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Newborn behavior and maternal and infant biomedical factors among the Efe and Lese of Zaire.

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NEWBORN BEHAVIOR AND MATERNAL AND INFANT BIOMEDICAL FACTORS AMONG THE EFE AND LESE OF ZAIRE

A Thesis Presented

By

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CHAPTER I

INTRODUCTION

The study of differences in the neurological and behavioral profiles of newborns from various groups has focused on three issues. One issue, addressed by many early studies, was whether or not differences in behavior or neurological status exist between different groups of newborns. These studies demonstrated that infants are not the same at birth. A second set of studies sought to identify the factors responsible for the differences found between groups of newborns. These studies showed that genetic factors and various environmental factors, such as obstetric medication and reproductive history, influenced neonatal status. But the pattern of relationships between environmental factors and newborn outcome varied between groups. A third issue is identifying the nature of the interaction of group differences and various environmental factors influencing newborn status.

Each of these issues has been addressed by many studies, and Super (1980) has compiled a comprehensive review of this literature. In the review which follows, studies that are often cited, and that exemplify the research on each issue have been selected for discussion.

Studies of Group Differences

It is well established that there are group differences in newborn behavior. Geber and Dean (1957) studied neurological development in a group of "African" (Ugandan) infants. They claimed that these infants were significantly more advanced at birth than white European infants. They cited the frequent absence of primitive reflexes such as the Moro, and a remarkable degree of head control as indices of "African newborn precocity." This study remains one of the most frequently cited and has stimulated a great deal of research looking at African newborn precocity. It is generally acknowledged that methodological problems and the lack of details in the report make these findings difficult to accept, and they have been difficult to replicate (Super, 1980). Griffiths (1969) investigated neurological and motor development in a group of South African Bantu infants. Although she did find advanced motor development in these infants over the first year of life, with respect to Geber and Dean's findings she concluded that the reflexes in these newborns were similar to those in European infants. Warren and Parkin (1974) attempted to replicate Geber and Dean's findings in

Kampala, Uganda. They found no differences in neurological development between their African sample and a group of European infants born in Kampala. They did note some differences between groups along dimensions of physical development, but attributed them to inclusion criteria which may have selected for a greater porportion of full-term African infants.

These studies limited their investigations to between-group differences in neurological development, as assessed by elicited reflexes. A growing compendium of empirical data on infant competencies, however, (for a review of this literature see Atkinson and Braddwick, 1982; Lipsitt, 1977; Tronick, Als and Brazelton, 1979) lead researchers to examine other areas of neonatal status.

Concurrently, several psychologists and pediatricians developed the Brazelton Neonatal Behavioral Assessment Scale (NBAS: Brazelton, 1973), an assessment aimed at evaluating the more complex functions and competencies of the newborn. The NBAS was conceptualized as an interaction between the neonate and the examiner. It assesses interactive behavior, motor tone and control, and state regulation, as well as elicited reflexes. Brazelton, Koslowski and Tronick (1976), using the NBAS, found significant differences in performance between Zambian and American infants. On the first day after birth, the

Zambian infants were less irritable, exhibited poorer motor control, and scored lower on items reflecting social engagement and interaction than American infants. By day 10 however, the Zambian infants scored higher on alertness, social interest, cuddliness, and motor tone than an American cohort. In contrast the American comparison group remained within the average range of scores on all exams. The authors suggested that the pattern of "recovery" or improvement of the Zambian infants stemmed from an interaction of environmental factors. The low day 1 scores were attributed to dehydration, caused by an impoverished intrauterine environment. Once the infants started nursing, they received the fluids and nutrients needed to recover and became much more reactive. It was also noted that these infants were handled vigorously and received a great deal of social stimulation, which was interpreted as indicating that the Zambian mothers expected their infants to recover from their initial limp, unresponsive state.

In Kenya, Keefer, Tronick, Dixon and Brazelton (1982) reported differences between Gusii infants and a sample of low risk white American infants. Both groups performed well and had relatively flat recovery curves, but the Gusii infants exhibited more tone and better control of motor functions. The differences were so striking that the standard NBAS scoring for general tone was modified so as to capture the qualitatively different performance of the Gusii infants.

Other studies have looked at group differences among non-African populations. Freedman and Freedman (1969), using an earlier version of the NBAS, found that Chinese-American infants differed significantly from European-American infants on items they categorized as temperamental. The Chinese-American newborns were less labile, less irritable, habituated more readily, and either calmed themselves or were more easily consoled when they did become upset than the European-American newborns. Freedman (1971) replicated these findings with Japanese-American and Navajo infants. Chisholm (1983), working with the same Navajo population, also found their newborns to be quieter and less irritable.

Brazelton, Robey, and Collier (1969) studied infant behavior and development among the Zinacanteco Indians of Southern Mexico. Only 5 infants were observed because cultural taboos limited access to the newborn by those not present at the birth. The Zinacanteco infants were quieter, more alert, better at visual orientation, and had smoother limb movements than a sample of three American newborns. No statistical comparisons were made. Brazelton (1972), noting the fit between newborn behavior and Zinacanteco culture, where "individual self-expression is not a goal, and conformity is highly valued and respected" (pg. 93), suggested that the behavior of these infants was the basis for the dominant personality characteristics of this culture.

Studies of other groups, including black West Indians (Hopkins, 1978), Australian Aborigines, Nigerians, Punjabi Indians (Freedman, 1974), Puerto Ricans (Coll, Sepkowski and Lester, 1981) and Japanese (Takahashi, 1973) have also documented between-group differences in neonatal behavior.

Demonstrating that there are differences in the behavior of newborns from different groups however, has not lead to agreement over the mechanism responsible for them. For example, Chisholm (1983) and Freedman (1971) found similar patterns of differences in newborn behavior between Navajo and Anglo infants. Freedman argued that these differences were predominantly due to genetic factors, whereas Chisholm invoked environmental mechanisms to explain the Navajo-Anglo differences. Freedman's position has been criticized by Super (1980). He states that since newborn status and behavior are not free from environmental effects, observed differences among newborns do not necessarily represent genetic differences. Super points out that many of the studies which claim to demonstrate genetically based differences between groups have failed to adequately control for those factors which may well be responsible for the findings.

Studies of Factors Influencing Group Differences

Among the factors which have been investigated in studies of newborn behavior are maternal characteristics (age, parity, prior birth interval, nutrition, obstetric history, attitude, etc.), perinatal variables (course of pregnancy and labor, type and dosage of medication), infant biomedical variables (gestational age, birthweight, apgar scores, ponderal index) and family socioeconomic status. These factors have often been related to newborn outcome in American and other Western studies.

Dixon, Keefer, Tronick and Brazelton (1982) sought to identify some of the perinatal factors affecting Gusii newborn outcome. In spite of what would be considered very high risk situations by Western criteria (poor prenatal nutrition, chronic parasitic infestation, anemia, etc.), Gusii mothers as a group delivered large, well-developed and behavoirally well-organized infants. Within this group, the investigators found that older mothers of higher parity had smaller infants who gained weight more slowly. These infants also tended to be somewhat more active, irritable, difficult to console, performed less well on social orientation tasks, and had less optimal alert states than infants of younger mothers.

Coll, Sepkowski, and Lester (1982) found effects of maternal age on newborn state behavior in a Puerto Rican sample. When they grouped infants of older and teenage mothers by level of obstetric complications, they found that among the low complication group, infants of teenage mothers spent more time in higher states of arousal, built up faster to a crying state, and changed state more often than infants of older mothers.

Analyzing data from the Navajo sample and groups of Chinese, Malay, and Tamil infants, Chisholm, Woodson and DaCosta-Woodson (1978) found a relationship between maternal prenatal blood pressure and newborn behavior. Mothers' second trimester and final 24 hour blood pressure were correlated with measures of the infants' range of state (irritability, peak of excitement, rapidity of build up and lability of state) on the NBAS. Differences in irritability within the Navajo sample were related to the prenatal environments provided by their mothers, even though the Navajo infants were as a group less irritable than Anglo infants.

Another aspect of the prenatal environment - maternal nutrition - and its relationship to newborn behavior was examined by Brazelton, Tronick, Lechtig, Lasky and Klein

(1977) in a study of Guatemalan infants. They found no effect of supplementation of maternal diet on newborn performance, but did demonstrate effects of birthweight, prior birth interval, maternal height, and SES. The authors suggested that the findings of relationships between the infant's performance and SES and maternal height, which they interpreted as reflecting the mother's own nutritional history, point to an influence of malnutrition transmitted over two generations. The association between a prior birth interval of greater than 29 months and poorer performance by the infants was attributed to some inadequacy of the maternal uterus, or more generally of maternal status. This inadequacy, which may have resulted in a long (for that culture) inter-birth interval, was also reflected in the poor performance of the infant when a pregnancy was successfully completed.

Brazelton, Tryphonopoulou, and Lester (1979) carried out a similar "within-group" study of environmental effects on newborn behavior among Greek infants. They found that infants from the Metera orphanage performed more poorly than infants born to intact lower and middle class families. This poor performance (significant on 9 NBAS items) was believed to result from nutritional insult during the first two trimesters of pregnancy, when the Metera mothers tended to undereat in attempts to self-abort or hide their illegitimate pregnancies. Additional support for this hypothesis was derived from the fact that there was a significant improvement of performance for the Metera infants on 17 items over the first ten days, when proper nutrition was provided by the orphanage. The social responsiveness of these infants did not show a recovery, as was the case with the two other groups. This may have occured because the Metera infants were kept isolated in hospital-like, routine, unstimulating environments. This study demonstrated effects of the prenatal environment and suggested that the immediate post-natal caretaking environment influences newborn behavior.

Studies of Group and Environmental Factors

Horowitz et al. (1977) have suggested that environmental factors, such as obstetric medication, may act in concert with genetic, biological and attitudinal factors to exacerbate or nullify affects on neonatal behavior. In their studies of groups from Israel, Uruguay and the U.S., they have found that low levels of obstetrical medication do not seem to have significant overall affects on newborn behavior. They suggest that different populations may have different thresholds for the effects of medication.

Similarly, Coll et al. (1981) found in their study of

Black, Puerto Rican and Caucasian infants, that whereas the biomedical variables gestational age, ponderal index, and obstetric risk predicted performance on NBAS cluster scores for the Puerto Rican group, no such relationship was found among the Black or Caucasian groups. Coll et al. felt that these findings were important in that they "illustrate the complex synergistic relationships between biomedical variables and neonatal behavior, and ... suggest that these relationships may vary in different cultural settings"(p. 153).

Dixon et al. (1982), as discussed earlier, came to the same conclusion. Gusii mothers, who on the basis of Western criteria would be classified as high risk for poor perinatal outcome, in fact delivered large, well developed infants, with very few problems. The authors speculated that factors such as regular vigorous exercise, adequate rest, the absence of major systemic disease, and the unambivalent desire to have many children may serve to reduce the effect of factors which in the West often lead to negative outcomes of pregnancy.

Criticisms of the Literature

In his comprehensive review of the cross-cultural literature, Super (1980) concludes that although the evidence makes it apparent that newborns of various groups differ in their typical patterns of behavior, problems and shortcomings in this research make it difficult to interpret, or draw theoretical conclusions from these differences. Much of his criticism centers around the failure of studies to adequately control for factors such as the gestational and post-natal age of the infant; parity (the number of previous live births); complications of pregnancy and labor; obstetric medication; and post-partum caretaking routines (feeding schedules, swaddling, etc.). Factors pertaining to testing methodology have also been cited as being poorly controlled for in many studies. These factors include the infant's state of arousal, experimenter differences in administering as well as scoring neonatal examinations, effects of experimenter expectations, and inadequate sampling procedures. There is even sufficient evidence to warrant the control of the physical and social setting of the examination as variables which may affect the performance of the newborn (deVries and Super, 1978).

Other problems exist as well. In Geber and Dean's (1957) study, no means or comparison group data are reported, and details of methodology are for the most part absent. Furthermore, the exam they used is a screen for neurological damage. Its power to identify differences among normal infants is unclear (see Andre'-Thomas, Chesni, and Saint Anne-Dargassies, 1960). Given these shortcomings, it is not surprising that Geber and Dean's findings have been difficult to replicate. Other aspects of their claim of "African newborn precocity" will be discussed later in this chapter.

The manner in which data are treated once they are collected is problematic in some studies. For example, Dixon et al. (1982) controlled for most of the variables and factors mentioned above. Yet, when they investigated the relationship between maternal factors and infant behavior, they generated more than 600 correlations. Because chance alone would predict at least 30 significant correlations at the .05 level, it is easy to question how many of the 52 significant correlations they report are real and meaningful (e.g., maternal height and the infant's habituation to pinprick only).

In many studies newborn behavior is examined with little or no consideration given to the cultural or physical environment in which the behavior occurs. The work of Brazelton, who attempts to understand the interrelationships of cultural values and practices, newborn behavior, and the mutual interactions of the two, demonstrates the importance of considering the infant in her socio-cultural context.

On a broader level, the use of findings from cross-cultural studies of newborn behavior to label attributes of a large group, in a stereotyped fashion, borders on racism. This is the case with a notion such as "African newborn precocity." Inherent is the assumption that the label "African newborn" represents a genetically and/or culturally homogeneous group, living in a uniform environmental setting. Upon close examination, the assumption is not justified. Intra-African groups may or may not be more genetically similar than inter-continental groups, but the existence of such morphologically diverse groups as the tall statured Watusi of Rwanda and the Mbuti Pygmies of the Congo Basin argues against the notion of "Africans" as a genetically homogeneous group. Similar diversity can be found in both cultural (modernized urban vs. technologically simple hunter-gatherer peoples) and environmental (arrid savannah vs. lowland tropical jungle) realms. Given that each of these factors has been shown to influence neonatal status and behavior, and that each of these factors shows wide variation on the African continent, it seems unreasonable to accept a notion or label such as "African newborn precocity." Support for this criticism can be found in the results of studies of various African groups, which yield disparate profiles of newborn behavior, and fail to replicate Geber and Dean's findings and claim. Lastly, one might wonder about the reception of this claim had it been phrased "European motor delays," rather than African precocity.

Summary

Methodological and conceptual problems notwithstanding, several conclusions can be drawn from the cross-cultural newborn literature. First, it is clear that there are differences among infants from various cultural samples. These differences however, are difficult to generalize, and conclusions should be made at the level of specific behaviors among specific groups. Second, the differences observed are the result of genetic and environmental factors. Yet, separating these two sources of variance is problematic, for as Lester and Brazelton (1982) point out, "attempting to make such a separation is impossible. We can never measure genotype directly, since our data are anchored in behavior" (p.22). A more useful strategy is to recognize phenotype (e.g., newborn behavior) as resulting from the **interaction** of **genotype** and **environment**. This formulation aids in understanding a third conclusion: There are group differences in the extent to which various environmental factors influence newborn status and behavior.

Given these conclusions, what is the value of further cross-cultural newborn research? On one level, these studies serve to increase our understanding of the range of "normal" newborn behavior, and how this range is influenced by various environmental and contextual factors. On another level, understanding the relationships of biomedical, cultural and environmental factors to neonatal outcome allows us to identify those infants who are at high risk for negative outcome. And finally, to the extent that infant behavior influences caretaking, it is important for us to document differences among infants in order to better understand the range of caretaking practices observed between and within different cultural groups (Lester and Brazelton, 1982; Winn, Morelli and Tronick, in press). This study of newborn behavior among the Efe and Lese was guided by these considerations.

C H A P T E R I I

THE RESEARCH SETTING

Background

The study of infant behavior reported here was part of a larger comparative longitudinal study of child development among two tropical rain forest dwelling peoples: the Efe and the Balese (see Note 1). The study of child development, in turn, was part of a larger collaborative project including biological anthropologists, ecologists, public health practitioners, physiologists and biologists. Work to date has provided complete demographic and anthropometric data on the study population, information on their health status and their sanitary practices, data on forest productivity, and descriptions of adult activity patterns and social exchanges.

The study area was a several kilometer band of fields on both sides of a 25 Km stretch of barely passable dirt road transecting the Ituri Forest in northeastern Zaire. Due to the deterioration of the road since Independence in 1960, the Efe and Balese (hereafter referred to as 'Lese') have had less interaction with the outside economic and cultural forces that are rapidly changing the ways of life of many central African peoples. Within the study area there were 16 Lese villages inhabited by approximately 550 people, and as many as 470 Efe living in camps in the forest adjacent to these villages.

The Efe

The Efe are a short-statured, semi-nomadic people, and are one of four groups comprising the Mbuti (Pygmies) inhabiting the Ituri Forest. Characterization of the Efe ancestral homeland and mode of subsistence is the subject of much speculation. It is not known whether the Efe once lived deep within the forest or on the forest/savannah edge, and whether they subsisted solely by hunting and gathering or in economic association with horticulturalists. However their ancestors lived, in all probability that lifestyle was unlike the Efe way of life today. The Efe do hunt and gather forest foods, but they rely mainly on cultivated foods for their caloric intake (Bailey & Peacock, in press).

Efe camp membership ranges from 6-50 people and often is made up of one or several extended families. The Efe are virilocal. Each family consists of brothers and their wives, children, unmarried sisters and parents. Women leave their group around the age of 18. This emigration is attributable to the practice of "sister exchange". Women from one band are exchanged for women of another band to provide men in each band with wives. Polygyny is extremely infrequent, usually limited to men of higher status or whose first wives have not borne any children. Members of each extended family build their huts close to one another. But the extended family is not the basic social unit of the Efe band. The basic social unit is the nuclear family. When changes in camp composition occur, the nuclear family, but not necessarily the extended family, remains intact.

The Efe move camp every 4-6 weeks to exploit the seasonally available forest and cultivated foods, and for health or personal reasons. The new camp site is often located at or near previous camp sites. Efe camps rarely exceed a day's walk from the road and Lese villages, and are more often within a 1-3 hour walk.

The Lese

The Lese are a Sudanic-speaking group of slash-and-burn agriculturalists, who probably moved into the forest from the northern savannah within the last 200-300 years (DeVore, 1979). They live in small virilocally organized villages of 15 to 100 people. Polygyny is more common among the Lese than among the Efe, but monogamy is the most common practice. Unlike the Efe however, Lese men generally pay "brideprice" for their wives with commercial resources such as local currency, metal, or domestic animals.

Each household annually clears approximately 0.5 hectare of either primary forest or varying stages of successional growth. They plant cassava, bananas, corn, squash and yams for subsistence, and rice and peanuts as cash crops.

The Efe-Lese Relationship

The exact nature of the Efe-Lese (Mbuti-villager) relationship has been the subject of much debate in the anthropological literature (see Bailey and Peacock, in press). In general, a long-standing reciprocal relationship exists between members of an Efe band and a single Lese village. Efe men provide the Lese with meat, honey, and other materials from the forest, and Efe women spend a majority of their out-of-camp work time in the fields of the Lese. In return the Lese provide the Efe with the cultivated foods that make up a majority of the Efe diet, as well as metal for tools and arrows, some clothing, tobacco and marijuana, and other goods the Efe cannot or do not procure on their own. During periods of food scarcity, an Efe band may draw on the resources of several Lese villages.

Lese men occasionally take Efe women as wives, but because the Lese view the Efe as second-class citizens the reverse is never true. When an Efe woman marries a Lese man, she moves to his village and is expected to adopt the ways of village life.

Choice of This Site

There are several reasons, then, why this research setting presented a valuable opportunity to study cross-cultural differences in neonatal status and behavior. In contrast to many studies in which newborn behavior is examined as an isolated phenomenon, the longitudinal, multi-disciplinary nature of this project allowed newborn behavior to be viewed within the context of the social, cultural, and physical environment. This setting also allowed both between and within-group comparisons, and the investigation of interactions between group and environmental factors. Moreover, this setting enabled several of the methodological problems raised by Super (1980) to be overcome in the design of the study. First, the on-site comparison of two groups simultaneously controlled for the possibility that group differences were the result of changes in the examiners over time. Second, because the same examiners examined both groups, effects of tester differences were minimized. Third, inclusion of all infants born in the study area during the two year duration of the project increased the likelihood that this sample was representative of the population. And fourth, because all exams were administered in the infants' homes, the infant's behavior was assessed in its naturally occuring environment, free of the effects often imposed by a hospital setting. deVries and Super (1978) have demonstrated the effect of such contextual influences among other African groups.

CHAPTER III

METHODS

Subjects

Thirty-three of the 42 infants born during the two year duration of the project are included in this study. These 33 infants, 19 Efe and 14 Lese, were judged to be healthy, full term newborns. Three Efe infants were excluded from this study. One mother died of labor complications; one infant was later found to have severe developmental disabilities; and one mother refused to participate. Six Lese villager infants were excluded. One infant was judged to be premature; one infant died of respiratory problems during the first two weeks of life; and 4 infants did not meet the criteria for inclusion in the Lese group. Infants whose maternal grandparents were both full Efe (i.e., whose mothers were full Efe) were excluded from the Lese group. Of the 14 infants included in the Lese sample, none had more than one full Efe grandparent. This problem was not encountered among the Efe group, all of whom are believed to be of full Efe ancestry.

All births took place in the home setting, using traditionally prescribed practices. Observations and interviews indicated that there were few differences between Efe and Lese birthing practices. These practices include physical and social support of the parturient woman; little or no intervention during the course of labor; and reception and care of the newborn by women other than the mother in the camp or village. Obstetric medication was limited to potions made from leaves, bark, fruit and water. These were sprayed on the abdomen and vagina, or breathed by the parturient woman. Whether or not the potions contained any active pharmaceutical agents is unknown. (For a more detailed description of birthing practices among these people see Morelli, Winn, Peacock and Zwahlen, 1984.)

Neonatal Assessments

Neonatal behavior was assessed using the Brazelton Neonatal Behavioral Assessment Scale (NBAS; Brazelton, 1973; see also Als, et al.,1979). The NBAS assesses 20 reflexes and 27 behavioral items. Each reflex is scored on a four-point scale: 0=absent, 1=low, 2=normal, 3=high. Each behavioral item is rated on a nine- point scale. The scale also uses state (Prechtl and Beintema, 1964) in the administration of each item, and as an index of the infant's level of organization.

Several modifications in the administration and scoring of the exam were necessary. The placing reflex was omitted because most exams were administered while the examiner was sitting on the ground in Efe huts or Lese houses, and the reflex was difficult to reliably elicit in this position. The pinprick item was also omitted. The examiners thought it was too intrusive and difficult to justify to the people watching the exam. Other variations in the administration of the exam were due to the caretaking practices of these groups. Efe and Lese infants are nursed several times per hour. This practice made examining an infant "one to two hours post-prandial" impossible. Furthermore, Efe and Lese infants are almost always in physical contact with another person. They are seldom, if ever, put down or left alone. When physical contact was broken to examine the infants, many of them woke up fussing or crying (see Note 2). When this occurred the habituation items were omitted , and the exam began with consoling of an upset infant, or the elicited reflexes of a quiet, awake infant.

These procedural modifications necessitated changes in scoring the exams. The "rapidity of buildup" item measures the timing and number of stimuli presented before the infant changes from an initially quiet state to a more agitated one. The pinprick is included in the criteria for scoring this item. It was not administered so "not until foot reflexes" was substituted for "not until pinprick."

The irritability item score also includes the pinprick. To score this item, the pinprick was omitted from the list of aversive stimuli on which the score is based.

The scoring of the elicited reflex items was modified. The four point scale for scoring these items was expanded to a six- point scale, with an additional point between "normal" and "low" and an additional point between "normal" and "high." This modification allowed for greater sensitivity in assessing the infant's neurological status.

Infants were examined 3 times during the first two weeks of life. The first ("early") exam was administered on days 1-3; the second ("middle") exam on days 4-9; and the third ("late") exam on days 10-14. The mean ages at exam were 1.4, 6.4, and 12.3 days for the Efe, and 1.2, 6.2, and 11.8 days for the Lese. The total number of exams administered was 16 at each age for the Efe and 12 early, 12 middle, and 13 late exams for the Lese. Seven Efe and 4 Lese infants were examined only once or twice. Missing exams were most often attributable to knowledge of a birth not reaching the examiners until it was too late to perform an early and/or middle exam. In other instances the family moved or was away before a late exam could be done, or severe weather conditions made traveling to the camp or village to administer the exam impossible.

Forty-three of the forty-eight Efe exams were administered in Efe huts. Huts were small (1.5m in diameter and 1.25m in height), dark, and often had a small fire burning, making them warm and smokey. The five exams not administered in huts took place outside in the shade, or under a canopy-like structure called a **baraza**. A similar proportion of Lese exams (31 of 37) were administered in Lese houses. These mud and wattle houses were more spacious than Efe huts, but were equally warm and dark, and tended to have a small fire burning inside. The other six Lese exams were administered in village **barazas**.

All mothers were present during the exam, and typically many other camp or village members attended. People watched with interest and responded positively to many test items, particularly when an infant "crawled", "walked", or turned her head to follow the examiner's face. Mothers were given a small piece of cloth and some soap for their infants in appreciation of their cooperation.

Three examiners administered the NBAS exams. To maintain standardization of administration in the field, two or three examiners were present during 28 of the 85 exams. Interobserver reliability was determined before, during, and after fieldwork, by the methods described by Als et al. (1979). Items scored within 1 scale point were counted as agreements. A reliability coefficient was determined by calculating a percent agreement score (# of agreements/(# of agreements + # of disagreements)}, and exceeded 90% for the standardized NBAS and for all modifications and additions.

Data Reduction and Analysis

Item scores on the NBAS were grouped into 7 *a priori* clusters: motor, habituation, orientation, state range, autonomic, state regulation, and reflex. These clusters, devised by Lester et al. (1978), group items that are conceptually related. They serve to reduce the number of statistical comparisons performed on the data set and provide standardized summary measures for comparisons with other studies using the NBAS. Because several item scores are curvilinear, items are rescored before clusters are formed so a higher score represents a more optimal performance. Each of the six behavioral clusters is derived by computing the mean score of the items which define that cluster (see Note 3). The reflex cluster is the total number of abnormal reflex scores. In this study, abnormal reflex scores were: 0) reflex not present; 1) reflex very weak; and, 5) reflex very strong.

Cluster scores were subjected to an analysis of variance, with one between-subjects (group) and one within-subjects (exam period) variable. Cluster scores were also used in Pearson correlations to investigate the relationships among maternal and infant biomedical factors and preformance on the NBAS. Biomedical data on mothers and infants was collected from two sources. Information on mothers age and reproductive history was provided by Robert Bailey. He collected this data as part of a demographic study of these people by extensively interviewing men and women from each village or camp. Height, weight, and head circumference data were obtained from the semi-annual Anthropometry of all individuals in the study site.

CHAPTER IV

RESULTS

Maternal Biomedical Factors

Efe and Lese maternal biomedical characteristics are presented in Table 1. Lese mothers were taller {$t(2,29) = 6.31; p<.001$} and weighed more {$t(2,27)=5.21; p<.001$} than Efe mothers. There were no other differences between the groups on these variables.

Efe mothers' age, gravida, and parity were highly related. Older mothers had been pregnant a greater number of times ($r=.90; p=.001$), and had more live births ($r=.90; p=.001$) than younger mothers (Table 2). There was a relationship between maternal morphology and birth spacing. Mothers with higher ponderal indexes had longer prior birth intervals ($r=.66; p=.026$).

Age, gravida, and parity were highly related among Lese mothers (Table 3). Like the Efe, older Lese mothers had been pregnant a greater number of times ($r=.95; p=.001$), and had more live births ($r=.94; p=.001$). The relationship between Lese maternal morphology and birth spacing, which approached significance, was diametrically opposite to that found in the Efe group. Mothers with higher ponderal indexes had <u>shorter</u> prior birth intervals ($r= -.61; p=.078$).

There was a difference between the two groups in the intercorrelations of maternal morphological features. Efe mothers who weighed more were taller (r=.53;p=.037), and had higher ponderal indexes (r=.79;p=.001). In contrast, Lese mothers who were taller had lower ponderal indexes (r= -.60;p=.031).

Infant Biomedical Factors

Efe and Lese newborn biomedical characteristics are presented in Table 4. T-tests showed that Lese newborns had higher birthweights {t(25)= -2.30;p=.03} and birthlengths {t(26)= -3.30;p=.003} than Efe infants. There were no differences between the groups in head circumference, ponderal index, or rate of weight gain over the first two weeks.

Although the birth weights and lengths of both groups were low by American standards, their ponderal indexes were extremely high. The mean value for ponderal index of 2.93 for Efe infants was above the 90th percentile, and the Lese group mean of 2.80 was above the 75th percentile.

Birthweight, length, and head circumference were highly related among Efe newborns (Table 5). Higher birthweight infants were longer (r=.71;p=.01), and had larger head circumference (r=.55;p=.041) than lower birthweight infants. Head circumference and length were also positively related (r=.61;p=.016). There was a relationship between the size of the infant at birth and the pattern of weight gain over the first two weeks. Infants with lower ponderal indexes grew at a higher rate (r= -.61;p=.037) than infants with higher ponderal indexes.

The only significant intercorrelation among Lese infant biomedical factors was between length and ponderal index (Table 6). Shorter Lese newborns had higher ponderal indexes (r= -.80;p=.002) than longer newborns. Shorter infants tended to grow at a lower rate, but this relationship failed to reach significance (r= -.57;p=.083).

Maternal-infant Biomedical Relationships

Different patterns of relationships between maternal and infant variables were found in the two groups. There were several significant relationships among the Efe (Table 7). Maternal age and parity were related to infant ponderal index. Higher ponderal index infants were born to older (r=.63;p=.015) and higher parity (r=.68;p=.008) women. Maternal height was positively correlated with infant birthweight (r=.55;p=.042) and head circumference (r=.71;p=.002). Maternal and infant weights were also correlated, with higher birthweight infants born to higher weight mothers (r=.59;p=.044).

Two relationships between Lese maternal and infant variables reached significance (Table 8). Birth spacing and infant length were related, with longer infants born to women with longer prior birth intervals (r=.70;p=.034). Maternal weight was related to infant weight gain. Infants of heavier mothers grew at a higher rate over the first two weeks (r=.67;p=.047).

Cluster Scores

Item scores used to generate cluster scores are presented in Table 9. Because there were so many missing data, the habituation cluster was not subjected to statistical analysis.

Analysis of variance. There were no significant group differences on any of the remaining 5 behavioral clusters (Table 10). Significant effects of exam period (early, middle and late), were found for motor {$F(2,32)=11.29$;$p<.001$}, state regulation {$F(2,38)=4.77$;p=.014} and autonomic {$F(1,18)=16.74$;$p<.001$} clusters. The effect of exam period approached significance on the range of state cluster {$F(2,32) = 3.13$; $p = .057$}. And there was a significant interaction of group and exam period on the state regulation cluster {$F(2,38)= 3.80$; $p = .031$}. There was no effect of group or time on the orientation cluster.

The distribution of scores on the reflex items was heavily biased towards "normal" scores, which precluded any statistical analysis of the reflex cluster. There were, however, several reflex items on which abnormal scores were frequent among both the Efe and Lese. At the early exam period, scores on the items "passive resistance" to arm and leg movements were skewed towards very strong, or hypertonic, scores. Four of 15 Efe, and 5 of 11 Lese infants received hypertonic scores on resistance to arm movements, and 8 of 15 Efe and 9 of 11 Lese infants received hypertonic scores on resistance to leg movements. This pattern of abnormal reflex scores decreased over time. By the third exam period most infants received normal scores on all items. Reflex item scores are presented in Table 11.

T-tests. T-tests were used to examine differences between early and middle, early and late, and middle and late exam cluster scores (Table 12). Efe and Lese data were combined for the motor and range of state clusters because the analysis of variance yielded no significant group differences. Separate, more conservative t-tests were performed on the Efe and Lese autonomic cluster data because assumptions of homogeneity of variance were not met. The significant group by exam period interaction for the state regulation cluster mandated separate t-tests for and between the two groups.

On the motor cluster there were significant differences between early and middle {$t(20) = -4.97$; $p<.001$} and early and late {$t(21)= -2.96$;$p =.007$} exam periods, but there was no difference between middle and late exam periods. On the range of state cluster the difference between middle and late exam periods approached significance {$t(23)=2.02$;$p=.056$}, but there were no significant differences between early and middle, or early and late exam periods

On the autonomic cluster of the Efe group there were significant differences between early and middle {$t(12)= -3.10$; $p=.009$} and early and late {$t(12)= -2.43$;$p=.032$} scores. Among the Lese group there was also a significant difference between early and late autonomic cluster scores {$t(8) = -3.77$; $p = .005$}, but the difference between early and middle scores did not reach significance {$t(9)= -2.07$;$p = .068$}.

There were several differences between the Efe and Lese on the state regulation cluster. For the Efe, late exam scores differed significantly from both early {$t(13)= 2.43$;$p= .030$} and middle {$t(13)=5.15$;$p<.001$} exam scores. For the Lese, however, there were no significant differences among early, middle and late state regulation cluster scores. The between-groups t-tests showed a significant difference between Efe and Lese state regulation scores at the middle exam period {t(25)=2.44; p=.022}, but not at the early or the late exam period.

Maternal and Infant Biomedical Factors and Newborn Behavior

Maternal factors and NBAS cluster scores. There were several significant relationships in both groups between maternal biomedical factors and infant NBAS cluster scores (Table 13). Among the Efe, infants of mothers with larger head circumference had lower state regulation cluster scores at the early exam period (r= - .65;p=.016). At the middle exam period, infants of higher weight mothers (r=.54;p=.044) and infants of higher gravida mothers (r=.52;p=.046) had higher irritability cluster scores. There were no significant relationships of maternal factors and cluster scores at the late exam period.

Among the Lese, four maternal factors were related to state regulation cluster scores at the early exam period. Infants of younger mothers (r= -.54;p=.053), taller mothers (r=.58;p=.039), mothers with larger head cirumferences (r=.70;p=.018), and lower gravida mothers (r= -.63;p=.026) had higher state regulation cluster scores. At the middle exam period, infants of older mothers (r=.75;p=.016) and higher gravida mothers (r=.85;p=.004) had higher orientation cluster scores. Mothers' gravida was also related to infant cluster scores at the late exam period. Infants of higher gravida mothers had higher orientation cluster scores (r=.60;p=.034) and higher autonomic cluster scores (r=.57;p=.033).

Infant factors and NBAS cluster scores. There were relationships between characteristics of the infants and the cluster scores they received for both groups at all three exam periods (Table 14). Efe infants who were longer at birth had higher autonomic cluster scores at the early exam period (r=.65;p=.014). There was no relationship between birthweight and cluster scores at this period, but infants who weighed more at the time of the exam had higher autonomic cluster scores (r=.48;p=.050). At the middle exam period, Efe infants who were gaining weight at a higher rate had lower autonomic (r= - .66;p=.005) and lower state regulation (r= -.56;p=.024) cluster scores. There were two significant relationships at the late exam period. Infants gaining weight at a higher rate had higher irritability cluster scores (r=.54;p=.032), and infants with higher ponderal indexes had higher orientation cluster scores (r=.81;p=.027).

There were several significant relationships between infant factors and cluster scores among the Lese. At the early exam period, higher birthweight infants

(r=.66;p=.013), higher ponderal index infants (r=.52;p=.051), and infants who weighed more at the time of the exam (r=.60;p=.025) all had higher motor cluster scores. Infants with larger head circumferences had higher range of state (r=.62;p=.039) and higher state regulation (r=.61;p=.030) cluster scores. And longer infants had lower orientation cluster scores (r= -.62;p=.050).

At the middle exam period, infants with larger head circumferences had lower motor (r= -.54;p=.043), higher irritability (r=.53;p=.037), and lower orientation (r= -.62;p=.050) cluster scores. Infants who gained weight at a higher rate had lower motor cluster scores on the middle exam (r= - .85;p=.001), and infants who weighed more at the time of the exam had higher irritability cluster scores (r=.62;p=.016).

There were three significant relationships at the late exam period. Infants with a higher ponderal index (r= -.54;p=045), and infants who weighed more at the time of the exam (r= -.72;p=.004) had lower state regulation cluster scores. Infants with larger head circumferences had higher irritability cluster scores (r=.72;p=.004).

CHAPTER V

DISCUSSION

Biomedical Factors

Infants in both of these groups were extremely short and had very low birthweights. In a worldwide sampling of more than 270 groups, Meredith (1970) found birthweights ranging from 2.40 to 3.83 Kg. The Efe would be the lowest birthweight group and the Lese the 7th lowest in this distribution. Efe infants weigh, on average, only 2400 gm and are only 43.6 cm long at birth. In most pediatric and neonatal settings, low birth weight is defined as all infants with a birth weight less than 2500 gm (Lowrey, 1978). These infants then, would be assigned the label "low birth weight" and would receive the special care given to high risk infants. Yet, these infants were robust and healthy, and their high ponderal indexes indicate that they were well nourished in utero. Undoubtedly, the small size of Efe and Lese infants is related to the small size of their parents. As Schwartz and Rosenblum (1983) have pointed out, smaller size places a greater stress on the neonate's fluid regulation and thermoregulatory capacity. It may be that a high weight for length ratio (ponderal index) serves to moderate the risk that these infants' small size places on them. This mechanism is also evident within the Efe group, where lower ponderal index infants gained weight at a higher rate than higher ponderal index infants.

Mothers in both groups fit the typical pattern for reproductive history: Older mothers were of higher gravida and parity. Among the Efe these older, multiparous women gave birth to higher ponderal index infants. Dixon et al. (1982) found greater maternal age and parity to be negatively correlated with infant size (head circumference, post-natal weight gain) among the Gusii. But in a study of black American infants, Crump et al. (1957) found that older, higher parity mothers produced larger infants. This is similar to the pattern seen in the Efe. There was also a positive relationship between maternal size and infant size among the Efe. Taller, heavier mothers had higher birthweight infants. Neither of these relationships between maternal and infant factors were found among the Lese.

In general there were more expected relationships in maternal-infant correlations, maternal factor inter-correlations, and infant factor intercorrelations (Tables 2-8) among the Efe than among the Lese. This may be because the "Efe" group was a more homogeneous sample, whereas the "Lese" group was a heterogeneous mixture of full Lese, mixed Efe-Lese, and other Sudanic villager parents. The variance contributed by this heterogeneity may have made it difficult to identify within-group relationships, especially in this small sample.

Newborn Behavior

Infants from both groups performed well within the normal range on the NBAS. Hypertonicity of the arms and legs in response to passive movements was the only exception to an otherwise unremarkable behavioral profile of these newborns. As noted here and elsewhere (Tronick, Winn, and Morelli, 1985) these infants' small size places them at greater risk for difficulties in heat regulation. Keeping their arms and legs retracted close to their torsos may attenuate this risk by reducing heat loss.

There is an additional point to be made about the small size of these infants and their performance on the NBAS. Because of their low birth weights these newborns would be viewed by Western standards as a high risk group. Yet, their scores on the NBAS are comparable to the scores of low risk American samples (Table 15). There are differences on some items, but there is no consistent pattern of poorer performance by Efe and Lese infants. Although not suitable for inferential statistics, these comparisons point out that these extremely low birth weight ("high risk") infants are as competent behaviorally as higher weight ("low risk") infants. These findings argue for caution in using any single measure, such as birthweight, as an index of risk status.

Cluster scores. There were no significant differences between Efe and Lese infants on the NBAS cluster scores. There are several possible reasons for this. First, the two groups studied turned out not to be as genetically or culturally distinct as expected. Because of intermarriage between Lese men and Efe women, many of the infants in the Lese group were in fact part Efe. Second, there were many similarities in the prenatal environments of these infants. Efe and Lese mothers live in the same area, eat many of the same foods, and engage in many similar daily work and subsistence activities. To the extent that these factors influence newborn behavior, differences between Efe and Lese infants are minimized. And finally, because differences have been found among various groups of newborns across cultures does not mean that significant differences must exist between any two groups chosen for study.

There was improvement over time on motor and autonomic cluster scores for these infants. On both clusters the change in performance was between the early exam and the two later exams. Performance on the range of state and state regulation clusters, however, deteriorated over time.

Sander's theory on the interaction of the newborn and its caregiving environment is useful in understanding these findings.

Sander (1975, 1977) states that the infant-environment system, and its regulation and change over time, is the context in which infant development must be understood. He views the infant as a composite of physiological subsystems. Each of these subsystems (heat and fluid regulation, sleep-wake cycling, state organization, etc.) must become organized within the infant, and "tune-up" with the caregiving environment. These subsystems are conceptualized hierarchically (e.g., an infant must organize basic homeostatic subsystems before she can devote more regulatory capacity to attention and interaction subsystems). Because the infant is part of a system, the caregiving enviornment influences the ways in which the infant's subsystems become organized. A better fit between caregiving rhythms and cycles, and the infant's endogenous cycles, enables the infant to become organized faster. For example, Sander (1975) has shown that newborns who receive caretaking which is synchronized to their endogenous cycle attain diurnal cycling and organize their interactional capacities faster than infants who receive caretaking at a regular but arbitrary tempo. Sander compared infants who roomed-in with a single caretaker and were fed on demand, with infants who were kept in a nursery and received 4-hourly scheduled feedings by many different caretakers. The rooming-in infants achieved a 24 hour diurnal cycle by the end of the first week, with their greatest amount of activity and crying in the day 12 hours. In contrast, the nursery infants failed to attain any circadian rhythmicity over the first ten days. There was a gross asynchrony in timing between caretaking interventions and episodes of infant activity, and the greatest portion of activity and crying remained in the night 12 hours. Moreover, because these infants had not yet negotiated the regulation of day-night cycling, there was an associated increased amount of crying, increased amount of intervention time, and multiple interventions, all of which diminish as organization emerges.

How do these findings relate to Efe and Lese caretaking patterns and infant behavior? Over the first few days an infant remains inside with her recuperating mother, is kept warm, and is fed and comforted on demand (see Morelli et al., 1984). This probably allows the newborn to achieve initial regulation of her more endogenous subsystems - those which are manifest in autonomic and motor control behaviors on the NBAS. Thus an improvement is seen in these spheres by day 5 or 6. Towards the end of the first week (when her umbilicus falls off) the newborn is brought out of her warm, dark hut or house. Because her mother begins to return to work, the infant is cared for by a greater number of individuals. This caretaking regime is more similar to Sander's nursery group, and may explain why a deterioration is seen in behaviors related to state organization. Additional support for this view is found in the difference between the pattern of change in the state regulation scores in Efe and Lese newborns. Lese infants, who were often brought out of their houses sooner than Efe infants, had lower scores by day 6, whereas scores for Efe infants did not deteriorate until after day 6. Sander's model is used here as a framework for interpreting these results. A more conclusive appraisal of the infant-environment interactions and regulations would require more detailed behavioral and physiological observations than were made in this study. These findings, however, reiterate the notion that early caretaking practices can and do influence newborn behavior in the first weeks of life.

Maternal and Infant Biomedical Factors and Newborn Behavior

Numerous studies have reported relationships between maternal biomedical factors and newborn behavior. Brazelton et al. (1977) found relationships of prior birth interval and maternal size to newborn performance of Guatemalan infants. Chisholm (1983) found that maternal age, parity and blood pressure were related to neonatal irritability among the Navajo. And many maternal factors were related to newborn behavior in Dixon et al.'s study of the Gusii (1982).

Yet data from this study show few relationships between Efe and Lese maternal factors and newborn behavior on the NBAS. There was no consistent pattern of relatedness in either group. In fact, the 180 correlations performed in this study to investigate the relationship between maternal factors and newborn behavior produced only 11 significant findings - only two more than would be expected by chance at the .05 level!

Similarily, few of the expected relationships between infant factors and newborn behavior were found. There were some significant patterns of relationship between the size of Lese infants and their performance on the NBAS. Infants with larger head circumference had better range of state scores at all three exams, better state regulation scores on the first exam, and poorer motor and orientation scores on the middle exam. Possibly these infants' larger heads made it harder for them to coordinate their heads so as to follow orientation stimuli, or to hold their heads up on items such as pull-to-sit. But the relationship of head size to state range or regulation is harder to understand.

Among Efe infants, only 6 of 90 correlations reached significance, and no clear pattern of relationships was evident. In neither group did we find the expected relationships of factors such as birthweight, or ponderal index, to newborn behavior. Many studies have reported these effects. Brazelton et al. (1977) found that higher birthweight Guatemalan infants performed better than lower birthweight infants. There was a relationship between postnatal weight gain and recovery of performance in Zambian newborns (Brazelton et al., 1976). And several studies of American infants have described performance deficits in lower birthweight or lower ponderal index infants (Als et al. 1976; Lester, Emory, Hoffman and Eitzman, 1976).

Perhaps one reason this study did not replicate these findings is that in studies such as those on Zambian and Guatemalan infants, the "lower birthweight" infants examined were in fact nutritionally deprived or dehydrated at birth. This is also the case in studies such as that by Als et al. (1976) on full term but underweight infants, which compared a healthy, robust group of infants with a group that was below the 3rd percentile on weight for height as measured by ponderal index. In contrast, none of the infants in this study were dehydrated or severely underweight at birth. Although several infants were of extremely low birthweight - six weighed 2200 grams or less

- their ponderal indexes were all high. To the extent that ponderal index reflects the infant's intrauterine nutrition (Lester and Brazelton, 1984; Scanlon, 1984) this indicates that both Efe and Lese infants are receiving adequate prenatal nourishment.

The small sample size may be another factor contributing to the small number of statistically significant relationships found in this study. In an ideal situation more infants would have been included. In this study setting, however, the low population density resulted in an unavoidably small sample, even though an attempt was made to include all infants born during the two years we were in the field. Furthermore, because of the large number of statistical procedures to which this data set was subjected, these findings must be interpreted with caution.

The Assessment of Efe and Lese Newborns

In this study, neither examiner impression nor statistical analysis of the NBAS data yielded a "typical" Efe or "typical" Lese infant. There were fussy infants, and quiet infants - but no distinctive pattern of irritability. Some infants had excellent motor control, and others were a bit floppy - but there was no distinctive pattern of motor tone. The only characteristic that seemed noteworthy was the somewhat hypertonic response to passive arm and leg movements in many - but not all - of these infants. As discussed, this may be related to their small size and the task of temperature regulation.

The value of the NBAS, however, does not lie solely in its ability to identify the "typical" infant in a given culture. We may in fact question the value of stereotyping any particular group of infants. What seems more useful is employing NBAS data to examine the relationships of various infant behaviors to caretakers' perceptions, attitudes, and behavior within a given culture. For example, Efe infants are not particularly fussy or quiet. But do more irritable Efe infants receive the same appraisal and caretaking as less irritable infants? The answer to questions such as this enables us to better understand the infant-environment system, as Sander refers to it, and how different infants, and different ecological and cultural environments influence and contribute to the development of the child.

Footnotes

1. Efe is pronounced "EF-fay" and Lese is pronounced "LESS-say."

2. As we have noted in previous reports (Tronick et al., 1985) the small size of these infants places them at a greater risk for temperature instability. Breaking physical contact between the infant and her caretaker may have stressed the young infants' thermoregulatory capacity.

3. Because there were missing data on many of the items used to create the NBAS clusters, the following criteria were used;

Motor cluster- at least 3 of the 5 items had scores
Orientation cluster- at least 5 of the 6 items had scores
Range of state cluster- at least 3 of the 4 items had scores
Autonomic cluster- at least 2 of 3 items had scores
State regulation cluster- at least 2 of 4 items had scores

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APPENDIX

TABLE 1

DESCRIPTIVE CHARACTERISTICS
OF EFE AND LESE MOTHERS

	EFE			LESE			
	Mean	S.D.	N#	Mean	S.D.	N	p@<
Age (yrs.)	28.0	5.8	19	28.8	8.1	14	
Gravida	3.9	2.2	19	3.9	2.3	14	
Parity	2.7	2.1	19	2.9	2.5	14	
Prior birth interval* (mo.s)	37.7	15.9	12	42.5	11.6	10	
Height (cm)	134.9	3.7	18	150.7	9.6	13	.001
Weight (kg)	38.2	5.6	15	52.0	8.8	13	.001
Head circ. (cm)	52.7	2.0	15	53.3	1.6	12	

Notes:
#. Missing data excluded
@. One-tailed t-test
*. Three Efe and four Lese mothers were primiparous

TABLE 2

EFE MATERNAL CHARACTERISTICS INTERCORRELATION MATRIX

	Age	Gravida	Parity	Height	Head circ.	Weight	Birth interval
Age		.899 19 .001	.895 19 .001				
Gravida			.985 19 .001				
Parity							
Height						.465 15 .08	
Head circumference							
Weight							.681 11 .021
Prior birth interval							

TABLE 3

LESE MATERNAL CHARACTERISTICS INTERCORRELATION MATRIX

	Age	Gravida	Parity	Height	Head circ.	Weight	Birth interval
Age		.946 14 .001	.940 14 .001				
Gravida			.991 14 .001				
Parity							
Height							
Head circumference							
Weight							
Prior birth interval							

TABLE 4

DESCRIPTIVE CHARACTERISTICS OF
EFE AND LESE INFANTS

	EFE			LESE			
	Mean	S.D.	N#	Mean	S.D.	N	p@<
Birthweight (kg)	2.4	.4	15	2.74	.3	12	.03
Birthlength (cm)							
Crown-heel	43.6	2.1	15	46.4	2.3	13	.003
Crown-rump	29.0	1.8	15	29.9	1.9	13	
Head circ. (cm)	34.0	1.4	17	34.4	1.0	13	
Ponderal index*	2.93	.3	14	2.80	.4	12	
Sex (male/female)		10/9			10/4		

Notes:
#. Missing data excluded
@. One-tailed t-test
*. Ponderal index = weight (kg)/length (cm) cubed

TABLE 5

EFE INFANT PHYSICAL CHARACTERISTICS INTERCORRELATION MATRIX

	Birth-weight	Birth-length	Head circ.	Ponderal index	Daily weight gain (gm)
Birth-weight		.705 12 .01	.551 14 .041		
Birth-length			.610 15 .016		
Head circumference					.549 13 .052
Ponderal index					-.575 12 .051
Daily weight gain					

TABLE 6

LESE INFANT PHYSICAL CHARACTERISTICS INTERCORRELATION MATRIX

	Birth-weight	Birth-length	Head circ.	Ponderal index	Daily weight gain (gm)
Birth-weight					
Birth-length				-.802 12 .002	
Head circumference					
Ponderal index					
Daily weight gain					

TABLE 7

EFE MATERNAL FACTORS AND INFANT PHYSICAL CHARACTERISTICS

	Birth-weight	Birth-length	Head circ.	Ponderal index	Daily weight gain (gms)
Mother's age				.634# 14 .015	
Parity				.675 14 .008	
Mother's height	.561 14 .037		.651 16 .006		.649 14 .012
Mother's head circ.					
Mother's weight	.559 11 .074				
Prior birth interval					

Note:
#. Correlation coefficient/N/Significance level on two-tailed t-test.

TABLE 8

LESE MATERNAL FACTORS AND INFANT PHYSICAL CHARACTERISTICS

	Birth-weight	Birth-length	Head circ.	Ponderal index	Daily weight gain (gms)
Mother's age					
Parity					
Mother's height					
Mother's head circ.					
Mother's weight					.656 9 .055
Prior birth interval		.704 9 .034			

TABLE 9

NBAS ITEM SCORES

	EXAM PERIOD					
	EARLY		MIDDLE		LATE	
	EFE	LESE	EFE	LESE	EFE	LESE
Habituation to:						
light	6.0#	6.0	7.3	5.5#	6.6	5.8
rattle	5.8	6.5#	7.2	6.3	6.7#	6.1
bell	7.2	7.8#	7.4	6.8	8.0#	6.8
Inanimate visual	4.5	5.3	5.7	5.4	5.5	5.6
Inanimate auditory	5.5	5.0	5.9	5.6	5.5	5.8
Animate visual	5.9	6.5	6.1	6.8	6.4	5.6
Animate auditory	5.6	5.5	6.4	6.0	6.6	6.3
Animate vis. and aud.	7.0	7.4	6.9	7.0	7.0	6.7
Alertness	5.2	4.9	5.7	5.0	5.7	5.1
Tonus	5.6	5.8	5.5	5.2	5.8	5.3
Maturity	4.3	4.0	5.4	4.5	5.6	5.3
Pull to sit	5.7	5.4	5.8	5.1	6.1	5.0
Cuddliness	5.3	4.9	5.2	4.7	4.4	4.5
Defensive movements	5.8	5.4	7.3	6.5	7.9	7.1
Consolability	4.6	4.9	4.6	4.3	3.6	3.8
Peak of excitement	5.7	5.6	5.9	6.3	6.6	6.2
Rapidity of buildup	5.5	5.8	5.6	5.4	5.5	5.7
Irritability	4.2	4.2	4.9	4.0	5.1	4.5
Activity level	4.7	4.3	5.3	4.4	5.7	4.4
Tremors	5.4	5.5	3.7	4.3	4.0	4.1
Startles	3.8	3.6	2.6	2.3	2.9	3.0
Lability of skin color	3.4	4.3	3.4	3.2	3.5	3.5
Lability of states	1.5	1.6	1.6	1.5	1.4	1.4
Self-quieting	5.3	4.6	5.3	3.6	3.8	3.7
Hand to mouth	5.9	6.0	6.2	4.2	4.7	5.3

Note:
#. $N < 5$

TABLE 10

NBAS CLUSTER SCORES

	EXAM PERIOD						ANOVA EFFECTS		
	EARLY		MIDDLE		LATE		GRP.	TIME	TIME x GRP.
	EFE	LESE	EFE	LESE	EFE	LESE			
Motor	4.85 .82 15	4.70 .69 11	5.70 .64 15	5.17 .93 11	5.64 .68 14	5.24 .80 12		.001	
Orien-tation	5.77 .81 11	5.83 .85 8	6.17 1.31 13	6.07 1.05 8	6.16 1.04 11	5.79 1.63 10			
Range of state	3.19 .99 13	3.45 .86 9	3.63 .70 15	3.24 1.24 12	3.19 .97 16	3.15 1.0 13		.057	
State regula-tion	5.22 1.26 16	5.09 1.09 10	5.32 1.33 16	4.32 .82 12	4.08 1.37 16	4.24 1.27 13		.014	.031
Autonomic	5.87 1.22 16	5.76 .82 11	6.81 .87 16	6.65 1.27 12	6.71 .62 15	6.46 .73 11		.001	

TABLE 11

NBAS REFLEX ITEM SCORES

	EFE			LESE		
	Early	Middle	Late	Early	Middle	Late
Plantar grasp	3.0#	2.9	3.0	3.2	3.0	3.0
Hand grasp	2.9	3.1	3.0	3.2	3.0	2.8
Babinski	3.0	3.0	3.0	2.8	3.0	3.0
Standing	2.7	3.0	3.0	2.8	2.8	3.1
Walking	3.1	3.1	2.9	2.8	2.3	2.8
Incurvation	2.3	2.2	2.4	2.6	2.4	2.8
Crawling	2.4	2.9	2.9	2.6	3.0	2.7
Glabella	3.0	3.0	3.0	3.0	3.0	2.6
Deviation of head and eyes	2.8	2.9	2.6	3.0	2.9	3.0
Nystagmus	2.8	2.9	2.9	3.0	2.8	3.0
Tonic neck reflex	3.0	3.0	3.0	3.0	3.0	3.0
Moro	3.0	3.0	3.0	2.9	2.8	3.0
Passive movements						
right arm	3.1	3.0	3.1	3.6	2.6	3.0
left arm	3.1	3.0	3.1	3.6	2.6	3.0
right leg	3.7	3.2	3.3	4.1	3.0	3.5
left leg	3.7	3.2	3.3	4.1	3.0	3.5

Note:
#. Reflex scores of 2, 3, or 4 were considered within the normal range. Scores of 1 or 5 were considered abnormal.

TABLE 12

T-TESTS OF NBAS CLUSTER SCORES

Cluster	Group	Early vs. middle	Early vs. late	Middle vs. late
Motor	pooled	.001	.007	--
Range of state	pooled	--	--	(.056)
Orientation	pooled	--	--	--
State regulation	Efe	--	.03	.001
	Lese	--	--	--
Autonomic	Efe	.009	.03	--
	Lese	(.07)	.005	--

TABLE 13

MATERNAL BIOMEDICAL FACTORS AND NEWBORN BEHAVIOR

	Motor			Range of state			Orientation			State regulation			Autonomic		
	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L
<u>Efe</u>															
Age															
Height															
Weight					.54										
Head circ.										.65					
Gravida					.52										
Prior birth int.															
<u>Lese</u>															
Age								.75		-.54					
Height										.58					
Weight															
Head circ.										.70					
Gravida								.85#	.60	-.63					.57
Prior birth int.															

Significance: unmarked p < .05
# p < .01

TABLE 14

INFANT BIOMEDICAL FACTORS AND NEWBORN BEHAVIOR

	Motor			Range of state			Orient-ation			State regula-tion			Auto-nomic		
	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L
<u>Efe</u>															
Birth-weight															
Head circ.															
Birth-length													.65#		
Pond-eral index									.81						
Weight gain						.54					-.56			.66#	
Weight at exam													.48		
<u>Lese</u>															
Birth-weight	.66*														
Head circ.		-.54		.62	.53	.72#			-.62	.61					
Birth-length							-.62								
Pond-eral index	.52										-.54				
Weight gain		-.85*													
Weight at exam				.62					-.72#						

Significance: unmarked p < .05
# p < .01
* p < .001

TABLE 15

NBAS SCORES FOR EFE, LESE, AND LOW RISK AMERICAN NEWBORNS

	Efe	Lese	American (Als et al.,1976)	American (Keefer et al.,1982)
Inanimate visual	4.5	5.3	5.9	5.3
Inanimate auditory	5.6	5.5	5.4	5.6
Animate vis. & aud.	7.0	7.4	6.2	6.6
Alertness	5.2	4.9	5.5	5.4
General tonus	5.6	5.8	5.0	5.7
Motor Maturity	4.3	4.0	4.1	4.3
Pull-to-sit	5.7	5.4	5.3	6.0
Cuddliness	5.3	4.9	5.5	6.0
Defensive movements	5.8	5.4	4.8	6.4
Consolability	4.6	4.9	6.7	7.1
Peak of excitement	5.7	5.6	5.6	5.8
Rapidity of buildup	5.5	5.8	4.0	3.9
Irritability	4.2	4.2	5.2	4.5
Activity	4.7	4.3	3.7	4.8
Tremulousness	5.4	5.5	5.5	5.1
Startle	3.8	3.6	5.1	4.7
Lability of skin color	3.4	4.3	4.6	4.2
Lability of states	1.5	1.6	3.0	2.9
Self-quieting	5.3	4.6	5.4	6.1
Hand to mouth	5.9	6.0	4.8	5.6