	T_5 30th Month	T_6 36th Month	T_7 42nd Month	T_8 48th Month	T_9 54th Month
CONTROLS	Range	16-23	19-31	23-36	25-40	24-40	30-50	33.00-44.50	34.00-47.00	16.00-22.00
	Mean	19.82	26.59	29.74	33.89	35.76	36.23	39.29	40-93	19.98
	Sig Sigma	1.32	1.56	1.61	2.30	1.99	3.29	1.76	1.77	1.11
	N	462	326	282	353	98	*188	*179	*176	*205
EXPERIMENTALS										
(Factor I)	Range	16-20	22-31	19-33	25-37	33-38	30-41		32.00-44.00	
	Mean	19.49	26.32	29.37	32.71	35.90	34.97		40.42	
	Sigma	1.10	1.50	2.04	2.94	1.34	3.00		1.88	
	N	118	91	54	78	21	*91		*88	
(Factor II)	Range	17-21	23-29	25-31	27-35	34-35		37.00-42.00		18.00-21.00
	Mean	19.28	26.30	28.80	32.60	34-57		38.90		19.25
	Sigma	1.21	1.79	1.77	2.15	.25		1.42		.96
	N	11	10	10	10	44		*13		*13
(Factor III)	Range	14-23	23-31	19-34	23-39	24-39	30-50	33.00-32.00	31.00-44.50	14.00-23.00
	Mean	19.39	26.39	29.60	33.51	35.76	36.21	35.21	40.31	19.26
	Sigma	1.57	1.46	1.87	2.54	2.04	3.05	1.19	1.91	1.60
	N	244	181	168	195	59	*101	*87	*95	*105
(Factor IV)	Range	14-23	22-30	26-34	26-39	29-39		33.20-46.50		14.00-23.00
	Mean	19.26	26.20	29.49	33.83	35.55		39.16		19.18
	Sigma	1.61	1.83	1.65	2.39	2.03		1.91		1.67
	N	83	64	53	68	26		*69		*76

* = Half-year study group

TABLE 7

NEONATAL COHORT: PERINATAL SOCIAL CLASS SCORES AT BIRTH (T_1), SIX MONTHS (T_2), TWELVE MONTHS (T_3), TWENTY FOUR MONTHS (T_4), THIRTY MONTHS (T_5), THIRTY SIX MONTHS (T_6), FORTY TWO MONTHS (T_7), FORTY EIGHT MONTHS (T_8), AND FIFTY FOUR MONTHS (T_9)

SUBJECTS		T_1 Birth	T_2 6th Month	T_3 12th Month	T_4 24th Month	T_5 30th Month	T_6 36th Month	T_7 42nd Month	T_8 48th Month	T_9 54th Month
CONTROLS	Range	14-84	16-84	20-84	14-84	14-84	16-84	14-84	16-84	16-84
	Mean	55.53	55.97	51.73	54.05	52.43	53.99	54.99	55.54	54.98
	Sigma	14.97	15.19	15.64	14.98	15.86	15.62	14.32	15.31	13.93
	N	494	334	281	358	150	*188	*179	*176	*205
EXPERIMENTALS										
(Factor I)	Range	32-84	24-84	24-81	24-84	38-81	24-84		24-84	
	Mean	65.91	66.24	62.15	64.60	63.45	63.97		65.65	
	Sigma	11.25	11.41	12.63	11.74	10.89	11.75		11.23	
	N	129	93	59	81	24	* 91		*88	
(Factor II)	Range	24-78	24-78	24-70	24-78	65-70		24-78		24-78
	Mean	61.39	58.82	57.63	62.80	67.50		60.46		60.46
	Sigma	11.21	13.33	12.21	14.21	1.80		12.56		12.56
	N	18	11	11	10	4		*13		*13
(Factor III)	Range	16-84	16-81	16-78	16-84	17-81	17-84	20-81	16-84	20-81
	Mean	51.56	49.52	45.87	49.51	49.01	51.85	52.42	51.17	51.00
	Sigma	16.70	16.61	15.71	16.85	16.47	17.30	15.27	17.63	14.99
	N	258	185	170	196	81	*101	*87	*95	*105
(Factor IV)	Range	24-84	24-84	24-80	24-80	24-80		24-84		24-84
	Mean	57.89	54.74	53.48	55.82	53.32		57.46		55.40
	Sigma	15.11	15.28	14.94	15.00	16.67		15.76		15.52
	N	100	64	54	69	34		*69		*76

* = Half-year study group

thirty six to fifty four months. They may be used as a basis for checking the possibility of subcohorts at criterion ages (T_n) being very different from the original birth cohort. Of the two physical measures grouped by predictor groups weight is the more significant for development. The third element, social class score is also an important predictor; shifts in SES composition of the study subjects - *probands* - over a period of four and a half years and nine* study periods would be a serious source of sampling error, though not an unexpected one.

Weight. Weights of the nine study groups (T_1. . . T_9) are shown in Table . It can be seen that all groups of subjects, controls and four experimental groups, started life with excellent mean birth weights. The means given for Factor III and IV groups are lower due to the presence of infants with and without additional problems who weighed less than five and a half pounds. The range for Factor III and IV groups are wide, and at the bottom end extend down to include infants with birth weights of approximately two pounds; this is a clearly high risk group, as recent British research (Report ..., 1971) has once more indicated. Comparison of subjects at 36, 42, 48, and 54 months indicates that for each study group the pattern of original weight at birth and weight increments *ad hoc* has been mutually consistent, and consistent with the $T_{(1)}$ birth cohort in these characteristics. In examing the tables touching on weight increment for the control cases at birth and in the four study periods of this report it should be kept in mind that some experimental groups are unreported as a consequence of the 36 month (T_6) decision to split the study population for purposes of tracing. The pattern of height increments shows essentially the same pattern as weight, leading to the conclusion

*really ten study periods, but the eighteen month data were not considered satisfactory and were not put in the data bank. Numbering filial cohorts excludes 18 month data.

that the physical characteristics of the filial cohorts (T_6 ... T_9) are essentially comparable to each other, and to the original birth cohort (T_1) from which they are drawn.

It is worth pointing out that the preceeding statement is not entirely self-evident. At first consideration it is apparent that any filial cohort (T_n) far removed in time from birth (T_1) probably consists of those probands who were reported at an earlier study period. In fact, this is only partly true; the pattern in sampling from the birth cohort (T_1) has included previously reported cases but it has also included cases not reported at the prior dates. In some cases this represents a temporary lapse; however, the act of splitting the study group was highly beneficial, and led to tracing some probands not examined for several study periods. As an example, one child traced and studied at fifty four months (T_9) had not been seen since birth. He was unavailable for study for seven study periods. This extreme case is given to illustrate the fact that changes due to increases as well as decreases in the number of accessible probands need to be considered in longitudinal study over extended periods of time.

McGuire and White (1955) social class scores at birth given in Table 7 show differential values for the independent variable groups. The control mean of 55.53 is illustrated by a white family living in a five room apartment. There are three children, and the father has a tenth grade education and works as a carpenter. The controls are, typically scattered around a lower middle class mean level. The birth Factor III and IV group means were very similar to the controls. The Factor II group has a lower social class level, represented by a <u>higher</u> McGuire and White social class score. The Factor I group birth SES level is still lower, and is about two thirds of a standard deviation below the controls. This is not surprising since prenatal complications are commonly associated with lower social class membership (Baird & Illsley, 1953; Butler & Bonham, 1963; Fitzherbert, 1963; Drillien, 1968; Hood et al, 1970). Fluctuations in SES level for the filial cohorts T_6 - T_9 given in Table 7 may be compared with the birth cohort (T_1). It can be seen that the mean SES scores, ranges, and standard deviations of all five predictor groups are very similar. The degree of fluctuation which is at all significant is that encountered in the small Factor II group. The range of scores presented in Table 7 for the filial cohorts is not large. The maximum range is encountered at T_3 and T_5 study periods, with the T_5 group of only four cases being the more deviant. The finding is interesting but not pressing because the T_5 group is not the subject of analysis in this report.

In general, it can be said that the children studied at several intervals between birth (T_1) and age fifty four months (T_9) reveal consistency in physical and social traits representing predictor variables. An initial discrepancy between factor groups at birth in social class level may be observed, but it is merely what can be expected in view of the documented association between perinatal risk and social circumstances.

THIRTY SIX MONTHS. The T_6 cohort is that portion of the 1966 birth cohort examined three years after birth. It is delimited by the selection of particular subgroups described previously and by the number of the target population actually traced and examined, which was three hundred and eighty.

Birth weight. The 1966 cohort included infants of low, average, and high birth weight. At birth control infants (T_1) had a mean weight of 7.32 lb. The T_6 mean birth weight was 7.28 lb., a difference of .04 lb. T_1 Factor I infants and T_6 Factor I infants had similar birthweights, 7.08 lb., and 7.24 lb. respectively. T_1 and T_6 Factor III infants also had similar birthweights,

TABLE 8

INFERENTIAL STUDY GROUP (T_6): PERINATAL SOCIAL CLASS SCORES AND WEIGHT AND LENGTH AT BIRTH, SIX, TWELVE, TWENTY FOUR, AND THIRTY MONTHS

		Perinatal Social Class Class	Birth Weight (lb.)	Birth Length (in.)	6th Month Weight (lb.)	6th Month Length (in.)	21th Month Weight (lb.)	21th Month Length (in.)	24th Month Weight (lb.)	24th Month Length (in.)	30th Month Weight (lb.)	30th Month Length (in.)
CONTROLS	Range	16-84	5.50-12.00	16-23	9.62-28.68	23-31	17.37-30.12	25-36	22-37	26-38	23.50 41.00	24-39
	Mean	53.99	7.28	19.88	17.14	26.49	22.51	29.77	28.12	33.87	29.79	35.43
	Sigma	15.62	1.04	1.33	2.44	1.55	2.46	1.47	3.36	2.27	2.83	2.36
	N	188	188	188	188	188	188	188	188	188	188	188
EXPERIMENTALS												
(Factor I)	Range	24-84	4.93-10.56	16-22	12.06-22.37	22-29	17.43-27.12	24-33	21-36	25-37	23.80-33.50	33-38
	Mean	63.97	7.24	19.52	16.86	26.36	22.16	29.35	27.80	32.78	29.12	35.87
	Sigma	11.75	1.02	1.11	2.16	1.34	2.61	1.62	3.60	2.88	2.80	1.37
	N	91	91	91	91	91	91	91	91	91	91	91
(Factor III)	Range	17-84	2.12-10.00	16-23	9.68-23.50	22-31	15.25-30.12	24-33	20-43	26-39	20-43	33-39
	Mean	51.85	6.93	19.63	16.92	26.25	22.18	29.48	28.10	33.52	29.71	36.25
	Sigma	17.30	1.70	1.47	2.52	1.80	3.14	1.85	4.02	2.73	4.23	1.33
	N	101	101	101	101	101	101	101	101	101	101	101

TABLE 9

INFERENTIAL STUDY GROUP (T_6): CRITERION VALUES AT THIRTY SIX MONTHS

SUBJECTS		Physical Domain		Motoric Domain			Cognitive Domain	
		(1) Weight (lb.)	(2) Height (in.)	(3) PAR Ambulation	(4) PAR Manipulation	(5) PAR Physical	(6) Communication	(7) PPVT
CONTROLS	Range	22.50-45.00	30-50	4-14	3.82-	10.0-22.5	3.5-12	0-52
	Mean	33.86	36.23	9.65	9.10	17.22	7.21	26.04
	Sigma	4.15	3.29	2.02	7.99	2.33	1.74	9.72
	N	188	188	188	188	188	188	188
EXPERIMENTALS								
(Factor I)	Range	24.00-41.00	30-41	5.50-13.5	3-15	10-23	4-10	4-49
	Mean	34.50	34.97	10.57	7.97	18.21	6.40	22.81
	Sigma	4.42	3.00	2.02	2.53	2.41	1.71	6.88
	N	91	91	91	91	91	91	91
(Factor III)	Range	24.00-51.00	30-50	6-13.5	4.15	i2-21.5	3.5-10	6-54
	Mean	32.79	36.21	9.94	8.19	17.61	7.88	27.09
	Sigma	4.82	3.05	1.68	1.95	2.00	1.78	10.34
	N	101	101	101	101	101	101	101

6.75 lb. and 6.93 lb. The data are summarized in Tables 5, 8, and 9.

Birth length. The average control baby in the 1966 cohort was 19.82 in. long. The T_6 controls averaged 19.88 in. T_6 Factor I's were 19.52 in. long, which is very close to the T_1 cohort's average length of 19.49 in. The Factor III cases in each cohort were similar also; the T_1 mean length for controls was 19.39 in., and that for T_6 Factor III infants was 19.63 in. Table 6 summarizes the data on length for the cohorts T_1 - T_6 while Table 8 summarizes the T_6 data.

Social class scores. The information in Table 8 includes McGuire and White (1955) social class scores. The theoretical range of values is from fourteen, representing the highest social class level, to eighty four, representing the lowest social class levels. Scores fall as social level rises. For the T_1 - T_6 groups it can be seen in Table 7 that there have been differences in social class level. Control cases have been highest in SES level from the beginning (T_1), and have been essentially consistent to age three (T_6). The Factor I group of infants, those with an associated history of gestational disorders, were lowest in social class level at birth (T_1) and remained close to that point in all study groups to age three years (T_6). Their mean level, was approximately two thirds of a standard deviation below the level of the controls, emerged from the connection between prenatal health in pregnant women and lower social class membership. The Factor III group, consisting of a heterogeneous group of neonatal problems, was closer to the controls in SES level at birth (T_1) and remained so thirty six months later (T_6). The T_1 and T_6 means 51.56 and 51.85, are virtually identical numerically, and are identical, functionally speaking. In summary, the thirty six month cohort, T_6, is identical to the larger birth cohort, T_1. Variation within the filial cohorts T_1 - T_6 was minor, and they maintained statistical consistency within major parameters of development.

Criteria. The significant characteristics of cohort T_6 are the measures of attainment at age three years given in Table 9. At thirty six months the average height for three hundred and eighty babies was thirty six inches. Their average weight was thirty three and a half pounds. More interesting are the measures of functional attainment. The grand mean score on the Peabody Picture Vocabulary Test (PPVT) was 25.60. At age thirty six months this yielded a mental age of thirty four months and an IQ of 95.

Factors III and Control mean scores and standard deviations on the PPVT were quite similar; however, the Factor I mean PPVT value were reduced by about one third of a (Control) standard deviation. The control mean was 26.04, and the mean of the Factor I cases was 22.81, which yields an IQ of 90. However, the Factor I group also had the lowest SES level (i.e. *highest* McGuire & White score); Table 35 shoes that there is a highly significant relationship between SES and PPVT scores, and that may explain the lower IQ scores. Mean values on the PAR *Physical* domain, which is the summed score for *Manipulation* and *Ambulation* subtests, were quite similar for control and both Factor groups of three year olds. Mean *Ambulation* and *Manipulation* scores were similar for all three groups. A third PAR subtest, *Communication*, produced similar mean scores for all three groups.

FORTY TWO MONTHS. At forty two months the total number of cases examined was three hundred and fifty nine. Study of the T_7 cohort shows that the group of three hundred and fifty nine children was representative of the larger birth cohort.

Birth Weight. The 1966 cohort included infants of high, average, and low birth weight. In birth cohort control infants (T_1) had a mean weight of 7.25 lb. and the T_7 control group had a mean birth weight of 7.30 lb. The differ-

TABLE 10

INFERENTIAL STUDY GROUP (T_7): PERINATAL SOCIAL CLASS SCORES, WEIGHT AND LENGTH

AT BIRTH, SIX AND TWELVE MONTHS

SUBJECTS		Perinatal Social Class Score	Birth Weight (lb.)	Birth Length (in.)	6th Month Weight (lb.)	6th Month Length (in.)	12th Month Weight (lb.)	12th Month Length (in.)
CONTROLS	Range	14-84	5.50-9.18	16.00-22.00	13.00-26.01	19.00-31.00	16.90-30.00	23.00-34.00
	Mean	54.99	7.30	19.97	17.47	36.57	22.69	27.99
	Sigma	14.32	.86	1.12	2.28	1.51	2.75	1.67
	N	79	79	79	79	79	79	79
EXPERIMENTALS								
(Factor II)	Range	24-78	5.62-8.69	18.00-21.00	11.37-19.50	23.00-29.00	16.62-30.00	25.00-31.00
	Mean	50.46	7.16	19.25	16.01	25.87	22.68	28.55
	Sigma	12.56	.74	.96	2.51	1.76	2.70	1.70
	N	13	13	13	13	13	13	13
(Factor III)	Range	20-81	2.50-9.75	14.00-23.00	11.50-22.50	23.00-19.00	17.56-30.00	26.00-34.00
	Mean	52.42	6.65	19.18	16.53	26.32	22.09	29.74
	Sigma	15.27	1.57	1.72	2.31	1.16	2.60	1.64
	N	87	87	87	87	87	87	87
(Factor IV)	Range	24-84	1.99-11.50	14.00-23.00	8.99-22.10	22.00-30.00	17.50-27.75	26.00-34.00
	Mean	57.46	6.54	19.18	6.37	26.08	21.12	29.41
	Sigma	15.76	1.76	1.67	2.55	1.68	2.31	1.59
	N	69	69	69	69	69	69	69

TABLE 10a

INFERENTIAL STUDY GROUP (T_7): WEIGHT AND LENGTH AT

TWENTY FOUR, THIRTY, AND FORTY TWO MONTHS

SUBJECTS		24th Month Weight (lb.)	24th Month Length (in.)	30th Month Weight (lb.)	30th Month Length (in.)	42nd Month Weight (lb.)	42nd Month Length (in.)
CONTROLS	Range	21.00-36.00	26.00-40.00	24.00-37.00	26.80-40.00	25.00-64.50	35.00-44.50
	Mean	27.99	34.16	29.53	35.86	33.89	39.29
	Sigma	3.42	2.05	8.03	2.05	4.73	1.76
	N	79	79	79	79	79	79
EXPERIMENTALS (Factor II)	Range	22.00-32.00	27.00-35.00	23.50-29.00	34.20-35.00	25.00-39.00	37.00-42.00
	Mean	25.77	32.33	25.37	34.50	31.88	38.90
	Sigma	3.64	2.10	2.16	.18	3.76	1.42
	N	13	13	13	13	13	13
(Factor III)	Range	19.00-37.00	23.00-37.00	22.00-32.00	33.00-37.20	22.00-32.00	33.00-37.20
	Mean	27.39	33.40	28.46	35.21	28.46	35.21
	Sigma	3.56	2.57	2.72	1.19	2.72	1.19
	N	87	87	87	87	87	87
(Factor IV)	Range	21.00-40.00	26.00-40.00	26.00-39.00	24.00-35.50	29.50-39.20	26.60-46.50
	Mean	27.88	33.73	28.00	35.17	33.61	39.16
	Sigma	4.49	2.54	3.17	2.03	5.40	1.91
	N	69	69	69	69	69	69

TABLE 11

INFERENTIAL STUDY GROUP (T_7): CRITERION VALUES AT FORTY TWO MONTHS

SUBJECTS		Physical Domain		Motoric Domain			Cognitive Domain	
		(8) Weight (lb.)	(9) Height (in.)	(10) PAR Ambulation	(11) PAR Manipulation	(12) PAR Physical	(13) PAR Communication	(14) PPVT
CONTROLS	Range	25.00-64.50	33.00-44.50	1-14	5.50-12.00	2-26	3-11	4-96
	Mean	33.89	39.29	11.10	8.43	19.48	7.84	31.33
	Sigma	4.73	1.76	1.93	.96	2.70	2.06	12.38
	N	179						
EXPERIMENTALS								
(Factor II)	Range	25-39	37-42	7.50-14.00	6.50-10.50	16.00-24.50	1.50-11.00	11-41
	Mean	31.88	38.90	11.30	8.57	19.88	7.03	24.61
	Sigma	3.76	1.42	2.26	1.19	3.02	2.84	9.66
	N	13						
(Factor III)	Range	25-45	9-42	7-14	7.00-11.50	15-78	2.50-11.50	5-60
	Mean	32.40	38.51	11.05	8.58	20.32	8.29	31.43
	Sigma	3.63	3.51	1.41	1.03	6.50	2.11	13.44
	N	87						
(Factor IV)	Range	26-60	33.20-46.50	7-14	6.00-11.50	14.00-24.50	3.50-11.00	10-54
	Mean	33.61	39.16	11.27	8.26	19.54	7.39	26.86
	Sigma	5.40	1.91	1.56	.96	2.20	2.11	11.62
	N	69						

ence of .05 lb. is trivial. T_1 and T_7 Factor II mean birth weights shown in Tables 5 and 10 are 7.08 lb., and 7.16 lb., which is also a very slight difference. T_1 and T_7 Factor III mean birth weights, 6.75 lb., and 6.65 lb. are very similar. Finally, T_1 and T_7 Factor IV mean birth weights are also very close, 6.37 lb., and 6.54 lb. Weight is, of course, a significant predictor of development, and the validity of the T_7 filial cohort in this regard is reassuring.

Birth length. Equally valid are the T_7 cohort lengths for all groups of probands. Tables 6, 10, and 10a show the essential comparability of the T_1 lengths at birth and the birth lengths of the present cohort T_7, and the dependent cohorts T_2 - T_6.

Social Class. McGuire and White (1955) social class scores developed at birth are given in Table 7 for the birth cohort T_1 and the dependent cohorts. The T_7 controls were very similar to the T_1 group in means and standard deviations. The variation of SES level over the first seven study periods was not great. The Factor II (delivery complications) group has demonstrated a slight drop in McGuire & White SES scores, which means a slight *rise* in SES level. The difference is about five points, or a third of a standard deviation. The Factor III (neonatal complications) group has been very stable in SES level as table 8 shows. The highest intra-cohort variation at three and a half years from the control cases is the small Factor II group which is lower by approximately one third of a standard deviation.

Criteria. The average height of all subjects three and a half years after birth was approximately thirty eight inches. The average weight was around thirty two pounds (see Table 11). The mean PPVT score of controls yielded a mental age of thirty nine months, and an IQ of 94. The Factor II group which was quite small, had a lower mean, 24.61, which may be expressed as an M.A. of thirty five months, and an IQ of 94. The Factor III group had a mean mental age identical with that of the controls, thirty three months. The Factor IV probands resembled the Factor II's more than the controls and Factor III's. The mean PPVT score for Factor IV cases was 26.86 (M.A. = thirty five months, IQ = 87). At this age the PPVT mean and standard deviation are 29.28, and 9.66.

Four Preschool Attainment Record subtests were administered. The subtests administered at forty two months were the *Ambulation* and *Manipulation* tests, which when summed give a Physical score. A fourth criterion score was the PAR *Communication* test. Table 17 shows that the scores of controls and three high risk groups were essentially comparable at forty two months. The sole exception is the slight elevation in mean reported for Factor III.

FORTY EIGHT MONTHS. The children tested at forty eight months, the T_8 cohort, were the identifiable, cooperating, portion of the study group traced and tested at thirty six months. At age three and one half the target population of children located and visited in their homes numbered four hundred and fifteen.

As with other filial cohorts it was advisable to see if the passage of time and attrition of the number of cases had altered the T_8 cohort Examination of Tables 5, 6, and 7 indicates the nature of height, weight, and social class in the T_1 cohort and Tables 12, 13, and 14 show the values for the T_8 group.

Social Class. Examination of Table 12 shows the McGuire and White (1955) perinatal social class score of the T_8 cohort, arranged as control, Factor I and Factor III subjects. The mean ranges and standard deviations may be compared with those for the 1966-67 T_1 birth cohort by consulting Table 7. The

TABLE 12

INFERENTIAL STUDY GROUP (T_8): PERINATAL SOCIAL CLASS SCORES AND WEIGHT AT BIRTH, SIX, TWELVE, TWENTY FOUR, THIRTY, THIRTY SIX AND FORTY EIGHT MONTHS

SUBJECTS		Perinatal Social Class Score	Weight (lb.)	Weight (lb.)	Weight (lb.)	24th Month Weight (lb.)	30th Month Weight (lb.)	36th Month Weight (lb.)	48th Month Weight (lb.)
CONTROLS	Range	16-84	5.50-12.00	9.60-28.60	17.60-30.10	22-37	23.50-36.00	24-46	24-51
	Mean	55.54	7.25	17.21	22.54	28.08	29.50	32.02	36.11
	Sigma	15.31	1.01	2.45	2.41	3.30	2.32	3.73	4.35
	N	176							
EXPERIMENTALS									
(Factor I)	Range	24-84	4.90-10.00	11.80-22.30	17.40-26.50	25-37	23.80-33.00	24-41	25-50
	Mean	65.65	7.13	16.62	21.91	32.73	28.96	31.71	35.50
	Sigma	11.23	.93	2.21	2.49	2.78	2.82	3.84	4.25
	N	88							
(Factor III)	Range	16-84	2.10-10.00	9.60-23.50	15.20-29.00	20-43	20-43	20-57	23-50
	Mean	51.17	6.66	16.86	22.12	28.23	29.78	31.50	35.48
	Sigma	17.63	1.72	2.52	3.07	4.21	4.09	5.28	4.67
	N	95							

TABLE 13

INFERENTIAL STUDY GROUP (T_8): LENGTH AT BIRTH, SIX, TWELVE, TWENTY FOUR, THIRTY, THIRTY SIX, AND FORTY EIGHT MONTHS

SUBJECTS		Birth Length (in.)	6th Month Length (in.)	12th Month Length (in.)	24th Month Length (in.)	30th Month Length (in.)	36th Month Length (in.)	48th Month Length (in.)
	Range	16-23	23-31	25-36	26-38	24-39	35-50	34-47
CONTROLS	Mean	19.87	26.54	29.83	33.73	35.41	38.18	40.93
	Sigma	1.32	1.47	1.48	2.41	2.40	1.63	1.77
	N	176						
EXPERIMENTALS								
(Factor)	Range	16-22	22-29	24-33	25-37	33-38	31-41	32-44
	Mean	19.49	26.22	29.33	32.73	35.72	37.41	40.42
	Sigma	1.06	1.37	1.62	2.78	1.35	1.78	1.88
	N	88						
(Factor)	Range	16-23	22-31	24-33	26-39	33-39	31.00-50.50	31.00-44.50
	Mean	19.55	26.20	29.45	33.73	36.26	37.65	40.31
	Sigma	1.51	1.73	1.85	2.53	2.80	2.26	1.91
	N	95						

TABLE 14

INFERENTIAL STUDY GROUP (T_8): TEST DELAY AND CRITERION VALUES AT FORTY EIGHT MONTHS (T_8)

SUBJECTS		Test Delay (wks.)	Physical Domain (15) Weight (lbs.)	Physical Domain (16) Height (in.)	Motoric Domain (17) Copy Forms	Cognitive Domain (18) PI (1)	Cognitive Domain (19) PI (4)	Cognitive Domain (20) PI (3)	Cognitive Domain (21) PI (2)	Cognitive Domain (22) PI Total	Cognitive Domain (23) Boehm
CONTROLS	Range	-3-+9	24-51	34.00-47.30	2-61	0-18	0-12	0-11	0-15	0-58	0-25
	Mean	.27	36.11	40.93	28.52	10.88	5.10	5.34	10.74	31.93	13.75
	Sigma	1.45	4.35	1.77	12.71	3.59	3.02	2.77	4.57	12.07	4.70
	N	176			141	176					
EXPERIMENTS											
(Factor I)	Range	-1-+12	25-50	32.00-44.00	2-59	0-17	0-11	0-10	0-19	0-53	0-23
	Mean	.69	35.50	40.42	24.46	11.04	4.31	4.70	9.47	29.54	12.77
	Sigma	1.94	4.25	1.88	14.82	3.84	3.09	2.67	4.43	11.78	4.92
	N	88			63	88					
(Factor III)	Range	-3-+6	23.40	31.00-44.50	2-60	0-17	0-11	0-30	0-19	0-52	0-23
	Mean	.16	35.48	40.31	30.49	11.22	5.49	5.94	11.36	33.81	14.27
	Sigma	1.28	4.67	1.91	13.94	3.62	2.80	3.91	4.30	11.98	5.08
	N	95			79	95					

differences revealed are virtually non-existent. In both the T_1 (birth) cohort and the T_8 cohort the McGuire and White social class scores of the Factor I (gestation disorders) cases are nearly a standard deviation higher than those of the control and Factor III (neonatal disorders) cases, indicating a lower social class origin.

Birth weight. Birth weights for the T_1 and T_8 groups, shown in Tables 5 and 12 show there is a basic identity in this regard.

Birth length. Birth lengths are also highly comparable, with identical values for Factor I cases in the T_1 and T_8 cohorts. The significance of these comparisons of social class score, weight, and height at birth is that it shows the representative nature of the T_8 cohort studied at forty eight months. The T_8 cohort is not altered in its original character from that of the larger T_1 birth cohort, from which it has been drawn. This finding of essential similarity in birth characteristics between filial cohorts and the original cohort T_1 has been observed consistently.

Test delay. At forty eight months the problem of tracing highly mobile families had become a high order priority. The possibility of significant delays caused by testing well after the target period around the birthday, about two weeks, was recognized. Table 14 reports the test delay for the three groups of subjects examined at forty eight months. The largest delay occurred in the lowest social class group, the Factor I group, who experienced a mean testing delay after the anniversary of birth ($\overline{M}$ = .69 weeks). The correlation for four hundred and fifty nine subjects between testing delay and social class is low, but it is also statistically significant ($r - .17$, $p < .01$) based on the degrees of freedom available.

Criteria. At age four the average control child weighed thirty six pounds (36.11 lb.), and most were between thirty two and forty pounds (sigma = 4.35 lb.).

The Factor I (gestational risk) and Factor III (neonatal risk) subjects were about a half a pound lighter with means of 35.50 lb., and 35.48 lb., respectively. The standard deviation values for experimental subjects were similar to those obtained for the controls (4.25 lb., and 4.67 lb.). The height of the subjects in all three groups were between forty and forty one inches, on the average, as Table 14 shows. Standard deviations were also similar, being 1.71 inches, 1.88 inches, and 1.91 inches.

The cognitive domain at four years of age was represented by the Boehm Test of Basic Concepts (1969), and the Preschool Inventory (Caldwell, 1970). The group values for the criterion measures are also given in Table 14. Of interest is the generally slightly high values obtained by the Factor III subjects, in comparison with the controls. The lowest set of scores was obtained by the Factor I subjects. The social class scores for the three groups in Table 12 follow the same sequence, however. The order of social class levels begins with Factor III at the top ($\overline{M}$ = 51.17), and is followed by controls ($\overline{M}$ = 55.64), with the lowest level attained by the Factor I group, which had the highest McGuire and White social score ($\overline{M}$ = 65.65).

Looking at the elements of the cognitive criterion series the Boehm test control group results are generally close to those of two experimental groups, and the greater difference is between the two experimental groups. The range of means, 12.77 to 14.27, cannot be interpreted normatively since publishers' norms apply only down to kindergarten age children. Also, only the first twenty five items of the Boehm Test of Basic Concepts were administered. The reasons were the ascending degree of difficulty and the fatigue of the children. No ceiling effects were encountered due to using the first twenty five Boehm items.

The results of administering the Preschool Inventory to controls and two biological risk groups are also recorded in Table 14. The total scores are highest for the Factor III risk children ($\overline{M}$ = 33.81, σ = 11.98), followed by the controls ($\overline{M}$ = 31.93, σ = 12.07), and the Factor I group of experimentals ($\overline{M}$ = 29.54, σ = 11.78). This sequence of highest scores obtained by Factor III cases, and lowest scores obtained by Factor I subjects obtains for four of the five Preschool Inventory scores. The exception is for the first subtest, Personal-Social Responsiveness, in which the Factor III group is highest ($\overline{M}$ = 11.27, σ = 3.62), the Factor II group is slightly lower ($\overline{M}$ = 10.88, σ = 3.59). The range for all three means is slight, and the ranges are virtually identical. The grand mean total score for all groups, 31.84, may be interpreted as at the mean ($\overline{M}$ = 30) given in the manual (Caldwell, 1970) for a national reference population at age four years to four years and five months.

The motoric domain of child growth was represented by the Ernhart Copy Forms test (Graham et al., 1960), which consists of a series of eighteen line drawings which children reproduce. Performance is scored in several categories including organization, intersection of elements and proportion. The means given in Table 14 for controls is 28.52, which is similar to the Factor III group mean of 30.49. The Factor I mean is a good deal lower, at 24.46. In all three groups the standard deviation and range were similar.

<u>FIFTY FOUR MONTHS</u>. Children studied at this criterion age were examined four and a half years after birth. The T_9 study group was composed of subgroups described at forty two months. The number of the target population actually traced and examined was four hundred and four and Table 17 shows the number of cases in each experimental factor subgroup.

Study of the T_9 cohort was valid because the group of four hundred and four children is representative of the original birth cohort. Tables 5, 6, and 7 provide an opportunity to compare the characteristics over time of the 1966

TABLE 15

INFERENTIAL STUDY GROUP (T_9): PERINATAL SOCIAL CLASS SCORES AND WEIGHT IN POUNDS AT BIRTH, SIX, TWELVE, TWENTY FOUR, THIRTY, FORTY TWO, AND FIFTY FOUR MONTHS

SUBJECTS		SES	Birth	6th Month	12th Month	24th Month	30th Month	42nd Month	54th Month
CONTROLS	Range	16-84	5.50-9.80	13-25	16.90-30.00	21-36	24-37	25.00-64.50	26.00-72.00
	Mean	54.25	7.26	17.22	22.47	27.80	29.50	33.88	38.88
	Sigma	14.01	.88	2.11	2.73	3.32	3.06	4.77	5.80
	N	189							
EXPERIMENTALS									
(Factor II)	Range	24-78	5.80-8.60	11.30-19.50	16.60-30.00	22-32	23.50-25.00	25.00-39.00	30-45
	Mean	59.72	7.10	15.97	22.95	26.14	24.16	31.68	41.63
	Sigma	13.49	.77	2.83	3.90	3.97	.62	4.03	4.32
	N	11							
(Factor III)	Range	24-84	2.50-9.70	11.50-22.50	17.10-30.10	19-37	22-32	25.00-45.00	28-52
	Mean	54.73	6.68	16.50	22.04	27.24	28.37	32.42	37.78
	Sigma	15.74	1.49	2.27	2.70	1.81	2.76	3.68	4.69
	N	92							
(Factor IV)	Range	20-81	[illegible].90-11.50	12.00-22.10	17.50-27.70	21-40	24.00-35.50	26.00-60.00	29-78
	Mean	49.88	6.48	16.53	21.05	27.81	28.00	33.84	38.56
	Sigma	15.00	1.73	2.34	2.34	4.42	3.25	5.41	6.82
	N	68							

TABLE 16

INFERENTIAL STUDY GROUP (T_9): LENGTH AT BIRTH, SIX, TWELVE, TWENTY FOUR, THIRTY, FORTY TWO AND FIFTY FOUR MONTHS

SUBJECTS		BIRTH	6th Month	12th Month	24th Mon h	30th Month	42nd Month	54th Month
CONTROLS	Range	17.00-22.00	19.00-30.00	23.00-34.00	26.00-40.00	26.80-40.00	33.00-44.50	32.50-48.00
	Mean	20.03	26.54	29.76	34.16	35.88	39.26	42.04
	Sigma	1.08	1.54	1.70	2.07	2.11	1.86	1.96
	N	189						
EXPERIMENTALS								
(Factor II)	Range	18.00-21.00	23.00-29.00	25.00-31.00	27.00-35.00	34.20-34.50	37.00-42.00	38.50-46.00
	Mean	19.16	25.66	18.50	32.14	34.40	38.83	41.56
	Sigma	1.06	1.97	1.80	2.35	.14	1.53	2.05
	N	11						
(Factor III)	Range	14.00-23.00	23.00-29.00	26.00-34.00	23.00-27.00	33.00-37.20	-48.00	38.50-45.80
	Mean	19.35	26.34	29.81	33.54	35.18	38.55	41.78
	Sigma	1.61	1.81	1.63	2.48	1.26	3.68	1.69
	N	92						
(Factor IV)	Range	14.00-23.00	23.00-30.00	26.00-34.00	26.00-39.00	29.50-39.20	33.20-46.50	39.30-53.00
	Mean	19.30	26.28	29.59	33.98	35.10	39.26	42.11
	Sigma	1.59	1.61	1.54	2.48	2.06	1.98	2.17
	N	68						

TABLE 17

TEST DELAY AND CRITERION MEASURES AT FIFTY FOUR MONTHS

SUBJECTS	Delay	Test Delay (wks)	Physical Domain: Weight (lb.)	Physical Domain: Height (in.)	Motoric Domain: Copy Forms	Cognitive Domain: *PI (1)	*PI (2)	*PI (3)	*PI (4)	*PI Total	Boehm
CONTROLS	Range	-5-+.3	26.00-72.00	30.50-49.00	1-67	1-18	0-12	0-15	4-19	9-61	5-25
	Mean	.05	38.88	42.04	36.65	13.60	7.18	7.52	13.97	42.11	17.34
	Sigma	1.55	5.80	1.96	12.96	3.04	2.72	3.03	3.59	10.46	4.24
	N	189									
EXPERIMENTALS											
(Factor II)	Range	-3-+1	30-45	38.50-46.00	15-48	10-16	2-10	1-11	8-17	24-50	9-23
	Mean	-.36	41.63	41.56	36.90	13.63	6.36	7-09	14.27	41.36	16
	Sigma	1.06	4.32	2.05	10.06	1.87	2.60	2.77	3.19	7.79	3.95
	N	11									
(Factor III)	Range	-6-+6	28-52	38.50-45.80	8-64	5-18	0-12	2-15	1119	18.67	6.25
	Mean	-.13	37.78	41.78	35.85	14.29	8.00	8.26	14.36	45.38	18.05
	Sigma	1.65	4.69	1.69	13.38	2.77	3.00	2.84	3.88	10.43	4.69
	N	92									
(Factor IV)	Range	-4-+8	29-78	39.50-53.00	3.65	4-18	0-12	0-13	3-19	8-57	3-24
	Mean	-.05	38.56	42.11	32.66	12.35	6.29	6.92	i2.58	38.30	15.98
	Sigma	2.06	6.82	2.17	13.68	3.46	3.09	3.17	4.38	12.28	4.95
	N	68									

$*PI_{(1)}$ = Preschool Inventory Personal-Social

$*PI_{(2)}$ = Preschool Inventory Concept, Activation-Sensory

$*PI_{(3)}$ = Preschool Inventory Concept Activation-Numerical

$*PI_{(4)}$ = Preschool Inventory Associative Vocabulary birth cohort with an account of the 1971 summer subgroup T_9 presented in Tables 15, 16, and 17.

Birth weight. The 1966 birth cohort of one thousand probands included infants of low, average, and high birth weight. At birth control infants (T_1) had a mean weight of 7.25 lb. and the T_9 control group had a mean birth weight of 7.26 lb. The difference of .01 lb. is trivial. T_1 and T_9 Factor II mean birth weights shown in Tables 5 and 15 are 7.08 lb., and 7.10 lb., which is also a very slight difference. T_1 and T_9 Factor III mean birth weights, 6.75 lb., and 6.68 lb. are very similar. Finally, T_1 and T_9 Factor IV mean birth weights are also very close, 6.37 lb., and 6.48 lb. Weight is, of course, a significant predictor of development, and the validity of the T_8 filial cohort in this regard is reassuring.

Birth length. Equally valid are the T_9 cohort lengths for all groups of subjects. Tables 6 and 16 show the essential comparability of the T_1 lengths at birth and the lengths of the study cohort T_9.

Social class. McGuire and White (1955) social class scores developed at birth are given in Table 7 for the birth cohort T_1 and the dependent cohorts. The T_9 controls in Table 15 are very similar to the T_1 means and standard deviations. The variation of SES level at nine study periods has been slight. The Factor II (delivery complications) group has demonstrated a slight drop in McGuire & White SES scores, which means a slight rise in SES level. The difference is about six points, or a third of a standard deviation. The Factor III (neonatal complications) group has been very stable in SES level, as Table 6 shows. The same consistency appears in Table 15 for the T_9 SES scores. The highest intra-cohort variation at four and a half years from the control cases is the small Factor II group which has generally been lower by approximately one third of a standard deviation. At fifty four months the SES level is closer to that of the controls and Factor III and IV groups. The McGuire and White (1955) social class score for all four hundred and four cases at fifty four months was 54.20. There is a slight degree of fluctuation between the four perinatal status groups. Controls and Factor III cases tended to be very similar in mean perinatal SES score. Factor II (delivery complications) were lower in SES scores; it is not unexpected, however, since low SES and delivery complications are generally associated (Butler & Bonham, 1963). In contrast, the multiple complication group is slightly higher in SES level, to the extent of one third of a standard deviation compared with the controls. Test delay at fifty four months was generally not a problem, although test administrations were delayed as much as eight weeks in one case. For the entire group of T_9 probands the mean delay in testing was .007 weeks.

The fifty four month criterion measures for all four hundred and four subjects show that variability between independent variable groups was slight. The grand mean score on the Preschool Inventory (Caldwell, 1970) was 41.53. The seventy nine Factor IV group cases had a lower mean of 37.58, and the one hundred and five Factor III group cases had the highest mean, 44.42. The range across groups is seven points. Boehm scores showed consistency between groups around a grand mean of 17.05. Copy Forms scores tend to consistency in range, mean, and standard deviation. The Factor IV mean, 32.66 was lower than the rest. The greatest inter-group range of means was for Factor IV, the lowest, and for the Factor III group, 38.85, which was slightly higher than the controls at 36.65.

INFERENTIAL FINDINGS

We may now turn to an inferential analysis of the data. The purpose is to examine the significance of perinatal data in an attempt to understand attainment at age three years. In this regard analysis of the data on three and four year olds is similar to the analyses reported previously in EDAP Technical Reports #2, #6, #8, #12, #13, and #14.

Thirty Six Months. The subjects consisted of three hundred and thirty two of the T_6 cases on whom complete information was available. This reduction in the amount of sixty cases was offset by facilitation of data processing.

The criterion series at age three years has been presented in Table 4. The measures presented there represent the development domains (a) *physical growth* (height, and weight) (b) *cognitive growth* (PPVT and PAR *Communication*) and (c) *motoric growth* (PAR *Ambulation, Manipulation,* and *Physical*). The status of the T_1 neonates as controls or children with suspicious pre- and para-natal histories (experimental Factor I indicating gestational complications, Factor III composed of neonatal complications) were used as the predictor series, and social class scores at birth were used as a covariant. Tables 19 - 21 summarize the inferential analyses testing the hypotheses just given. Results are given for seven criteria in three domains. The first of these, shown in Table 19, is Physical Growth.

PHYSICAL GROWTH. Two measures of physical growth, height in inches and weight in pounds, were used as criteria. Regression model one in Table 19was the full model used to generate an optimum prediction of the physical criteria at thirty six months. In Table 19 this is shown

TABLE 18

REGRESSION MODELS USED AT 36 MONTHS

	Model*	Explanation
1.	$Y_{1-n} = a_o u + a_1 x_1 + a_2 x_2 + a_3 x_3 + a_4 x_4 + e$	Full Model
2.	$Y_{1-n} = a_o u + a_1 x_1 + a_2 (x_2 + x_3 + x_4) + e$	Collapses membership vectors
3.	$Y_{1-n} = a_o u + a_1 x_1 + a_2 (x_2 + x_3) + e$	Collapses experimental membership vectors
4.	$Y_{1-n} = a_o u + a_1 x_2 + a_2 x_3 + a_3 x_4 + e$	Deletes SES scores

Y_{1-n} = criterion series

*x_1 = social class scores

e = error vector

x_2 = Factor I group membership (prenatal complications)

x_3 = Factor III group membership (neonatal complications)

x_4 = Control group membership

TABLE 19

COMPARISON OF REGRESSION MODELS OF PHYSICAL GROWTH AT 36 MONTHS (T_6)

Model	Criterion	R^2	F	P
1. 2.	(1) Weight	.03 .01	5.80	.01* .01 .10*
1. 3.	(1) Weight	.03 .01	4.85	.01* .02 .01*
1. 4.	(1) Weight	.03 .02	2.41	.01* .02 .12*
1. 2.	(2) Height	.07 .04	11.04	.00002* .0009 .001*
1. 3.	(2) Height	.07 .05	4.90	.00002* .02 .00006*
1. 4.	(2) Height	.07 .03	8.43	.00002* .003 .004*

*Significance of the difference from zero.

TABLE 20

COMPARISON OF REGRESSION MODELS OF MOTORIC GROWTH AT 36 MONTHS (T_6)

Model	Criterion	R^2	F	P
1.		.08		.0001 *
	(3)PAR *Ambulation*		5.30	.02
2.		.06		.00002*
1.		.08		.00001*
	(3)PAR *Ambulation*		.95	.32
3.		.07		.00001*
1.		.08		.00001*
	(3)PAR *Ambulation*		16.64	.00006
4.		.03		.004*
1.		.01		.32*
	(4)PAR *Manipulation*		3.45	.06
2.		.00001		.06*
1.		.01		.32*
	(4)PAR *Manipulation*		.05	.75
3.		.0008		.23*
1.		.01		.32*
	(4)PAR *Manipulation*		.11	.73
4.		.008		.70*
1.		.05		.0006*
	(5)PAR *Physical*		7.63	.0006
2.		.02		.007*
1.		.05		.0006*
	(5)PAR *Physical*		.61	.43
3.		.05		.002*
1.		.05		.0006*
	(5)PAR *Physical*		6.70	.01
4.		.03		.004*

*Significant of the difference from zero.

TABLE 21

COMPARISON OF REGRESSION MODELS OF COGNITIVE GROWTH AT 36 MONTHS (T_6)

Model	Criterion	R^2	F	P
1.		.23		<.00001*
	(6) PAR *Communication*		8.66	.00002
2.		.19		<.00001*
1.		.23		<.00001*
	(6) PAR *Communication*		12.80	.0004
3.		.20		<.00001*
1.		.23		<.00001*
	(6) PAR *Communication*		59.53	.00001
4.		.09		<.00001*
1.		.12		<.00001*
	(7) PPVT		5.30	.02
2.		.11		<.00001*
1.		.12		<.00001*
	(7) PPVT		.75	.38
3.				<.00001*
1.		.12		<.00001*
	(7) PPVT		34.85	.004
4.		.09		<.00001*

*Significance of the difference from zero

as the R^2 value ·03 for regression model 1. Models 2, 3, and 4 are the alternate or restricted models for the criterion *weight*. Model 1 with an R^2 of ·07 is the full regression model for *height*, and models 1, 2, and 3 are the restricted models used to evaluate the significance of selected vectors (see Table 19). The same arrangement is used for Tables 20 and 21.

Weight. Comparison of models 1 and 2 examined the contribution of information about the status of children by deleting all vectors representing membership as control and experimental cases. The loss of prediction was expressed by reduction of the R^2 value for weight from ·03 to ·01, a statistically significant difference ($F = 5.80$, $p = .01$). Significance of experimental status - Factor I representing gestational problems and Factor III representing neonatal abnormality - was expressed by comparing models 1 and 3. Model 3 had an R^2 value of .01 which was a statistically significant reduction ($F = 4.85$, $p = .02$). Comparison of models 1 and 4 tested the contribution of social class scores to prediction of weight. The drop in R^2 values was from .03 to .02, and was significant ($F = 2.41$, $p = .02$).

Height. Comparison of models 1 and 2 examined the contribution of membership information to prediction of height at thirty six months. R^2 values dropped from .07 to .04; the results were statistically significant ($F = 11.04$, $p = .0009$). Models 1 and 3 when compared tested the significance of the experimental group membership data. The results were also statistically significant, the R^2 value of model 3 declines to .05. ($F = 4.90$, $p = .02$). The contribution of social class data was examined by comparing regression model 4 with the full model. The result was a decline in R^2 value from ·07 to ·03, which was statistically significant ($F = 8.43$, $p = .004$). See Table 19.

MOTORIC GROWTH. Two subscales of the Preschool Attainment Record (PAR) *Ambulation* and *Manipulation* were employed. The summed value of the two subscales yields a PAR *Physical* score. Motoric Growth at age thirty six months was assessed by means of the three scores. See Table 19.

Ambulation. The full regression model of *Ambulation* scores, model 1 in Table 20, had an R^2 value of .08. Restricted model 2 deleting all membership information produced a statistically significant drop in R^2 values to .06 ($F = 5.30$, $p = .02$). Use of model 3 against the full model tested the significance of the experimental vectors and produced insignificant results. The R^2 value of model 3 was .07 ($F = .95$, $p = .32$). The role of social class scores was examined by comparing restricted model 4 with the full model. The R^2 value of the restricted model was lower than that of the full model, declining to .03 ($F = 16.64$, $p = .00006$).

Manipulation. The full model of this criterion, model 1, had a very low R^2 value, $R^2 = .01$. Restricted model 2 deleting membership status vectors, had a lower R^2 value of .00001. The difference was statistically insignificant ($F = 3.45$, $p = .06$). Equally insignificant results were obtained for model 3, which collapsed the experimental membership vectors and developed an R^2 value of .008. The difference in R^2 values was not significant ($F = .05$, $p = .75$). Social class was equally insignificant as restricted model 4 produced an R^2 value of .008. The drop in prediction was statistically insignificant ($F = .11$, $p = .73$).

Physical. The summed scores for *Ambulation* and *Manipulation* expressed as the PAR *Physical* score are also given in Table 12. Full model 1 had an R^2 value of .05. Restricted model 2 testing the contribution of membership vectors yield an R^2 value of .02. The difference was statistically significant (F = 7·63, p = .006). The experimental vectors were tested by model 3, which had the same R^2 value as the full model (F = .61, p = 43). Restricted model 4 tested the contribution of social class scores. The R^2 value was .03, a statistically significant decline (F = 6·70, p = .01).

COGNITIVE GROWTH. Two measures were employed as criteria of cognitive attainment, the PAR *Communication* subscale, and the Peabody Picture vocabulary Scale (PPVT), and are reported in Table 21.

Communication. Regression models 1 and 2 in Table 21 tested the contribution of membership data to prediction of PAR *Communicatin* scores, dropping R^2 values from .23 to .19. The results were significant (F = 18·66, p = .00002). Models 1 and 3 examined the significance of the experimental membership vectors with statistically significant reduction to an R^2 of .20 (F = 12.80, p = .0004). Restricted model 4, which examined the contribution of social class scores, had an R^2 value of .09. The difference from the full model was highly significant (F = 59.53, p = .00001).

PPVT. The Full model of PPVT scores, regression model 1, Table 21, had an R^2 value of .12. Restricted model 2, which had an R^2 value of .11, was reduced indicating the importance of group membership information. The reduction was slight, but statistically significant (F = 5·30, p = .02). Restricted model 3 examined the significance of the experimental vectors, with negative outcomes (F = ·75, p = .38). Social class was examined as a hypothetically critical vector in restricted regression model 4. It's R^2 value of .03 was lower than that of the full model to a statistically significant degree (F = 34·85, p = .004).

Forty Two Months. Tables 23, 24, and 25 summarize the inferential analyses testing the hypotheses just given. Results are given for seven criteria in three domains using regression models in Table 22.

PHYSICAL GROWTH. Two measures of physical growth, height in inches and weight in pounds, were used as criteria. Regression model one in Table 3 was the full model used to generate an optimum prediction of the physical criteria at thirty six months. In Table 23 this is shown as the R^2 value .05 for regression model 1. Models 2, 3, 4, and 5 are the alternate or restricted models for the criterion *weight*. Model 1 with an R^2 of .03 is the full regression model for *height*, and models 2, 3, 4, and 5 are restricted models used to evaluate the significance of selected vectors.

Weight. Comparison of models 1 and 2 in Table 23 examined the contribution of information about the status of children by permitting only the vector representing status as Factor II (gestational complications) cases to have an independent regression weight. The change of prediction was expressed by reduction of the R^2 value for weight from .05 to .03, an almost significant difference ($F = 3.33$, $p = .06$). The significance of Factor III representing neonatal abnormality - was expressed by comparing models 1 and 3. Model 3 had an R^2 value of .04 which was a statistically insignificant change ($F = 1.16$, $p = .28$). Models 1 and 4 tested the significance of Factor IV (multiple complications) with insignificant results ($F = .007$, $p = .93$). Comparison of models 1 and 5 tested the contribution of social class scores to prediction of weight. The change in R^2 values was from .05 to .02, and was significant ($F = 7.07$, $p = .008$).

TABLE 22

REGRESSION MODELS USED AT 42 MONTHS

Model	Explanation
1. $Y_{1-n} = a_o u + a_1 x_1 + a_2 x_2 + a_3 x_3 + a_4 x_4 + a_5 x_5 + e$	Full model
2. $Y_{1-n} = a_o u + a_1 x_1 + a_2 x_2 + a_3 x_3 + a_4 (x_4 + x_5) + e$	Tests x_2 Factor II subjects as discrete vector
3. $Y_{1-n} = a_o u + a_1 x_1 + a_2 x_2 + a_3 x_4 + a_4 (x_3 + x_5) + e$	Tests x_4 Factor III subjects as discrete vector
4. $Y_{1-n} = a_o u + a_1 x_1 + a_2 x_2 + a_3 x_5 + a_4 (x_3 + x_4) + e$	Tests x_5 Factor IV subjects as discrete fector
5. $Y_{1-n} = a_o u + a_1 x_2 + a_2 x_3 + a_3 x_4 + a_4 x_5 + e$	Delete social class scores

Y_{1-n} = criterion series

x_1 = social class scores

x_2 = controls

x_3 = Factor II group membership (delivery complications

x_4 = Factor III group membership (neonatal complications)

x_5 = Factor IV group membership (multiple complications)

TABLE 23

COMPARISON OF REGRESSION MODELS OF PHYSICAL GROWTH AT 42 MONTHS (T_7)

Model	Criterion	R^2	F	P
1.		.05		.0002*
	(8) Weight		3.33	.06
2.		.03		.003*
1.		.05		.0002*
	(8) Weight		1.16	.28
3.		.04		.001*
1.		.05		.0002*
	(8) Weight		.007	.93
4.		.05		.0007*
1.		.05		.0002*
	(8) Weight		7.07	.008
5.		.02		.02*
1.		.03		.01*
	(9) Height		3.08	.07
2.		.02		.03*
1.		.03		.01*
	(9) Height		.03	.84
3.		.03		.007*
1.		.03		.01*
	(9) Height		.59	.44
4.		.03		.01*
1.		.03		.01*
	(9) Height		4.58	.03
5.		.02		.06*

*Significance of the difference from zero

TABLE 24

COMPARISON OF REGRESSION MODELS OF MOTORIC GROWTH AT FORTY TWO MONTHS (T_7): CRITERIA (10), (11), AND (12)

Model	Criterion	R^2	F	P
1.		.08		<.00001*
	(10) PAR *Ambulation*		.12	.71
2.		.08		<.00001*
1.		.08		<.00001*
	(10) PAR *Ambulation*		.09	.76
3.		.08		<.00001*
1.		.08		<.00001*
	(10) PAR *Ambulation*		.01	.91
4.		.08		<.00001*
1.		.08		<.00001*
	(10) PAR *Ambulation*		30.80	<.00001
5.		.08		<.00001*
1.		.01		.40*
	(11) PAR *Manipulation*		2.63	.10
2.		.004		.71
1.		.01		.40*
	(11) PAR *Manipulation*		.98	.32
3.		.009		.38*
1.		.01		.40*
	(11) PAR *Manipulation*		.01	.91
4.		.01		.26*
1.		.01		.40*
	(11) PAR *Manipulation*		.75	.38
5.		.009		.35*
1.		.02		.08*
	(12) PAR *Physical*		1.75	.18
2.		.01		.09*
1.		.02		.08*
	(12) PAR *Physical*		.01	.91
3.		.02		.04*
1.		.02		.08*
	(12) PAR *Physical*		.38	.53
4.		.02		.04*
1.		.02		.08*
	(12) PAR *Physical*		5.46	.01
5.		.008		.43*

*Significance of the difference from zero

TABLE 25

COMPARISON OF REGRESSION MODELS OF COGNITIVE GROWTH AT FORTY TWO MONTHS (T_7): CRITERIA (13) and (14)

Model	Criterion	R^2	F	P
1.		.12		<.00001*
	(13) PAR *Communication*		3.01	.08
2.		.11		<.00008*
1.		.12		<.00001*
	(13) PAR *Communication*		.16	.68
3.		.12		<.00001*
1.		.12		<.00001*
	(13) PAR *Communication*		1.91	.16
4.		.12		<.00001*
1.		.12		<.00001*
	(13) PAR *Communication*		39.96	<.00001
5.		.02		.06*
1.		.18		<.00001*
	(14) PPVT		1.05	.30
2.		.18		<.00001*
1.		.18		<.00001*
	(14) PPVT		.16	.68
3.		.18		<.00001*
1.		.18		<.00001*
	(14) PPVT		.96	<.32
4.		.18		<.004*
1.		.18		<.00001*
	(14) PPVT		68.01	<.00001
5.		.01		.08*

*Significance of the difference from zero

Height. Comparison of models 1 and 2 in the lower half of Table 23 examined the contribution of Factor II information to prediction of height at forty two months. R^2 values dropped from .03 to .02; the results were statistically insignificant (F = 3.08, p = .07). Models 1 and 3 when compared tested the significance of the Factor III group membership data. The results were also statistically insignificant, the R^2 value of model 3 was unchanged (F = .03, p = .84). Factor IV status, model 4, was also insignificant (F = .49, p = .44). The contribution of social class data was examined by comparing regression model 5 with the full model. The result was a decline in R^2 value from .03 to .02, which was statistically significant (F = 4.58, p = .06).

MOTORIC GROWTH. Two subscales of the Preschool Attainment Record (PAR) *Ambulation* and *Manipulation* were employed. The summed value of the two subscales yields a PAR *Physical* score. Motoric Growth at age thirty six months was assessed by means of the three scores. See Table 24.

Ambulation. The full regression model of *Ambulation* scores, model 1 in Table 19, had an R^2 value of .08. Restricted models 2, 3, and 4 testing membership information all produced no change in R^2 values. The role of social class scores was examined by comparing restricted model 5 with the full model. The R^2 value of the restricted model was lower than that of the full model, declining to .008 (F = 5.46, p = .01).

Manipulation. The full model of this criterion, model 1 in the middle of Table 19, had a very low R^2 value, R^2 = .01. Restricted models 2 - 4 representing membership status vectors, had lower R^2 values. The differences were statistically insignificant. Equally insignificant results were obtained for model 5, which collapsed the SES vector. The difference in R^2 values was not significant (F = .75, p = .38).

TABLE 26

REGRESSION MODELS USED AT 48 MONTHS

Model	Explanation
1. $Y_{1-n} = a_o u + a_1x_1 + a_2x_2 + a_3x_3 + a_4x_4 + a_5x_5 + e$	Full model
2. $Y_{1-n} = a_o u + a_1x_1 + a_2(x_2 + x_3 + x_4) + a_4x_5 + e$	Tests significance of data on classification as Controls, Factor I, and Factor III subjects.
3. $Y_{1-n} = a_o u + a_1x_1 + a_2x_2 + a_3(x_3 + x_4) + a_4x_5 + e$	Tests Controls as a discrete vector versus Factor I and Factor III subjects as a discrete vector
4. $Y_{1-n} = a_o u + a_1x_2 + a_2x_3 + a_3x_4 + a_4x_5 + e$	Deletes social class scores
5. $Y_{1-n} = a_o u + a_1x_1 + a_2x_2 + a_3x_3 + a_4x_4 + e$	Deletes vector representing testing delay

Y_{1-n} = criterion series

$a_o u$ = unit vector

x_1 = social class scores

x_2 = controls

x_3 = Factor I group membership (gestation complications)

x_4 = Factor III group membership (neonatal complications)

x_5 = Testing delay in weeks

e = error vector

TABLE 27

COMPARISON OF REGRESSION MODELS OF PHYSICAL AND MOTORIC GROWTH AT 48 MONTHS (T_8) CRITERIA (15, (16), AND (17)

Model	Criterion	R^2	F	P
1.		.007		.64*
	(15) Weight		.84	.43
2.		.002		.66*
1.		.007		.64*
	(15) Weight		.09	.76
3.		.006		.49*
1.		.007		.64*
	(15) Weight		.71	.39
4.		.005		.61*
1.		.02		.04
	(16) Height		4.29	.01
2.		.004		.47*
1.		.02		.04
	(16) Height		.54	.46
3.		.02		.03*
1.		.02		.04
	(16) Height		1.42	.23
4.		.02		.03*
1.		.14		<.000001*
	(17) Copy Forms		.17	.84
2.		.14		<.000001*
1.		.14		<.000001*
	(17) Copy Forms		.25	.61
3.		.14		<.000001*
1.		.14		<.000001*
	(17) Copy Forms		39.26	<.000001
4.		.02		.06*

*Significance of the difference from zero.

TABLE 28

COMPARISON OF REGRESSION MODELS OF COGNITIVE GROWTH AT FORTY EIGHT MONTHS (T_8): CRITERIA (18), (19), AND (20)

Model	Criterion	R^2	F	P
1.		.08		<.00001*
	(18) $PI_{(1)}$ Responsiveness		1.81	.16
2.		.07		<.00001*
1.		.08		<.00001*
	(18) $PI_{(1)}$ Responsiveness		2.35	.12
3		.07		<.00001*
1.		.08		<.00001*
	(18) $PI_{(1)}$ Responsiveness		31.50	<.00001
4.		.004		.69*
1.		.18		<.00001*
	(19) $PI_{(2)}$ Vocabulary		.001	.98
2.		.18		<.00001*
1.		.18		<.00001*
	(19) $PI_{(2)}$ Vocabulary		.001	.96
3.		.18		<.00001*
1.		.18		<.00001*
	(19) $PI_{(2)}$ Vocabulary		65.24	<.00001
4.		.03		<.006*
1.		.11		<.00001*
	(20) $PI_{(3)}$ Numerical		.38	.68
2.		.11		<.00001*
1.		.11		<.00001*
	(20) $PI_{(3)}$ Numerical		.36	.54
3.		.11		<.002*
1.		.11		<.00001*
	(20) $PI_{(3)}$ Numerical		31.97	<.00001*
4.		.04		.002*

*Significance of the difference from zero

TABLE 29

COMPARISON OF REGRESSION MODELS OF COGNITIVE GROWTH AT FORTY EIGHT MONTHS (T_8):

CRITERIA (21), (22), and (23)

Model	Criterion	R^2	F	P
1.		.25		<.00001*
	(21) $PI_{(4)}$ Sensory		.07	.93
2.		.24		<.00001*
1.		.25		<.00001*
	(21) $PI_{(4)}$ Sensory		.09	.75
3.		.25		<.00001*
1.		.25		<.00001*
	(21) $PI_{(4)}$ Sensory		103.43	<.00001*
4		.03		.01*
1.		.22		<.00001*
	(22) PI_{Total}		.48	.61
2.		.22		<.00001*
1.		.22		<.00001*
	(22) PI_{Total}		.47	.49
3.		.22		<.00001*
1.		.22		<.00001*
	(22) PI_{Total}		91.27	<.00001
4.		.02		<.01*
1.		.16		<.00001*
	(23) Boehm		.17	.84
2.		.16		<.00001*
1.		.16		<.00001*
	(23) Boehm		.24	.62
3.		.16		<.008*
1.		.16		<.00001*
	(23) Boehm		54.21	<.00001
4.		.03		<.00001*

*Significance of the difference from zero

Physical. The summed scores for *Ambulation* and *Manipulation* expressed as the PAR *Physical* score are also given at the bottom of Table 24. Full model 1 had an R^2 value of .02. Restricted models 2 - 4 testing the contribution of Factor II - IV vectors yielded R^2 values whose differences were statistically insignificant. Only restricted model 5 testing the contribution of social class scores, was statistically significant ($F = 5.46$, $p = .01$).

COGNITIVE GROWTH. Two measures were employed as criteria of cognitive attainment, the PAR *Communication* subscale, and the Peabody Picture Vocabulary Scale (PPVT), and are reported in Table 25.

Communication. Full regression model 1 in Table 25 tested the contribution of membership data to prediction of PAR *Communication* scores, having an R^2 value of .12. Results were insignificant when restricted. Models 2 - 4 examined the value of the experimental membership vectors. Restricted model 5, which deleted, and thereby examined, the contribution of social class scores had an R^2 value of .02. The difference from the full model was highly significant ($F = 29.96$, $p = <.00001$).

PPVT. The full model of PPVT scores, regression model 1 had an R^2 value of .18. Restricted models 2 - 4 had only slightly reduced R^2 values. This indicated the insignificance of group membership information in predicting PPVT scores. Social class was examined as a hypothetically critical vector in restricted regression model 5. It's R^2 value of .01 was much lower than that of the full model, to a statistically significant degree ($F = 68.01$, $p = <.00001$).

Forty Eight Months. The inferential results of the multiple linear regression models in Table 26 are shown in Tables 27, 28, and 29. The first series of results, given in Table 27, shows the results for the forty eight month criteria in the physical growth domain.

PHYSICAL GROWTH. Two measures of physical growth, *weight* in pounds and *height* in inches, are reported. The full model of weight, model 1, is shown in Table 27 to have an R^2 value of .007. None of the restricted models, 2 - 4, varied more than a little from the R^2 values of the full model. Model 2 declines to an R^2 of .002, but, like all the analyses of weight, it was statistically insignificant. The result was an absence of effects in the restricted regression models for group information, model 2, for control cases versus experimentals, model 3, and for social class effects, regression model 4.

Height produced a slightly higher R^2, one which achieved a level of statistical significance for the full model ($p = .02$). Only one comparison, the use of restricted model 2, produced a statistically significant decline in the R^2 value. This comparison examined the significance of information about group membership in toto. The difference between Factor I and Factor III cases versus controls produced no real decline in the R^2 value of .02 ($F = .54$, $p = .46$). The other comparison testing social class effects ($F = 1.42$, $p = .23$) was not significant.

MOTORIC GROWTH. The full regression model of Copy Forms raw scores model 1 at the bottom of Table 27, produced an R^2 value of .14. Comparison with restricted model 2 testing group information produced an identical R^2 value, which was of course in no way statistically different ($F = .17$, $p = .84$). Comparison of full model 1 and restricted model 3 tested the significance of the difference between the two experimental groups. The results were insignificant since there was no appreciable difference in the R^2 value ($F = .25$, $p = .61$). The contribution of social class data, however, was very different. Comparison of model 4 with the full model produced a drop in R^2 from .14 to .02. The comparison yeilded a statistically significant difference ($F = 39.26$, $p = <.000001$).

COGNITIVE GROWTH. Two instruments were used to assess cognitive development at forty eight months, The Boehm Test of Basic Concepts (1969), and Caldwell's Preschool Inventory (1970). Tables 28 and 29 show that the results of multiple linear regression analyses, using the models shown in Table 26.

Preschool Inventory. This criterion differed from others in that the results of administering the test were recorded for four sub-sections together with a fifth full scale score. The four sections are abbreviated in Tables 28 and 29 as $PI_{(1) - (4)}$, and PI_{Total}.

Personal-Social Responsiveness $PI_{(1)}$. Full regression model 1 developed an R^2 of .08. Restricted model 2 testing the value of knowledge of status as a control versus experimental groups (Factors I and III) was almost identical in R^2 value .07, and so was insignificantly different as a predictor ($F = 1.81$, $p = .16$). Restricted model 3 testing the difference between the two experimental groups also produced an R^2 value of .07, and was insignificantly different from the full model ($F = 2.35$, $p = .12$). In contrast, model 4, which deleted the social class scores, produced a significant drop in R^2 value $R^2 = .004$ ($F = 31.50$, $p = .00001$).

Associative Vocabulary $PI_{(2)}$. The full regression model for this subtest of the Preschool Record, model 1, had an R^2 value of .18. The value of status in two experimental groups and the control group was tested by comparing restricted model 2 with the full model. The effects were insignificant ($F = .001$, $p = .98$). Comparison of the two experimental groups by use of regression model 3 was also insignificant ($F = .001$, p = .96). As with other criteria the regression model deleting social class was very different in R^2 value from the full model. The R^2 for restricted model 4 was .03, which is significantly different from the value .18 obtained for the full regression model (F = 65.24, p = .00001).

Concept Activation-Numerical $PI_{(3)}$. The full regression model of the numerical subscore was statistically different from zero (p<.00001), although the R^2 was not high (R^2 = .11). An identical R^2 value was developed by the first restricted model, 2, indicating a lack of significance in the data indicating membership in the experimental and control groups (F = .38, p = .69). Similar results ob ained for comparison of the two experimental groups when restricted model 3 was compared with the full model (F = .36, p = .54). Social class effects were found, due to the drop in R^2 obtained by use of model 4; R^2 = .04, (F = 31.97, p = <.00001).

Concept Activation-Sensory $PI_{(4)}$. The full model of this criteria had the highest R^2, .25. Similar predictive power was developed by the first regression model 1, which evaluated membership in experimental and control groups (F = .07, p = .93). Equally ineffective as a predictor was the second restricted model 3, comparing the two experimental groups. The R^2 was also .25, yielding a small F-ratio (F = .08, p = .75). Once more the social class restriction in model 4 materially reduced the predictive power of the regression model, in this case model 4 in Table 29. The R^2 of .03 has significantly different from the full model (F - 103.43, p = <.00001). Test delay was insignificant in its effects on prediction reducing the regression model 5 R^2 by only .01 to .24 (F = .24, p = .62).

Total score. The sum of the raw scores on the four subtests was used as a criterion in Table 29. The full regression model for this criterion was .22. Model 2, testing information on status as experimental and control cases was only slightly different (F = .48, p = .61). Similar results were obtained for comparison of the two experimental groups by comparing model 3 with the full model (F = .47, p = .48). Model 4 was constricted by deleting social class scores. The effect was to depress the R^2 from .22 to .02 (F = 91.27, p = .00001).

Boehm Test. The full model of Boehm scores, 1, was highly significant (R^2 .16, p = <.00001). The first restricted model tested the significance of information about status as a control, Factor I, or Factor III case. The results were insignificant (F = .17, p = .84). Equally insignificant outcomes emerged from testing the second hypothesis of differences between the two experimental groups, and controls using model 3, (F = .24, p = .62). In contrast, the hypothesized influence of social class scores was demonstrated in model 4. Highly significant reduction of the model R^2 resulted, and model 4 had an R^2 of .03, a reduction of .12 (F = 54.21, p = .00001).

Fifty Four Months. Tables 31, 32, and 33 summarize the inferential analyses for nine criteria in three domains using the regression models in Table 30. The first of these, shown in Table 31, is Physical Growth.

PHYSICAL GROWTH. Two measures of physical growth, height in inches and weight in pounds, were used as criteria. Regression model one in Table 31 was the full model used to generate an optimum prediction of the physical criteria at previous intervals of six months. In Table 31 this is shown as the R^2 value .03 for regression model 1. Models 2, 3, 4, and 5 are the alternate or restricted models for the criterion *weight*. Table 3 also records the regression values for *height*. Model 1 with an R^2 of .03

TABLE 30

REGRESSION MODELS USED AT 54 MONTHS

	Model	Explanation
1.	$Y_{1-n} = a_o u + a_1 x_1 + a_2 x_2 + a_3 x_3 + a_4 x_4 + a_5 x_5 + a_6 x_6 + e$	Full model
2.	$Y_{1-n} = a_o u + a_1 x_1 + a_2 x_2 + a_3 x_3 + a_4 (x_4 + x_5) + a_5 x_6 + e$	Tests x_2 Factor II subjects as discrete vector
3.	$Y_{1-n} = a_o u + a_1 x_1 + a_2 x_2 + a_3 x_4 + a_4 (x_3 + x_5) + a_5 x_6 + e$	Tests x_4 Factor III subjects as discrete vector
4.	$Y_{1-n} = a_o u + a_1 x_1 + a_2 x_2 + a_3 x_5 + a_4 (x_3 + x_4) + a_5 x_6 + e$	Tests x_5 Factor IV subjects as discrete vector
5.	$Y_{1-n} = a_o u + a_1 x_2 + a_2 x_3 + a_3 x_4 + a_4 x_5 + a_5 x_6 + e$	Deletes social class scores
6.	$Y_{1-n} = a_o u + a_1 x_1 + a_2 x_2 + a_3 x_3 + a_4 x_4 + a_5 x_5 + e$	Deletes vector representing testing delay
7.	$Y_{1-n} = a_o u + a_1 x_1 + a_2 x_2 + a_3 x_6 + e$	Deletes group membership information

Y_{1-n} = criterion series

x_1 = social class scores

x_2 = controls

x_3 = Factor II group membership (delivery complications)

x_4 = Factor III group membership (neonatal complications)

x_5 = Factor IV group membership (multiple complications)

x_6 = Testing delay in weeks

e = Error vector

u = Unit vector

TABLE 31

COMPARISON OF REGRESSION MODELS OF PHYSICAL AND MOTORIC GROWTH AT 54 MONTHS (T_9) CRITERIA (24), (25), AND (26)

Model	Criterion	R^2	F	P
1.		.03		.04*
	(24) Weight		.80	.37
2.		.02		.03*
1.		.03		.04*
	(24) Weight		1.36	.28
3.		.02		.04*
1.		.03		.04*
	(24) Weight		.41	.51
4.		.02		.28*
1.		.03		.04*
	(24) Weight		6.56	.01
5.		.01		.01
1.		.02		.04*
	(25) Height		1.15	.28
2.		.01		.13*
1.		.02		.14*
	(25) Height		.36	.54
3.		.02		.09*
1.		.02		.14*
	(25) Height		.006	.93
4.		.02		.08*
1.		.02		.14*
	(25) Height		5.38	.02
5.		.008		.58*
1.		.20		<.000001*
	(26) Copy Forms		5.27	.02
2.		.19		<.000001*
1.		.20		<.000001*
	(26) Copy Forms		2.44	.11
3.		.19		<.000001*
1.		.20		<.000001*
	(26) Copy Forms		.18	.66
4.		.20		<.00001*
1.		.20		<.000001*
	(26) Copy Forms		75.05	<.000001
5.		.03		.01*

*Significance of the difference from zero

TABLE 32

COMPARISON OF REGRESSION MODELS OF COGNITIVE DEVELOPMENT AT 54 MONTHS (T_9):

CRITERIA (27), (28), AND (29)

Model	Criterion	R^2	F	P
1.		.14		<.000001*
	(27) $PI_{(1)}$ Responsiveness		10.65	.0001
2.		.11		<.000001*
1.		.14		<.000001*
	(27) $PI_{(1)}$ Responsiveness		2.76	.09
3.		.13		<.000001*
1.		.14		<.000001*
	(27) $PI_{(1)}$ Responsiveness		.001	.97
4.		.14		<.00001*
1.		.14		<.000001*
	(27) $PI_{(1)}$ Responsiveness		42.96	<.000001
5.		.03		.008*
1.		.19		<.000001*
	(28) $PI_{(2)}$ Vocabulary		9.06	.002
2.		.17		<.000001*
1.		.19		<.000001*
	(28) $PI_{(2)}$ Vocabulary		.28	.59
3.		.19		<.000001*
1.		.19		<.000001*
	(28) $PI_{(2)}$ Vocabulary		.95	.32
4.		.19		<.000001*
1.		.19		<.000001*
	(28) $PI_{(2)}$ Vocabulary		70.65	<.000001
5.		.03		.009*
1.		.25		<.000001*
	(29) $PI_{(3)}$ Numerical		8.61	.003
2.		.23		<.000001*
1.		.25		<.000001*
	(29) $PI_{(3)}$ Numerical		.40	.52
3.		.25		<.000001*
1.		.25		<.000001*
	(29) $PI_{(3)}$ Numerical		.70	.40
4.		.24		<.000001*
1.		.25		<.000001*
	(29) $PI_{(3)}$ Numerical		97.76	<.000001
5.		.04		<.000001*

*Significance of the difference from zero

TABLE 33

COMPARISON OF REGRESSION MODELS OF COGNITIVE DEVELOPMENT AT 54 MONTHS (T_9):

CRITERIA (30), (31), AND (32)

Model	Criterion	R^2	F	P
1.		.15		<.000001*
	(30) $PI_{(4)}$ Sensory		4.09	.04
2.		.14		<.000001*
1.		.15		<.000001*
	(30) $PI_{(4)}$ Sensory		3.05	.08
3.		.14		<.000001*
1.		.15		<.000001*
	(30) $PI_{(4)}$ Sensory		.57	.45
4.		.15		<.000001*
1.		.15		<.000001*
	(30) $PI_{(4)}$ Sensory		56.19	<.000001*
5.		.02		.10*
1.		.24		<.000001*
	(31) PI_{Total}		10.64	.001
2.		.22		<.000001*
1.		.24		<.000001*
	(31) PI_{Total}		2.04	.15
3.		.24		<.000001*
1.		.24		<.000001*
	(31) PI_{Total}		.03	.84
4.		.24		<.000001*
1.		.24		<.000001*
	(31) PI_{Total}		97.36	.000001
5.		.03		<.006*
1.		.19		<.000001*
	(32) Boehm		5.04	.02
2.		.18		<.000001*
1.		.19		<.000001*
	(32) Boehm		.25	.61
3.		.19		<.000001*
1.		.19		<.000001*
	(32) Boehm		.38	.53
4.		.19		<.000001*
1.		.19		<.000001*
	(32) Boehm		75.39	<.000001
5.		.02		.04*

*Significance of the difference from zero

is the full regression model for *height*, and models 2, 3, 4, and 5 are restricted models used to evaluate the significance of selected vectors

Weight. Comparison of models 1 and 2 examined the contribution of information about the status of children by permitting only the vector representing status as Factor II (delivery complications) cases to have an independent regression weight. The change of prediction was expressed by reduction of the R^2 value for weight from .05 to .02, an insignificant difference (F = .80, p = .37). The significance of Factor III representing neonatal abnormality was expressed by comparing models 1 and 3. Model 3 had an R^2 value of .02 which was a statistically insignificant change (F = 1.16, p = .28). Models 1 and 4 tested the significance of Factor IV (multiple complications) with insignificant results (F = .41, p = .51). Comparison of models 1 and 5 tested the contribution of social class scores to prediction of weight. The change in R^2 values was from .13 to .01, and was significant (F = 6.56, p = .01).

Height. Comparison of models 1 and 2 examined the contribution of Factor II information to prediction of height at forty two months. R^2 values dropped from .03 to .01, which is statistically insignificant (F = 1.15, p = .28). Models 1 and 3 when compared tested the significance of the Factor III group membership data. The results were also statistically insignificant, the R^2 value of model 3 was unchanged (F = .36, p = .54). Factor IV status, model 4, was also insignificant (F = .006, p = .93). The contribution of social class data was examined by comparing regression model 5 with the full model. The result, a decline in R^2 value from .02 to .008, was statistically significant (F = 5.38, p = .02).

MOTORIC GROWTH. Results of testing hypotheses about performance on the

Copy Forms test are also given in Table 31. The full regression model for this criterion was reduced from .20 to .19 when Factor II group membership was allowed to operate with an independent regression weight in model 2. The drop in R^2 was statistically significant (F = 5.27, p = .02), although the decline in R^2 value was only .01. An equally slight reduction was reported when the Factor III status had an independent regression weight. The reduction to R^2 = .19 was not statistically significant, however, (F = 2.44, p = .11). No reduction in R^2 was associated with model 4 which tested the independent contribution of Factor III status (F = .18, p = .66). A very different outcome, however, was produced by comparing model 5 with the full model. The comparison, which tested the contribution of social class scores, produced a drop in R^2 value from .20 to .03, F = 75.05, p = <.000001).

COGNITIVE GROWTH. Two measures of cognitive attainment employed at forty eight months were repeated. The first was the *Preschool Inventory* (PI), with its four components labelled (1) *Personal-Social* (2) *Conceptual-Sensory* (3) *Conceptual-Numerical* (4) *Associative Vocabulary*. The second was the *Boehm Test of Basic Concepts*. Results for PI and Boehm Tests are in Tables 32 and 33.

Preschool Inventory $PI_{(1)}$: *Personal-Social Responsiveness*: Comparison of regression model 2 which permitted Factor II membership to have an independent regression weight with full model 1 reduced the R^2 from .14 to .11 (F = 10.65, p = .001). No such effect was detected for Factor III status; regression model 3 had an R^2 value of .13 (F = 2.76, p = .09). Equally insignificant findings emerged from comparison of model 4 which tests the significance of Factor III risk status (F = .001, p = .97). The influence of social class was tested by comparing full model 1 with model 5 which omitted the social class scores given in Table IV. The result was a significant loss of prediction associated with restricted model 5. The R² value dropped from .14 to .03 ($F = 42.96$, $p = <.000001$).

PI$_{(2)}$: *Associative Voacbulary.* The second PI area, Associative Vocabulary, fell below the third in predictability with an R^2 of .19. The effect associated with Factor II was tested by comparing regression model 2 with full model 1. Significant results were achieved despite a drop in R^2 to only .17 ($F = 9.06$, $p = .002$). Trivial results were produced for Factor III status, with the R^2 value of model 3 remaining .19 ($F = .28$, $p = .59$). Equally insignificant effects were associated with Factor IV status ($F = .95$, $p = .32$). As with other *Preschool Inventory* criterion measures a powerful social class effect was detected ($F = 70.65$, $p = <.000001$).

PI$_{(3)}$: *Concept Activation-Numerical.* The full model for this cri terion, 1, had the highest R^2 value of the four PI subdomains, $R^2 = .25$. The effect associated with delivery problems, Factor II, was slight, but achieved statistical significance ($F = 8.61$, $p = .003$). No loss of prediction was associated with perinatal risk status, when restricted model 3 was compared with the full model ($F = .40$, $p = .52$). A drop in R^2 from .25 to .24 was identified with model 4 testing the effect of multiple complications, Factor IV ($F = .70$, $p = .40$). Social class effects were high, as for other PI subtests. Deletion of McGuire & White social class scores in model 5 dropped the R^2 from .25 to .04 ($F = 97.76$, $p = <.000001$).

PI$_{(4)}$: *Concept Activation-Sensory* The full model R^2 value shown in Table 33 for this criterion was .15. The loss of prediction due to collapsing

Factors III and IV, and allowing Factor II to maintain an independent regression weight was slight, .01. However, the loss of prediction was significant at the .05 level ($F = 4.09$, $p = .04$). An equally slight loss associated with Factor III was elicited by comparing restricted model 3 with full model 1 ($F = 3.05$, $p = .08$). No loss of prediction ($R^2 = .15$) was associated with Factor III ($F = .57$, $p = .45$). A considerable effect due to the presence of social class scores in the full model was detected in restricted model 5 which deleted social class scores ($F = 56.19$, $p = <.000001$).

Preschool Inventory Total Score. This criterion was developed by summing the raw scores on the four subtests. The R^2 of full model 1 which is given in Table 33 as .24, was reduced by the role of Factor II status in restricted model 2. The drop of .02 to $R^2 = .22$ was statistically significant ($F = 10.64$, $p = .001$). No effects were associated with Factor III status ($F = 2.04$, $p = .15$), or with Factor IV status ($F = .03$, $p = .84$). Model 5, deleting social class scores produced a drop in R^2 from .24 to .03. The loss was statistically significant to a high degree ($F = 97.36$, $p = <.000001$).

Boehm Test of Basic Concepts. The R^2 value for full model 1 was .19. A slight loss of predictive power from .19 to .18 due to the influence of Fa tor II status was statistically significant ($F = 5.04$, $p = .02$). No effect was detected in the comparison of restricted model 3 with the full model, due to Factor III information ($F = .25$, $p = .61$). Factor IV was equally insignificant when allowed to have an independent regression weight in model 4. Social class effects were pronounced when model 5 which omitted social class scores was tested against the full model ($F = 75.39$, $p = <.000001$). See Table 33.

Part Five

PART FIVE
DISCUSSION

THIRTY SIX MONTHS. The hypotheses of the inferential analysis were examined by comparing regression models of development. The models varied considerably in their capacity to account for criterion variance. The R^2 values in Tables 19, 20, and 21 show that a wide range exists; the full models of physical growth in Table 19 had R^2 values of .03 and .07. These low values are consistent with what has been presented in previous reports from birth to age thirty months. The models of motoric growth in Table 20, model 1, were a little higher for *Ambulation* and the summed *Physical* scores; however, the *Manipulation* R^2 value for the full regression model was only .01, which is very low. The two measures of cognitive attainment in Table 21 were predicted better by full the regression model. The PAR *Communication* R^2 value was .23 and the R^2 value for the Peabody Picture Vocabulary Test was .12. In view of the importance of cognitive attainment the R^2 values for these two criteria are more encouraging that those for other criteria.

Predictors. Group membership data, that is, perinatal status as a control case (risk free) or an experimental case - prenatal risk factors (Factor I) and neonatal risk factors (Factor III) - was the first hypothesis applied to seven criteria at age three years. In most cases it emerged that information about the subjects added to prediction of their developmental status. In the case of the Motoric domain (see Table 20) the contribution of group membership data, specification of status as control and experimental cases at birth, was significant only for *Ambulation* scores ($F = 5.30$, $p = .02$). This is a criterion of gross motor activity which includes such early childhood activities as running, balancing, climbing, jumping, and hopping. The *Manipulation* score, the other element in this domain, just missed the .05

level of significance ($F = 3.45$, $p = .06$). This PAR subscale deals with finer motor activities such as unwrapping, assembling, throwing, catching, and copying designs. The summed scores were highly related to the information in vectors representing birth status ($F = 7.63$, $p = .006$). Group membership information was significantly associated with the weight and height in the Physical growth domain. The probability levels were quite different; height turned out to be more highly significant ($p = .0009$) and the regression model was also more sturdy ($R^2 = .07$) than that of weight. The latter variable, weight, reached the .01 level of statistical association with the group membership predictor.

Experimental group membership status (prenatal and neonatal risk) failed to reach significant levels of statistical association with the criterion series in four instances. A modest if not high relationship between experimental groups membership and weight and height was evident ($p = .02$). A more robust association was found with PAR *Communication* scores ($p = .0004$), and none was found with PPVT scores, the second of the two cognitive criteria.

Experimental group membership (Factors I & II) information, on the other hand was related to three aspects of development. Experimental status in the perinatal period, i.e. being at risk, was quite unrelated to attainment in the motoric domain. Experimental group information was related to development in the physical domain. Experimental status was related at a highly significant level to one element in the cognitive domain, PAR *Communication* ($p = .0004$), but not to the second element, PPVT scores.

The third hypothesis applied to the criterion series of seven elements treated the contribution of McGuire & White social class scores.

TABLE 34

SUMMARY OF SIGNIFICANT RELATIONSHIPS BY PROBABILITY LEVEL AT 36 MONTHS

Predictor	Physical Domain		Motoric Domain			Cognitive Domain	
	(1)Weight	(2)Height	(3)Ambulation	(4)Manipulation	(5)Physical	(6)Communication	(7)PPVT
Group Membership	.01	.0009	.02	-	.006	.00002	.02
Experimental Groups	.02	.02	-	-	-	.0004	-
Social Class	-	.003	.00006	-	.01	.00001	.00001

TABLE 35

MATRIX OF INTERCORRELATIONS FOR $T_{(6)}$ GROUP AT 36 MONTHS (N = 380)

	36 Month Height	36 Month Weight	Ambulation	Manipulation	Physical	Communication	PPVT	SES
36 Month Length		-.44	-.16	-.05	-.05	.18	.12	-.19
36 Month Weight			.24	.007	.18	-.18	-.04	.11
Ambulation				.02	.92	-.16	.05	.22
Manipulation					.02	.18	.10	.005
Physical						-.08	.08	.16
Communication							.43	-.41
PPVT								-.32

*p = <.05

**p = <.01

This predictor was significant in five of seven relationships, most of them at a highly significant level, as Table 34 shows. Social class score was related to height (p = .003). *Ambulation* was also related (p = .00006), but *Manipulation* was not, although the summed score *Physical*, was related p = .01). Social class scores were related to both cognitive measures, PAR *Communication* and PPVT, at a highly significant level (p = .00001).

Of the three predictive elements examined, total information about perinatal status, information about at risk perinatal status, and social class scores, the most significant was social class data. Examination of the correlation matrix, Table 35, shows a number of robust correlations. Some are negative, reflecting the inverse relationship between status and McGuire & White scores. The correlation with PPVT scores (r = -.32, p = <.001) is quite substantial, while that with PAR *Communication* scores is greater (r = .22, p = <.001), and height at age three (r = -.19, p = <.001) are also sturdy. They show that social class effects are well established at age three. This observation may be related to previous findings (Jordan, 1971) in which the influence of social class progressively increased during the first two years of life.

Criteria. Consideration of the three domains of development at age three years indicates that cognitive attainment is most predictable. The full regression model scores accounted for twenty three percent of the variance of PAR *Communication* scores and twelve percent of the variance of PPVT scores. The correlation between the two variables is high (r = .43, p = <.001), although they differ markedly in predictability. The physical domain, growth in height and weight, is the next most predictable of the three indices of development; in terms of variance accounted for by the full regression model, and by elements in the predictor series. The *Motoric* domain was least efficiently predicted by the regression model. Most of the poor predictability was due to the PAR *Manipulation* subtest.

Forty Two Months. The R^2 values in Tables 23, 24, and 25 range from .01 to .18. The full models of physical growth in Table 23 had R^2 values of .03 and .05. These low values are consistent with what has been presented in previous reports from birth. The full models of motoric growth in Table 24 were a little higher for *Ambulation* and the summed *Physical* scores; however, the *Manipulation* R^2 value for full regression model 1 was only .01, which is very low. The two measures of cognitive attainment were predicted comparatively well by full regression models. The PAR *Communication* R^2 value was .12, and the R^2 value for the Peabody Picture Vocabulary Test was .18. The R^2 values for these two criteria are encouraging when compared to the other R^2 values.

Predictors. Group membership data, that is, perinatal status as a control case (risk free) or an experimental case - prenatal risk factors (Factor I) and neonatal risk factors (Factor III) - was the first hypothesis applied to the criteria at age three and a half years. In most cases it emerged that information about the subjects' biological risk status added little to prediction of their developmental status. In the case of weight and height Factor II (delivery complication) approached significance. In the case of the Motoric domain (See Table 24) the contribution of group membership data, specification of status as biological *risk* cases at birth, was significant for none of the criterion scores. Perinatal risk status was equally insignificant for cognitive attainment.

TABLE 36

SUMMARY OF SIGNIFICANT RELATIONSHIPS BY PROBABILITY LEVEL AT 42 MONTHS

Predictor	Physical Domain		Motoric Domain			Cognitive Domain	
	(8) Weight	*(9)* Height	*(10)* Ambulation	*(11)* Manipulation	*(12)* Physical	*(13)* Communication	*(14)* PPVT
Factor II	-	-	-	-	-	-	-
Factor III	-	-	-	-	-	-	-
Factor IV	-	-	-	-	-	-	-
Social Class	.008	.03	.00001	-	.01	<.00001	<.00001

TABLE 37

MATRIX OF CORRELATIONS FOR $T_{(7)}$ GROUP AT 42 MONTHS (N = 337)

	42 Month Height	42 Month Weight	PAR Ambulation	PAR Manipulation	PAR Physical	PAR Communication	PPVT	SES
42 Month Height		.49**	.09	.11*	.07	.05	.09	.10
42 Month Weight			.07	.20**	.09	.07	.19**	.13*
Ambulation				.38**	.53**	.006	-.17**	-.29**
Manipulation					.40*	.33**	.14*	.05
Physical						.13*	-.05	-.11*
Communication							.48**	.42**
PPVT								-.43**

*p = <.05

**p = <.01

Social class emerged in analysis of development at age forty two months as the only significant predictor. The associations given in Table 21 are robust, and show that social class effects are well established by age three and a half years. At the risk of over-interpretation they are perhaps slightly stronger than they were at age three, and certainly not weaker. Examination of the correlation matrix in Table 37 shows a number of robust correlations. Most are negative reflecting the relationship between growth and social class. The correlation with PPVT scores ($\underline{r}$ = .42, p = <.001) is also sturdy. Social class effects are well established at age three and a half.

Criteria. Consideration of the three domains of development at age three years, physical, motoric, and cognitive growth, indicates that cognitive attainment is most predictable. The full regression model scores accounted for eighteen per cent of the variance of *PPVT* scores and twelve per cent of the variance of PAR *Communication* scores. The correlation between the two variables is high ($\underline{r}$ = .48, p = <,001). The physical domain, growth in height and weight, is the next most consistently predictable of the three indices of development in terms of variance accounted for by the full regression model. The Motoric domain was least efficiently predicted by the regression model. Most of the poor predictability was due to the PAR *Manipulation* subtest.

FORTY EIGHT MONTHS. The amount of data in the basic regression models given in Table 26 is not large. The vectors consisted of social class data, mutually exclusive classification as a control, Factor I, or Factor III case, and the delay in testing expressed in weeks, together with the unit vector and the error vector. The R^2's which were generated were, accordingly, not excessively low, due to the limited but critical data employed. The lowest R^2 values were obtained for the physical measures, weight and height. Higher values were obtained for the cognitive measures. The lowest Preschool Inventory R^2 value was .08, obtained for the criterion *Personal-Social Responsiveness*. The highest R^2 was obtained for the full model of the subscore, *Concept Activation-Sensory* (R^2 = .25). The Boehm Test R^2 value fell between the two, approximately, at .16.

Predictors. At forty eight months the predictive variables were status as control, Factor I (gestation complications), or Factor III (neonatal risk), cases, together with a perinatal social class score. Testing delay was included as a procedural check, in view of possibly excessive delays after the optimal testing period. Factor I, the disorders in mother or child in the prenatal stage, and Factor III, neonatal disorders, did not produce an abnormal performance when compared with control cases. Further, the two experimental groups did not differ from each other. The only significant finding about group membership was in the Physical domain. A statistically significant value was associated with knowledge of subjects' status in the control and experimental groups for the criterion forty eight month height. It should be pointed out that this finding touches on classification in any of the three groups of subjects, controls, Factor I (gestation factors), or Factor III (neonatal risk). The value of the knowledge was tested by assigning a common regression weight to the three classification groups. In contrast, no associations were found between social class scores and height or weight. Social class scores were, however, highly significant, as Table 38 shows, and were correlated at a high level (r = .27 - .49) with all measures in the cognitive domain. The strength of association is clear when expressed by probability

TABLE 38

MATRIX OF CORRELATIONS FOR $T_{(8)}$ GROUP AT 48 MONTHS (N = 359)

	SES	Delay	Weight	Height	Boehm	$PI_{(1)}$	$PI_{(2)}$	$PI_{(3)}$	$PI_{(4)}$	Total	Copy Forms
SES		.17**	-.06	-.06	-.39**	-.27**	-.42**	-.32**	-.49**	-.47**	-.38**
Delay			-.003	-.007	-.15**	-.05	-.13**	-.15**	-.10*	-.12*	-.06
Weight				.55**	.07	.07	.16**	.03	.11	.11*	.07
Height					.03	.05	.12*	.02	.07	.07	.06
Boehm						.62**	.63**	.59**	.67**	.73**	.50**
$PI_{(1)}$							.62**	.54**	.62**	.83**	.45**
$PI_{(2)}$								.48**	.67**	.82**	.49**
$PI_{(3)}$									.55**	.70**	.44**
$PI_{(4)}$										.89**	.66**
PI_{Total}											.64**

*p = <.05

**p = <.01

TABLE 39

SUMMARY OF SIGNIFICANT RELATIONSHIPS BY PROBABILITY LEVEL AT 48 MONTHS

Predictor	Physical Domain		Motor Domain	Cognitive Domain					
	(15 Weight	(16 Height	(17) Copy Forms	(18) $PI_{(1)}$*	(19) $PI_{(2)}$*	(20) $PI_{(3)}$*	(21) $PI_{(4)}$*	(22) PI_{Total}	(23) Boehm
Group Membership	-	.01	-	-	-	-	-	-	-
Experimental Groups	-	-	-	-	-	-	-	-	
Social Class	-	-	<.000001	<.00001	<.00001	<.00001	<.00001	<.00001	

*$PI_{(1)}$ = Preschool Inventory
Personal-Social

*$PI_{(2)}$ = Preschool Inventory
Concept Activation-Sensory

*$PI_{(3)}$ = Preschool Inventory
Concept Activation-Numerical

*$PI_{(4)}$ = Preschool Inventory
Associative Vocabulary

levels in Table 29. However, it is equally clear when expressed as decline in R^2 values in Tables 27, 28, and 29. The decline in R^2 due to deletion of social class scores is seen in the Preschool Record total score. Restricted model 4 in Table 29 has an R^2 value of .02, compared with the full model with a value of .22. The difference in R^2 values shows that ninety percent of the variance is due to social class effects. In the Preschool Inventory subtest, *Concept Activation-Sensory* (see Table 29) the decline in R^2 due to social class is also marked. Eighty four percent of the variance is due to social class scores.

In summary, two predictor effects may be seen. First, biological risk data have virtually lost their predictive value, and social class influences on cognitive attainment have become quite clear.

Criteria. The least predictable criteria are clearly those in the physical domain. They are also least influenced by the predictor series. On the other hand, the cognitive measures are fairly predictable from limited information, with the Preschool Inventory R^2 value of .22. Presumably, more extensive predictor series can give much larger accounts of criterion variance. The inter-relations of measures in this report is interesting. Boehm test scores relate quite closely to Preschool Inventory test scores; the correlations in Table 26 ranges from .62 to .73, which with over four hundred degrees of freedom, are highly significant.

Test delay is significantly related to social class (r = .17) and emerges from the difficulty encountered in tracing and testing lower class families. Test delay did not emerge as significant in the regression analysis of height and weight. It played some role in the cognitive measures. The Boehm R^2 dropped from .16 to .15 when the vector representing testing delay in weeks was dropped. One Preschool Inventory subtest, *Concept Activation-Numerical*, dropped in R^2 from .11 to .10 ($F = 4.14$, $p = .04$). The reality of the change is better represented by the R^2 value than the probability level of the F-ratio. The Preschool Inventory total score was not affected by the testing delay. The R^2 value remained unchanged, .22, after the delay vector was deleted.

An interesting finding is the lack of a significant relationship between social class and physical measures. The correlation of SES and height, and weight is identical ($r = -.06$) with the negative value showing direction favoring higher growth with *rising* SES level. However, the r-value is not great and did not achieve statistical significance. The finding is all the more interesting in view of the contrasting strong correlations between SES and cognitive attainment, all of which are significant at the .05 level, with some being at a higher level. The correlation between McGuire and White SES scores and Preschool Inventory total scores is, for example .47, which is very high for between three and four hundred cases.

FIFTY FOUR MONTHS. The hypotheses of this investigation study the effects of perinatal status and social class within a context of regression equations. The basic data are rich in a clinical sense, but when represented in the regression equations are much more restricted. Accordingly, expectations for the predictive value of regression equations should be modest. As Tables 31 to 33 show, the full regression models provide moderate accounts of raw score criteria variance. The lowest account of criteria variance by a full regression model is that provided for fifty four month weight, $R^2 = .02$. The other physical criterion, height, was predicted to an equally limited extent, $R^2 = .03$. A far more robust state of affairs obtains for the cognitive criteria. The lowest values, .14 and .15, were generated by the *Preschool Inventory* (PI) subtests *Personal-Social Responsiveness*, and *Concept Activation-Sensory*, respectively. *Copy Forms*, PI *total* scores, and *Concept Activation-Numerical* scores yielded similar R^2 values of .20, .24 and .25. The remaining PI subtest, *Associative Vocabulary*, had an R^2 value of .19. The R^2 values available for analysis in the comparison of regression models varied from substantial in the case of the cognitive measures to virtually non-existent in the case of the physical criteria.

Predictors. The problems of gathering data in a longitudinal study are many. Delays in administering tests are inclined to arise because families move; lower-class families can be hard to trace and child study may occur well after the target date for test administration. For the reason the regression model shown in Table 30 include a vector, x_6 which represents test delay. The mean delay in testing for all subjects at fifty four months was .007 weeks, which is trivial. The maximum delay for any single case was thirteen weeks. The value of the x_6 vector was tested by deleting it from the full regression model for all nine criteria. In no case was there a significant effect in predicting the criterion score due to test delay. This procedural element can be set aside in favor of the conceptual elements in the predictor series.

The role of perinatal risk in development at fifty four months was assessed by vectors representing membership in three categories of risk, Factor II (delivery complications), Factor III (neonatal complications and Factor IV (multiple complications). Factor II effects were not found for the two physical criteria. In contrast Factor II effects were found for all seven cognitive criteria in the small Factor II group (N = 11).

Statistically significant reductions in R^2 values appeared when Factor II status information was deleted from the full models shown in Tables 31 and 33. The significance is expressed by the probability level associated with the F-test value. However, the statistical model of this research activity, multiple linear regression, directs investigators' attention to an additional element, the reduction in R^2. The proportion of variance actually associated with the statistically significant findings in Tables 32 and 33 ranges from .01 to .03. The statistical significance is primarily a consequence of the degrees of freedom available. In the face of a small but statistically significant effect associated with the small number of cases a second regression analysis was performed. This analysis uses an alternate way to assess Factor II effects by using a different set of full and restricted regression models. The models employed were regression model #7 in Table 30, and regression model #[1] The comparison was made for all seven cognitive criteria. The results, presented in Table 40, were insignificant, both in the reduction of R^2 values in the probability levels associated with the F-test. The meaning of the re-examination of Factor II effects is that they are not confirmed. A lack of significance for Factor effects with 54 month criteria is consistent with the findings at earlier stages of development.

No Factor III (neonatal risk), or Factor IV (multiple complications) effects were associated with the two physical criteria, the psychomotor criterion, or with the six cognitive criteria.

The predictor, social class, based on McGuire and White social class scores, stands in marked contrast to the other pedictors. This predictor was a powerful influence in all three criterion. Deletion of social

[1]This alternate mode of comparison was developed by Dr. Steven D. Spaner

TABLE 40

RE-EXAMINATION OF FACTOR II EFFECTS AT 54 MONTHS
FOR CRITERIA (26), (27), (28), (29), (30), (31), and (32)

Model	Criterion	R^2	F	P
2.		.19		<.000001*
	(26) Copy Forms		.90	.34
7.		.19		<.000001*
2.		.11		<.000001*
	(27) $PI_{(1)}$		.59	.44
7.		.11		<.000001*
2.		.14		<.000001*
	(28) $PI_{(2)}$		1.60	.22
7.		.14		<.000001*
2.		.23		<.000001*
	(29) $PI_{(3)}$		.03	.84
7.		.23		<.000001*
2.		.17		<.000001*
	(30) $PI_{(4)}$		.10	.74
7.		.17		<.000001*
2.		.22		<.000001*
	(31) PI_{Total}		.29	.59
7.		.22		<.000001*
2.		.18		<.000001*
	(32) Boehm	.18	.01	.89
7.		.18		<.000001*

*Significance of the difference from zero

TABLE 41

MATRIX OF CORRELATIONS FOR $T_{(8)}$ GROUP AT 54 MONTHS (N = 358)

	54 Month Weight	$PI_{(1)}$	$PI_{(2)}$	$PI_{(3)}$	$PI_{(4)}$	PI_{Total}	Boehm	SES	Copy Forms
54 Month Height	.77**	.12*	.13**	.09	.10*	.14**	.08	-.10**	.11*
54 Month Weight		.08	.11*	.13**	.09	.13**	.10*	-.13**	.14**
$PI_{(1)}$			.66**	.56**	.64**	.84**	.55**	-.33**	.46**
$PI_{(2)}$				.53**	.60**	.81**	.59**	-.41**	.47**
$PI_{(3)}$					.59*	.78*	.64*	-.48**	.53**
$PI_{(4)}$						.86**	.62**	-.37**	.62**
PI_{Total}							.71**	-.47**	.62**
Boehm								-.42**	.55**
SES									-.42**

*p = <.05

**p = <.01

TABLE 42

SUMMARY OF SIGNIFICANT RELATIONSHIPS BY PROBABILITY LEVEL AT 54 MONTHS

	Physical Domain		Motoric Domain	Cognitive Domain					
	(24) Weight	(25) Height	(26) Copy Forms	(27) $PI_{(1)}$	(28) $PI_{(2)}$	(29) $PI_{(3)}$	(30) $PI_{(4)}$	(31) PI_{Total}	(32) Boehm
Factor II	-	-	-	-	-	-	-	-	-
Factor III	-	-	-	-	-	-	-	-	-
Factor IV	-	-	-	-	-	-	-	-	-
Social Class	.01	.02	<.000001	<.000001	<.000001	<.000001	<.000001	<.000001	<.000001

*$PI_{(1)}$ = Preschool Inventory Personal-Social

*$PI_{(2)}$ = Preschool Inventory Associative-Vocabulary

*$PI_{(3)}$ = Preschool Inventory Conceputal-Numerical

*$PI_{(4)}$ = Preschool Inventory Conceptual-Sensory

TABLE 43

CONTRIBUTION OF SOCIAL CLASS DATA BY R^2 VALUE AND MEAN R^2 TO PREDICTION OF CRITERIA* IN THREE DOMAINS AT FOUR AGES

DOMAIN	AGE								
	36 Months	$\bar{M}$	42 Months	$\bar{M}$	48 Months	$\bar{M}$	54 Months	$\bar{M}^1$	$\bar{M}^2$
Physical	*(1)* .01 *(2)* .03		*(8)* .03 *(9)* .01		*(15)* .002 *(16)* .00		*(24)* .02 *(25)* .01		*.014*
Motoric	*(3)* .05 *(4)* .009 *(5)* .02		*(10)* .00 *(11)* .001 *(12)* .012		*(17)* .12		*(26)* .17		*.047*
Cognitive	*(6)* .14 *(7)* .03		*(13)* .1[illegible] *(14)* .17		*(18)* .076 *(19)* .22 *(20)* .07 *(21)* .15 *(22)* .13 *(23)*		*(27)* .11 *(28)* .16 *(29)* .21 *(30)* .13 *(31)* .21 *(32)* .17		*.14*
$\bar{M}$		*.041*		*.046*		*.10*		*.13*	

*(n) = criterion number in preceding tables.
$\bar{M}^1$ = column mean
$\bar{M}^2$ = raw mean

class for the weight criterion was influential, and it was even more significant as an influence on height. Virtually the only functional element in the predictor series for Copy Forms was social class. Much the same observation may be made about the Preschool Inventory raw scores used as criterion measures, and about the role of social class scores with the Boehm criterion. The McGuire and White social class scores accounted for better than two thirds of the variance in all nine of the criterion measures. The role of social class was equally distinct for the three domains, physical attainment, psychomotor attainment, and cognitive attainment. The role of social class far outweighed perinatal status in the predictor series.

Criteria. The use of three domains of development at age four and a half years was an attempt to represent the breadth of children's attainments towards the end of the preschool period. The criteria remained as predictable as they had generally been earlier in the preschool years. The physical measures yielded unimpressive R^2 values, and did not attain statistical significance, even with substantial groups of children. The psychomotor measure, the Ernhart Copy-Forms, was moderately well predicted by the group information and by social class, and the cognitive measures were quite well predicted. The Preschool Inventory results are intended to be used as a single score, despite the format which permits separate subscores to be computed for four areas. The $PI_{(3)}$ Conceptual-Numerical area yielded the highest R^2 from the full model, $R^2 = .25$, in contrast to the other subtest scores with R^2's of .14 (PI_1), .15 (PI_4), .19 (PI_2), and .24 (PI_{Total}). A closer examinations shows that the more robust of these R^2 values, e.g. $PI_{(3)}$ and $PI_{(Total)}$ are highly influenced by social class effects. In the case of $PI_{(Total)}$ the contribution of social class to the R^2 value is .21, leaving only .03 to be assigned to other sources. In the case of $PI_{(3)}$ Conceptual-Numerical, the contribution to the criterion variance is .21 also, leaving .04 of the criterion variance to be assigned to other sources in the regression model. In the case of the Boehm criterion the results are about the same; the R^2 value of .19 is largely explained by social class (.17), leaving .02 of the variance to other sources in the regression model.

Table 41 presents correlations between the variables employed at 54 months of age. There is confirmation in the correlation matrix for the view that Preschool Inventory performance should be used as a total score, rather than as a set of subscores. The PI subtest correlations are all statistically significant, many well beyond the .01 level of probability.

The relationship between the Boehm score and the Preschool Inventory total score is high and positive (r = .71, p = <.01). Both Boehm score and the five PI scores are significantly associated with social class scores, with a spread of r values from .33 to .48; the latter correlation is for the Concept-Activation-Numerical subtest, which also has the highest correlation with the Boehm (r = .64, p = <.01). Far less robust correlations exist between length and weight and social class.

In general, the 54 month data summarized in Table 42 support the emerging picture in prior reports of perinatal status 'at risk' declining in importance in the years after birth; conversely, the influence of social class continues to rise, contributing increasingly to the proportion of criterion variance, especially for non-physical criterion measures.

Having discussed the nature of the findings at each age-level it is now appropriate to consider the age span, 36 - 54 months, and the phenomena of the period beginning with the Physical domain.

<u>PHYSICAL DOMAIN</u>. At 36 months it was possible to detect the influence of perinatal *risk* status on the domain of Physical growth. This is reasonable, since it is rational to expect that biological predictors will relate to biological criteria. However, the predictions and criteria are not precisely matched, since the *risk* predictor status are slightly different from the criteria expressed in pounds and inches. By age forty two months, however, the influence of perinatal biological risk had disappeared from the domain of physical development. Conversely, social class exerted some influence at 36 and 42 months (see Tables 35 and 37). By 48 months of age it had declined and reappeared in a modest role (p = .01, .02) at 54 months.

<u>MOTORIC DOMAIN</u>. It is helpful to point out that the measures of motoric skill were not as homogeneous as the physical criteria. They varied in two ways. First, they ranged from gross to fine with increasing age; second, they changed from heavily (though not totally) indirect measurement at ages 36 and 42 months, to direct measure at ages 48 and 54 months.

There was only one age at which perinatal *risk* information affected criterion performance. That was at age 36 months, and it appeared on the PAR *Ambulation* criterion. This influence was also seen in criterion (5), which was the sum of the two PAR motor tests. After age 36 months no effects of the risk data on motoric growth were detectable. Social class effects for PAR *Ambulation* were evident both at 36 months and at 42 months, but not for PAR *Manipulation*. At 48 and 54 month social class effects were evident on the quite precise tasks of the Copy Forms criterion.

<u>COGNITIVE DOMAIN</u>. At 36 months perinatal status information influenced the PAR *Communication* scores. A slight effect (.02) was detected on the

PPVT scores. By 42 months both effects were gone, and did not reappear. In contrast, social class effects were present in this domain at age 36 months, and proceeded to persist throughout all ages and for all cognitive measures. It is clear from the preceding commentary that perinatal *risk* data plays a small but limited role at ages three and four. The influence exists, but extinguishes relatively quickly. In contrast, the social class data, McGuire & White (1955) scores based on occupation, education, and source of income, played a far more significant role.

SOCIAL CLASS. Consideration of Table 43 shows the role of social class, expressed as R^2 values. Table 43 shows that social class effects are generally low and trivial in the physical domain. Ses effects in the motoric domain were equally slight at 36 months, but increase substantially with the four year criteria. In contrast to both of the preceding domains the effects of SES on cognitive attainment were comparatively pronounced. SES effects were relatively substantial at age three and increased their contribution at age four.

Examination of column and row mean R^2 values in Table 43 shows SES effects by specific ages, and by domains. At each age level the mean R^2 values due to SES effects for all three criterion domains are shown. The SES effect within the regression models is very low at age 36 months, mean $R^2 = .041$. At age forty two months it increases slightly to $R^2 = .046$. At age 48 months it jumps substantially to $R^2 = .13$. These values should be evaluated within the context of limited regression models which yield correspondingly low R^2 values. Thus, the column R^2 mean values in Table 43 are proportionately higher than they would seem. The trend to clearly emerged SES influences by age three and four is evident.

It can be seen that perinatal *risk* data, information in traditional biological formulations, plays a modest role in the attainment of three and four year olds at best. This view should be mediated by recalling the nature of the risk data. The range of degree of risk in the predictor series is wide. The reason was that moderate and mild risk are present in children, as well as high risk. In this latter category there is an abundance of information, as Part Two of this report and the Bibliography demonstrate. The contribution of categorical risk, i.e., prenatal, -natal and postnatal risk at all degrees permits some attenuation of effects. On the other hand, there is little evidence on the outcomes of apparent mild risk, while high risk is so well investigated that no real urge to inquire into its isolated effects seems justified.

The combination of social class and risk factors in a study population is combined, to some extent. At age three the correlation between social class and Factor I (prenatal) risk is .31 ($p = < .01$), while the correlation between Factor III (perinatal) risk and SES is .21. Accordingly, the probability arises that putative risk assigned to biological data may, in fact, be largely attributable to social effects. That is, the presence of risk and identified disability may emerge from adverse social effects. This observation is supported by the Kauai Longitudinal Study of Werner, Bierman, and French (1971). Their Hawaiian data led to the conclusion that the contribution of a poor environment was ten times greater than that of "serious perinatal stress," as they expressed it.

What remains is to elucidate the nature and course of development in the early years. That enterprise should identify the ages and stages most conducive to intervention and rational planning of salutary experiences for the very young.

Part Six

PART SIX

DISABILITY STATES

INTRODUCTION. The program of studies from which this report emerges has as its object the study of the contribution of early social and biological adversity to learning characteristics in school age children. Within that broad assertion are a number of subordinate propositions, one of which is assessment of disability states at the end of the preschool years. A knowledge of the nature and correlates of disabilities can contribute to instructional planning in the school entry years.

The nature of difficulties which children show at age four is not self-evident. The writer believes that we need to distinguish a series of separate conditions in children (Jordan, 1962). The first is *disease*, referring to tissue-level problems in children, some of which are mild and perhaps of merely aesthetic significance. The instances of this condition are illustrated by mild visual disorders in girls, who dislike wearing glasses, or in a more serious degree by the loss of hair in a girl after an acute illness. Such difficulties need not interfere with learning or living.

The second term is *disability*, and it refers to interference with life processes. Again, the condition may have minor or major significance. An example is loss of a limb; a farm child who loses his left arm in a farm accident, and there are such children, is incapable of a number of motor activities which are basic to his life style. The term *disability* connotes loss of a normal body activity. It's evaluation depends on contextual factors, losing use of the left hand is far less critical than loss of right-hand functions.

Finally, there is the term *handicap*, which the writer uses (Jordan, 1971c) to describe the tissue and disability states which manifestly disrupt the teaching/learning process. A condition becomes an *instructional handicap* when it interferes with expected classroom functioning.

The three-term nomenclature presented here moves from tissue to classroom function, with increasing attention to the instructional context. It follows that children's problems at age four can be described as *disability states*, because they have been assessed in a context of home life. They may or may not be at the tissue-level; they cannot be interpreted automatically as instructional handicaps. That determination will be made in a context of learning and teaching, a very different context from that used in this investigation because behavioral expectancies are quite different.

The basic intent of this three-term nomenclature is to distinguish problems of priority concern for instructional planning from problems in the most general sense. There is ample reason for doing so. Scholarship generally tends to generate new terms on the basis of an explicit set of ground rules, *vide* principles of taxonomy in biology and trans-uranic physics. In medicine the condition *appendicitis* was not introduced until 1886 (Crichton, 1971), although a variety of acute abdominal signs had been observed for centuries. In contrast, education has not been intellectually self-conscious and conservative. The term *learning disability* has at least three connotations none of which is explicit except to the person using the neologism. Equally dangerous is the introduction of terms which turn out to be non-existent (Rutter, Graham, & Birch, 1966), a form of innovation which has endless possibilities (Jordan, 1971d).

The solution is, of course some eight hundred years old, and consists of unsheathing Occam's Razor when nominalism appears in modern dress.

On the basis of the foregoing it can be seen that the writer's study of problems in four year olds is a consideration of disability states. Problems identified in the context of repeated clinical case studies in the home do not automatically constitute learning handicaps. The materials to be presented should be construed as reflecting the preceding considerations.

PROBLEM. The object of the study reported in this section is description of the incidence and correlates of disability states.

Attempts to study the incidence and nature of problems in school children have been reported in recent years by Sapir and Wilson (1967), Haring and Ridgway (1967), and Keogh & Smith (1970).

Sapir and Wilson (1967) applied a developmental scale composed of ten psycholinguistic, motor and orientation tasks to a population of young children. The developmentally oriented scale successfully identified salient deficits, which were related to subsequent instructional problems in the first two years of schooling.

Haring and Ridgway (1967) took a larger population, 1200 children, beginning with ratings of children made by their teachers. A sophisticated battery of diagnostic tests was administered. ITPA subtests produced useful results, and several other nominally instruction-related diagnostic tests produced relatively little useful information. General language ability seems to have been the most useful factor in the complex of tests.

Keogh and Smith (1970) studied identification of learning problems by means of the Bender-Gestalt test. The scale was used to identify

TABLE 44

INCIDENCE OF PROBLEMS INDICATED BY THE DISABILITY SCREENING CHECKLIST AT AGE FOUR YEARS

(N = 810)

		Visual Disorders	Hearing Disorders	Mental Retardation	Experiential Deprivation	Motor Disorders	Behavior Disorders	Speech Disorders
	N	%	%	%	%	%	%	%
Control Cases	405	.02	.00	.03	.11	.01	.04	.10
Experimental Factor I Cases (prenatal risk)	101	.00	.01	.02	.21	.01	.04	.08
Experimental Factor II Cases (delivery risk)	12	.08	.00	.00	.33	.00	.00	.17
Experimental Factor III Cases (neonatal risk)	215	.02	.00	.03	.12	.00	.06	.12
Experimental Factor IV Cases (multiple risk)	77	.03	.00	.06	.19	.03	.10	.16
All Cases	810	.02	.00	.03	.14	.01	.05	.11

TABLE 45

MATRIX OF CORRELATIONS FOR DISABILITY SURVEY DATA

	Race (B)	SES	Visual Disorder	Hearing Disorder	Mental Retardation	Experiential Deprivation	Motor Disorder	Behavior Disorder	Speech Disorder
Sex (M)	-.01	-.02	.009	.02	-.02	-.004	-.04	.03	.15**
Race (B)		.57**	.004	-.01	.07*	.36**	.002	-.01	-.07*
SES			.02	.002	.07*	.31**	.03	.04	.04
Visual Disorder				-.009	.13**	.05	.18**	.008	.10*
Hearing Disorder					-.01	-.02	-.006	-.01	.05
Mental Retardation						.18**	.06	.17**	.26**
Experiential Deprivation							.08*	.03	.09*
Motor Disorder								.04	.06
Behavior Disorder									.22**

*p = <.05
**p = <.01

children at *risk* of learning difficulty. Interesting findings from this study were that evidence of low risk was a better predictor than high risk, and that statements made at kindergarten level were useful predictors at fifth grade.

All of these efforts came after children are enrolled in the mechanisms of instruction. What is called for is data in advance of need which will give early warning of problems and will estimate the extent and nature of problems. This section addresses itself to the second of these needs.

METHOD. The ascertainment of disability states was tied to data collection procedures at 48 and 54 months. Caseworkers administered the criterion test series to the cooperating probands at study periods eight (T_8) and nine (T_9). This testing was a repeat of child study at previous times and was often part of continued study by the same examiner over several years. Directions called for completion of a questionnaire immediately after test administration and scoring, and with the full developmental history (excluding perinatal *risk* status) available. Examiners were urged to see the four-year criterion measures as a controlled experimental situation providing information for a *Disability Screening Instrument* (DSI).

The categories of behavior assessed by the disability screening pro cedure are as follows:

1. Category Visual Disorders. Score yes for children reported by Mother as having visual problems and for children who, in the testing situation, showed visual limitations, e.g. wore glasses or held materials close to their eyes.
2. Category Hearing Disorders. Score yes for children reported by

Mothers as not hearing (not inattentive), or showing difficulty hearing in the testing situation.

3. Category Mental Retardation. (Score yes for children scoring low on tests of cognitive attainment.)

4. Category Experiential Deprivation. Score yes for children with STIM score 26 and below, or when you feel there are significant restrictions on child experiences, e.g., a clearly disorganized home run by an inadequate mother.

5. Category Motor Disorders. This category is meant to record children with obvious muscular problems, crippled children. Score yes for obvious defects.

6. Category Behavior Disorders. Score yes for abnormal behavior, more than five year old's awkward and defensive behavior.

7. Category Speech Defects. All Five year olds have some speech defects. Score yes for children who have speech which is not easy to understand. Ignore simple consonant substitutes such as wabbit for rabbit.

FINDINGS. Table 44 lists the incidence of disability states in the 1966 birth cohort at age four. Ages 48 and 54 months were combined. The six month difference in developmental age was not considered a crucial piece of information likely to influence reporting disability states. In Table 44 percentage figures are given for seven disability states. The percentages are reported in terms of perinatal *risk* status, the independent variable of the entire investigation, and for all subjects.

Data were reported on 810 children at age four. In 405 control (low risk) children the incidence of apparent hearing problems was zero.

Motor problems were next in order of rarity (1%), followed by vision problems (2%), mental retardation (3%), and behavior disorders (4%). A distinctly higher rate of incidence sets apart the remaining conditions. Significant speech disorders were encountered in ten percent of the four year-olds, and experimental deprivation was reported in eleven percent.

For the Factor I (gestational risk) the figures in 101 four year olds were slightly lower, by one percent, in most categories. One disability state, experiential deprivation, however, was much more common in Factor I cases. The incidence of reported experiential deprivation was 21%.

The small number of Factor II (delivery complications) makes use of incidence figures unreliable. In this group of twelve children there were no reported cases of hearing problems, mental retardation, motor disorders, or behavior disorders. In contrast, the incidence of vision problems, one case, was high; speech disorders were more common in this small group of children (17%) than in any other. Finally, as Table 44 shows, the incidence of experiential deprivation was also the highest reported - 44% - which is one child in three.

The Factor III (neonatal risk) group was substantial with data reported on 215 children. No hearing or motor disorders were reported. Visual and intellectual problems were quite low, two and three percent, respectively. There was a six percent incidence of behavior disorders, and the highest incidence figures arose from experiential deprivation and speech disorders, twelve percent in each category.

In seventy seven Factor IV (multiple complications) cases the only unreported category was hearing disorders. Three percent incidence was reported for vision and motor problems, both of which were the highest incidence, except for the small Factor II group. Mental retardation was reported in six percent of the Factor IV children at age four years. Much higher incidence of the remaining categories was reported; ten percent incidence of emotional disorders, sixteen percent incidence of speech problems, and an incidence of nineteen percent for experiential deprivation were ascertained.

The last row in Table 44 combines the incidence figures for eight hundred and ten children. The incidence figures are very similar to those for the controls, who constituted exactly fifty percent of the reported cases.

Most consistently deviant were the Factor IV (multiple risk) probands, amounting to seventy seven cases. The incidence of mental retardation was double the figure for the controls, six versus three percent. Motor disorders were three times as common, three versus one percent. Behavior disorders were two to three times more common in multiple risk children than in control cases, ten versus four percent. Speech disorders were half again as common, sixteen versus ten percent.

Closest to the controls were the Factor I (gestational risk) and Factor III (neonatal risk) probands. In the Factor I group the incidence of experiential deprivation, however was double the control group's incidence figure.

DISCUSSION. The first observation which may be made is that there is clear significance in some if not all perinatal risk data. In particular, knowledge that there have been multiple complications (Factor IV) predisposes children at age four to intellectual and behavior disorders. For all risk groups there is associated probability of experiential deprivation. It is least for the Factor III cases, but is roughly doubled for the substantial Factor I and IV groups of children.

The incidence of experiential deprivation at age four is alarming. For controls it is on the order of eleven percent, meaning one child in ten of this population is growing under adverse family circumstances of maternal deprivation or in a setting whose structure is inadequate. Setting aside the small Factor II group we see a still higher incidence in the Factor I and Factor IV cases. Given the high incidence of several problems in the Factor IV (multiple complications) probands it is disturbing to see that one in five (19%) is growing under adverse environmental circumstances.

Table 45 indicates the extent to which disability states are related to race and social class, and to each other. It is helpful to note that race and social class are highly correlated in the group of four-year olds ($\underline{r} = .57$, $p < .01$). This arises because most black subjects are lower class and 42% of the probands are black. Race itself turns out to be connected with the disability states mental retardation and speech disorder to a low but statistically significant extent ($\underline{r} = .07$, $p < .05$). The statistical significance is marginal, and due to the high number of degrees of freedom. In contrast, the correlation of race/experiential deprivation is substantial, and accordingly statistically significant ($\underline{r} = .36$, $p < .01$). As in the relationship with social class the connection is not surprising. It is however, regrettable, since it puts the population of black children clearly at *risk* in the social sense. Sex, being a boy, is associated with only one disability state, speech problems ($\underline{r} = .15$, $p < .01$).

The disability states tend to be largely independent of each other. The most statistically sound connection is between mental retardation and speech disorders ($\underline{r}$ = .26, p <.01). The next most common is speech disorders and behavior disorders ($\underline{r}$ = .22, p <.01), a connection the writer has discussed extensively elsewhere (Jordan, 1972). The third most robust pairings are the connection between mental retardation and experiential deprivation ($\underline{r}$ = .18, p <.01), and visual disorders and motor disorders ($\underline{r}$ = .18, p <.01). This is followed by mental retardation and behavior disorder ($\underline{r}$ = .17, p <.01).

It is worth noting that the disability state most consistently associated with other disability states is speech. The strength of the relationship to other states is not large, with correlation coefficients no higher than .26. However, the connection is extensive and involves all seven disability states except visual disorders. It is helpful to recall the eleven percent incidence figure for all eight hundred and ten children given in Table 44. Special problems constitute a pervasive and connecting element in the nexus of disability states in young children.

The general observation emerges that a population of low biological risk four year olds contains a number of children with significant problems. When a contrast group of perinatal *risk* children is studied a more acute picture of problems of potential significance for schools emerges. The range of incidence figures is generally highest for experiential deprivation, speech problems, and behavior disorders.

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