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The Effectiveness of Perinatal Behavioral Assessments in Predicting Preschool Intelligence

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THE EFFECTIVENESS OF PERINATAL BEHAVIORAL ASSESSMENTS IN PREDICTING PRESCHOOL INTELLIGENCE

by

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VITA

The author, James Stephen Gyurke, is the son of James M. Gyurke and Rita Louise (Zuzik) Gyurke. He was born July 13, 1960 in Greensburg, Pennsylvania.

His elementary education was obtained at Saint Pius X School, Mount Pleasant, Pennsylvania, and secondary education at Father Geibel High School, Connelsville, Pennsylvania, where he graduated in 1978.

In September, 1978, he entered Saint Vincent College, Latrobe, Pennsylvania, and in May, 1982 received the degree of Bachelor of Arts Summa Cum Laude, with a major in psychology. While attending Saint Vincent College, he was on the Dean's list for four years. In 1982, he received the Psychology Excellence award for being the outstanding graduating senior in the department, the Saint Vincent College Distinguished Service Award for exemplary service to the college community, and the Sarah Carr McComb Scholarship for outstanding scholarly and community service. In addition, he was also elected to Who's Who Among American Colleges and Universities.

In September of 1982 he was granted an assistantship in developmental psychology at Loyola University of Chicago.

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INTRODUCTION

Psychologists have long been interested in the predictability from infant intelligence tests to later intellectual development. This interest originally stemmed from concern over the psychometric properties of these tests. After the flurry of test development in the 1930's, concern with predictive validity was so great that, no matter how well standardized or reliable the test was, without predictive validity it was doomed to obscurity (Brooks-Gunn and Weinraub, 1983). From the 30's to the present, the concern with predictive validity of infant assessments has remained high. The present research is a further examination of the issues surrounding infant assessment.

Some of the earliest attempts at establishing the predictive validity of these assessments were performed by Nancy Bayley, one of the pioneers in the field of infant assessment. In one of the earliest predictive validity studies, Bayley used California Mental Scale scores averaged over the 7th, 8th, and 9th months to predict scores obtained at 2 years. With her sample of 61 upper-middle-class, normal children, Bayley obtained a correlation of only .22 between these two measures (Bayley, 1933).

Another mental test employed in these early validity studies was the Iowa Test for young children (Fillmore, 1936). In an attempt to establish the predictive validity of this scale, Fillmore examined a large number of home reared children and found a correlation of .26 between scores obtained at 5½ months with those obtained at 18½ months (Fillmore, 1936).

One of the most innovative approaches at addressing this question of validity was taken by Anderson (1939). In her work, Anderson attempted to predict 5 year Stanford Binet IQ from a test composed of the most predictive items from the Gesell, Buhler, and Linfert-Hierholzer. The obtained correlations between this composite measure and the 5 year IQ score were small and nonsignificant (Anderson, 1939). Based on the findings of these and other early studies of predictive validity, the outlook for infant mental tests was poor.

Following the disappointing results of this round of psychometric interrogation in the 30's the focus turned to improving and modifying the existing infant intelligence tests. Cattell, one of the leaders of this movement, designed the Cattell Infant Intelligence Scale for just this purpose. This scale offered statistical and conceptual improvements over the Gesell scales from which it was patterned; however, the Cattell Scale was found to have no more predictive validity than the tests of the 30's. Cattell (1940) in an effort to predict 3 year Stanford Binet IQ scores from 3 month Cattell scores for a sample of 274 middle-class children found a dismal correlation of .10. Similar results were obtained with another new infant test, the Griffiths Scale of Mental Development (Griffiths, 1954). The Griffiths Scale drew heavily from the Gesell and was standardized on a sample of 574 British children. Hindley (1960) provided the predictive validity information for this test when he studied the correlation of scores obtained at 3 months with those at 12 months in a stratified sample of 108 British children. The results of this study were very discouraging; the correlations between 3 and 12 month scores were found to be small and negative.

While new tests were being developed, researchers were continuing to attempt to establish the predictive validity of the older tests. Using modified procedures and predicting over shorter periods of time these attempts were, like earlier attempts, unsuccessful. Bayley (1940) in a study employing the California Scales, looked at the relationship between scores obtained at 1, 3, and 4 months and those at 18 months. She found small negative correlations between these two sets of scores. In a study of 144 adopted children, Wittenborn and his colleagues (1956) found that a modified version of the Gesell could not significantly predict preschool Stanford Binet scores. And finally, Escalona and Moriarty (1961) reported near 0.0 correlation between Gesell scores of 58 normal children and the WISC scores of these children at school age.

It is quite evident from these studies that for a general, unselected sample, test scores obtained during infancy have little predictive validity for standardized IQ scores obtained during the preschool years and later. This conclusion is supported by Bayley (1969) who commented that test scores obtained in the first two years of life have relatively little predictive validity, and that there is probably more to be learned for predictive purposes from assessments of neurological and physical functioning.

Despite the failure of infant intelligence tests to predict later IQ in normal, unselected samples, and the indictment leveled against them by Bayley, interest in these measures has remained high, with a slight change of focus. The focus has now shifted to the use of these measures within high risk samples. The reason for this shift can be traced to the recent changes in medical care. The last two decades has seen a dramatic change in the nature and delivery of pediatric care, resulting in a number of infants surviving an extremely distressed labor and delivery (Hunt, 1981; McCall, 1983). With this new population of survivors comes the question of their developmental outcome; more specifically, are these infants at risk for developmental delay?

One of the first attempts at addressing this problem was a longitudinal project by Cavanaugh, Cohen, Dunphy, Ringwald, and Goldberg (1957). In this study Cavanaugh et al. examined the relationship between 6 month Cattell Infant Intelligence Scale scores (CIIS) and later Stanford Binet IQ scores for a group of infants born at risk. Analysis of variance and Pearson r analyses revealed that 6 month CIIS scores were not predictive of either 3 or 4 year Stanford Binet IQ scores.

A more recent longitudinal study by Hunt (1981) has obtained similar results. Data were collected on 114 high risk infants born at or below 1500 grams. Hunt collected a variety of medical, psychological, neurological, and sociological measures on these children. Two results of this study merit special attention. First, test scores obtained at 6-12 months were not predictive of those obtained at 2-3 years, adding further evidence to the indictment that infant intelligence tests are poor predictors of later IQ. The second result of interest is that environmental and behavioral measures, when added to the regression equation predicting later IQ, increase the predictability of this equation. This finding will be dealt with more thoroughly in a future section.

Up to this point it has been shown that the available infant intelligence tests possess little predictive validity for later IQ scores in both normal and high risk samples. A number of possible explanations have been offered to account for the lack of predictability of these early assessments. McCall, Hogarty, and Hurlburt (1972) have suggested that the problem lies in the basic concept of "intelligence." They suggest that intelligence not be viewed as a pervasive and unchanging characteristic which governs an individual's performance at all ages. Rather, intelligence is a qualitatively changing entity and, in infancy, the term "mental performance" should be abandoned in favor of something more neutral, such as Piaget's "sensorimotor performance." This explanation, though theoretically sound is of little empirical value since it offers no hypothesis as to when performance does become mental; and, whether there are periods of transition when behavior can be both mental and non-mental.

A second possibility is that infant tests may be too simple. Harris (1983) has stated that most infant tests rely on easily administered items which focus on easily codable motor or vocal behavior. He suggests that instead infant tests should attempt to measure higher order cognitive behaviors (e.g., habituation, orientation, etc.). Attempts at introducing such items into standardized testing have produced mixed results. Kagan, Kearsley, and Zelazo (1978), assessing a group of infants at 3½ and 5½ months using a visual fixation task, found no relation between performance on this task and 29 month Bayley scores. On the other hand, Fagan and McGrath (1981) have found that recognition memory scores at 4 months, as measured by mean percent of total fixation to novel targets, significantly predicted vocabulary IQ scores at 4 and 7 years of age. These mixed results warrant further study, but at this time, provide no conclusive evidence to support the claim that infant sensorimotor intelligence tests are too simple to measure cognitive behavior.

A third, and possibly more plausible explanation is that infancy is the period of greatest change and that at no other time during the course of the child's life will the environment impact as significantly upon performance (Sigman, Cohen, and Forsythe, 1976). This fact has been discussed at length by Sameroff and Chandler (1975) and forms the basis for their transactional model of development. This theory suggests that, when attempting to predict from one point in time to another, a number of factors can influence the course of development and affect one's ability to predict. Specifically, the environment and the child transact over time. It is necessary that in order to identify continuity from infant assessments to later intellectual assessments the infant, the environment, and the transaction of the two must be taken into account. As will be seen, this is where the field of infant assessment is heading.

Because standardized infant intelligence tests have failed to provide much in the way of prediction for later intellectual development in either general unselected samples or, more recently, a high risk sample, researchers have turned to other assessment procedures. Using these procedures, either alone or in combination, researchers hoped that they might gain some early indication of later intelligence. The assessments that replaced infant intelligence tests focused on the medical and physical condition of the organism. It has been demonstrated that the physical well being of the infant bears an important relationship to later intellectual capacity (Lubchenco, Papadopoulous, and Searles, 1972). Medical complications during gestation and the postnatal period resulting in a high risk infant greatly affect the quality of development months and even years after delivery. Measures such as the Obstetrical Complication Scale (OCS) (Littman and Parmelee, 1974), a 41 item scale designed to identify complicating factors in the maternal history; the Parmelee Postnatal Complication Scale (PCS) (Littman and Parmelee, 1974), a scale designed to identify the perinatal, pregnancy, and neonatal events impacting upon the infant; and, various types of neurological assessment procedures, have all been employed in attempts to identify those environmental and idiopathic factors that influence later intellectual development.

In an attempt to correlate developmental outcome with medical complications of the prenatal, intrapartum, and postnatal periods, Littman and Parmelee (1978) followed a group of 126 preterm infants prospectively from birth to 2 years of age. Using the OCS and PCS scales, these authors attempted to predict Bayley scores at 18 and 24 months. No relationship was found between these OCS and PCS scales and later Bayley scales suggesting that neonatal complications are more insult than injury, and that the relationship between early factors and later developmental outcome may be more complex than originally thought.

Similar results were obtained by Cohen and Parmelee (1983). Examining the relationship between OCS and PCS scores and 5 year Stanford Binet IQ in a group of 100 preterms, Cohen and Parmelee found that neither of these two measures significantly predicted 5 year IQ. In addition, these authors employed the Parmelee Newborn Neurological Examination (Howard, Parmelee, Kopp, and Littman, 1976), as a measure of neurological integration at birth. This measure, like the OCS and PCS was not predictive of 5 year Stanford Binet IQ. Other research (Ireton, Thwing, and

Gravem, 1970) employing neurological assessments as predictors of later intellectual development lends support to this finding.

The failure of individual perinatal medical measures has led to the use of risk systems (Parmelee, Kopp, and Sigman, 1976). A risk system is a composite of a number of medical measures that provide an overall risk score for the infant. This risk system approach was employed in a study by Parmelee et al. (1976) in which they utilized the OCS, PCS, and the Newborn Neurological Exam in hopes that this system would more accurately identify those infants at risk for later developmental delays. The results of this study, presented as individual case studies, suggest that for a given individual this approach has more merit than the traditional approach of employing individual measures to predict later development. However, a later study (Sigman, Cohen, and Forsythe, 1981) employing this risk system approach for a sample of 100 preterm infants found that this risk score provided little improvement over single medical or neurological measures suggesting that the risk system approach may be more effective on an individual basis than for group predictions.

The results of these studies demonstrate that perinatal medical measures, either alone or in combination, are no more effective than infant intelligence tests at predicting later intellectual development. These findings can be generalized to those infants which have not been severely distressed at birth. It has been shown that those infants which suffer extreme damage at birth have their range of potential development severely limited. A very likely explanation for the findings of those studies using less stressed infants is that neonatal condition is related to outcome in complex ways, as was suggested earlier. When considering this relationship one must take into account those behavioral and environmental variables such as child-caregiver interaction (Beckwith, Cohen, Kopp, Parmelee, and Marcy, 1976), parent education, and race (Hunt, 1981), which may influence the course of development in these high risk infants.

Because neither standardized infant intelligence tests nor perinatal medical measures predict later IQ scores for high risk samples, researchers have been forced to turn to other types of assessments in search of early measures which may predict later intellectual development. This search has led them to consider behavioral assessments. Conceptually, the behavioral assessment model offers a break from traditional models. Behavioral assessments examine the infant's efforts to control his or her own environment (Lester, 1983), a dimension not considered in other assessment models. Because of this consideration of both the infant and the environment, behavioral assessments appear to be an improvement over traditional models.

Much of the work to date using behavioral assessments has concentrated on their effectiveness in clinically normal samples. Two of these assessments, the Brazelton Neonatal Behavioral Assessment Scale (BNBAS) (Brazelton, 1973), and behavioral state observations, have received much of the attention.

A recent study by Nugent, Greene, and Brazelton (1984) in which they examined the relationship of 1 and 3 day scale scores and Stanford Binet IQ scores at 3 years in a homogenous sample of full-term, Irish infants, obtained significant prediction between these two measures. Specifically, scale scores on the orientation, range of state, and habituation clusters (Lester, 1982) significantly predicted ($r = .60$, $p < .004$) 3 year Stanford Binet IQ. Similarly, Scarr and Williams (1971) have found a significant relationship between 1 and 4 week BNBAS scores of low-birthweight infants and 1 year Cattell DQ scores for these same infants. Though obtaining significant prediction, it should be noted that the length of time between the two testings is short enough that the principle components of behavior may not have significantly changed during this time. These studies indicate that behavioral assessments may have long term predictive validity for a normal sample. Further, these studies also demonstrate the predictive validity of these assessments for up to 1 year in a high risk sample. The question that remains unanswered is the long term predictive validity of these measures for a high risk sample.

The other behavioral measure that has received a great deal of attention is behavioral state. State organization has been associated with maturational level of the organism (Tanquaray, Ornitz, Forsythe, and Ritvo, 1976), neurological integration of the organism (Thoman, Denenberg, Sievel, Zeidner, and Becker, 1980), environmental influences (Brazelton, 1973), and with future developmental delays (Petre-Quadens, 1971).

Thoman et al. (1980) have used a state profile in identifying infants at risk for developmental delays. Twenty-two healthy infants were observed for 7 continuous hours on weeks 2, 3, 4, and 5. From these observations Thoman and her colleagues computed the percentage of time spent in each of the behavioral states during each observation period, resulting in a profile of the infant during that observation. These profiles were then analyzed for consistency using an analysis of variance procedure. This ANOVA procedure utilized two sources of variance: Between States and the interaction of States x Weeks. Thus the more similar the profile from week to week the larger will be the Between States mean square and the smaller will be the mean square for States x Weeks. From this analysis an F ratio for each infant was obtained and used as descriptive statistics to indicate relative degree of profile consistency--how parallel the profile curves are for each infant. Using this F ratio to predict 6 and 30 month Bayley scores, Thoman et al. found that those infants with low profile consistency also had low DQ's, thus suggesting a relationship between state organization and later intellectual development.

This review of the literature suggests that infant intelligence tests have little predictive validity for later intellectual development in either normal or high risk samples. Similarly, perinatal medical measures, either alone or in combination, are no more effective than infant intelligence tests at predicting later IQ. On the other hand, behavioral measures do offer some hope. The long term predictive validity of behavioral assessments has been established for normal samples but not for high risk samples. Thus the question remains: are behavioral assessments predictive of intellectual development over an extended period of time for a high risk sample.

This research will attempt to establish the long term predictive validity of perinatal behavioral assessments. Specifically, the Brazelton Neonatal Behavioral Assessment Scale and assessment of behavioral state will be used to predict 39 month Stanford Binet IQ scores in a sample of normal and high risk infants.

METHOD

Subjects

The sample consisted of 43 infants: (a) 11 preterms (PT), (b) 10 fullterms in intensive care (FT/ICN), (c) 7 fullterms with sick mothers (FT/M), and a control group (d) 15 healthy fullterms (FT). These infants were part of an ongoing longitudinal project at Evanston Hospital, Evanston, Illinois. All infants were from middle to upper middle-class, intact families, had appropriate prenatal care, and were without known damage to the central nervous system. The preterm infants were less than 37 weeks gestational age; fullterms were 38 to 42 weeks gestational age - all by the Dubowitz assessment (Dubowitz, Dubowitz, and Goldberg, 1970). All infants were of weights appropriate for gestational age. Precise demographic data are provided in Table 1.

Measures and Procedures

Two perinatal behavioral measures, the Brazelton Neonatal Behavioral Assessment Scale (Brazelton, 1973) and behavioral state observations, and one preschool intelligence measure, the Stanford Binet Intelligence Test Form L-M (Lewis and Terman, 1972) were employed in this study.

The BNBAS is a behavioral examination designed to evaluate the quality and organization of higher level functions

TABLE 1

Descriptive Statistics of Sample: Means and Standard Deviations

VARIABLE	Group 1 (PT)	Group 2 (FT/ICN)	Group 3 (FT/M)	Group 4 (HFT)
Sex				
Male	7	4	5	6
Female	4	6	2	7
Gestational Age (weeks)				
$\bar{X}$	33.36	39.60	40.14	40.46
SD	2.11	1.58	0.69	0.88
Birth Weight (grams)				
$\bar{X}$	2096.18	3125.70	3565.57	3483.23
SD	616.97	474.47	414.67	387.17
Length of Hospitalization (days)				
$\bar{X}$	20.91	13.20	7.28	3.85
SD	11.96	9.75	2.05	1.57
1 Minute Apgar				
$\bar{X}$	6.82	7.00	8.86	8.08
SD	1.72	2.40	0.38	1.75
5 Minute Apgar				
$\bar{X}$	8.27	8.70	9.14	8.54
SD	0.79	0.48	0.38	2.63

(table continues)

TABLE 1 (continued)

Descriptive Statistics of Sample: Means and Standard Deviations

VARIABLE	Group 1 (PT)	Group 2 (FT/ICN)	Group 3 (FT/M)	Group 4 (HFT)
Obstetrical Complication Scale				
$\bar{X}$	90.09	106.90	89.28	116.46
SD	11.42	25.50	20.36	28.96
Postnatal Complication Scale				
$\bar{X}$	80.18	82.90	160.00	151.38
SD	9.99	12.09	0.00	21.03

in the newborn (Brazelton, Als, Tronick, and Lester, 1979). The exam consists of 26 behavioral items and 20 elicited reflexes which assess neurological organization.

The BNBAS was administered according to standard procedure to each infant by one of two trained examiners (D.L.H. and J.N.R.). Each exam was performed in a small procedure room adjoining the nurseries at a point approximately midway between feedings. Following administration, the scale was summarized into seven clusters (Lester, Als, and Brazelton, 1982): orientation, response to animate and inanimate stimuli and overall alertness; habituation, response decrement to repeated auditory, visual, and tactile stimulation; motor cluster, integrated motor acts and general muscle tones; range of state, the rapidity, peak, and lability of state changes; regulation of state, infant's efforts to control state; and autonomic regulation, signs of physiological stress seen as tremors, startles, etc. The seventh or reflex cluster is the sum of deviant reflex scores, where higher scores signify a greater number of deviant reflexes. To derive the six behavioral clusters, the curvilinear scale items are rescored as linear (Lester et al., 1982). The cluster score is the mean of the rescored items that define the cluster, with higher scores denoting better performance. Though this scoring procedure has recently come under question (Jacobsen, 1984), it was chosen for its effectiveness in other research projects of this nature (Nugent, Greene, and Brazelton, 1984).

The other perinatal measure obtained was behavioral state observations. These observations were obtained on each infant within 48 hours of discharge so as to provide an assessment of the infant's state organization at the time he was to be discharged from the hospital. The infants were observed in their usual location in their respective nurseries by a single observer who sat beside the infant's open crib. The length of each observation was planned for 9 hours per day per infant; however, due to interruptions (i.e., feedings, medical interventions, etc.) the mean length of observation time for the infants was 5.73 hours. During each observation period an observer (who was trained to a 90% reliability level) continuously recorded the infant's predominant state in 10 second intervals, except when a parent or hospital staff member interacted with the infant. During any such interaction, observation was discontinued until 10 minutes after the interaction terminated.

The state categories utilized in this study were defined solely on the basis of behavioral criteria that could be directly observed. The seven states were:

NO-REM: SLEEP. The infant's eyes were closed and still. Little or no motor activity was noted (i.e., no more than a slight startle or limb movement).

ACTIVE: SLEEP (without REM). The infant's eyes were closed and still, but motor activity was present (i.e., limb movements, non-nutritive sucking).

REM SLEEP. The infant's eyes were closed (they may have opened briefly), and rapid eye movements occurred during the 10 second epoch. Motor activity may or may not have been present.

DROWSY. The infant's eyes may have been partially open or fully open but dazed in appearance without focusing. Rapid eye movements and motor activity may or may not have been present.

ALERT: INACTIVITY. The infant's eyes were wide open, focused, bright, and shining (Wolff, 1966). Motor activity was absent except for that involved with the infant's looking behavior (i.e., head movements while following object with eyes).

ALERT: ACTIVITY. The infant's eyes were wide open and motor activity was present.

CRYING. The infant's eyes may have been opened or closed, and motor activity was usually present. Agitated vocalizations (i.e., fussing or crying) were present.

The percentage of time in each of these states was computed and used to calculate percent total sleep (percent total sleep = % NO REM SLEEP + % ACTIVE SLEEP (without REM)

+ % REM SLEEP), percent total awake (percent total awake = 100 - percent total sleep), percent cry (percent cry = % CRYING/percent total awake), and percent drowsy (% DROWSY/ percent total awake). The percent of time spent in each state, rather than absolute time, was calculated since the length of observation time for each infant varied due to interruptions; thus, this was a form of prorating. In addition, rather than using the percentage of time spent in each individual state to predict 3 year IQ, four variables: percent total sleep, percent total awake, percent cry, and percent frowsy, were calculated so as to better capture the quality of the infant's behavior. Three of these computed variables, percent total sleep, percent cry, and percent drowsy, were used as predictor variables in a regression analysis.

At 39 months corrected age (X = 39.32 SD = .562), the Stanford Binet Intelligence Test Form L-M (Terman and Merrill, 1972) was given to each child by one trained examiner (J.G.). It should be noted that this examiner (J.G.) was blind to each child's previous history so as to avoid any possible bias that may have resulted from this knowledge.

RESULTS

Two separate regression analyses, one stepwise, the other forced entry, were completed. The stepwise regression used habituation, orientation, range of state, reflexes, autonomic stability, percent total sleep, percent drowsy, and percent cry as independent predictor variables, and 39 month Stanford Binet IQ scores as the criterion variable.

As can be noted from Table 2 the correlations between these predictor variables and the criterion variables were, for the most part, small and negative. Due to the low correlations, none of the predictor variables could account for a significant proportion of the variance in 39 month Stanford Binet IQ.

The second regression analysis employed the forced entry procedure. This procedure allows for variables to be selected by the researcher and entered in a designated order. Because individual predictor variables did not account for a significant proportion of the variance in the criterion variable, this second analyses employed block variables. A block variable is a variable which is comprised of several individual variables. This block variable pools the variance associated with each individual variable, thus adding to the possibility of accounting for a significant propor-

TABLE 2

Correlation of Predictor Variables with 39 Month Stanford Binet

	Stanford Binet
Habituation	-.089
Orientation	-.013
Motor Maturity	.026
Regulation of State	.088
Autonomic Stability	-.113
Reflexes	-.157
% of Total Sleep	-.113
% Cry	.099
% Drowsy	-.227

tion of the variance in the criterion variable. Two separate block variables were constructed: A) Brazelton Variable - orientation, habituation, range of state, motor, regulation of state, reflexes, and autonomic stability, and B) State Variable - percent total sleep, percent cry, percent drowsy, and used as predictor variables of 39 month Stanford Binet IQ scores.

Neither predictor variable A ($F = .2778$, $df = 18$, $p < .05$) nor predictor variable B ($F = .2776$, $df = 15$, $p < .05$) was found to account for a significant amount of variance in 3 year Stanford Binet IQ scores. These two analyses suggest that perinatal behavioral measures are not effective predictors of later IQ in this sample.

DISCUSSION

These data suggest that perinatal behavioral measures are nor predictive of preschool IQ scores in a selected sample of high risk infants. This finding is particularly interesting in light of the previous success of these behavioral measures to predict in a normal sample (Nugent et al., 1984; Scarr and Williams, 1971; Thoman et al., 1980). Given the variability of outcome within high risk samples, one would expect these behavioral measures would be at least as effective as in a normal sample in predicting to later IQ scores; however, this does not seem to be the case.

An examination of the sample for this study shows that the majority of infants were born into families that were extremely homogenous on characteristics such as SES and education, both of which are known to have a profound effect upon the course of development. Hunt (1981), in her study of high risk infants, found that controlling for environmental influences can produce dramatically different outcomes. Specifically, high risk infants from less than optimal environments tend to experience significant developmental delays, while infants who are similarly at risk and are raised within an optimal environment tend to develop normally. This suggests that environmental influences, when consistently positive, can change the course of development. In terms of the present research, what may be occurring is that those infants who were originally at risk and may have exhibited behavioral patterns suggestive of later developmental problems (i.e., abnormal BNBAS scores or poor state control) do not develop these problems because of the optimal circumstances in which they were raised. This explanation would account for the lack of predictability of these behavioral measures in this particular sample. What remains unanswered, however, is the effectiveness of these measures in predicting later IQ in a sample raised in less than optimal conditions.

Further, the results of this study suggest that presently no available measure or combination of measures can yield a perinatal score predictive of later intellectual functioning. As was previously stated, neither infant intelligence tests, nor perinatal medical measures have been found to be predictive of later IQ in high risk samples. The only measures which appeared to be predictive from earlier research were behavioral measures. However, upon closer inspection, it becomes apparent that those studies which did obtain significant prediction while using behavioral measures employed infants that were past the perinatal period of development. Thoman et al. (1980) calculated a profile measure from observations on infant's from weeks 2 through 5. Likewise, Scarr and Williams (1971) administered the BNBAS to their infants at 1 and 4 weeks. By employing these older infants these studies have looked at infants that have had an opportunity to stabilize medically and gain experience with their environment. Also, most, if not all, of these infants have been discharged from the hospital, indicating that they are in some sense stable. The failure of the present study to obtain significant prediction of the behavioral measures to later IQ scores may be due to the very fact that the measures were obtained early in the perinatal period; a period, especially for high risk infants, full of change and transition. It appears that to date we have no measure which captures the variability in this perinatal period in a manner that allows us to predict to later intellectual functioning.

This study, utilizing perinatal behavioral state measures to predict preschool IQ in a high risk sample, failed to demonstrate these measures effectiveness in accomplishing this goal. It is possible that in this sample the reason for this failure may have been due to the mediating effect of the optimal environment in which the sample was raised. Especially in the present sample, it is likely that the positive influence of the environment has raised the parameters of developmental outcome, thus making later prediction difficult. The question then is raised as to whether these measures may be more effective in predicting for a high risk sample that is not raised in such optimal circumstances. In addition to environmental influences making later prediction difficult, there is the fact that the perinatal period consists of such great change and variability. At no other time during the infant's life is he so susceptible to the varying influences of extraneous factors which result in the tremendous variability that characterizes this period. Because of the rapidly occurring changes during the perinatal period and the mediating effects of the environment, obtaining an accurate picture of the infant for the purpose of long term prediction is difficult, if not impossible.

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The thesis is therefore accepted in partial fulfillment of the requirements for the degree of Master of Arts, Developmental Psychology.

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