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LANGUAGE DEVELOPMENT
IN
PREMATURE AND HIGH RISK CHILDREN

By

© PATRICIA SARAH TOLKIN-EPPEL, B.A., M.A., M.Sc.

A Thesis
Submitted to the School of Graduate Studies
in Partial Fulfilment of the Requirements
for the Degree
Doctor of Philosophy

McMaster University
June 1984

LANGUAGE DEVELOPMENT

IN

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ABSTRACT

With advances in neonatal intensive care, many infants born at risk due to very low birthweight (1500 grams or less), due to intrauterine growth retardation (the small-for-gestational age infant has a birthweight less than 2 SD below the mean for gestation) or due to severe Respiratory Distress Syndrome and birth asphyxia, survive free of major debilitating sequelae. However, these apparently 'healthy' children may experience difficulties in perceptual, cognitive and academic performance.

The early language development of 12 'healthy' children potentially at risk due to their pre- and perinatal histories, and a group of comparison children matched for sex and social class was investigated. The analysis of language during this rapid phase of acquisition (18 to 30 months) indicated whether the two populations were acquiring language similarly. Of further interest was the ambient linguistic environment provided by the mothers of these children.

The language measures, derived from the child's spontaneous speech, quantified verbal output (the rate and amount of speech), syntactic complexity (mean length of utterance, upper bound and type-token ratio) and morphemic

acquisition. Comprehension and expressive scores were also derived from the Reynell Language Scales. The mothers' speech was scored for verbal output and syntactic complexity.

The high risk children were as verbose as the comparison children, but their language was syntactically less complex. Comprehension scores were also significantly lower for the high risk group. Although the high risk scores (uncorrected for the degree of prematurity) were within normal range, they were still significantly below those of the comparison children. The language of the two groups of mothers did not differ.

It was concluded that the early language of the high risk children showed evidence of maturational delay and/or cortical lesion, and that but for the perinatal insult the high risk children may have performed better.

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Linda Graham, who took over the typing at the last moment from Marg Belec, has kept my margins straight and has given me invaluable assistance in the final presentation of this thesis.

I dedicate this thesis to my husband, Alan, my children Ayelet and Noam and to my parents, Jacqueline and Gerald Tolkin.

> So the stout fetus, kicking and alive,
> Leaps from the fundus for his final dive,
> Tired of the prison where his legs were curled,
> He pants, like Rasselas, for a wider world.
> No more to him their wonted joys afford,
> The fringed placenta and the knotted cord.
>
> <u>Oliver Wendell Holmes</u>

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INTRODUCTION

Preamble to the Introduction

This thesis was concerned with the ontogenesis of language in a population of very low birthweight (VLBW), small-for-gestational age (SGA), respiratory distress syndrome (RDS) and birth asphyxiated infants who survived these pre- and perinatal stresses without major sequelae.

Such a population of infants, born in the 1970's, has benefitted from neonatal intensive care. However, the prognosis for the 'healthy' high risk infant is not always clearly defined, because, while the original trauma and possible central nervous system lesions continue to act on the child's development, sequelae are often subtle and not evident until later in the child's life.

Language acquisition is one critical skill through which developmental disability may express itself. Unlike most outcome studies which have concentrated on the general developmental deficits, this thesis focused on the specifics of early language acquisition.

Two bodies of literature are covered in the introduction. The first addresses the nature of, and the developmental outcome for, the high risk infant. The second discusses language acquisition and the measurement of linguistic performance.

Abbreviations

AGA	Appropriate-for-gestational age
CNS	Central nervous system
CP	Cerebral Palsy
CPAP	Continuous positive airway pressure
DQ	Development Quotient
ELBW	Extremely low birthweight
HMD	Hyaline membrane disease
IQ	Intelligent Quotient
ITPA	Illinois Test of Psycholinguistic Abilities (Kirk, McCarthy and Kirk, 1968).
IVH	Intraventricular hemorrhage
LAD	Language Acquisition Device
LBW	Low birthweight
MLU	Mean Length of Utterance
MR	Mental Retardation
NIC	Neonatal Intensive Care
PPVT	Peabody Picture Vocabulary Test (Dunn, 1965).
RDS	Respiratory Distress Syndrome
RLF	Retro-lental fibroplasia
SD	Standard Deviation
SES	Socioeconomic status
SGA	Small-for-gestational age
VLBW	Very low birthweight
WISC-R	Wechsler Intelligence Scale for Children – Revised

Introduction

With the introduction of neonatal intensive care (NIC)[1] and the continued refinement of perinatal management techniques, the infant born at risk is provided with nutritional, metabolic and respiratory support to compensate for underdeveloped and mal-functioning organs. According to Blake, Stewart and Turcan, (1977) there is evidence to suggest that major handicaps of perinatal origin occur only if NIC fails to prevent serious hazards such as hypoxia.[2]

High risk infants (that is, the very low birth-weight infant (VLBW), the small-for-gestational age infant (SGA) and infants with respiratory difficulties) are now more likely to survive and less likely to have major sequelae, (for example, cerebral palsy, mental retardation, hydrocephaly[3]) (Alden, Mandelkorn, Woodrum

---

[1]Two to three percent of newborn infants require attention in NIC due to severe illnesses or abnormalities (Reynolds, 1978). For details on NIC practices, see Blake, Stewart and Turcan, (1977) and Reynolds, (1978).

[2]Given the different etiological conditions associated with the small-for-gestational age infant (SGA), and the appropriate-for-gestational age infant (AGA), (see pages 14 ff) perinatal care appears to most benefit the AGA infant (Sabel, Olegard and Victorin, 1976).

[3]These and other sequelae are discussed on pages 41 ff

et al., 1972; Blake, Stewart and Turcan, 1977; Calame, Reymond-Goni, Maherzi et al., 1976; Dann, Levine and New, 1964; Davies, 1976; Davies and Stewart, 1975; Davies and Tizard, 1975; Drillien, Thomson and Burgoyne, 1980; Fitzhardinge, 1975; Fitzhardinge, Kalman, Ashby et al., 1978; Fitzhardinge and Ramsay, 1973; Francis-Williams and Davies, 1974; Grassy, Hubbard, Graven et al., 1976; Hagberg, Hagberg and Olow, 1975; Hagberg, Olow and Hagberg, 1973; Horwood, Boyle, Torrance et al., 1982; Johnson, Malachowski, Grobstein et al., 1974; Kitchen, Orgill, Rickards et al., 1982; Kitchen, Ryan, Rickards et al., 1980; Knobloch, Malone, Ellison et al., 1982; Levene and Dubowitz, 1982; Lubchenco, Delivoria-Papadopoulos and Searles, 1972; Nickel, Bennett and Lamson, 1982; Orgill, Astbury, Bajuk et al., 1982; Pape, Buncic, Ashby et al., 1978; Parkinson, Wallis and Harvey, 1981; Rawlings, Reynolds, Stewart et al., 1971; Reynolds and Taghizadeh, 1974; Rothberg, Maisels, Bagnato et al., 1981; Rubin, Rosenblatt and Balow, 1973; Sabel, Olegard and Victorin, 1976; Saigal, Rosenbaum, Stoskopf et al., 1982; Siegel, Saigal, Rosenbaum et al., 1982; Stewart and Reynolds, 1974; Stewart, Reynolds and Lipscomb, 1981; Stewart, Turcan, Rawlings et al., 1977; Teberg, Hodgman, Wu et al., 1977; Thompson and Reynolds, 1977; Tuck and Ment, 1980; Yu and Hollingsworth, 1980).

These studies indicate that there is the prospect of an improved outcome for the infant born weighing 2500 grams or less (Pharoah and Alberman, 1981). A survey of world literature concluded that since the introduction of NIC, survival rates have trebled and the handicap rate has remained stable at 6 to 8% of VLBW livebirths (Stewart, Reynolds and Lipscomb, 1981).[1]

Morbidity rates have also been calculated based on the number of survivors, rather than on the number of livebirths. A review of 10 studies gives an overall incidence of 18% of surviving VLBW infants with significant neurological handicaps, including CNS damage, cerebral palsy and retardation, indicated by a developmental quotient score of less than 80, corrected for the degree of prematurity (Levene and Dubowitz, 1982).

Studies comparing the incidence of major sequelae in VLBW infants before and after the introduction of NIC in a hospital or area, conclude that these rates have remained stable, although there is a larger percentage of

---

[1]The studies included in the review by Stewart, Reynolds and Lipscomb, (1981) were those in which all livebirths were accounted for, and the prevalence of handicaps was noted in infants of at least 12 months of age, (corrected for the degree of prematurity). The handicaps of interest were those of a neurological nature, such as cerebral palsy, and mental retardation defined as an IQ score of 2 S.D. below the mean, or a developmental quotient score of less than 70.

infants surviving without major sequelae (Jones, Cummins and Davies, 1979).[1]

The extent and nature of the improvement varies with the population under study,[2] with the center or hospital and whether the infants were inborn or referred after birth,[3] the social and ethnic status of the population,[4] the age of the children at follow-up,[5] the

---

[1] A decrease in the number of handicapped children, as a percentage of the number of survivors, is accompanied by an increase in the proportion of infants who have not benefitted from NIC procedures (Alberman, 1978). Thus, while NIC reduces major morbidity rates it does so selectively most benefitting those infants with perinatal, as opposed to early fetal, insult.

[2] Outcome studies for the various high risk populations are discussed on pages 8 ff.

[3] Infants who are referred from other centers are subjected to the stresses of transportation and are without the benefits of early treatment.

> "Inadequate resuscitation at birth, prolonged hypoxia and acidaemia, together with the cold stress of transport that is seen so frequently in the referred patient influence not only the immediate neonatal period but also the type and frequency of developmental sequelae." (Fitzhardinge, Kalman, Ashby et al., 1978, p. 140).

[4] See pages 32 ff.

[5] Developmental deficits manifest with great variability and may not be evident at birth. Some problems only emerge at school (Blake, Stewart and Turcan, 1977; Kitchen, Ryan, Rickards et al., 1980).

attrition rate in long term outcome studies,[1] and the method of data collection.[2]

In spite of the breadth of information available on the prognosis of the high risk infant, many studies do not clearly elucidate the developmental status of these children due to shortcomings in their design. Common problems include vague definitions of morbidity which do not specify the nature of the deficits.[3]

---

[1] Siegel, (1982 (a)) compared the early infant test results (on the Bayley, Uzgiris-Hunt and Reynell Language Scales) of those premature infants who were unavailable for testing at 3 years and those who were. Infants remaining in the study had higher scores than did those infants who 'dropped out'. Thus, a low drop-out rate reduces the possibility of bias in the data, since those likely to drop-out are those most likely to be severely affected by perinatal trauma.

Hunt, Tooley and Harvin, (1982) reported that in their follow-up study 11/121 or 9% of the survivors were never seen, 6/121 survivors were evaluated only during the first year, 102/121 (84.3%) had been seen at age 4 or older, and of that later group only 60 had been evaluated at 8 or 11 years.

[2] Studies which rely on parental reports for the incidence of neurological, perceptual and especially intellectual disturbances (for example, see Horwood, Boyle, Torrance et al., 1982) suffer from non-standard "ascertainment" procedures, and may underestimate the incidence of these problems, because parents may not be fully aware of the extent and nature of the difficulties.

[3] See Saigal, Rosenbaum, Stoskopf et al., (1982) for example, who defined mild dysfunction as "a child who is performing appropriately in OASDL [ordinary activities and skills of daily living] for corrected age, despite developmental or structural abnormality". Definitions such as this may fail to clarify precisely the nature of the difficulties high risk children will encounter.

Reliance on test norms without information on comparison children may also pose problems. Some studies have reported that high risk populations perform within normal ranges (usually defined as a score of not less than 1 S.D. below the mean). However, in studies which have included comparison populations, this performance is still significantly below that of the comparison children.

These and other methodological difficulties are underlined and reiterated in the pages to come which outline the nature of the high risk infant and the associated developmental picture.

The Nature of the High Risk Infant

The Low Birthweight Infant (LBW)

Incidence: The low birthweight infant is born weighing 2500 grams or less.[1,2]

---

[1]Birthweight is the index generally used to define prematurity, since the determination of gestational age is prone to error (Lubchenco, 1970). However, fetal weight is not always the most reliable guide to fetal maturity. Infants born with a birthweight of 2 S.D. below the mean for their gestational age present as a specific sub-population of high risk infants, with a different growth pattern (Fitzhardinge and Steven, 1972 (a)) and prognosis (Davis, 1981; Fitzhardinge and Steven, 1972 (b)). Further details on the small-for-gestational age infant (SGA) are found on pages 14 ff.

[2]Numerous factors carrying differing risk values are associated with the low birthweight and high risk infant. These factors include maternal socioeconomic status, maternal age, maternal height and weight, marital status, nutritional status, smoking, parity, past obstetric history, multiple births, gestational diabetes, abruptio placentae, PROM, toxemia of pregnancy, placental insufficiency, and maternal infections (e.g., rubella) (Abramowicz and Kass, 1966; Fedrick and Anderson, 1979).

The number of births registered as low birthweight varies with the criteria used to define stillbirths, livebirths and abortions (Alden, Mandelkorn, Woodrum et al., 1972) and the comprehensiveness of the 'ascertainment' techniques (Hagberg, Hagberg and Olow, 1975).

In Sweden, 4.9% of all infants born between 1969 and 1970 were designated LBW (Sabel, Olegard and Victoria, 1976). The incidence of LBW in the U.S.A. was 7.3% in 1977, with 8.8% of all livebirths being less than 37 weeks gestational age, a point which defines prematurity (U.S. Department of Health, Education and Welfare; Public Health Service, National Center for Health Statistics).

Approximately 1% of all livebirths in the U.S.A., Canada and England and Wales weigh between 500 and 1501 grams at birth (Desmond, Wilson, Alt et al., 1980; Pharoah and Alberman, 1981; Thompson and Reynolds, 1977). This range is considered to be very low birthweight, (VLBW).

The Very Low Birthweight Infant (VLBW)

Eight infants in the present study were designated as being very low birthweight – five of these were appropriate-for-gestational age, (AGA) and three were small-for-gestational age, (SGA).[1]

---

[1] SGA infants in the present study had a birthweight of at least two standard deviations below the mean weight for their gestational age (Usher and McLean, 1969).

The VLBW infant is most susceptible to those respiratory and metabolic problems which are associated with deleterious outcomes [1] (Driscoll, Driscoll, Steir et al., 1982) and the incidence of developmental sequelae[2] is greater in the under, as compared with the over 1500 gram population. Further, the VLBW SGA infants are at particular risk since they are that group of SGA infants subjected to early and chronic insult (Harvey, Prince, Bunton et al., 1982; Parkinson, Wallis and Harvey, 1981).

However, the VLBW infants are that population for which there is the greatest improvement in both mortality and morbidity statistics (in terms of major sequelae), coincident with the use of improved neonatal intensive care techniques (Rawlings, Reynolds, Stewart et al., 1971).

Many VLBW Infants Survive Without Major Sequelae:

> . . . it can be generally stated that with the exception of infants who experience certain very high risk factors, (seizures, intraventricular hemorrhage, prolonged respiratory insufficiency, severe intrauterine growth retardation, CNS infection), the outcome for the majority of infants weighing 1500 grams or less appears to be good. (Desmond, Wilson, Alt et al., 1980, p. 21).

---

[1] Brain damage is more common in the VLBW infant due to the vulnerability of the periventricular area in infants born prior to 32 to 35 weeks gestational age to changes in cerebral blood flow secondary to variations in arterial pO_2 and pCO_2. (Fitzhardinge, 1978).

[2] Further information on the incidence and nature of the major and minor sequelae is found on pages 41 ff.

The general consensus of research opinion is that many VLBW infants survive without major neurological abnormality (i.e., cerebral palsy, hydrocephalus, etc.), and have the possibility of a reasonable developmental outcome free from incapacitating physical and mental defects. This picture is in contradistinction to that based on results emanating from 1950 cohorts where 53% of the VLBW children had physical defects, and 50% were uneducable in normal schools (Drillien, 1961).

However, studies which have broadened the definition of morbidity have found that VLBW children are at risk for cognitive, linguistic and learning disabilities [1] (Hunt, 1981; Hunt, Tooley and Harvin, 1982; Siegel, 1979; 1982 (b); 1983; Siegel, Saigal, Rosenbaum et al., 1982).

The Extremely Low Birthweight Infant - Under 1000 Grams

One female SGA infant in the present study had a birthweight of less than 1000 grams.[2]

Although the extremely low birthweight infant (ELBW) infant is less likely to survive,[3] the morbidity profile for

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[1] These are discussed further on pages 49 ff.

[2] There is a high proportion of SGA infants in the ELBW group (Driscoll, Driscoll, Steir et al., 1982).

[3] Mortality rates for the ELBW infant are confounded by the ambiguity over the term 'viable' (Davies, 1976) but they range from 19% to 48% (Levene and Dubowitz, 1982).

this population is improving (Alden, Mandelkorn, Woodrum et al., 1972; Blake, Stewart and Turcen, 1977; Driscoll, Driscoll, Steir et al., 1982; Fitzhardinge and Ramsay, 1973; Francis-Williams and Davies, 1974; Grassy, Hubbard, Graven et al., 1976; Hunt, Tooley and Harvin, 1982; Knobloch, Malone, Ellison et al., 1982; Orgill, Astbury, Bajuk et al., 1982; Pape, Buncic, Ashby et al., 1978; Teberg, Hodgman, Wu et al., 1977; Yu and Hollingsworth, 1980), and does not approach the 100% major morbidity rate noted in 10 year old children born in the 1950's (Lubchenco, Horner, Reed et al., 1963).

The ELBW infant is at greater risk than the VLBW infant for developmental and neurological sequelae. Incidences of major handicap vary from study to study. Knobloch, Malone, Ellison et al., (1982) found that 40% of infants born with birthweights of between 751 and 1000 grams had major handicap. Alden, Mandelkorn, Woodrum et al., (1972) reported that 8/20 ELBW infants tested at 10 months had abnormal (< 69) or borderline (70 - 89) developmental quotients (test unspecified) when their scores were corrected for the degree of prematurity.[1] Pape, Buncic, Ashby et al., (1978) noting evidence of intracranial

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[1]Although not reported it may be assumed that the uncorrected developmental quotient scores were lower, and may have redistributed the infants downwards with more children falling within the abnormal or borderline categories. The question of the correction for prematurity is discussed on pages 244 ff.

hemorrhage in this population found major neurological defects in 9% of the survivors, and severe developmental delay[1] in 21% of the children at 1 1/2 years, when scores were corrected for prematurity. Britton, Fitzhardinge and Ashby (1981) suggest that while prognosis for the 700 to 800 gram infant is reasonable, no infant weighing less than 700 grams survived intact.

Driscoll, Driscoll, Steir et al., (1982) concluded that although morbidity is high, the improved survival rates for the ELBW infant were not associated with a higher incidence of neurological problems. It may be the case, however, that the sequelae manifest in less severe form, since Nickel, Bennett and Lamson (1982) reported that 16/25 children with a mean age of 10.2 years (classified as ELBW at birth) were placed in special education programmes.

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[1]This study does not report the uncorrected Bayley scores and the previous comments on page 12 would also apply.

In the Bayley Scales separate scores are derived for the mental and psychomotor components of the scales, with no provision for a combined or average score. Since this averaging was carried out in the study by Pape, Buncic, Ashby et al., (1978) it is difficult to interpret the significance of severe developmental delay when this is defined as a <u>mean</u> developmental quotient of < 80.

The Small-for-Gestational Age Infant

Three infants in the present study were small-for-gestational age (SGA), that is, born with a birthweight of 2 S.D. below the mean for their gestational age (Usher and McLean, 1969).

Three to four percent of all pregnancies are SGA (Winer, Tejani, Atluru et al., 1982) and at least 25% of neonates weighing less than 2500 grams have a gestational age greater than 37 weeks (Harding, 1976).

In contradistinction to the AGA premature infant, the SGA infant is more likely to make a successful cardiovascular and respiratory adjustment, but since the SGA infant has likely suffered from nutritional deprivation, his over-all growth is retarded and chemical reserves are depleted (Fitzhardinge and Steven, 1972 (a); Harding, 1976).

The SGA Syndrome – Etiology: In general terms, the following factors are implicated (Harding, 1976):

1) Genetic anomalies and infection (fetal rubella) retard growth and may result in abnormal cell multiplication in spite of normal maternal and placental stimulation.

2) Placental insufficiency and a reduction in the vascular capacity of the umbilical circulation due to fetal-maternal exchange problems.

3) Fetal malnutrition due to maternal undernutrition.

Hypertensive disorders are a common clinical feature of the mothers of SGA infants (Winer, Tejani, Atluru et al., 1982) along with toxemia, heart disease and diabetes. 'Crowding' in twins is also associated with the SGA birth (North, 1966).

SGA infants may also manifest acute fetal distress such as hypoxia which may be imposed on pre-existing placental insufficiency (Gruenwald, 1963).

Developmental Outcome: Chronic fetal distress may retard growth and lead to neurological sequelae. Outcome studies do indicate the potentially adverse effects of intrauterine growth restriction during vulnerable periods of brain development, although the evidence is not clear-cut.

That conflicting evidence stems in part from the fact that outcome for the SGA infant is a function of that infant's birthweight, so that the lower the birthweight the greater the risk of developmental deficit (Parkinson, Wallis and Harvey, 1981). Term SGA infants, for example,

---

[1]Protein deficiency in female rats results in a reduction of DNA and protein in the brains of off-spring (Zamenoff, Van Marthens and Margolis, 1968). The developing brain is vulnerable to malnutrition in both the pre- and post-natal period (Winick, 1969). This period of vulnerability begins around mid-gestation (Dobbing and Smart, 1974).

There is evidence of altered weight and cellularity, reduced myelin lipids and other biochemical indicies in the SGA infant, with the cerebellum being selectively prone to lesion (Chase, Welch, Dabiere et al., 1972; Dobbing and Smart, 1974).

rarely exhibit major neurological defects, but tend to have retarded growth and a diffuse form of brain damage including perceptual deficits and learning difficulties (Commey and Fitzhardinge, 1979; Fitzhardinge and Steven, 1972 (a), 1972 (b)).

One further important factor is the time of the onset of the retardation. There is a distinction in the developmental course between those infants with retarded growth prior to 26 weeks, and those with normal head growth in utero – the former having the poorer prospects (Harvey, Prince, Bunton et al., 1982; Parkinson, Wallis and Harvey, 1981).

Developmental Picture: The SGA infants are likely to exhibit neurological signs (such as seizures), developmental delay and retarded growth (Beargie, James and Greene, 1970; Commey and Fitzhardinge, 1979; Davies, 1981; Davies and Stewart, 1975; Drillien, 1970; Fitzhardinge, Kalman, Ashby et al., 1978; Fitzhardinge and Ramsay, 1973; Fitzhardinge and Steven, 1972 (a); 1972 (b); Lubchenco, Bard, Goldman et al., 1974; Stewart and Reynolds, 1974). As a group they show poor school performance (Rubin, Rosenblatt and Balow, 1973) lower IQ and a greater incidence of psychomotor handicaps (Francis-Williams and Davies, 1974; Parkinson, Wallis and Harvey, 1981) and cerebral palsy (Sabel, Olegard and Victorin, 1976).

Comparison of the SGA and AGA Infant: Some investigators question the extent to which SGA infants have a different developmental picture to that of preterm AGA infants. Kitchen, Ryan, Rickards et al., (1980) indicated a better outcome at 8 years for the SGA infant (based on WISC-R scores), a finding similar to that of Stewart, Turcan, Rawlings et al., (1978). Siegel, Saigal, Rosenbaum et al., (1982) on the basis of results from the Bayley Mental and Psychomotor scales and the Reynell Language Scales at 24 months concluded that the SGA infant showed less developmental delay than the AGA premature infant (less than 1500 grams), their scores not differing significantly from those of term comparison children. AGA and SGA children did not differ in their performance on the McCarthy Scales at 5 years of age (Siegel, 1982 (b)).

Other research indicates that the SGA infant is, in fact, more at risk for developmental sequelae. While there was the same severity of postnatal complications in the under 1500 gram SGA and AGA groups, the SGA infants had lower Bayley and more neurological handicaps at 18 months (Fitzhardinge, Kalman, Ashby et al., 1978).[1] The finding that the SGA infant is more at risk is supported by results

[1] In this study, the infants at greatest overall risk for developmental handicaps were survivors of intraventricular hemorrhage. The SGA infants were the group next at risk for sequelae.

from Commey and Fitzhardinge (1979), Davies (1981), Drillien (1970); Fitzhardinge and Steven (1972 (b)), Francis-Williams and Davies (1974).[1] According to Saint-Anne Dargassies (1977) mental retardation is encountered more frequently in the SGA infant, and these group differences carry through to school age (Nickel, Bennett and Lamson, 1982; Rubin, Rosenblatt and Barlow, 1973).

Summary: The small-for-gestational age infant has a different etiological and clinical history than the AGA infant. Like the AGA infant, however, they are vulnerable to deleterious sequelae, with the suggestion that their prognosis may be worse. The severity of the sequelae is a function of the birthweight of the SGA infant, timing of the insult and the perinatal course (including the incidence and severity of asphyxia and the use of mechanical ventilation to circumvent respiratory difficulties).[2] The specificity of the outcome measures (i.e., in terms of gross neurological pathology or the finer perceptual and

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[1] AGA and SGA infants may differ on variables other than the weight-for-age factor. These other variables, e.g., birth asphyxia and the need for mechanical ventilation, may contribute to the outcome also.

[2] Respiratory difficulties are discussed on pages 19 ff.

motor difficulties noted in such populations of infants) also affects the statement on the developmental prognosis for these infants. SGA infants were included in the present study.

Respiratory Distress Syndrome (RDS)

Four of the high risk infants in the present study were male survivors of Respiratory Distress Syndrome.

Respiratory Distress Syndrome or Hyaline Membrane Disease (HMD) of the newborn infant is a severe disorder of the lungs which vies with congenital malformation as the commonest primary or contributive cause of neonatal death (Avery and Mead, 1959; Farrell and Wood, 1976). In infants weighing less than 1000 grams, RDS is associated with high mortality rates (Adamsons and Myers, 1973; Alden, Mandelkorn, Woodrum et al., 1972; Vapaavuori and Raiha, 1970).

The primary disposing factor is prematurity (Hallman and Gluck, 1977) – more than 90% of the fetal RDS cases are less than 35 weeks gestational age, with an inverse relationship existing between the occurrence of RDS and gestational age (Usher, Allen and McLean, 1971).

Perinatal asphyxia, elective Cesarean Section, maternal diabetes, the male sex and second born twin are some of the other significant factors increasing the likelihood of the occurrence of RDS. The critical factors are associated with a delay in the functional maturity of the lungs, preventing the premature infant from making a satisfactory respiratory adjustment postnatally.[1]

Respiratory Distress Syndrome – Outcome Studies: The major issue here is not whether infants with RDS have major or minor neurological and psychological sequelae, but whether these adverse effects can be attributed to RDS per se.

One way to answer this is to compare populations matched for birthweight and differing primarily in the incidence of RDS. Such studies have found the same proportion of psychological deficits (at age 4, based on results from the Gesell and Stanford-Binet and Graham-Ernhart Block Sort Test; Ambrus, Weintraub, Niswander et al., 1970), and neurological abnormalities at 4 years (Ambrus, Weintraub, Niswander et al., 1970) and 6 1/2 years of age (Robertson and Crichton, 1969) in these populations. However, these results must be interpreted with caution, since it is possible that the population without RDS may have had an array of other complications (such as hypoxia attacks, etc.) which predisposed those infants to risk in the same way that RDS did. It may be for this reason that between group differences are minimal (Field, Dempsey, Ting et al., 1982).

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[1]See Brown, Gabert and Stenchever (1975), Gluck and Kulovich (1973) and Hallman and Gluck (1977) for discussions on the development of the fetal lung, the role of surfactant in lung maturity and the clinical features of respiratory distress syndrome.

Stewart and Reynolds (1974) found that 3 to 6 year old children who suffered RDS (but no other complications such as abnormal cerebral signs) had no major handicaps. However, there are at least four relevant variables which preclude the making of an unequivocal statement on the outcome effects of RDS per se.

1. Birthweight: The severity and incidence of RDS and birthweight are inversely related, with a high incidence of RDS in the under 1000 grams group (Driscoll, Driscoll and Steir et al., 1982). Bacola, Behrle, deSchweinitz et al., (1966 (a)) reported a higher incidence of severe mental retardation in 4 year old survivors of RDS who weighed less than 1250 grams at birth. However, it also appears that RDS in the mature infant results in more psychomotor abnormalities than are found in a comparable birthweight control group (Fisch, Gravem and Engel, 1968). Field, Demsey, Ting et al., (1982) found that gestational age alone explained 18% of the variance of corrected Bayley scores of infants at 1 year who had RDS in the neonatal period.

2. Severity of RDS: The severity of the RDS episode may differentially affect outcome. Mild RDS[1] did

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[1] See page 123 for definition.

not result in mental retardation (Bacola, Behrle, deSchweinitz et al., 1966 (a)) while severe RDS increased the incidence of developmental deficits (Harrod, L'Heureux, Wagenstein et al., 1974; Johnson, Malachowski, Grobstein et al., 1974; Outerbridge, Ramsay and Stern, 1974; Stahlman, Hedvall, Dolanski et al., 1973; Vapaavuori and Raihi, 1970).

3. Age at Follow-up and Outcome Measures: Fisch, Gravem and Engel (1968) found a higher incidence of neurological abnormalities in 1 year old survivors of RDS than in infants matched for birthweight, but who did not have RDS (statistical significance not reported). However, by 4 years, the incidence of abnormal psychomotor scores (based on motor items from the Stanford-Binet Scales and scores on the Graham-Ernhart Block Sort Test) converged for those infants under 2500 grams (Fisch, Bilek, Miller et al., 1975). For those infants weighing greater than 2500 grams at birth, the incidence of abnormalities in the RDS population exceeded that in the non-RDS comparison population (statistical significance not reported). Field, Demsey and Shuman (1981) found that significant differences on the Bayley Scales at 1 year had diminished by 2 years for the RDS and non-RDS term groups. By 2 years the Bayley scores for the RDS group approached the mean for the scale.

Siegel (1982 (a), 1982 (b), 1983) using a risk index encompassing reproductive, demographic and perinatal variables found that RDS was significantly correlated with the scores of VLBW infants on the Stanford-Binet, and the Reynell Language Comprehension Test at 3 years, and with alphabet recitation at 5 years (although the amount of variance accounted for was not large).

Such results suggest that the effects of a perinatal insult such as RDS may manifest in different skills at different ages. Deficits in psychomotor skills may recede with age, while those skills emerging later in the child's life may be vulnerable to the continuing effects of the original trauma (Field, Demsey and Shuman, 1979; Hunt, Tooley and Harvin, 1982).

4. <u>Mechanical Ventilation</u>: Mechanical ventilation is used to circumvent infants' breathing difficulties.

In general, RDS survivors who were mechanically ventilated have a reasonable prospect for developmental outcome, with no evidence of an increased incidence of cerebral palsy and epilepsy (Fitzhardinge, 1978). Studies with pre-school children reported as high as 80% surviving mechanical ventilation as being normal or only minimally handicapped (Johnson, Malachowski, Grobstein et al., 1974). This study, although lacking controls, found only 4/50 children had IQ scores of less than 85 (Stanford-Binet).

Orgill, Astbury, Bajuk et al., (1982) and Tuck and Ment (1980) similarly reported favourable outcomes for ventilated ELBW and VLBW infants respectively, with no evidence of iatrogenic sequelae.[1] However, Dinwiddie, Mellor, Donaldson et al. (1974) did report significantly lower IQ scores for this group of infants by school age.

Once again, birthweight is a critical factor since those ventilated survivors weighing less than 1501 grams fared less well than non-ventilated infants, with the highest incidence of major handicap in this population of infants (Fitzhardinge, Pape, Arstikaitis et al., 1976; Harrod, L'Heureux, Wangenstein et al., 1974; Johnson, Malachowski, Grobstein et al., 1974; Rothberg, Maisels, Bognato et al., 1981).

The indication for ventilation is another significant factor. VLBW infants ventilated for RDS alone had no major sequelae (Stewart, Turcan and Rawlings et al., 1978). On the other hand, those ventilated for respiratory failure associated with abnormal CNS signs (e.g., seizures) and for

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[1]The mask used in mechanical ventilation had been attached by a Velcro band across the occiput. Compression and molding had been noted, and on autopsy cerebellar and intraventricular hemorrhage was found in infants following mask rather than endotracheal tube ventilation (Pape, Armstrong and Fitzhardinge, 1976). The mask is not common usage now (private communication from Dr. J. Tolkin).

birth asphyxia had a very high morbidity rate. CNS defects associated with the ventilator survivor were not due to ventilation per se but to the hypoxic insults prior to, or during, the ventilation (Fitzhardinge, 1978).

With respect to the older premature infant,[1] those over 35 weeks who were ventilated solely for RDS were unlikely to sustain severe damage (Fitzhardinge, 1978).

Apart from some of the more obvious indicators of psychoneurological difficulties noted above, VLBW ventilated infants had a developmental lag in their visual and auditory tracking and orienting (Daum, Kurtzberg, Ruff et al., 1980). At 48 weeks post conception these infants' scores matched those of the 38 week non-ventilated infants, and there was further evidence of delay at 7 months as measured by the Bayley Scales.

Summary Statement: Any statement relating to the outcome of RDS is subject to qualifications concerning the nature of the cohort, the severity of the symptoms, the age at follow-up, whether mechanical ventilation was administered, and the specificity of the outcome measures.

While there is evidence to suggest that RDS per se is not implicated in increased morbidity figures except for

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[1]Three infants in the present study had severe RDS and a gestational age > 35 weeks.

the lower birthweight groups, RDS is intricately associated with LBW, prematurity and their concomitant hazards; the combination of low birthweight and RDS is an index of increased morbidity. Further, those aspects of prematurity which predispose the infant to RDS (e.g., impaired pulmonary function) may themselves result in CNS damage.

The majority of the studies reviewed suggest that in terms of general functioning the RDS infant is at risk, however, the precise nature of the deficit is not often specified. The analysis of early language development was undertaken in the present study in a population of high risk infants, which included those at risk due to severe RDS.

Respiratory Pathology

Four high risk infants in the study were asphyxiated in addition to having other perinatal complications.

Complications of placental, maternal and neonatal origin lead to asphyxia, hypoxia and its associated metabolic disorders (Adamsons and Myers, 1973; Csermely, 1972). The newborn infant can shift his circulation preferentially to critical areas such as the brain and heart and extend tolerance to asphyxia (Behrman, Lees, Peterson et al., 1970). However, the infant depressed at birth may have already exceeded his tolerance level. The lack of oxygen and the excess of carbon dioxide may result in brain damage, with mental and somatic retardation.

Partial asphyxiation[1] in utero occurs due to prolapse or compression of the cord, maternal analgesics, maternal preeclampsia and hypertension, abruptio placentae, placenta previa, abnormal myometrial activity[2] and placental insufficiency (see Adamsons and Myers, 1973 and Myers, 1972, for further details).

The consequence of these complications is to interfere with maternal-fetal oxygen exchange, with significant central nervous system repercussions such as intraventricular hemorrhage (Cole, Durban, Olaffson et al., 1974; Fitzhardinge, 1975)[3] in severe cases.

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[1]Acute total asphyxia rarely occurs (Adamsons and Myers, 1973).

[2]An elevated resting tone of the uterus and prolonged duration of contraction (but not necessarily an increase in the amplitude or frequency of the contractions) may result in asphyxia.

[3]Clinically, asphyxia is indicated by a low Apgar score (of less than 5 at one minute), meconium staining and fetal bradycardia. It can be corrected by the support of cardiac output, by the correction of acidosis and with the use of mechanical ventilation and CPAP (continuous positive airway pressure, Gregory, Kitterman, Phibbs et al., 1971).
For further details on the pulmonary and metabolic problems in the infant (including hypovolemia, hypothermia and patent ductus arteriosus) see Werthmann (1981).

Partial asphyxiation results in damage to hemispheral rather than brain stem structures, affects the cerebellum and cerebrum with the progressive impairment of blood circulation becoming more generalised in the brain[1] (Myers, 1972). Damage to the basal ganglia is implicated since athetoid cerebral palsy was the most common outcome in a population of children with severe birth asphyxia (Scott, 1976).

Outcome Studies: The lack of oxygen is both potentially lethal to the LBW and SGA infant (Commey and Fitzhardinge, 1979) and may cause brain damage (Alberman, 1978). Hypoxia, as partial deprivation of oxygen poses a more subtle threat. It leads to a depletion of oxygen reaching the tissues, and may cause a permanent loss of their function.

As a general statement it can be said that hypoxia and asphyxia (and the resultant metabolic acidosis) are associated with poorer developmental outcome and neurological sequelae (Amiel-Tison, 1969; Driscoll, Driscoll, Steir et al., 1982; Fitzhardinge, 1975; Gottfried, 1973; Rawlings, Reynolds, Stewart et al., 1971; Scott, 1976) and with the

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[1]Areas vulnerable to damage include the middle third of the paracentral region and the posterior parietal cortex, and the basal ganglia including the caudate nucleus and putamen.

impairment of cognitive and linguistic skills at 2 years (Siegel, Saigal, Rosenbaum et al., 1982) and 5 years (Siegel, 1982 (b)) in VLBW infants.

The adverse effects of respiratory pathology are seen more often in the VLBW infant (Bacola, Behrle, de-Schweinitz et al., 1966 (a); O'Brien, Usher and Maughan, 1966; Stewart and Reynolds, 1974). Intrapartum hypoxia in AGA infants over 37 weeks gestational age did not result in a greater incidence of cognitive and linguistic disturbances in children up to 5 years of age, when compared with non-hypoxic term children (Low, Galbraith, Muir et al., 1983).

The association between respiratory pathology and outcome may be dependent on the nature of the pathology. Apnea[1] was not associated with an increased risk of major handicap if the infant was resuscitated before a severe hypoxic attack (Alden, Mandelkorn, Woodrum et al., 1972; Stewart, Turcan, Rawlings et al., 1977) although Siegel, Saigal, Rosenbaum et al., (1982) reported that expressive language scores in the premature infants were affected by the severity of apnea.[2]

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[1]This was defined as two or more episodes of cessation of breathing greater than 30 seconds duration.

[2]Defined in terms of the number of days it occurred and by the number of days it was treated with theophylline.

The age at follow-up and the outcome measures chosen are other critical factors qualifying statements of prognosis. Scott (1976) reported that 76% of children who suffered from severe asphyxia showed no neurological abnormalities when seen between the ages of 2 and 7 years, and significant IQ differences between the anoxic and comparison groups at earlier ages had often disappeared by age 7 (Corah, Anthony, Painter et al., 1965). Gottfried (1973) had noted that early childhood intellectual impairment in children who suffered anoxia at birth had diminished by the time they were adolescents.

Apart from methodological problems such as the attrition rate in long term studies, the longer the period between the perinatal insult and the outcome measure, the more critical the role of environmental factors in determining those outcome measures. Broman (1979), for example, found that considered alone signs of perinatal anoxia explained only 2 to 3% of the variance of Bayley scores at 8 months, and by 4 to 7 years they explained less than 1% of the variance of Standford-Binet and WISC-R scores. By 7 years, the most significant predictors of outcome were SES and the mother's educational level.[1]

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[1]The role of social class and familial factors are discussed on pages 32 ff.

Thus, as the child grows it is less likely that isolated perinatal episodes (such as anoxia and apnea) solely determine outcome. Rather it is these factors, in association with environmental features which affect the child's later life.

Summary

The populations of interest in this study (the VLBW, ELBW, SGA, RDS and asphyxiated infant) have been discussed, and their prognosis evaluated. The child's sex and social class are variables which also affect that prognosis, and these are now addressed.

The Infant's Sex is Associated with Outcome

Male infants are more susceptible to biological hazards (Rutter, 1970) and are more likely to be affected by prematurity and its neurological and developmental sequelae (Fitzhardinge, 1975). Neurological signs (e.g., seizures, dystonia) are more common in VLBW infant males than females (Drillien, 1972). Amongst neurologically normal LBW infants, boys' outcome is inferior to that of control boys (Drillien, Thomson and Burgoyne, 1980), a finding not noted for girls.

Outcome studies have indicated that premature males perform more poorly than girls on developmental tests

(Braine, Heimer, Wortis et al., 1966; Fitzhardinge and Ramsay, 1973; Honzik, Hutchings and Burnip, 1965), with difficulties in hearing and speech subscales (Eaves, Nutall, Klonoff et al., 1970), and at school in reading and writing (DeHirsch, Jansky and Langford, 1966; Rubin, Rosenblatt and Balow, 1973; Wortis and Freedman, 1965). This pattern holds for the SGA male also (Parkinson, Wallis and Harvey, 1981).

These results are consistent with the hypothesis that boys are more vulnerable than girls to stress events (Wortis and Freedman, 1965), which would include pre- and perinatal insults.

<u>The High Risk Infant and Socioeconomic Status (SES)</u>

> The effects of socioeconomic factors on subsequent mental development of premature infants in this and other studies appear to be so consistent as to warrant caution in ascribing subnormal mental development to some single event or circumstance of a biological nature without consideration of the cultural and economic factors. (Bacola, Behrle, deSchweinitz et al., 1966 (b), p. 373).

In the literature concerned with the prognosis of the high risk infant, opinions such as this are widespread. The general statement can be made that lower social class infants have a poorer prognosis than do higher social class infants, a pattern which also holds for the high risk and premature infant (Dann, Levine and New, 1964; Davies and Stewart, 1975; Drillien, 1961; 1964; 1970; Drillien, Thomson and Burgoyne, 1980; Eaves, Nuttall, Klonoff et al., 1970; Francis-Williams and Davies, 1974; Janus-Kakulska and Lis, 1966; Kitchen, Ryan, Rickards et al., 1980; Knobloch and Pasamanick, 1960; Parkinson, Wallis and Harvey, 1981; Pasamanick, Knobloch and Lilienfeld, 1956; Robinson and Robinson, 1965; Sameroff and Chandler, 1975; Stewart, Turcan. Rawlings et al., 1977; Werner, Bierman and French, 1971; Wortis and Freedman, 1965). Developmental outcome is closely related not only to pre- and perinatal difficulties but also to environmental features (Sameroff and Chandler, 1975), especially those which facilitate the child's cognitive and linguistic development (Siegel, 1979; 1981; 1982 (c)).

Has Social Class the Primacy?:

> The data indicate that aside from physical size and major physical defects, social class assumes much more importance than does birthweight in determining a child's developmental prognosis. (Robinson and Robinson, 1965, p. 433).

The negative effects of perinatal stress on later development appear to be greater in children from poorer homes, suggesting that SES interacts with perinatal history to determine intellectual outcome.[1]

Drillien, Thomson and Burgoyne (1980) reported at the conclusion of a 6 to 7 year follow up of children who

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[1]Goldstein, Caputo and Taub (1976) found that SES did not relate to IQ at 1 year, although ethnicity did.

weighed less than 2000 grams at birth, and who did not suffer intrauterine growth retardation nor neurological abnormalities in their first year, that their scores on a vast array of academic achievement tests[1] along with those from the WISC-R were similar to those of comparison children in similar homes (as measured by SES).

However,

> . . . the disadvantage of low birthweight as compared with control was more obvious in children from middle-class homes than it was in children from poor working class homes, where presumably the effect of low birthweight itself was diluted by the effects of environmental disadvantage common to LBW and control children. (Drillien, Thomson and Burgoyne, 1980, p. 30).

Thus, while neurological deficit due to perinatal trauma is critical in determining the child's outcome status (Wiener, Rider, Oppel et al., 1968),[2] it appears that

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[1]These tests included the Burt-Vernon Word Recognition Test (giving a reading quotient), the Burt-Inglis Spelling Test, the Bender-Gestalt Test, and a test to determine fine and gross motor activity. See Drillien, Thomson and Burgoyne (1980) for further details.

[2]In the study by Drillien, Thomson and Burgoyne (1980) discussed above, the high risk and comparison groups generally did not differ in the incidence of academic impairment, this not being the case for those children with early neurological signs who scored significantly lower than the comparison group.

socioeconomic factors modulate, by attenuation or intensification, the adverse effects of perinatal complications[1] which diminish or are heightened during childhood as more potent familial and social factors exert their influence (Sameroff, 1979). Excluding those children with severe brain damage, the IQ of preschool (Escalona, 1982; Francis-Williams and Davies, 1974) and schoolage children (Francis-Williams and Davies, 1974; Hunt, 1981) was significantly correlated with SES.

SES was amongst those variables predicting 2 year scores of children who were VLBW on the Bayley (MDI) Scale and the Reynell Expressive Language Scale at 2 years (Siegel, Saigal, Rosenbaum et al., 1982) and the Peabody Picture Vocabulary Test and alphabet recitation at 5 years (Siegel, 1983). SES also predicted 3 year Reynell Expressive and Comprehension scores and MLU (mean length of utterance) of children who were born weighing less than 2000 grams, (Smith, Somner and Von Tetzchner, 1982).

Douglas (1960) noting a generally favourable outcome for LBW infants, except in the area of school

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[1]Although the middle class high risk group had lower scores than the middle class comparison group, both of these groups had higher scores than the lower class children (Drillien, Thomson and Burgoyne, 1980).

performance, maintained that these consistently lower scores are explained by poorer familial and living conditions, a 'continuum of caretaking casualty' must be postulated to account for these results (Baum, 1977).

Socioeconomic Status – Not Specific Enough: SES is not a unitary variable, rather it stands as a short-hand form for an array of environmental features. Lower SES is not necessarily analogous to stimulus deprivation, lack of caretaker concern and affective behaviours (Tulkin and Kagan, 1972), and for this reason it is possible to find lower SES children succeeding and higher SES children failing. This does not negate consistent findings of associations between lower SES and poorer developmental prognosis, but as an index, SES differentiates some significant dimensions, but not all.

Since the explanatory force of SES is weak (Jones, 1972), there is the need to define more precisely those aspects of the home environment which limit the effectiveness of the 'caretaking continuum' (Baum, 1977) and which places the high risk infant at further risk.

According to Kitchen, Ryan, Rickards et al., (1980, p. 184), "the answer most probably lies in the diminished capacity of our lower-class families to locate and mobilize opportunities for the development of a very vulnerable infant". This 'diminished capacity' may cross socio-economic boundaries, however, and it is the quality of the home environment which is the more critical factor. Support for this view comes from Siegel (1981, 1982 (a)) who found that preterm and term infants at developmental risk (i.e., scoring less than 85 on the Bayley Scales), but whose subsequent performance at 2 and 3 years was normal, came from homes with more stimulating environments (as measured by the HOME inventory — Caldwell Inventory of Home Stimulation). The reverse situation also applied; those infants not at risk based on early infant tests, but who were delayed at 2 and 3 years came from home settings with lower HOME evaluations.

There are two pertinent issues here. Not only may the lower social class setting provide a poorer environment for the growing child, is it also the case that the high risk infant himself may elicit and influence caretaking behaviours which do not facilitate a good mother-child relationship (Bell, 1971; Sameroff and Chandler, 1975) and which may further exacerbate poor living conditions?[1]

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[1] Abnormal or deleterious conditions tend to occur together and may act synergistically (Prechtl, 1967).

The High Risk Child and His Mother[1]: High risk infants have been reported to be less active, less responsive and to interact less with their mothers, when compared with term infants (Brown and Bakeman, 1980; Field, 1977; Field, Hallock, Ting et al., 1978). However, a compensatory mechanism appears to be operative since caretakers initiated more interactions with high risk than with healthy infants (Beckwith and Cohen, 1978; Brown and Bakeman, 1980). Crawford (1982) found that while 6 month old premature infants behaved differently to term infants in respect of fretfulness and talkativeness, in general their mothers were more affectionate towards them (although interacted less with them).

Of further interest are the findings that the nature of maternal care can facilitate the early cognitive development of high risk infants (Beckwith, Cohen, Kopp et al., 1976;[2] Beckwith, Sigman, Cohen et al., 1977; Sigman, Cohen, Beckwith et al., 1981). Cohen, Beckwith and Parmelee (1978)

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[1]See Marton, Minde and Ogilvie (1981) for a brief overview of pertinent research.

[2]"Infants who were assessed at 9 months as more skillful in sensorimotor performance had at 1 month more mutual caregiver-infant gazing, at 3 months more interchanges of smiling during mutual gazing and more contingent response to their fuss cries . . ." (Beckwith, Cohen, Kopp et al., 1976, pp. 585-586).

reported that receptive language development[1] in preterm infants was facilitated by positive caretaker interaction; the more linguistically competent child at 24 months had the more facilitative and attentive mother, who had more reciprocal interactions with the child. Caretaker-infant interactions at 1 month and 8 months were also predictive of the infants' developmental outcome (as indicated by the Gesell and Bayley Scales) at 2 years.

In conclusion, while high risk infants may not perform as well as might be expected given the greater intensity of maternal interaction, neither do they perform as poorly as might be suggested by the nature of the perinatal complications (Sigman, Cohen and Forsythe, 1981). These findings must be qualified, of course, since these compensatory mechanisms may not be operative across all social classes.

The present study investigated one aspect of the maternal-child dyad — namely, language interaction. Of interest was the degree of similarity in the manner in which the high risk and comparison mothers interacted with their children, as measured by linguistic parameters.

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[1]Based on a non-standardised comprehension test, sampling nominals, locatives, modifiers and action words.

The High Risk Infant — Conclusion

The high risk infant has been identified. The literature reviewed suggests that the VLBW, ELBW, RDS, SGA and asphyxiated infant born in the 1970's has a reasonable chance of surviving free of major sequelae. However, these infants are vulnerable to an array of minor sequelae which may manifest in cognitive, linguistic and academic problems. The outcome status for these infants depends both on their pre- and perinatal history and the environmental conditions in which they are reared.

The next section deals with the nature of the sequelae to be expected in this population of children with emphasis on perceptual, cognitive and linguistic skills. It will be argued that the major neurological and psychological sequelae have been identified, but that the more diffuse and subtle forms of deficit which may now be the likely handicap the high risk child will have to overcome in the 1980's have been overlooked in many of the studies.

Prognosis for the High Risk Infant.

Severity of Outcome

A general indicator of the high risk infant's morbidity status and development picture is his birthweight and/or gestational age.[1]

An inverse relationship exists between gestational age/birthweight and the risk for subsequent neurological and intellectual disabilities (Alden, Mandelkorn, Woodrum et al., 1972; Bacola, Behrle, deSchweinitz et al., 1966 (a); 1966 (b); Britton, Fitzhardinge and Ashby, 1981; Commey and Fitzhardinge, 1979; Dann, Levine and New, 1964; Cassady, 1982; Douglas and Gear, 1976; Drillien, 1961; 1972; 1980; Driscoll, Driscoll, Steir et al., 1982; Davies and Stewart, 1975; Fitzhardinge and Steven, 1972 (b); Francis-Williams and Davies, 1974; Levene and Dubowitz, 1982; Horwood, Boyle, Torrance et al., 1982; Lubchenco, Delivoria-Papadopoulous and Searles, 1972; Lubchenco, Horner, Reed at al., 1963; Saint-Anne Dargassies, 1977; Wiener, Rider, Oppel et al., 1968).

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[1] While head circumference and body length are also measures of gestational age, birthweight combined with gestational age is a measure less contaminated by individual variation.

According to Saint-Anne Dargassies (1977) 32 weeks is a turning point after which survival and morbidity figures improve.

> Making a gross generalization from our findings it would seem that the risk of neurological sequelae may approach one in three with gestation less than 32 weeks, one in five from 32 to 35 weeks, and only one in ten at 37 weeks. (p. 467)

Drillien (1972) distinguished three etiological groups. The first with the highest risk of handicap is affected adversely in early gestation. The second, with mild mental retardation and neurological handicap is affected in later pregnancy (by malnutrition or hypoxia, for example), and the third group is potentially normal at birth but suffers trauma perinatally.

Neurological Handicaps

A major handicap is a "disability that prevents, or is likely to prevent the child from going to a normal school, or causes serious interference with normal function in society" (Stewart, Turcan, Rawlings et al., 1977, p. 101). Major neurological sequelae are associated with high risk births, and include cerebral palsy[1] in severer forms, hydrocephalus and epilepsy.[2] Mental retardation is also indicative of neurological damage, although its definition may vary with the study.[3]

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[1]Cerebral Palsy (CP) is a general term covering non-progressive damage to the developing brain. CP manifests in three basic forms. Spastic CP is the most common form, and is evident in 75% of CP children. Muscles have increased tone, and contract too tightly. Athetoid CP results from damage to the basal ganglia, and manifests in a lack of co-ordination amongst different movements. Ataxic CP results from damage to the cerebellum. There is control of the muscles, but unsteadiness and a lack of balance. (A Parents' Guide to Cerebral Palsy. Canadian Cerebral Palsy Association. No date.)

Both perinatal (e.g., birth asphyxia) (Franco and Andrews, 1977) and prenatal (e.g., placental insufficiency) (Hagberg, Hagberg and Olow, 1972; Sabel, Olegard and Victorin, 1976) factors are implicated in the development of CP.

The incidence of CP is decreasing in cohorts born in the 1960's and 1970's (Alden, Mandelkorn, Woodrum et al., 1972; Sabel, Olegard and Victorin, 1976) and does not approach the 35% of VLBW children affected who were born in the 1950's (Lubchenco, Horner, Reed et al., 1963).

Survivors of mechanical ventilation may be moderately to severely, rather than mildly, affected and survivors of intracerebral hemorrhage are prone to quadriplegia and hemiplegia (Fitzhardinge, Pape, Arstikaitis et al., 1976).

[2]The association between prematurity and epilepsy has been noted (Caputo and Mandell, 1970; Fitzhardinge and Steven, 1972 (b); Lilienfeld and Pasamanick, 1955). Fitzhardinge and Ramsay (1973) reported a high incidence of abnormal electroencephalograms in low birthweight AGA and SGA infants.

[3]In general, mental retardation is defined as a score of more than 1 S.D. below th[illegible]an for the particular developmental (e.g., Bayley[illegible]) or intelligence (e.g., WISC-R) test. Other studi[illegible]e the cut-off point at 2 S.D. or some arbitrary fig[illegible]ch as a score of 80 or 90 or less. These scores are u[illegible]lly corrected for the degree of prematurity.

Early Neurological Signs

Reflex milestones develop as a function of the infant's gestational rather than birth age (Amiel-Tison, 1968; Dubowitz and Dubowitz, 1981; Saint-Anne Dargassies, 1966). The timetable for the emergence of reflexes in premature infants appears to be stable and follows that of term infants.[1,2] However, there is evidence of more uneven development of the nervous system functions in the premature infant at 40 weeks post-conception when compared with term infants (Parmelee, 1975), with more vigorous and sustained muscle contractions (Saint-Anne Dargassies, 1966) and an inability to sustain high levels of arousal during a standardised neurological examination, (Michaelis, Parmelee, Stern, et al., 1973).

The absence or persistence of neonatal reflexes, transient tone disturbances and irritability, neonatal cerebral distress and epilepsy may signal the potential for developmental abnormalities (Calame, Reymond-Goni, Maherzi

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[1]Extrauterine life does not accelerate motor and reflex development; brain development is more closely associated with gestational age.

For a comprehensive review of the behavioural and neurological status of the premature infant from 28 to 40 weeks post-conception, see Saint-Anne Dargassies, 1966.

[2]The onset of milestones in the first 6 months, (e.g., the recognition of voice, orienting, but not smiling) was the same for term and preterm infants when their age was corrected for prematurity (Sugar, 1977).

et al., 1976) since these are indicative of long term fetal stress (Amiel-Tison, 1969). Infants at 2 and 3 years have a greater chance of minimal brain damage and mental retardation if there were neurological signs at birth (Drillien, 1972).

Sensorineural Hearing Defects

Approximately 17% of deaf school aged children are born prematurely (Desmond, Wilson, Alt et al., 1980).

Premature infants are likely to have higher serum bilirubin levels, and consequently more prone to kernicterus, a known cause of deafness. Small infants are also more prone to the ototoxic effects of streptomycin (Abramowicz and Kass, 1966 (d)), and other factors including incubator noise (Levene and Dubowitz, 1982).

Although sensorineural hearing defects have been noted in high risk infant studies (McDonald, 1967; Nickel, Bennett and Lamson, 1982; Sabel, Olegard and Victorin, 1976), the incidence of deafness has been reduced from rates such as 10.5% of VLBW infants born in the 1950's (Lubchenco, Horner, Reed et al., 1963) to rates of less than 2% for the same population (Davies and Tizard, 1975; Stewart and Reynolds, 1974).

Sensorineural hearing defects may affect language and speech development (Holm and Luvern, 1969) and in some cases language delay may be secondary to hearing defects (Desmond, Wilson, Alt et al., 1980).

Visuomotor Deficits

According to Desmond, Wilson, Alt et al. (1980) visual impairments are one of the most frequently encountered problems of the VLBW infant. Difficulties in the area of visually mediated behaviour have been widely reported based on test items of the WISC-R, Bender-Gestalt Test and the McCarthy Scales, for example, measuring such skills as eye-hand coordination, block design and the copying of figures (DeHirsch, Jansky and Langford, 1966; Fitzhardinge and Ramsay, 1973; Francis-Williams and Davies, 1974; Gaiter, 1982; Hunt, Tooley and Harvin, 1982; Lubchenco, Horner, Reed et al., 1963; Siegel, 1982 (b); Taub, Goldstein and Caputo, 1977; Wiener, Rider, Oppel et al., 1968).

The high incidence of blindness and refractive errors seen in earlier cohorts (Drillien, 1964; Lubchenco, Horner, Reed et al., 1963) were in large part due to retrolental-fibroplasia, (RLF). The recognition of the association between RLF and oxygen therapy has reduced its occurrence (Davies and Tizard, 1975; Stewart and Reynolds, 1974) although RLF is still seen especially in the under

1000 gram population (Nickel, Bennett and Lamson, 1982; Orgill, Astbury, Bajuk et al., 1982; Pape, Buncic, Ashby et al., 1978).

Early 'Cognitive' Behaviour

The early behavioural responses of premature infants may differ from those of term infants.[1]

Premature infants of 29 weeks gave fewer motor reponses (i.e., startles) than did full term neonates to visual and auditory stimuli (Katona and Berenyi, 1974). Field, Dempsey, Hatch et al. (1979) reported that older premature infants (mean age 37.4 weeks) showed no deficits in behavioural responsiveness to the repeated presentation of a buzzer noise, but that cardiac responsiveness did not significantly decrease (which would be predicted with the constant presentation of a stimulus). When matched for gestational age, preterm and term infants at 40 weeks detected sound equally well, except that the full term infants detected it better in the state of 'active sleep' (Bench and Parker, 1971).

Other studies support the finding of reduced responsiveness to stimuli. Many preterm infants showed extremely long durations of visual attention (Sigman, Kopp, Littman et al., 1977) indicative of a failure to show

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[1]Preterm and term infants may differ on dimensions other than gestational age alone, such as the incidence of birth asphyxia, which may affect outcome also.

appropriate response decrement. Ten week old infants, who were preterm at birth, blinked significantly less than did 10 week old term infants in response to an approaching object (Petterson, Yonas and Fisch, 1980).

Kurtzberg, Vaughan, Daum et al. (1979) reported a marked reduction in visual and auditory responsivity at 40 weeks post conceptual age in many LBW infants (mean gestational age 34.7 weeks) with neurological disorders when compared with infants born at term. Similarly, Daum, Kurtzberg, Ruff et al. (1980) noted that ventilated infants did worse on orientation tasks.

Some of these differences persist in to the first year, and have been noted in the premature infants' decreased preference for novel stimuli at 4 months, corrected for gestational age (Sigman and Parmelee, 1974), and at 8 months, along with less exploratory behaviour at this time also (Sigman, 1976). While term infants discriminated between a familiar and a novel stimulus at 6 and 12 months, premature infants did so only at 12 months, corrected age, indicating a developmental lag in the visual discrimination abilities of preterm infants (Rose, Gottfried and Bridger, 1979).

In conclusion, it appears that on tasks which are precursors to more complex cognitive behaviours yet to emerge, premature infants exhibited behaviour indicative of a more immature and less well organised central nervous system.

It should be noted, however, that this is not a consistent finding, and differences were often minimal with the correction for prematurity. Paladetto, Mansi, Rinaldi et al. (1982) found only small differences (on the habituation to light and hand-to-mouth items) on the Brazelton Scales, a finding supported by Liejon (1982) and Sostek, Quinn and Davitt (1979) for healthy LBW infants tested at or later than 40 weeks post conceptional age, when compared with term infants at the same age.

Finally, Sigman, Cohen and Forsythe (1981) concluded that early behavioural measures contributed very little to the prediction of 18 month Bayley and 24 month Gesell scores, suggesting that these early lags may not necessarily be indicative of later deficits in cognitive performance.

Intellectual Performance and Mental Retardation

A review of 10 studies concerned with the developmental outcome of VLBW infants indicates that 14.6% of 859 infants in total were assessed as being mentally retarded, that is, with a developmental quotient score less than or equal to 80 (Levene and Dubowitz, 1982).[1]

The literature also indicates that as a group LBW and high risk children have lower developmental quotient (DQ) and intelligent quotient (IQ) ratings, and a greater incidence of cognitive disabilities than do those children born at term and with a normal perinatal history (Alden, Mandelkorn, Woodrum et al., 1972; Calame, Reymond-Goni, Maherzi et al., 1976; Caputo and Mandell, 1970; Davies and Stewart, 1975; Dann, Levine and New, 1964; Drillien, 1958; 1961; 1964; Fitzhardinge, Pape, Arstikatis et al., 1976; Fitzhardinge and Ramsay, 1973; Francis-Williams and Davies, 1974; Goldstein, Caputo and Taub, 1976; Harper, Fischer and Rider, 1959; Hunt, 1981; Kitchen, Ryan, Richards et al., 1980; Lubchenco, Horner, Reed et al., 1963; Lubchenco, Delivoria-Papadopoulos et al., 1972; Pape, Buncic, Ashby et al., 1978; Rabinovich, Bibace and Caplan, 1961; Rawlings and Reynolds, 1971; Rubin, Rosenblatt and Barlow, 1973; Siegel, 1982 (b); Siegel, Saigal, Rosenbaum

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[1]DQ and IQ ratings and development abilities have been measured by various standardised scales, including the Bayley Scales of Infant Development, the Merrill-Palmer Scale of Mental Tests, the Cattell Infant Intelligence Scale, McCarthy Scales of Children's Abilities, Uzgiris-Hunt Scale, Gesell Developmental Schedules, Stanford-Binet, Bender Visual Motor Gestalt Test, Weschsler Pre-School and Primary Scale of Intelligence (WPPSI), and the Weschsler Intelligence Scale for Children (WISC-R).

et al., 1982; Stewart and Reynolds, 1974; Taub, Goldstein and Caputo, 1977; amongst others).

It should be noted, however, that many investigators while reporting poorer performance by the high risk children as a group, also noted that their mean scores still fall within the average range for the IQ test (DeHirsch, Jansky and Langford, 1966; Francis-Williams and Davies, 1974).

However, subtle difficulties still exist in motor, perceptual-motor and linguistic behaviour putting the high risk infant at an academic risk[1] (Hunt, Tooley and Harvin, 1982).

School Performance

Prematurely born infants constitute an 'academic high risk' group (DeHirsch, Jansky and Langford, 1966) and problems in academic achievement have been widely reported. These include reading disorders[2] (Caputo and Mandell,

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[1]An individual IQ or DQ rating may mask specific cognitive difficulties such as have been noted in VLBW children who perform poorly on the Bender Gestalt tests indicating problems in perceptual motor integration (Francis-Williams and Davies, 1974). Siegel (1982 (b)) reported difficulties for the VLBW infant on sub-sections of the McCarthy Scales relating to perceptual motor functions (e.g., design drawing).

[2]Reading ability has been measured by the Wide Range Achievement Test, the Durrell Oral Reading Test for reading comprehension, and the Burt-Vernon Word Recognition Test.

1970; Drillien, Thomson and Burgoyne, 1980; Nickel, Bennett and Lamson, 1982) and deficits in mathematical reasoning[1] (Nickel, Bennett and Lamson, 1982; Wiener, 1970). Hunt, Tooley and Harvin (1982) reported that 16/20 VLBW children who were considered normal at school entry showed poorer WISC-R scores at 8 years and were having difficulties with the more demanding abstract reasoning requirements as they progressed through school.

Thus, in the absence of clinically detected handicaps, and even when the children may have normal IQ ratings, studies indicate that many LBW, and especially VLBW children are having academic problems. These more diffuse less severe manifestations of neurological lesions such as learning disabilities may be identified only in the school situation (Davies and Tizard, 1975; Desmond, Wilson, Alt et al., 1980). Poor school performance is, of course, exacerbated by the cluster of handicaps that may accompany lower IQ (Davies and Stewart, 1975).

The number of children at disadvantage at school varies with the study. Stewart (1972) and Kitchen, Ryan and Rickards et al. (1980) noted that only 5 to 6% of the VLBW infants were unable to attend normal school, a figure

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[1]Mathematical reasoning was tested on the WRAT sub-test of the WISC-R (Nickel, Bennett and Lamson, 1982).

indicating a vast improvement since the 1950's when Drillien (1964) found that 50% of the children were in this situation. There is recent evidence, however, that the ELBW child is having scholastic problems, since 64% (16/25) of these children were in special education programmes, and only 28% were functioning at grade level (Nickel, Bennett and Lamson, 1980).

Summary

The high risk infant and child is vulnerable to an array of developmental disorders. These include major and minor neurological handicaps, visual and auditory sensory deficits, mental retardation, lower IQ performance, and now that populations of high risk infants surviving with the help of neonatal intensive care facilities are attending school, academic delay. One area critical to the child's developmental status is language acquisition, and this will now be addressed.

The High Risk Infant and Language Acquisition

Language delay and deficit is a likely expression of brain dysfunction due to pre- and perinatal insult, and it is a recurrent problem noted in the high risk infant. While language problems are associated with cerebral palsy and mental retardation, they are also reported in children of otherwise normal potential (Ehrlich, Shapiro, Kimball et al., 1973; Fitzhardinge and Ramsay, 1973).

What Risk Factors are Associated with Language Dysfunction?: Low birthweight, very low birthweight and extremely low birthweight infants have been reported to be at risk for language delay (Beckwith, Sigman, Cohen et al., 1977; Britton, Fitzhardinge and Ashby, 1981; DeHirsch, Jansky and Langford, 1964; Drillien, 1961; Escalona, 1982; Fitzhardinge and Ramsay, 1973; Kastein and Fowler, 1959; Kelsey and Barrie-Blackley, 1976; Kitchen, Ryan, Rickards et al., 1980; Nickel, Bennett and Lamson, 1982; Noble-Jamieson, Lukeman, Silverman et al., 1982; Pasamanick, Constantinou and Lilienfeld, 1956; Phillips, 1968; Rider, Taback and Knobloch, 1955; Rubin, Rosenblatt and Balow, 1973; Siegel, 1979; 1981; 1982 (a); 1982 (b); 1982 (c); 1983; Siegel, Saigal, Rosenbaum et al., 1982; Smith, Somner and Von Tetzchner, 1982; amongst others).

Studies of the small for gestational age child likewise indicate a vulnerability for language problems (Beargie, James and Greene, 1970; Bhargava, Datta and Kumari, 1982; Drillien, 1964; Escalona, 1982; Fitzhardinge and Steven, 1972 (b); Kelsey and Barrie-Blackley, 1976; Rubin, Rosenblatt and Balow, 1973; Siegel, 1979; 1981; 1982 (a); 1982 (b); 1982 (c); Siegel, Saigal, Rosenbaum et al., 1982; Walther and Raemakers, 1982).

A number of studies implicate general perinatal complications including asphyxia and RDS (Corah, Anthony, Painter et al., 1965; D'Souza, McCartney, Nolan et al., 1981; Field, 1979; Field, Demsey and Shuman, 1981; Fitzhardinge and Ramsay, 1973; Low, Galbraith, Muir et al., 1983; Siegel, 1979; 1981; 1982 (a); 1982 (b); 1982 (c); 1983; Siegel, Saigal, Rosenbaum et al., 1982); intraventricular hemorrhage (Williamson, Desmond, Wilson et al., 1982); and prenatal exposure to ethanol (Shaywitz, Caparulo and Hodgson, 1981). Some of these studies have taken high risk status to be one or more of LBW, prematurity, SGA, Rh incompatibility, RDS, hyperbilirubinemia, hypercalcemia, hyperglycemia (Ehrlich, Shapiro, Kimball et al., 1973; Zarin-Ackerman, Lewis and Driscoll, 1977). Wiig, Semel and Crouse (1973) did not specify the nature of the high risk features.

The Nature of the Language Delay

Early Studies: Swoboda, Morse and Leavitt (1976) found that 8 week old high risk infants[1] discriminated phonetic categories in a manner similar to control infants. Beckwith,

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[1]Cross study comparisons may be limited by the fact that the criteria used to define 'high risk' differ from study to study. In the study by Swoboda, Morse and Leavitt (1966), for example, 'high risk' included postmature infants, infants delivered by Cesarean Section and those with a high bilirubin count, amongst other factors.

Sigman, Cohen et al. (1977) on the other hand found that premature infants between the ages of 1 month and 3 months increased their level of vocalisation more gradually than did term infants, although between 3 to 8 months, the groups did not differ in vocal output.

Honzik, Hutchings and Burnip (1965) similarly reported that infants with birth complications imitated vocal sounds less than did controls. This pattern was also noted in 16 month old infants who vocalised less than did control infants (Crawford, 1982).

These studies suggest that early linguistic milestones differentiate premature and high risk infants from control infants. Do these differences persist?

General Findings on Language Development

Many studies have based their findings on the verbal scales or sections of general IQ tests such as the WISC-R (Francis-Williams and Davies, 1974;[1] Kitchen, Ryan,

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[1]The significance of the results from this study are not clear since there were no results from a comparison population. The VLBW children had mean IQs for the verbal and performance scores which were within normal range (i.e., less than 1 S.D. from the mean). Other studies (e.g., see Noble-Jamieson, Lukeman, Silverman et al., 1982) with similar findings for VLBW children found that these scores were nevertheless significantly below those of comparison children.

Rickards et al., 1980;[1] Nickel, Bennett and Lamson, 1982; Noble-Jamieson, Lukeman, Silverman et al., 1982;[2] Taub, Goldstein and Caputo, 1977)[3] and the Gesell Developmental Scales (Bhargava, Datta and Kumari, 1982).[4]

These studies in general indicate difficulties for the high risk child which vary from mild to severe problems with delayed onset, retarded articulation, immature vocabulary and generally delayed maturation of receptive

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[1]At 8 years, the VLBW children performed at a significantly lower level on the full, performance and verbal scales of the WISC-R. The ELBW children performed at a lower level than the VLBW children, this reaching significance for the verbal scale ($p < .05$).

[2]In this study, mean scores for the verbal IQ were 98.4 for the VLBW children and 106.8 for the matched comparison group (for age, sex and SES) ($p < .02$). Mean scores for the performance IQ were 98.5 for the VLBW children and 106.6 for the comparison population ($p < .005$).

[3]The scores for prematurely born children at 7 to 9 years did not differ from a comparison group of term children for the verbal scale, but did for the performance scale, with sub-tests requiring visually mediated behaviour being particularly affected.

[4]This longitudinal study of SGA and control children (matched for sex, per capita income, maternal education and the number of siblings) seen at 1, 2, 3, 4 and 5 years found a widening gap between the two groups with the advancement of age.

and expressive abilities (Fitzhardinge and Ramsay, 1973; Fitzhardinge and Steven, 1972 (b)).[1]

Studies Concentrating on Specific Language Parameters:[2] DeHirsch, Jansky and Langford (1964) compared the performance of 5 year old children, born weighing between 1000 and 2239 grams, and that of term children on a variety of measures associated with language (e.g., auditory memory span, word recognition (PPVT)) along with measures of the child's syntax (e.g., the mean length of the 5 longest utterances, and the number of complex or compound utterances used to retell a story). Results indicated that the premature infants performed more poorly on 7 of the 15 measures ($p < .05$) chosen.

Kelsey and Barrie-Blackey (1976) also measured parameters of spontaneous speech (between the child and the examiner) in 3 and 4 year old children, high risk at birth from the higher socioeconomic levels. In this study, there were no differences for the amount of language

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[1]Fitzhardinge and Steven (1972 (b)) found that 29% of term SGA children at ages 3 to 4 were referred to a speech therapist. Fitzhardinge and Ramsay (1973) reported that 13/20 males and 4/12 females who were VLBW had delayed language acquisition.

[2]Section 2 of the introduction discusses in detail measures used for the analysis of the young child's language.

used, the average length of utterance, the completeness of the child's language structures and the use of syntax for the LBW, SGA and term infants ($p > .05$).[1]

On a test of the child's understanding and use of morphological rules, Wiig, Semel and Crouse (1973) found that children of 3 and 4 years who were at risk for neurological disorders due to perinatal problems (the nature of which were not specified), gave significantly fewer correct responses than did control children ($p < .001$) thereby indicating "quantifiable reductions in the ability to use morphological rules" (p. 461).

Studies Using Standardised Language Tests: Phillips (1968) using the Illinois Test of Psycholinguistic Abilities (ITPA, 1968) found significant differences ($p < .01$) between the high risk (defined as a birthweight less than 5 1/2 pounds — less than 2500 grams) and control term groups in the total ITPA scores and on some of the auditory and visual decoding and encoding subsections, features seen as the sub-structure of language. The children were tested between 4 and 7 years of age.

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[1]The finding of no differences between these groups may be possibly explained by their selective social class standing, since lower social class children are at a disadvantage for language acquisition, especially those who are high risk (see pages 32 ff). Further, LBW infants are not as much at risk as VLBW infants, who were excluded from this study.

Ehrlich, Shapiro, Kimball et al. (1973) with children of a similar age and using a wider range of language and IQ tests (e.g., the PPVT, ITPA, Lieter, WPPSI) found that 50% of these 5 year old high risk children scored below average,[1] and required therapy for language problems, this in spite of normal IQ scores.

Zarin-Ackerman, Lewis and Driscoll (1977) tested 2 year old high risk and matched controls[2] on a modified Peabody Picture Vocabulary Test (PPVT), incorporating a production task along with the comprehension task, using the same format (four pictures on a page) but requiring labelling or pointing, respectively. In addition, knowledge of prepositions, and adjectives[3] was measured. The comparison children had better comprehension production scores ($p < .05$) on the modified PPVT and they also performed significantly better on the adjectival contrasts ($p < .05$).

The Reynell Developmental Language Scales[4] have been used by D'Souza, McCartney, Nolan et al. (1981) with

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[1]This study lacked controls, and the high risk childrens' performance was measured against standardised norms.

[2]SES was limited to levels 3, 4, 5 on the Hollingshead Scale.

[3]These included 'in front of/behind' and 'under/on top of', and the children had to manipulate objects or act out the instructions. The adjectival contrasts included knowledge of 'dry/wet', 'short/long' etc., and the child had to choose one of two objects corresponding to the adjective.

[4]See pages 86ff.

children aged 2 to 5, who as infants were resuscitated after severe perinatal asphyxia. One third of those surviving without handicaps had deficits in speech and language (that is, they scored under the 10th percentile – a Reynell standard score of -1.3). Walther and Raemakers (1982) reported that 3 year old children who had been malnourished in utero, but otherwise healthy, were delayed by 4 months on the comprehension and 5 months on the expressive scales when compared with comparison children (matched for age, sex and SES) ($p < .05$). Low, Galbraith, Muir et al. (1983), however, found that 3 1/2 year old children, who had been exposed to intrapartum hypoxia, had expressive and comprehension scores within normal range, and not differing significantly from those of comparison children.

Siegel (1979; 1981; 1982 (a); 1982 (b); 1982 (c); 1983 and Siegel, Saigal, Rosenbaum et al., 1982) in a series of studies attempting to delineate predictors of development in VLBW and SGA infants found that various perinatal, early cognitive and environmental/familial factors predicted language performance at 3 and 4 years, as scored on the Reynell Developmental Language Scales. Amongst the many findings in this series, the AGA preterm children at 2 years had significantly lower expressive

($p < .005$) and comprehension ($p < .01$) scores than the term children. Smith, Somner and Von Tetzchner (1982) using a Norwegian version of the Reynell Scales with 3 year old children, who were at risk at birth, also related perinatal complications to outcome on the Scales.

The Reynell Scales were also chosen for the present study, and further details are found on pages 86 ff.

Language Acquisition – Conclusion

These studies indicate that infants at risk due to a variety of pre- and perinatal stresses are likely to exhibit varying degrees of language deficit and delay. This outcome is evident in children surviving without major sequelae, as in the present study.

Few[1] of the studies have concentrated on the period in which language is emerging to determine if these children show delayed language milestones at this critical time, that is, from 18 months on. Language acquisition is naturally progressing at a rapid pace at this age. The sampling of language at three monthly intervals would allow the determination of whether the high risk child acquires language in a manner similar to that of the child who was born at term and without perinatal stress. The collection

[1]The majority of the studies outlined above studied high risk populations of between 3 to 12 years of age.

of data within three monthly intervals would also facilitate an approximate correction for the degree of prematurity. This correction has not been previously applied to studies of the child's spontaneous language.

It is also the case that few studies have sampled either the high risk child's spontaneous language[1] or that of the mother. To this end, a home setting was used to gather information on possible unique interactional patterns.

A prospective design was used, and weaknesses noted in the literature avoided — namely, a lack of controls,[2] inadequate matching of controls,[3] and a reliance on ill-

[1]Field (1977) and Kelsey and Barrie-Blackley (1976), for example, did collect spontaneous speech at one particular age only, and this was in a clinic setting with the experimenter interacting with the child.

[2]D'Souza, McCartney, Nolan et al. (1981) for example, compared the performance of their high risk infants against test norms. This poses a problem since many infants have been found to score above the average on the Reynell Language Scales (Walther and Raemakers, 1983; Randal and Reynell, 1974). There is the need for information on the performance of an appropriate comparison group, i.e., on children not at risk because of perinatal trauma.

[3]Phillips (1968) for example, did not indicate the social class standings of the groups. Social class is a significant variable in language acquisition, and an unequal distribution of social class levels may affect results.

specified or inappropriate linguistic measures. The following pages of the introduction discuss in detail language analysis and the selection of appropriate linguistic measures.

Preamble to Language Acquisition

The toddler period (approximately 18 months to 3 years) is the most rapid phase of language acquisition, and it is for this reason that indicators of how well the high risk infant copes with his emerging language system were investigated within this time period. This section of the introduction serves to acquaint the reader with the complexity and diversity of the skills involved when the child acquires language, and further serves to describe the measures chosen for this study. The difficulty in specifying the sufficient and necessary conditions for the emergence of language is apparent in this discussion. However, some weight is given to the ambient linguistic environment provided by the mother.

A reading of this section will make clear the, as yet, piecemeal picture available. Construction of a general theory of infant language development is difficult since, in contradistinction to adult language for which there exist commonly accepted notions of 'grammaticality' and 'well-formedness', the guidelines as to what are and what are not acceptable exemplars of child language are not well defined. However, the study of language acquisition is facilitated by the orderly and consistent emergence of linguistic features which allows delay and deviancy to be noted.

Introduction to Language Acquisition

Sound empirical data exist (Berko, 1958; Bowerman, 1976; 1978; Braine, 1963; 1976; Brown, 1973; Brown and Bellugi-Klima; 1964; Brown, Cazden and Bellugi-Klima, 1969; Brown and Hanlon, 1970; Cazden, 1968; deVilliers and deVilliers, 1973; Klima and Bellugi, 1966; Lee, 1971; Lenneberg, 1967; 1969; McNeill, 1970; Menyuk, 1971; 1974; Nelson, 1973; Slobin, 1970; amongst many) to permit the conclusion that there are predictable patterns in the acquisition of language, patterns which are also seen cross-culturally.[1]

While the rate of development is variable (Brown, 1973; Moerk, 1974), the sequence in which linguistic features are acquired is relatively uniform. This predictability allows recognition of developmental delay in clinically defined populations, and facilitates research of the kind undertaken in this study. The view that language development should proceed in a similar manner for all children (Lenneberg, 1967) whether Down's Syndrome, mentally retarded, language delayed or normal, is supported by work by Fowler, Gelman and Gleitman (1980), and Morehead

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[1]See Slobin (1970), for a review of the literature.

and Ingram (1976). Their conclusion is that the order of acquisition and the system acquired are generally similar for all groups.[1] In summary,

> . . . the structure of retarded language seems to develop like normal language — invariant, and insensitive to a most distinctive difference in genetic make-up and perhaps even environmental input (Fowler, Gelman and Gleitman, 1980, p. 12).

These predictable patterns of language acquisition are evident in the period which crosses the boundary from prelinguistic utterances,[2] through the one word holophrastic stage (Brown, 1973),[3] through the embryonic stages of syntactic development at the two word stage. From there acquisition entails the elaboration of the noun and verb phrase; the development of morphophonetic rules (for example, word ending inflections (Cazden, 1968)); the unfolding of semantic roles (for example, agent-locative;

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[1] Menyuk (1964) and Lee (1966) did report some omissions of syntax and transformations on the part of some language-delayed children. However, Lackner (1976), has argued that if children are matched in terms of a linguistic criterion such as the mean length of utterance (see pages 82 ff), rather than chronological age, or intelligence quotient scores, that the picture is one of delay in the acquisition of syntactic forms, rather than the absence of these forms.

[2] Vocalizations without syntactic form, generally known as babbling.

[3] This stage contains the germs of grammar, single word utterances standing for complex ideas (Lenneberg, 1969).

Bowerman, 1976; Schlesinger, 1974); the modulation of the simple sentence by the use of interrogatives and negatives; and the rules for combining, embedding and developing complex syntactic transformations.[1]

Prelinguistic Language

> . . . our experience with the children and a more extensive review of the recent literature over the past 2 1/2 years indicate the importance of the prelinguistic forms of behaviour for subsequent language acquisition. Indeed, the possibility exists that these processes, which are not linguistic in a formal sense, and certainly not verbal, constitute the necessary basis for the development of functional language (Bricker and Bricker, 1974, pp. 443-444).

The age range of the children in this study, that is, 18 to 30 months, places them on the border between that period in which their vocalizations mimic in form and intonation (but not content) more mature utterances and that period in which these vocalizations contain syntactic and semantic forms.

It has been claimed that there is developmental continuity between these two periods, that the prelinguistic utterances serve as the foundation for the emerging language system, and that the former are necessary

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[1]See Brown (1973) and McNeill (1970) for a fuller discussion on the development of these forms.

precursors to the later[1,2] (Bateson, 1975; Bruner, 1976; Bullowa, Jones and Bever, 1964; Rees, 1972; Stern, Jaffe, Beebe et al., 1975). Lieberman (1967) charted definite intonational patterns in the cry; and infants use prosody to mark differences between utterances of apparently identical structure — stress carries out a function later performed by inflections and function words (Crystal, 1973). In addition, Bruner (1976) emphasized the development of communication systems ("speech acts") during the pre-linguistic stage, that is, the knowledge of how language is used to further and sustain communication.

> By the time he begins to speak the child may have already laid down within himself the formal structure of the language system of his culture. This would encompass a multiplicity of interlocking aspects; rhythmic and syntactic 'hierarchies', supra-segmental features, and para-linguistic nuances. . . . (Condon and Sander, 1974, p. 101).

In the present study, pre-and paralinguistic utterances were included for analysis, and further details are found on pages 135 ff. of the method.

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[1]However, see Jakobson (1968) who rejected the notion of continuous phonological development.

[2]The development of articulatory skills facilitates the development of the auditory feedback loop (Rees, 1972).

The Acquistion of Language

Receptive and expressive linguistic competence entails not only the semantics of language (the meaning of words and the relationships between them); the syntax of language (the forms used to express those relationships); but also the morphological rules for the composition of words (a morpheme is the smallest meaningful unit in language); the phonological rules for speech (language at the phonetic level consists of a finite set of mutually exclusive classes -- phonemes);[1] the pragmatics of language (the rules for usage -- the pragmatic school of language speaks of "speech acts" used to convey the child's intentions prior to the acquisition of syntactic forms (Bates, Camaroni and Volterra, 1975; Bruner, 1976)); and finally the strategies for social communication (Clark, 1978).[2]

> The literature on language development has started to recognize that young children's language competence develops at differential rates in various areas such as lexicon growth, grammatical structures, etc. Language might not be a unitary construction but rather a conglomerate of skills slowly coalescing into a general language competence. (Zarin-Ackerman, Lewis and Driscoll, 1977, p. 983)

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[1]See Ingram (1976) for an overview of the development of these forms.

[2]Preschoolers engage in a variety of communicative acts including inviting and insulting (Garvey, 1975).

The interesting aspect of this is the fact that these devices for the modulation of meaning are generally, acquired, used and understood by a three or four year old child,[1] and that the child's speech is well adapted to the listeners' perspective (Mueller, 1972).

> The fundamental problem to which we address ourselves is the simple fact that language acquisition occurs in a surprisingly short time. Grammatical speech does not begin before one-and-one-half years of age; yet, as far as we can tell, the basic process is complete by three-and-one-half years. Thus a basis for the rich and intricate competence of adult grammar must emerge in the short span of twenty-four months. To appreciate this achievement, we need only compare the child with himself in other departments of cognitive growth as outlined, say, in the work of Piaget. Add to rapid acquisition the further fact that what is acquired is knowledge of abstract linguistic structure, and the problem of accounting for language development can be seen to pose unusual difficulties for our collection of explanatory devices. (McNeill, 1966, p. 15)

Receptive Language

Developmentally, children show a general superiority of comprehension over production, with specific grammatical features understood before they are produced, (Fraser, Bellugi and Brown, 1963; Lenneberg, 1969; Reynell, 1969).

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[1]See C. Chomsky (1969) for certain exceptions.

Despite this precocity, there is a relative sparsity of research concerning receptive skills. The determination of such skills is very difficult, and comprehension studies pose a problem. Even with a child who performs exactly as instructed, it is not possible to tell how successfully he has responded to the instructions, what aspects of the instructions were salient, and whether extra-linguistic features (that is, when compliance with instructions is based on natural associations such as a man riding on a horse and not vice versa, or when contextual cues furnish appropriate responses) were also critical. Bloom (1974) suggests that early comprehension is helped by contextual cues and the large measure of redundancy in maternal speech (see page 93).

The determination of receptive language skills in young children is especially difficult; "data on the infant's perception of linguistic structural properties and his comprehension of the function of these properties is still largely missing" (Menyuk, 1974, p. 213).[1] While evident with young children, the question of appropriate response parameters is critical at any stage, since comprehension should be investigated independent of verbal

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[1]See Menyuk (1974) and Cairns and Butterfield (1978) for overviews of research on neonatal and infant receptive abilities.

responses. With the need to investigate more complex syntactic and semantic features, it becomes a problem to devise portrayable counterparts for grammatical forms.

There is some information on the older child's understanding of verb and noun forms, and syntactic structures such as the passive and active tenses, singular and plural subjects (Brown and Bellugi-Klima, 1964; deVilliers and deVilliers, 1973; Ervin-Tripp, 1964). Fraser, Bellugi and Brown (1963) devised an Imitation, Comprehension and Production Test (ICPT) where the same form was tapped in three different modes.

These afore-mentioned works deal with more complex linguistic structures and functions than are evident at the 18 to 30 month stage. The standardized comprehension test used in the present study is appropriate for this age range, and further details about the Reynell Developmental Language Scales (1969) may be found on pages 86 ff.

Expressive Language

The main body of research on early child language concerns the developmental patterns evident in expressive, rather than receptive, abilities.

Introduction: This study concentrated on the analysis of the performance ("la parole") rather than the competence ("la langue") properties of language. Linguists interested in the latter are generally associated with the work of Chomsky (1957; 1965; for example). In his formal, non-taxonomic system, the surface characteristics of language are ultimately described in invariant, abstract and universal deep structural terms. The rules of the system are constructed so as to generate an infinite set of grammatical and none of the non-grammatical sentences. According to Chomsky, these deep structures are similar from language to language, override differences between individuals and differences in intelligence and experience and are unaffected by transient psychological factors.[1]

The Process of Acquisition:[2]

> . . . early language for which a grammar is written is the end result of psychological processes leading to its acquisition, and to write a grammar of that language at any point in its development is in no sense to explicate the nature of its acquisition (Bruner, 1976, p. 256).

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[1]For an outline of how transformational and phrase structure grammars are written and applied to language corpora, see McNeill (1970, appendix, p. 144 ff). For a discussion on the nature of deviant language using a transformational model see Leonard, 1972.

[2]Psycholinguists employ the term "acquisition" to free them from the need to identify the nature of the learning process.

While Chomsky's theory is descriptively powerful, it addresses the question of language acquisition in general terms, suggesting only that those linguistic operations requiring more steps or transformations are acquired later.[1]

Chomsky (1965) and Lenneberg (1967) see language as an autonomous process - an emergent feature in both phylogenetic and ontogenetic terms, and not a more complex instance of something to be found elsewhere in the animal kingdom, nor within the child's own cognitive repertoire. The capacity to learn language is species-specific with the a priori or ipse intellectus being the innate language acquisition device (LAD - Chomsky) or the hereditary differentiation of the central nervous system (Lenneberg, 1967; Whitaker, 1971). "The role of experience is only to cause the innate schematism to be activated" (Chomsky, 1965).

<u>The Theory's Limitation for Early Language Study</u>: While it is an assumption to state that there is an isomorphic

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[1]This has been validated for young children (Brown, 1973) although not necessarily for adults, in that those sentences which are psychologically the most complex are not necessarily those requiring the most transformations (Cromer, 1980).

relationship between Chomsky's formal linguistic system and the psychological processes involved in language production (Whitaker, 1971), the theory's underlying premises have permeated and influenced recent psycho-linguistic endeavours. More specifically, weight is given to the innate predisposition a child has for language learning. Further, the language learning child is seen less as a passive recipient of the ambient linguistic environment, and more a formulator of ordered and appropriate linguistic rules, which may or may not be conceptualized in transformational terms. According to Ervin-Tripp (1964), any system of analysis which omits the rule governed features of language or the gradual changes within these rules is contradicted by evidence from all levels of the child's linguistic behaviour.[1]

The phrase structure and transformational grammars have, however, limited application in the study of <u>early</u> language development. In so far as this competence model, with its emphasis on linguistic knowledge rather than performance, matches the child against an ideal speaker

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[1]"The very intricate simultaneous differentiation and integration that constitutes the evolution of the noun phrase is more reminiscent of the biological development of the embryo than it is of the acquisition of a conditioned reflex" (Brown and Bellugi-Klima, 1964, p. 151). See Reber (1973) for a discussion of learning theory approaches to language acquisition.

model, and looks to see how it deviates from that model, it is at variance with the vast array of research which studies child's language sui generis (Vetter and Howell, 1972). Further, studies utilizing grammars at different stages of development are problematic since the rate of acquisition is so rapid that a stable perspective is impossible to attain (Lackner, 1976).[1]

The interest of the present study was an investigation of early language development in a high risk and comparison population, with the analysis of surface, as opposed to deep structural, features.

Surface Features

Relying on a small and intensively followed number of children, investigators have described regularities in the ontogenesis of grammatical forms. Distributional analyses of these forms (i.e., words appearing in similar contexts are assumed to belong to the same grammatical class in the child's grammar) have been carried out, and stages of linguistic development specified.

Among the many syntactic and morphological features studied, often, although not exclusively (Berko, 1958),

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[1]Attempts to characterise early rule systems as 'telegraphic' (Brown and Fraser, 1963) or 'pivot-open' (Braine, 1963) have been critised as being 'false leads' (Brown, 1973) or of being too superficial and lacking in generality and ignoring semantic components of early language (Bloom, 1971; Brown, 1973; Schlesinger, 1974; Slobin, 1970).

from spontaneous language samples, have been the development of WH-questions (Brown, 1968; Brown, Cazden and Bellugi-Klima, 1969), the development of negation (Bloom, 1970; Klima, 1964; Klima and Bellugi, 1966; see also McNeill, 1970, p. 87 - 96), and the child's use of inflections and significant morphemes (Berko, 1958; Brown, 1973; Cazden, 1968; deVilliers and deVilliers, 1973; Ervin, 1964).

These morphemic forms offer a linguistic tool for the study of early language development as used in this study.

The Acquisition of Morphemes

English transmits meaning through phonetically minimal forms, such as word ending inflections, and other significant morphemes. A morpheme is the smallest meaningful element in a language, and many of those of interest here are unbounded (e.g., 'ed' to signify past tense) in that they do not stand apart from content words.

Brown (1973) has charted the development of 14 particular morphemes which first appear at Stage II (when the child's mean length of utterance falls between 2.00 and 2.50 morphemes per utterance). The scoring of these morphemes is facilitated by the fact that they are demanded in certain obligatory contexts.[1] "One way to separate the absence of a construction in the child's competence from the rarity of that construction in his performance is to look for the frequency of forms in contexts which make them obligatory" (Cazden, 1968, p. 433). One of the reasons for the gradual appearance of these morphemes[2] is precisely because the constraints which define linguistic obligation are also acquired over time.

<u>The 14 Morphemes</u>: The fourteen morphemes investigated by Brown (1973) were as follows:-

(1) The present progressive form (ing), which has two allomorphs[3] /in/ and /ɪŋ/.

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[1]For example, the plural form /-s/ is obligatory in the sentence "two apples"; this obligation is defined by the syntax and semantics of the sentence. See page 149 for a further discussion of these obligatory contexts.

[2]There may be as long as a year from the first appearance of a morpheme to the point of 'acquisition' – arbitrarily defined as when the morpheme is supplied in 90% of the obligatory contexts in three successive speech samples (Brown, 1973).

[3]An allomorph is a variant pronunciation of a morpheme conditioned by the phonetic environment in which it occurs. For example, the plural allomorph /iz/ is used after a sibilant /s, z, š, ž/ and the affricatives /č, ǰ/ (see Ahlsfeld and Tucker, 1967).

It is interesting to note that forms using the same phonetic invariants (e.g., /s/ for the plural, present indicative third person and possessive) do not appear at the same time, suggesting that their appearance is not a function of phonetic development.

(2) The past tense, which has the allomorphs /-d ~ -t ~ ɨd/ when applied to weak verbs.

(3) The irregular past tense, which is applied to strong verbs.

(4) The third person singular present indicative, which has three allomorphs /-s ~ -z ~ ɨz /.

(5) The plural form which has the allomorphs /-s ~ -z ~ ɨz /

(6) Irregular plural forms.

(7) The possessive ('s) form.

(8) The preposition 'in'.

(9) The preposition 'on'.

(10) The articles 'A' and 'The'.

(11) The copula of the verb 'to be' in uncontracted form – 'am', 'is' and 'are'.

(12) The copula in contracted form 'I'm', 'he's' and 'they're'.

(13) The auxillary form of the verb 'to be' in uncontracted form.

(14) The auxillary form of the verb 'to be' in contracted form.

<u>Morphemes Are Acquired in Invariant Sequence:</u>

> . . . children could string together content words with no extra function words at all but clearly they do not do so. Instead, as they produce longer sentences, children add the basic grammatical morphemes, and the order in which they add these morphemes to their speech shows a remarkable degree of invariance. (deVilliers and deVilliers, 1973, p. 273).

The order in which the morphemic forms are acquired is relatively invariant (i.e., the present progressive emerges and reaches the point of acquisition before the past and present indicative, etc.). While the rate of acquisition may vary with child, there is a strong inter-child correlation in the order of acquisition (Brown, 1973; Cazden, 1968, deVilliers and deVilliers, 1973; Fowler, Gelman and Gleitman, 1980; James and Khan, 1982), a pattern which also holds for language-impaired children (Stekol and Leonard, 1979).

On a final note, Brown (1973) reports that there is a nonsignificant correlation between the frequency of these morphemes in parental speech and the child's acquisition of these forms – the acquisition of which _is_ correlated with the complexity of their transformational and semantic rules. This argues for 'innate controls' on the emergence of these forms.

This invariant pattern of morphemic development, along with systematic errors of omission and commission, are guides to the child's linguistic competence and make them good candidates for measures in this study on young children's language acquisition. Further, since morphemic scores have been shown to differentiate the speech of normal and language impaired children (Stekol and Leonard, 1979), they may also differentiate a population of children at risk such as those in the present study.

Mean Length of Utterance — MLU

> Although MLU appears to be a very crude measure, it may well be that best single indicator of language development (if a single measure is necessary), at least for children of age five and under. (Dale, 1972, p. 274.)

One of the more prominent measures used in language development research is that of the mean length of utterance (MLU) (Brown, 1973).

The MLU is a simple, objective index of grammatical development, which permits quantification of the stream of linguistic behaviour. It is a sensitive measure of linguistic progress (Schachter, Shore, Hodapp et al., 1978) and almost every new kind of knowledge increases its length, whether this is the number of semantic roles expressed in the sentence, the addition of significant morphemes or the transformations of embedding and coordination.

Brown used the MLU index to delineate stages in language acquisition, from stage I (MLU 1.75 to 2.25) to stage V (MLU 3.50 to 4.00) — these levels being characterised by distinct linguistic achievements.

> It has been shown that while individual children vary enormously in the rate of linguistic development, and so in what they know at a given chronological age, their constructional and semantic knowledge is fairly uniform at a given MLU. (Brown, 1973, p. 100).

Thus, the MLU measure is a better predictor of the level of linguistic achievement than is chronological age (deVilliers and deVilliers, 1973; Menyuk, 1964). Two children matched for MLU are more likely to have speech that is internally and structurally similar than would two children of the same chronological age.

There is, however, a significant and positive correlation between age and MLU (Miller and Chapman, 1981), and age ranges can be specified that would be considered normal for the acquisition of particular MLU scores (Menyuk, 1979). For these reasons, the MLU measure is especially appropriate for the study of early language development (Baldwin and Baldwin, 1973; Bohannon and Marquis, 1977; Braine, 1976; Brown, 1973; Dunn, Wooding and Hermann, 1977; Moerk, 1974; Seitz and Marcus, 1976; Sharf, 1972).

MLU — Its Limitations: The toddler period is the most rapid phase of language acquisition and the MLU is the index that best reflects progress during this time. (Brown, 1973). However, as the MLU reaches 4.00 it begins to "depend more on the characteristics of the interactions than on what the child knows . . . " (Brown, 1973, p. 54). Beyond 4.00 (Stage V), the MLU is too variable to serve as an index of developmental level. The power of the MLR (mean length of response, a variant of the MLU) to predict language development decreased in children over 60 months of age (Shriner, 1969).

Cowan, Weber, Hoddinott, et al., (1967) and Shriner, (1969) found that with older children, the MLU can vary as a function not only of the sample size, the sex and age of the child, transcriber agreement, SES, IQ, but also experimental setting and stimuli.

The MLU Measure - Its Calculation: The calculation of the MLU and upper bound indicies[1] is described more fully in the method section (pages 82 ff.), and by Brown (1973, p. 54 ff). In general, the total number of morphemes (or whatever unit is selected - words, syllables) is divided by the total number of utterances.

Many studies have used morphemes as the basic measure (Bohannon and Marquis, 1977; Braine, 1976; Dunn, Wooding and Hermann, 1977) while others maintain that there are only small and insignificant differences between this measure and that of words (Fraser and Roberts, 1975; Nelson, Carskadden, Bonvillian, 1973; Phillips, 1973; Ringler, Kennell, Klaus et al., 1975; Schachter, Shore, Hodapp et al., 1978; Seitz and Marcus, 1976; Snow, 1972) or syllables (Brown and Fraser, 1963; Moerk, 1974).

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[1]Since the MLU measure may sometimes underestimate productive capabilities, it is teamed with an upper bound measure (i.e., an indication of the corpus' longest utterance).

The MLU measure facilitates the application of statistical procedures to linguistic research, of particular importance for the present study. It is associated with relatively high intra- and inter- examiner reliability coefficients (Shriner, 1969).

Many mother-child language studies (see pages 89 ff.) have used the MLU as a measure common to both the child and mother (Moerk, 1974). For the mother, the MLU measure is not an index of her linguistic competence, but rather an index of the accuracy of her speech adjustment in the presence of her child (Cunningham, Reuler, Blackwell et al., 1981). The ratio of the mother's speech complexity (as measured by the MLU) to that of her child's gives an indication of whether there are changes with the age and linguistic level of the child, and more specifically addressing the research at hand, whether the mother of the high risk infant accommodates her speech in a manner similar to that of the control mother.

<u>The Standardised Language Test</u>: In addition to the measures derived from the spontaneous language of the high risk and comparison infants, a standardised language test was administered. This afforded not only a comparison of performance under two different sampling conditions, but the Reynell Language Scales cover areas of linguistic competence untapped in spontaneous interactions, more

specifically language comprehension, and the development of some semantic and cognitive skills.

The Reynell Language Scales

The Reynell Language Scales (1969) have been designed to assess, in standardised form, the language acquisition of children from 6 months to 6 years, with their greatest sensitivity in the range 18 months to 4 1/2 years.

The Scales encompass the child's prelinguistic and linguistic skills, use familiar objects and are tailored to the shortened attention span of younger children, making them appropriate for the ages of the children in the present study.

The Scales have been used with a variety of populations including the hearing impaired (Reynell, 1972), children with specific language delay (Siegel, Cunningham and van der Spuy, 1979), and children with high risk birth histories (Siegel, 1979; 1981; 1982(a); 1982(b); 1982(c); Siegel, Saigal, Rosenbaum et al., 1982), including those with hypoxic insults at birth (Low, Galbraith, Muir et al., 1983) and those malnourished in utero (Walther and Ramaekers, 1982).

The Sub-Scales: The expressive and comprehension sub-scales aim to assess these respective skills independent from each other. The comprehension tasks require no spoken responses, and the expressive tasks require comprehension of simple instructions. The ordering of the test items (see appendix I) reflects trends in language development – in general terms, towards more complexity, and a gradual progression from concrete to hypothetical application. Separate standard scores have been provided for male and female children.

The Expressive Sub-Scale: This scale consists of three sections:

1. Language structures: The development of linguistic features from presymbolic and prelinguistic babbling through to the use of grammatical forms, the ordering of these forms within sentences, and the production of well formed complex sentences with subordinate clauses, are scored.

2. Vocabulary: The simple naming of objects, the naming of pictorial representations and the defining of words without the presence of objects or pictures are scored.

3. The creative aspects of language, and the verbalization of connected thoughts are scored.

The Comprehension Sub-Scale: This scale scores the following:

1. The selective recognition of words on an affective level.

2. Comprehension of simple concrete nouns.

3. Early representations of people and animals.

4. The ability to relate two concepts together.

5. The comprehension of the attributes of perceived objects.

6. The comprehension of activity attributes of perceived objects.

7. The understanding of concepts other than nouns and verbs — i.e., size and position.

8. The ability to assimilate a large number of concepts in the correct sequential order.

9. The use of hypothetical reasoning with little concrete support.

Appendix (I) outlines in detail the test items.

Summary — Language Acquisition and Analysis

The clarification of the myriad of skills coalescing into mature language underlines the enormous task the young child faces in acquiring language. It further indicates that any deficit (s) evident in a high risk population, while quantified from surface features, may in fact represent difficulties in any one or more of the skills outlined — be they prelinguistic in nature, specifically receptive difficulties, problems in generating valid hypotheses about the deep and surface structures of language, or deficits in the semantic and cognitive components.

There is another major piece yet to be placed in the enigmatic jig-saw entitled "language development". Regardless of what aspects of language are deemed critical or salient for the developing child, the role of the ambient linguistic environment has yet to be clarified. Differences in environmental input and styles of maternal language may account for individual differences among children in the subsystems of language (Menyuk, 1974). It may be argued, for example, that language delay in a high risk population may be related to a style specific to a mother of a high risk infant. This area will now be addressed.

Mother-Child Studies

Introduction

> To understand the process of language transmission the following aspects have to be investigated in detail: the contingencies between maternal and child behavior, the frequencies of the specific interaction patterns, the types of linguistic information transmitted thereby, and the children's incorporation of the provided information. (Moerk, 1976, p. 1064).

In the past ten to fifteen years, the study of language acquisition has branched in new directions, with the investigation of the role the mother plays in that acquisition.[1,2]

It has been assumed (Chomsky, 1965; McNeill, 1970) that the young child extrapolates linguistic rules from a random sample of adult utterances characterised by stutters, mistakes, inconsistencies, dangling participles, parenthentical digressions and disfluences — this view consolidating the belief that the young child is pre-programmed for the tasks of language learning.

Empirical evidence suggests that this view mis-represents the ambient linguistic environment of the growing child (Baldwin and Baldwin, 1973; Broen, 1972; Cherry and Lewis, 1976; Drach, Kobashigawa and Pfuderer et al., 1969; Fraser and Roberts, 1975; Garnica, 1977; Moerk, 1974; 1975;

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[1]See Clarke-Stewart (1973) for an outline of broader mother-child developmental processes.

[2]While the father interacts less with and speaks less to the child than does the mother (Friedlander, Jacobs, Davis et al., 1972; Golinkoff and Ames, 1979; Malone and Guy, 1982; Rebelsky and Hanks, 1971), the father, like the mother, adjusts his language to match that of his child's (Giattino and Hogan, 1975), and uses "Motherese" (Golinkoff and Ames, 1979; Hummel, 1982; Wilkinson, Hiebert and Rembold, 1981).

For an overview of research pertinent to the question of the differential interactional styles of mothers and fathers with female and male children, and the implications of this for later development, see Lamb (1975; 1977).

1976; Nelson, 1977; Newport, 1976; Phillips, 1973; Reichle, Longhurst and Stepanich, 1977; Seitz and Marcus, 1976; Seitz and Stewart, 1975; Slobin, 1975; Snow, 1972; 1977). The fact is that adults' language to children is not the same as that to other adults (Brown and Bellugi-Klima, 1964; Drach, Kobashigawa, Pfuderer et al., 1969). Mothers alter the complexity and nature of their speech so that the child's "introduction to English ordinarily comes in the form of a simplified, repetitive and idealized dialect" (Brown and Bellugi-Klima, 1964, p. 135), which falls within the range of the child's comprehension (Longhurst and Stepanich, 1975).[1] The mother's use of more sophisticated grammatical structures is correlated with the emergence of those same structures in the child's speech (Moerk, 1975; Newport, 1976; Snow, 1972), and in general, the young child receives from the adult a smaller subset of the varieties of adult speech (Baldwin and Baldwin, 1973; Broen, 1972; Phillips, 1973; Nelson, 1973; Snow, 1972).

The Nature of the Mother's Language – Motherese

The following is a catalogue of research findings relating to the mother's language in the presence of her

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[1]Maternal language in the presence of her child has been coined "Motherese" (Newport, 1976).

child, the profile being of brief grammatical sentences of a limited range of structures, (coined Motherese, (Newport, 1976)).[1]

Shorter: The mother's speech is shorter, with reduced sentence length. Her MLU increases with that of her child's (Broen, 1972; Moerk, 1975; Newport, Gleitman and Gleitman, 1975). Reduction in this manner serves to reduce the load on the child's memory.

Simpler: The mother's speech is simpler, with less complex syntax (Brown and Bellugi-Klima, 1964; Phillips, 1973); fewer modifiers per noun phrase (Snow, 1972); smaller type-token ratios[2] and more concrete nouns (Broen, 1972). This simplicity gives the child clear exemplars of syntactic rules (Drach, Kobashigawa and Pfuderer et al., 1969), as does the fact that the mother exhibits fewer disfluencies, false starts, errors and ungrammatical

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[1]This process is not confined to mothers, but is also used by strangers (Snow, 1972), kindergarten teachers, (Granowsky and Knossner, 1970), and by 4 year olds talking to 2 year olds, (Shatz and Gelman, 1973).

[2]Type-token ratios indicate the diversity of speech by measuring the number of different speech parts (e.g., nouns, verbs, modifiers) as a percentage of the total number of these forms.

sentences (Drach, Kobashigawa and Pfuderer et al., 1969). In general, the mother's speech is sensitive to the comprehension levels of her child (Brown and Bellugi-Klima, 1964; Longhurst and Stepanich, 1975; Newport, 1976).

Repetitious: The mother's language is more repetitious (Ervin-Trip, 1971; Snow, 1972) a feature which retains the general syntactic form with changes in the order, intonation, stress or vocabulary. Further, the use of recastings and paraphrasing (Nelson, Carskaddon and Bonvillian, 1973), indicating that different syntactic structures have similar meaning, facilitates the child's understanding of the consistency of underlying syntactic relationships when the surface features change. The mother's use of redundant words (Broen, 1972; Snow, 1972) allows the child to familiarize himself with the same words over and over.

Pace of Speech: The mother speaks at a slower rate (Broen, 1972). In speaking to the child, the mother's pitch is higher, and there are more stressed words (Garnica, 1977) – techniques to keep the child's attention. The longer inter-utterance pauses allow the child to segment one utterance from another.

Mother's Language – Conclusion

Investigation of language corpora shows a large proportion of grammatical complete sentences (Sherrod, Friedman, Crawley et al., 1977) with incorrect language models rarely occurring (Broen, 1972). Newport, Gleitman and Gleitman (1979) argue persuasively for the notion of brevity rather than for a smaller sub-set of syntactic structures in maternal language.

The Mother As Language Instructor

Although mothers are generally unaware of the didactic nature of their speech, and they do not teach linguistic rules in the sense of reinforcing and punishing the child (Brown and Hanlon, 1970), nevertheless, "it can be concluded that mothers are generally sensitive and versatile language teachers" (Moerk, 1974, p. 115), and that they use a variety of specific techniques (Baldwin and Baldwin, 1973; Brown and Bellugi-Klima, 1964; Friedlander, Jacobs, Davis et al., 1972; Moerk, 1976; Reichle, Longhurst and Stepanich, 1976).

Mothers frequently provide new information, exercise the child's previously learned rules and eliminate incorrectly formulated ones, by such techniques as corrective feedback, expansions,[1] modelling, prodding and questioning

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[1]Brown and Bellugi-Klima (1964) noted that between the ages of 28 and 35 months, up to 35% of the child's utterances were expanded by the mother. The mother's expansion of her child's incomplete and perhaps ambiguous utterance results in a more syntactically complete utterance without the addition of further semantic information, (Brown, Cazden and Bellugi-Klima, 1969). "The expansion encodes aspects of reality that are not coded by the child's telegraphic utterance" (Brown and Bellugi-Klima, 1964, p. 419).

the child. (Dunn, Wooding and Hermann, 1977; Giatinno and Hogan, 1975; Moerk, 1975; 1976; Sherrod, Friedman, Crawley et al., 1977). These techniques diminish as the language skills of the child increase (Slobin, 1968) and the child becomes older (Moerk, 1976).

Are these the necessary and sufficient conditions?: The clarification of some of the techniques used by mother suggests that these are characteristics of adult speech which facilitate syntax and semantic acquisition, but the question is whether they are the sufficient and necessary conditions for the emergence of language in the child.

Paradoxically, the consensus of research opinion is that there is no strong evidence for parental training as the determining factor in grammatical development. "The finding that Motherese has properties of its own does not show that these give acquisitional support" (Newport, Gleitman and Gleitman, (1979, p. 123)).

Although there is an inverse relationship between the frequency of maternal imitations and expansions and the age and linguistic competence of the child (Slobin, 1968), there is a weak correlation between the mother's use of these techniques and the child's progress. Intensive conversation without corrective feedback may be as effective. In fact, there is evidence to suggest that the over-use of corrective techniques may be counter-productive, since they may misinterpret the semantic intent of the child's utterance. Too premature a use of differential reinforcement and correction by the mother retards, rather than advances progress, since it inhibits the child's own hypothesis testing of the linguistic rules (Hubbell, 1977; Nelson, 1973).[1] "It is the generally accepting mother who appears to be the most facilitative . . . correcting early errors is unproductive" (Nelson, 1973, 113).

The child's spontaneous imitations of the mother also decline[2] with age (Bowerman, 1973; Moerk, 1974), – but these are not 'grammatically progressive' (Ervin-Tripp, 1964). An increase in the length of the adult model does not result in an increase in the length of the child's utterance, there being a selective and systematic omission of certain features such as functors, inflections and unstressed words (Brown, 1973). The omission of these

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[1]Even practice does not appear to increase the response strength of already acquired forms, such as the irregular form of strong verbs (e.g., come) which reverts to the incorrect form ('camed') before being reinstated again (often with much persistent parental correction – personal observation) in its irregular form (McNeill, 1966).

[2]These imitations decline from 10% of adult utterances prior to three years of age, to 2 to 3% after three years (Brown and Bellugi-Klima, 1964; Brown, Cazden and Bellugi-Klima, 1969).

selected features cannot be explained by a language acquisition model based on the principles of imitation (Chomsky, 1959).

In transformational terms, children do not imitate surface features that cannot be related to the deep structure. It appears that children respond best to a level of speech slightly more advanced than their own (Shipley, Smith and Gleitman, 1969).

What is the role of the mother?: The mother's use of expansions and other techniques while not directly advancing linguistic development, may be facilitatory in other ways.

> The single maternal variable which was most highly related to the factor of children's competence was verbal stimulation . . . This suggests that during early stages in language development — acquiring a primitive lexicon and learning to understand verbal communication — the child needs a language model more than a language reinforcer . . . (Clarke-Stewart, 1973, p. 60-63, 70).

After the child reaches three years of age, both he and his mother use less imitation (Brown and Bellugi-Klima, 1964; Reichle, Longhurst and Stepanich, 1976) because they understand each other better. 'The purpose of the repeated utterance is . . . to indicate that the message has been received. It means "I am listening"' (Rees, 1975, p. 348). Parental expansions act as verification of the child's thoughts, and mothers seem to pay less attention to incorrect syntax and more to the sentence's truth value or appropriateness (Brown and Hanlon, 1970).

Parents do correct pronunciation and irregular allomorphs (Rees, 1975), can facilitate the development of vocabulary (Whitehurst and Vasta, 1975), and through modelling indicate the appropriate context for language use (Shatz and Gelman, 1973). However, the acquisition of syntax appears to be immune from the effects of direct teaching procedures (Brown and Bellugi-Klima, 1964; Cazden, 1965; Dale, 1972; Ervin-Tripp, 1964; 1971).[1]

Conclusion

> There is disappointing inconclusiveness to what can be said concerning the contribution of experience to language acquisition . . . there is nothing calling for behaviorist principles of language acquisition, but when situations favorable to response-learning are examined, such as imitation or overt practice, one finds no effects that behaviorist principles can explain . . . (McNeill, 1970, p. 112).

While not a sufficient condition, the mother's language does play a critical role in limiting and selecting the child's ambient linguistic environment. The impact of the mother is less direct and more diffuse in facilitating the child's orderly acquisition of linguistic rules.

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[1]Nelson, Carskaddon and Bonvillian (1973) did demonstrate some syntactic progress in nursery school age children, but under conditions far more intensive than normally encountered between a child and his mother.

". . . it seems likely that differences in linguistic styles are greatly influenced (if not determined) by environmental influences" (Dore, 1973, p. 628-629). Mother's language is critical in providing the optimal setting for the child, this being a necessary ~~rather than~~ a sufficient condition, however.

While parental language to young children may not be as 'finely tuned' as some investigators suggest (Snow, 1972), mothers do modify their speech in response to attentional and comprehension cues, and also to such cues as the child's sex.[1]

The specific question of interest in this study is whether the high risk nature of the child affects the mother's language.

The following characteristics of the child will be addressed:-

1) The presence or absence of the child
2) The child's level of comprehension
3) The child's age
4) The child's sex
5) Social class
6) The delayed child

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[1]"From the historical review it is evident that, for both sociology and psychology, the importance accorded the child's contribution to behavior development was linked with the value placed on biological factors during any given era" (Bell, 1971, p. 64).

See Gewirtz and Boyd (1976) for a discussion of mother-child interaction research, and interpretation of the direction of effects.

Critical Child Characteristics

The Present Or Absent Child

> We propose that child speech that is responsive to mother's speech provides a gauge whereby mothers monitor their language to the child. This enables the child to exert an active influence on his language environment so that it changes with his increasing competence. (Seitz and Stewart, 1975, p. 768).

Sherrod, Friedman, Crawley et al., (1977) reported that mothers' speech to 4 and 6 month old infants was paradoxically longer and more complex than that to 8 month olds. Snow (1972) under different circumstances found that the speech of mothers who were asked to tell a story as if an absent child were listening was more complex than when a child was actually listening. The conclusion was that the effect on the mother's language of physical and psychological absence was similar; neither the absent nor the young child provided to the mother discriminative feedback.[1]

These findings suggest that, at the very least, the minimum condition for the mothers' adjustment of her speech

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[1]It should be noted that in the early months, say, prior to 12 months, the nature of the mothers' language is of lesser importance than in later stages, since the factors which facilitate language development are more exclusively biological (Krashen, 1975; Lenneberg, 1967).

(Motherese) is the presence of the child,[1] although something more than this alone is involved — that is, the child's level of comprehension and how well he responds to his mother.

The Child's Level of Comprehension

Bohannon and Marquis (1977) have suggested that "the child's comprehension feedback is the main determining factor in the occurrence of Motherese . . . (and) that comprehension responses by the child occur differentially to adult utterances of different lengths" (p. 1003). In fact, whenever a child indicated non-comprehension, there was a subsequent reduction in the adults' MLU. This adjustment has also been noted in 4 year old children in the presence of younger children (Shatz and Gelman, 1973).

This adjustment of the adult's language to meet the comprehension limits of the child (Van Kleek and Carpenter, 1980) allows differences in linguistic competences to be held at a minimum, and restricts the occurrence of those syntactic and semantic forms the child is unable to

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[1]Mother-infant communication does not begin when the child learns to speak. On the contrary, language serves to enrich communication patterns evident soon after birth (Anderson, Vietze and Dokecki, 1977; Bateson, 1975; Condon and Sander, 1974(b); Stern, Jaffe, Beebe et al., 1975).

comprehend.[1] The end result is that the speech the child hears is tailored to his cognitive and linguistic level. Shipley, Smith and Gleitman (1969) noted that children responded best to speech slightly more advanced than their own.

Thus, in addition to comprehension feedback, cues such as compliance with commands (Sherrod, Friedman, Crawley et al., (1977), and the child's level of language production itself (Baldwin and Baldwin, 1973; Phillips, 1973) serve to ensure the mother fits her language to her child's competency.

The Child's Age

The age of the child appears to be a characteristic which governs the complexity and nature of maternal speech. Mothers do simplify their speech to younger children (Broen, 1972; Newport, Gleitman and Gleitman, 1975), and their mean length of utterance and utterance complexity varies systematically with the age of the child (Seitz and Stewart, 1975; Snow, 1972).

Broen (1972), Fraser and Roberts (1975) and Phillips (1973) found that the age of the child had a detectable

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[1]The younger child needs to make fewer transformations from the surface structure of the mother's shorter sentences to reach the base structure and its meaning.

effect on almost all features of the mother's speech, with the most marked effects coming between the ages of 1 1/2 and 2 1/2 years. Moerk's (1974) data suggest that since the mothers have a slightly higher MLU than that of the child, that "this discrepancy could serve as a challenge and a model for the child" (p. 107).

Other linguistic features show similar trends. For example, there was a positive correlation between the functional categories in the mother's and child's language (Moerk, 1975) – the child's imitation was positively correlated with the mother's modelling from picture books. In general, the child's more mature forms of communication appear at the same time as more sophisticated forms are evident in the mother's speech. Similarly, Reichle, Longhurst and Stepanich (1976) noted that the mother of the 3 year old as opposed to the mother of the 2 year old had language characterised by more elaborations, more complex forms, and more modelled questions ('Is this a dark red ball or a light red ball?').

These interactional techniques – which include expansions, modelling and questions – eventually decline in intensity as the child's language matures to adult level (Moerk, 1974; Slobin, 1968).

The Male and the Female Child

Given that mothers respond differentially to their children on the basis of cues such as age, it is relevant to ask whether the generally accepted superior linguistic skills of girls reflects similar adjustments.[1]

Sex has been consistently, although never strongly, correlated with the rate of language learning (McCarthy, 1954; Reynell, 1969). There could be two possible explanations for this finding. Either girls are developmentally more precocious than boys and thus elicit more mature sophisticated language from mothers; or, mothers foster differential development on the basis of differential expectations. Condry and Condry (1976) maintain that observed sex differences are partly attributed to perceiver preconceptions.

At this stage of investigation, the answer is not clear, since even the data on sex differences in language are not unequivocable (Winitz, 1959). The studies are quoted here with the recognition that the type of measures reported[2] may account for part of the variance between the

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[1]Hirst (1982) questions whether these differences are innate and suggests that maturity may be a more significant factor than sex in determining the rate of linguistic development.

[2]The parameters of linguistic performance vary from gross measures such as verbal fluency to more specific indices such as MLU, and the use of transformational rules.

male and female population. There may also be interactional effects with social class and ethnic background (Koenigsknect and Friedman, 1976).

<u>Clinic Populations</u>: Wulbert, Inglis, Kriegsmann et al., (1975) reported that 80% of language delayed children in their study were male. This finding was noted earlier by Templin (1957) who found that in the normal population of 3 to 6 year olds, males had higher language scores. However, the males also made up the majority of the clinical populations. Silva (1980) found significantly more males than females in the language delayed group (indicated by a score of less than 2 SD below the mean on the Reynell Developmental Language Scales).

The poorer performance of male children is not universally upheld. According to Bishop (1979) in a population of language disordered children, girls fared more poorly on comprehension abilities. Rutter and Mittler (1972), however, found no sex differences in the children with receptive disorders, but that more boys had expressive disorders.

<u>The Toddler Period</u>: Linguistic performance measured in terms of MLU and upper bound indicates that girls are significantly more advanced than boys — that is, talk earlier (Cowan, Weber, Hoddinott et al., 1967; Schachter,

Shore, Hodapp et al., 1978). Boys are slower in their acquisition of vocabulary (Nelson, 1974). Girls use significantly more words at 21 months and more sentences at 24 months (Largo and Howard, 1979). The general conclusion is that girls display a higher language competence than do toddler boys (Clarke-Stewart, 1973). At a later stage, around 4 years when there is a spurt in syntax development, girls progressed faster (Koenigsknecht and Friedman, 1976). Both Randall, Reynell and Curwen (1974) and Silva (1980) using the Reynell Scales found females to have higher mean scores than boys between 3 and 5 years.

Other studies have not reported sex differences. Parisi (1971), investigating syntactic comprehension in children aged 3 to 6 found no sex differences, a similar result to that of Lee (1969) and Menyuk (1963) using transformational grammar analyses of expressive language, with nursery and first grade children. Cherry and Lewis (1976), Golinkoff and Ames (1979) and Maccoby and Jacklin (1974) found no main sex effects on a number of linguistic measures.

<u>Summary</u>: While it is true that girls' linguistic performance surpasses that of boys, the extent of these differences should not be over emphasized. As Rutter and Mittler (1972, p. 10) stated "what is striking is that the

sex difference is so small within the normal range in view of the fact that marked delays in development are so much commoner in boys than girls".

The Mother and Her Male and Female Child

No Evidence for Differential Maternal Language: Phillips (1973) with toddlers, Fraser and Roberts (1975) with grade school children and Moerk (1975) with preschool children concluded that mothers' language to their children did not vary as a function of the child's sex. This finding has been reiterated in studies by Ringler, Trause, Klaus et al. (1978), Bee, VanEgeren, Streissguth et al. (1969), Cohen and Beckwith (1977), Golinkoff and Ames (1979), while Wilkinson, Hiebert and Rembold (1981) found that neither the mothers nor the fathers distinguished between male and female children.

There Is Evidence for Differential Maternal Language: While no differences were found in the language abilities of a group of male and female 2 year olds, the mothers of the girls talked more, asked more questions, repeated their utterances more often and used longer sentences (Cherry and Lewis, 1976). In general, the mothers of 6 month old girls used more conversation maintaining devices, and providing a richer linguistic environment for them, vocalising more (Goldberg and Lewis, 1969). Mothers imitated their daughters more than their sons (Moss, 1967).

These results are consistent with general patterns of mother-child interaction studies. Parents interact more with girls than with boys (Harper, 1975; Lewis, 1972), although Beckwith, Cohen, Kopp et al. (1976) and Moss (1967) found results to the contrary, while Lewis (1972) reported that mothers spoke more to their girls, but held their boys more often.

Sex Differences – Interactive Effects: Some studies have indicated that while main sex effects were not evident, interactive effects were. For example, Levine, Fishman and Kagan (1967) found differences in mother-male interaction patterns as a function of social class – an effect which did not hold for female children. Likewise, Maccoby and Jacklin (1974) noted that sex differences in language development are larger among children from less educated families.

Thus, while it may be concluded that in general girls acquire language faster than males, and that there is some evidence for differential mother-female and mother-male interactions, the issue is still equivocable, since other features in the child's environment act synergistically to give unique outcomes.

Social Class

Differences in the linguistic styles of middle and lower social class individuals have been conceptualized in terms of 'restricted' and 'elaborated' codes (Bernstein, 1962). The restricted code is evident in the lower social classes and is typified by a rigid and restricted grammar. The 'elaborated' code, on the other hand, is used by the middle classes and is seen to be more flexible, richer and with a more complex syntax. Other variables differentiated by the codes are speech fluency, expiation and the specification of meaning.[1,2]

These social class distinctions in the style and usage of language have been generally confirmed and validated (Dunn, Wooding and Hermann, 1977; McCarthy, 1954; Wooton, 1974), although it has been argued by Adler (1973) that it is not necessarily the case that lower social class speech is less effective. It has further been noted (Tulkin and Kagan, 1972; Wulbert, Inglis, Kriegsmann et al., 1975)

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[1]Some specific subcultural deviances include tense markers 'I be playing', double negation 'he don't never do that', and reduction of final clusters 'sen him a letter'.

[2]Subcultural differences in language behaviour may necessitate a 'weaker' version of the concept of universal linguistic competence. The hypothesis should be restated in terms of differences in the rate of acquisition with the omission or addition of additional transformations (Cazden, 1965).

that there is great within class variation in the quality and quantity of speech.

The Child: Despite Adler's proviso, there is evidence to suggest that lower social class children are at a disadvantage when acquiring language. Templin (1957) noted that lower SES children lagged in phonetic development, and 2 year old children showed social class differences in the ability to learn using verbal (as opposed to non-verbal) material (Golden, Bridger and Montare, 1974). Five and 6 year old lower social class children experienced more difficulty in using and understanding passive voice sentences and complex transformations (Dewart, 1972). In terms of comprehension abilities, lower social class 3 to 5 year olds performed less well than middle class children (Parisi, 1971). There is a greater risk for language disorder in lower SES children (Klackenberg, 1980).

Mother-Child Interactional Patterns: In suggesting that SES is a potent force in the child's acquisition of language, it can be argued that differences in mother-child communicative patterns, themselves determined in part by social factors, will foster differences in the child's linguistic development (Cohen and Beckwith, 1976; Hess and Shipman, 1965). There is evidence to support this.

Middle class mothers of 4 and 5 year old children were noted to be less controlling, more positive, while their language showed more syntactic complexity and diversity of grammatical forms (Bee, VanEgeren, Streissguth et al., 1969). While there were no significant differences in the use of "Motherese" in three different occupational groups, academic and lower middle class mothers did use more expansions and fewer imperatives than did working class mothers (Snow, Arlman-Rupp, Hassing et al., 1976). According to Hess and Shipman (1965), the lower social class mother's use of imperatives is a pattern associated with the developmental delay seen in their children.[1] Other investigators have recorded similar differences in mother-infant interactional patterns, with middle class mothers engaging in more verbal interactions with their children (Tulkin and Kagan, 1972). In general, the characteristics which mark impoverished conditions for language learning include a lack of positive and instructive feedback from the adult to the child.

> . . . working class mothers, then, care for their infants as extensively as middle class mothers; differences occur mainly in areas involving maternal stimulation of cognitive development (Tulkin and Kagan, 1972, p. 39).

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[1]See page 95 f for a discussion on the counter-productive use of corrective techniques.

Social class affects the extent to which mothers perceive their role as 'instructive' (Ringler, Kennell, Klaus et al., 1975).

Any conclusions drawn relating to the importance of social class as a factor in language acquisition are tempered by the fact that as a short-hand form for a cluster of social and personal interactional features, the SES measure is non-specific. One should determine the contribution of the parameters of the home environment (Jones, 1972) or the maternal response contingencies and linguistic patterns (Elardo, Bradley and Caldwell, 1977) rather than relying on the general SES measure alone.

This study, while using a rough dichtomization of social class (upper and lower — Hollingshead Scales 1/2 and 3/4/5) did investigate the nature of upper and lower class mothers' language as a possible influence on the developing child's language.

The Mother and Her Delayed Child

It is often the child's self-motivated speech which sets in motion instances of communication (Schachter, Kirshner, Klips et al., 1974) — this being a phenomenon seen in a variety of behavioural contexts (Bell, 1971; Harper, 1975).

The Effect of the Child on His Mother: The language-delayed or retarded child, being less responsive and possibly giving confusing linguistic feedback may change the nature of the mother's linguistic responses (Cunningham, Reuler, Blackwell et al., 1981; Siegel, Cunningham, Vander Spuy, 1979) and lead to potential communication problems (Seitz and Marcus, 1976).

Studies have shown, in agreement with Bell and Harper's (1977) contention that adults respond to inactive and unresponsive behaviour with directive controls aimed at increasing the child's level of social interaction, that there was a tendency for mothers of retarded children to use more commands (Cunningham, Reuler, Blackwell et al., 1981). Terdal, Jackson and Garner (1974) (in Seitz and Marcus, 1976) found that impaired and confusing feedback from delayed children resulted in intrusive and jussive language.

Does the Mother Provide a Different Linguistic Environment? While not specifying the direction of effects (and cognisant of the appropriateness of a transactional model (Sameroff and Chandler, 1975)), it appears that the linguistic environment of the delayed or retarded child differs in some respects from that of normal children.

At the outset, the less frequent interactions between mothers and their delayed children could allow for fewer language teaching opportunities (Moerk, 1975, 1976).

Mothers of delayed children do interact less with their children. Wulbert, Inglis, Kriegsmann et al. (1975) found that language delay in middle class children was associated with mothers who were less responsive, less involved. A similar finding was reported by Jones (1972) who concluded that mothers of language-delayed boys provided few opportunities for the use and development of language skills.

This pattern also holds for the mothers of Down's Syndrome children, who interacted with them less, and paid less attention to their language activities than did mothers of non-delayed children (Petersen and Sherrod, 1982). Buium, Rynders and Turnure (1974) found that while these children were exposed to a higher number of utterances, maternal MLU was lower than that of control mothers – in effect, language to Down's Syndrome children was less complex.

Is this Changed Maternal Language Adaptive?: This study (Buium, Rynders and Turnure, 1974) suggests that parental language to the delayed child may be appropriate to the child's developmental, if not chronological, level. Lederberg (1980) has concluded from a review of the literature that adults, in fact, respond appropriately to the delayed child's language – that is, in a manner similar to that of parents of normal children of equivalent developmental level. Cramblit and Siegel (1977) concur on this position — mothers and fathers respond to their language-delayed children as if to a younger child, in a simplified manner.

Conclusion

While it is the case that the linguistic environment of some language delayed children differs from that of normal children (Mahoney, 1975), in some cases the differences are minimal and do not necessarily hold for all linguistic measures (Cross, 1976).

In the present study, it was hypothesised that those measures related to the complexity and amount of maternal language may possibly differentiate the premature and high-risk mother-child dyad from the comparison mother-child dyad. This position is based on the hypothesis that the premature infants who may act and appear younger than their chronological (although not their gestational) age, or who may be delayed in their language acquisition, may elicit maternal language which is simpler and slower.

The ratio measure of the mother's MLU to that of her child's has been shown to distinguish between normal and retarded dyads (Cunningham, Reuler, Blackwell et al., 1981) and indicates the amount of divergence between the

the mother's speech and that of her child's. This ratio measure was also seen to be relevant to possible unique interactional patterns in the high-risk mother-child dyad, and was used in this study.

Summary Statement

The acquisition of language is an extremely complex, albeit orderly, process entailing a multitude of linguistic skills.

In comparing the progress of early language development in high risk premature, low birthweight, small-for-gestational age and respiratory distress syndrome infants and comparison term infants, the literature indicates that the following measures are appropriate:-

a) quantitative measures (e.g., MLU, upper bound, rate of speech, type token ratio)

b) qualitative measures (morphemic features)

c) measures from a comprehensive standardized language test (The Reynell Language Scales).

The quantitative measures are similarly applicable to the language of the mothers, who are seen to play a central role in their child's language development.

The independent variables of social class and infant's sex were also investigated to determine their effects on language acquisition.

The method section gives further details on these measures, their calculation and scoring.

Some final issues need to be clarified concerning the decision to investigate language development in the natural setting of the child's home. The following is a discussion of data collection in an unstructured home setting.

Methodological Issues

> Paleontology, geology and astronomy seem to be alive and well without manipulating fossils, continents, or heavenly bodies, and we might look into our own backyard at Jean Piaget to observe the impact detailed naturalistic description can have on a discipline even when the maximum number of subjects is only three (McCall, 1977, p. 337).

A survey of some recent literature (Anderson, Vietze and Dokecki, 1977; Baldwin and Baldwin, 1973; Bateson, 1975; Bell, 1964; Dunn, Wooding and Hermann, 1977; Giatinno and Hogan, 1975; Jones, 1972; Moss, 1965; Schachter, Shore Hodapp et al., 1978; Snow, 1972; Yarrow, 1963; for example) reveals strong interest in the description of behaviour in naturalistic settings.

The collection of language samples within the child's own home can and does prove immensely fruitful, although the research demands are different to those in experimental settings where independent variables are manipulated and controlled.

> . . . we would like to express the distaste experimentalists must feel for the assumptions, compromises and qualifications involved in the use of naturalistic data. We find that naturalistic studies build an appetite for experiment - for controls, complete data, large samples and statistical analysis. But we also find the reverse. The two kinds of research are complementary activities and complementary forms of evidence. In experimental work one uses the ingenuity he has on advance planning for data collection, whereas in naturalistic

> work little ingenuity goes into the data collections and all that is available goes into data analysis. The history of psychology and of psycholinguistics in particular shows that careful experimental work provides no sure path to truth (Brown and Hanlon, 1970, p. 51 - 52).

The Naturalistic Study

> Lack of standardization is both a strength and weakness for naturalistic observations. One cannot effectively equate mother and infant on ecological factors. However, these factors do influence the dynamics of the interaction, and if one is interested in the actual life situation, the natural structure and unique qualities of the home are relevant variables that should be considered for studying mother-infant relations. (Moss, 1965, p. 484).

The study of the child as he interacts with his mother in their home is, itself, however, subject to problems of a different nature.

In naturalistic settings, there is the possibility that behaviour may 'pile up' (Bell, 1964) so that a small number of behavioural categories contain the majority of data. Likewise, behaviour may be distributed across a large number of behavioural categories, with two few data in the cells to permit analysis.[1] It is also the case that a naturalistic setting does not necessarily sample the full

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[1]Low frequencies of behaviour are associated with low observer agreement, depressed test-retest stability and there is the necessity for longer periods of observation, (Bell, 1964).

range of activities in which the mother and child may engage under usual circumstances.[1]

The Free Play Setting

These considerations have led to use of observational techniques in semi-structured situations. A popular procedure for the generation of speech samples is the free play situation. This approach balances the probability of variation between the classes of behaviour and variation within the class of behaviour under study. The play situation reduces the complexity of the data without excluding important variables.

> The amount of control which it is necessary or desirable to exercise over stimuli and behaviour presents a considerable problem in interaction studies. (Lytton, 1971, p. 652).

Consequently,

> . . . a halfway house between the highly structured task and the completely unstructured interaction is the situation in which child behavior is allowed to vary at will, but where the external circumstances are standardized. This happens in the 'free play' interaction investigations. (Lytton, 1971, p. 664).

There are also developmental reasons as to why the play setting is ideal for the collection of language samples.

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[1]Attempts have been made to continuously monitor the child at home. See Friedlander, Jacobs, Davis et al., (1972).

The mother's speech to the young child tends to be object related and tied to the immediate context (Brown and Bellugi-Klima, 1964) and is especially integrated with play activities, (Messer, 1978). In the early stages of language development, children respond more to toys than to books (Koenigsknecht and Friedman, 1976).

Since topic and task are features which interact with the type of language sampled (Cazden, 1970; Scott and Taylor; 1978) settings can be devised to maximize the quality of the language sampled.

> The toy task was probably more successful in setting the child to communicate because it resembled a natural familiar situation. Children play with and talk about toys all the time. Evidence that young children have rudimentary communication skills depends both on the domain in which a task is set and on the simplicity or naturalness of the task itself. (Shatz and Gelman, 1973, p. 31).

These authors also found that speech measured by MLU did not differ in spontaneous settings from that in semi-structured play settings.

In the present study, the spontaneous language samples were collected in a standardized play setting. Further details may be found on pages 126 ff.

METHOD

Subjects

The twelve high risk and twelve comparison infants in this study were selected from those subjects participating in a longitudinal project under the auspices of Dr. Linda Siegel, Department of Psychiatry, McMaster University, Hamilton, Ontario. This parent project was designed to determine the consequences of certain high risk perinatal, familial and demographic factors on the subsequent physical and behavioural development of these infants.

The high risk subjects consisted of three clinically defined sub-groups, a premature, a small-for-gestational-age and a respiratory distress syndrome population.

In the first sub-group were those preterm infants designated very low birthweight (VLBW), that is registering a birthweight of less than 1500 grams. While premature, these infants had birthweights that were appropriate-for-gestational age (AGA) (Usher and McLean, 1969).

The small-for-gestational-age (SGA) infants present as a different sub-group from the VLBW infants, their low birthweight being primarily a function of intrauterine growth retardation (Fisher, 1976; Fitzhardinge and Steven , 1972). The SGA infants in this study had a birthweight of at least two standard deviations below the mean weight for the gestational age (Usher and McLean, 1969).

Since the determination of gestational age by the last menstrual period (LMP) is prone to error due to irregular menses, the occurrence of bleeding post conception, and the use of oral contraceptive (Lubchenco, 1970; Neligan, 1965), a combined neurological and morphological scale (Dubowitz, Dubowitz and Goldberg, 1970) having 95% confidence limits of ± 2 weeks supplemented calendar evidence. The combined gestational age and birthweight information is necessary to determine the status of the infant as AGA or SGA.

The <u>respiratory distress syndrome</u> (RDS) infants in this study were both premature and term births, and all weighed more than 1500 grams. RDS presents as a clinical syndrome soon after birth, and can vary in its severity. The designation severe RDS indicates X-ray evidence of the syndrome, assisted ventilation, and O_2 level greater than 80%. Moderate RDS indicates the use of assisted ventilation, continuous positive air-way pressure (CPAP) and O_2 levels of between 40% and 80%. In mild RDS, oxygen levels of less than 40% are administered.

Further details on the nature of these high risk syndromes can be found in the Introduction, pages 8 **ff** .

The <u>comparison group</u> differed from the high risk infants in terms of the birth history, having had a normal perinatal course after a term birth (i.e. 40 ± 3 weeks post conception). However, the high risk and comparison populations did not differ in the distribution of sex, birth order and socioeconomic status (Hollingshead Scale), (Fisher's Exact Text, $p > .005$ for each factor)..

Table **I** summarizes the birth histories and demographic characteristics of the 24 infants enrolled in the study. The high risk group is distinguished from the comparison group primarily by the factors of prematurity and low birthweight, as well as by the risk factors of RDS and SGA.

<u>Enrolment</u>

The enrolment period for the language study extended from January 1977 to October 1978. Infants in the parent project were investigated to determine whether or not they met the inclusion criteria, which were as follows -- the infants had to have been 18 months of age during the enrolment period, have come from an English speaking background and have lived within a 10 miles radius of Hamilton, an area which encompassed Burlington, Dundas, ~~Ancaster~~ and Stoney Creek. Twins were excluded from the study as

Table I

Birth History and Demographic Characteristics

Group	Sex	Gestational Age Weeks	Weight Kg.	Respiratory Distress Syndrome	S.E.S. Hollingshead Scale	Birth Asphyxia
High Risk						
Premature AGA ≤ 1.50 Kg.	F	30	1.44	mild	5	No
	M	34	1.50	severe	3	Yes
	F	30	1.20	none	4	No
	F	26	1.03	moderate	1	No
	F	28	1.10	mild	4	No
Premature SGA ≤ 1.50 Kg.	F	30	0.80	moderate	3	No
	M	35	1.42	none	4	No
	F	34	1.39	none	4	No
Respiratory Distress Syndrome AGA ≥ 1.50 Kg.	M	35	2.43	severe	4	No
	M	30	1.56	severe	3	Yes
	M	39	3.56	severe	4	Yes
	M	42	3.63	severe	5	Yes
Comparison						
Term ≥ 2.50 Kg.	F	42	3.99	none	4	No
	F	41	2.88	none	5	No
	F	38	2.84	none	1	No
	F	39	3.10	none	5	No
	M	41	3.43	none	3	No
	M	40	4.15	none	3	No
	M	40	3.00	none	2	No
	M	40	3.27	none	2	No
	M	40	3.40	none	3	No
	F	41	3.51	none	4	No
	M	40	3.60	none	3	No
	M	38	2.75	none	4	No

were infants with diagnosed or suspected organic syndromes such as hydrocephalus and/or mental retardation and those with sensory deficits such as blindness and deafness.

Table II details the selection procedure and accounts for exclusions from the main study. There was one refusal in the comparison group and one high risk mother declined due to an impending divorce.

Procedure

Home visits were made every three months, from eighteen months to thirty months (five visits per child), to collect language samples from the mother and child in an interactive situation, and to administer a standardized language test.

The play sessions were instigated after a five to ten minute settling-in period during which time the observer carried on informal conversation. It was required that the language samples be of ten minutes duration, although the semi-structured play sessions often lasted longer. The mothers were informed that the child's language was of primary interest and with this in mind they were asked to engage the child in play activities. The mother was instructed as follows.

TABLE II

Selection Of Infants For Language Study

Group	Total In Parent Study	Died and/or Lost to Follow-Up	Out of Town	Less Than 18 Months at Time of Enrolment	Other[1]	Number In Language Study
High Risk	112	14	60	8	18	12
Comparison	78	6	21	27	12	12

[1] Other: This category consisted of infants who were 18 months of age but excluded for the following reasons:- Non-English speaking parents - six in the High Risk group and two in the Comparison group; twins, accounting for six and two infants respectively; four High Risk and two comparison infants with organic and perceptual deficits; and refusals or unstable family situations, which accounted for two High Risk and six Comparison infants.

> I would like you to play with (child's name) for fifteen to twenty minutes and use these toys as a basis of conversation with him/her. I will be taking notes to help me clarify ambiguous or unclear speech when I come to transcribe the tapes.

At the end of the play session, the mother was asked to instruct the child to return the toys to a bag.

The mother-child language samples were recorded on a Uher 4200 Stereo taperecorder while the observer noted the child's utterances and the contextual and semantic background in which they occurred. These served to clarify inaudible and ambiguous verbalizations at the time of transcription.

Equipment

For the eighteen, twenty-one, twenty-four and twenty-seven month visits the mother and child were given the same set of toys. These consisted of a collection of different dolls, a set of farm animals, plastic cutlery, a telephone, building blocks with pictures, a set of toy eggs in a case, stacking cups, trucks and cars and three Ladybird books (Ladybird Books Ltd., Loughborough, Leicestershire, England).

For the final visits at thirty months, the toys were replaced with two picture books entitled "Let's Eat" and "Sleepy Time" (Gyo Fujikawa, published by Zokeisha Publications Ltd.). These books consisted of large, well-

TABLE III

Summary Of Data Collection

Group	18	21	Months 24	27	30
High Risk N = 12 Comparison N = 12	Toys & Reynell Scales	Toys	Toys & Reynell Scales	Toys	Books & Reynell Scales

defined pictures, with a minimum of written commentary. The mother was asked to use these books as a basis of conversation with her child.

In addition to the language samples collected, a standardized language assessment scale -- the Reynell Developmental Language Scales -- was administered at the eighteen, twenty-four and thirty month visits, after the mother-child play sessions. Since the Reynell Developmental Scales (see Introduction, page 86 ff.) were initially standardized on British children, some minor vocabulary changes were necessary, such as the substitution of "store" for "shop". Appendix I gives an outline of the test sheets and notes the changes made.

Age of Infants at Time of Visits

All home visits were made as close to the eighteen, twenty-one, twenty-four, twenty-seven and thirty month date after birth as possible. However, the actual timing of the visit varied due to illnesses, holidays and other cancellations.

Table IV gives the range and mean age for each age group. The date is represented as a decimal fraction of a year (McVarish, 1962). Thus, the average age of the High Risk infant seen for the twenty-seven month visit is 2.29 (or 2 years 107 days).

TABLE IV

Age of Infants at Visits

Group	18 (1.5)	21 (1.75)	24 (2.0)	27 (2.25)	30 (2.5)
High Risk					
Range	1.53 - 1.64	1.72 - 1.90	1.95 - 2.08	2.24 - 2.36	2.48 - 2.60
Mean	1.59	1.77	2.04	2.29	2.54
Comparison					
Range	1.51 - 1.66	1.70 - 1.86	1.98 - 2.10	2.18 - 2.38	2.45 - 2.69
Mean	1.57	1.78	2.04	2.28	2.53

TABLE V

Number of Visits Within Range

Group	18 Months* ±45 Days	21 Months ±30 Days	24 Months ±30 Days	27 Months ±30 Days	30 Months ±30 Days
High Risk	90.9%	90.9%	100.0%	81.1%	100.0%
Comparison	88.9%	91.7%	90.9%	90.9%	90.9%

* Percentage figures for 18 Months ±30 Days were 54.6 (High Risk) and 66.7 (Comparison).

Table V gives the percentage number of children seen within thirty days (in the case of the eighteen month visit, 45 days) of the actual dates.

Missed Visits

In five and six instances for the High Risk and Comparison groups respectively, no home visits were possible, due to illnesses, holidays and unavoidable cancellations. In the case of the four infants not visited at eighteen months, the Reynell language Scales were administered at twenty-one months.

Transcription of Language Tapes

Fifty-five language tapes for the high risk group and fifty-four for the comparison group were transcribed by the observer of the play sessions. Both the mother's and the child's speech was transcribed, beginning with the first audible, clear utterance and continuing for ten minutes.

A post-transcription reliability check was carried out on six (five percent) randomly selected corpora with the help of a second transcriber. Overall inter-transcriber agreement was 97.2% for the mothers' speech and 94.1% for that of the children. Agreement was measured when the second transcriber concurred with the first on all aspects of the mother's or child's utterance — that is, its boundaries, whether it was an intelligible or unintelligible utterance, and the linguistic features of that utterance. The inter-transcriber agreement was calculated as a perentage of the number of utterances in which both agreed over the total number of utterances in the transcript.

1. Exclusions: The following portions of the tapes were not transcribed at all. Where appropriate, allowances were made for time so that the language corpora consisted of ten minutes of mother-child interaction solely.

a). Miscellaneous non-linguistic sounds such as coughs, laughs, crys, humming and singing.

b) Sentences ostensibly spoken to the child but, in fact, directed to the observer, as occurred, for example, in transcription PG:30:5.[1]

> M: We can't understand you if you insist on speaking with a Scottish accent.

Comments such as these were understood to be for the benefit of the observer.

---

[1]This denotes the corpus of child PG at thirty months of age, page 5 of the transcript.

c) Mothers' conversations with other adults, the observer, children and animals.

d) Recitation of the alphabet and long runs of numbers. Counting was retained if it was an integral part of the conversation, as in transcript, CR:30:8.

M: And how many candles?

C: One, two three.

M: Yeah, three candles.

e) Long runs of "no" in admonition, KT:18:9.

M: Kevin.

M: Kevin.

M: Come here, come here, come here.

M: No, no, no, no, no, no, no, no, no, no, no.

Language Corpora

Barring the exclusions listed above, the ten minute language samples generated the corpora on which the linguistic analyses were carried out. A corpus is a list of intelligible word combinations (Braine, 1976) the nature of which has varied both with the investigator and intent of the study. While a minimum of one hundred intelligible utterances is generally required for the purpose of generating grammars and carrying out distributional analyses (see Brown, 1973; Lee, 1971, for example), in this study a time demarcation was chosen instead. First, the age of the children did not ensure that a pre-defined number of utterances would be elicited, this being expecially the case prior to 27 months. However, while undoubtedly greater precision is attained with larger numbers of utterances, less than 100 gives a reliable reading also. Darley and Moll (1960) used 50 sentences and reported a reliability coefficient of 0.85, while Layton and Stick (1979) demonstrated that very reliable estimates of MLU can be calculated from the first 15 sentences of a transcript, and the addition of further utterances does not add appreciably to the power of the MLU statistic.

This study was not concerned to generate grammars nor to draw up complete descriptions of the child's linguistic competency. Of primary interest was a comparative study of two groups of infants performing under regular conditions in a home setting. The lack of, or sparsity of, speech was seen to be as informative as its presence.

The Language Corpora — Their Description

1. Prelinguistic Utterances: The definition of a language corpora as given by Braine (1976) was extended slightly in this study due to the presence in the early stages of language acquisition of freqently occurring non-linguistic utterances, amenable neither to syntactic nor semantic

analysis. Most investigators have excluded such utterances from their corpora (Cherry and Lewis, 1976; Nelson, Carskadden and Bonvillian, 1973; for example), and while these utterances did not play a significant part in the analyses they did prove to be of interest. These pre-linguistic "patterned vocalization(s) simulating speech" (Reynell, 1969, p. 21) serve as primitive communicative units (Bateson, 1975; Stern, Jaffe, Beebe, et al., 1975) and are the foundations for the emerging language system.

The presence of these utterances was noted on the child's corpus. Decisions as to what constituted end points for these utterances followed the criteria laid down for intelligible utterances (see pages 140 ff), that is, based on pause and intonation patterns. The delineation of prelinguistic utterances in this manner was based on the belief that the intonation of the breath group (utterance) takes on a linguistic function before the child has acquired language proper (Lieberman, 1967).

2. Para-linguistic Utterances: Unlike the prelinguistic utterance, the para-linguistic utterance is meaningful, being culturally and socially determined and recognised within the linguistic community (Abercrombie, 1968). However, neither were these utterances amenable to the usual forms of linguistic analyses carried out on intelligible sentences. Appendix II outlines the most commonly occurring

para-linguistic utterances found in the transcripts, along with their transcribed form and semantic equivalence. Some frequently occurring examples are "Oh" (indicating surprise), "Eh?" (standing in for "what") and "Uhuh" (an affirmative). These nonword sounds tend to be made as complete utterances (Sherrod, Friedman, Crawley et al., 1977) and stand alone.

3. Unclear Utterances: The third category of utterance to be simply noted and not included in the main body of the linguistic analyses is that of the unclear utterance. Background noise, whispering and other extraneous factors sometimes precluded the transcription of an utterance in intelligible form. The context, however, indicated that the utterance was probably a well-defined, meaningful unit. These utterances were noted as 'unclear' this standing for a complete utterance or just a word in an otherwise clear utterance.

Thus, barring the exclusions already outlined on pages133 , all utterances were initially transcribed including nonfluencies, grammatical reformulations and word findings. Prelinguistic, paralinguistic and unclear utterances were noted. Idiosyncratic familial words were retained if their meaning was apparent, as in the following cases:

M: No bucking into the fireplace (banging).
AC:27:6

C: I want more, I want tune-tune (bottle).
AC:21:8

Figure 1 schematically represents the reduction of the complete language sample to those utterances on which the core analyses were performed, as discussed now.

Transcription of Intelligible Utterances

The collapsed nature of the early phonemic system (whereby the limited range of sounds in the child's repertoire may represent a broad range of sounds in the adult model) demanded special care in the transcription. Speech was transcribed in standard English rather than in phonetic form, although consistently omitted syllables were not represented, as in the following examples:

C: Boon (balloon).
P.G.:30:7

M: What's in his hand?

C: Ban.

M: Banana, yeah.
J.R.:24:5

Care was also taken in the transcription of significant morphemes which are phonetically minimal features, but grammatically and developmentally meaingful. These features include the plural inflection, represented by "s" which includes the three allomorphs /-s; -z; -ɪz /; the

Reduction of Language Samples for Analysis

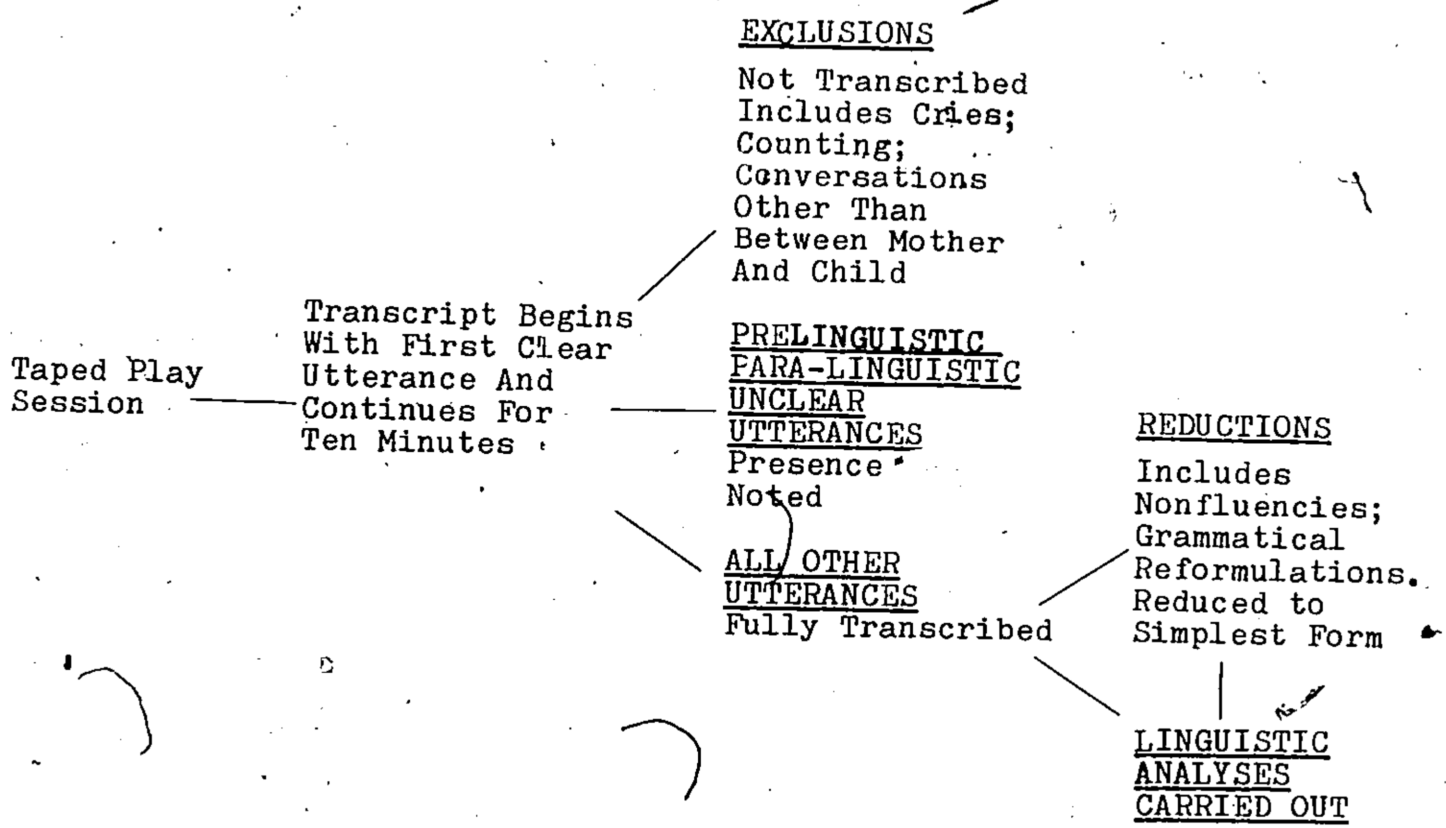


FIG. 1

past regular morpheme "ed", including the allomorphs /-d; -t; id/; prepositions, articles and contracted auxilliaries (e.g. he's going).

The Intelligible Utterance

The word combinations were organized in terms of the unit of analysis — an utterance. An utterance has been operationally defined in different ways, but the demarcation of one utterance from another is made primarily on the basis of content, grammatical completeness, stress, intonation and pause patterns (Fraser and Roberts, 1975; Golinkoff and Ames, 1979; Lee, 1974; Seitz and Marcus, 1976; Siegel, 1963; Snow, 1972).

According to Lieberman (1967) there is an innate physiological basis for the "breath group" which segments speech into sentences, and these take two forms in present day English. The first has as an acoustic correlate a terminal fall in fundamental frequency characterizing simple declarative sentences, and the second, a terminal rise used in yes/no questions.

A complete utterance is not isomorphic with a grammatically defined sentence, since the former may lack a finite verb and [illegible] other deletions. Consequently, an utterance some[illegible] comprised one or two sentences, and sometimes simply a single word. While occasionally an utterance extended across a pause, generally phrases and sentence fragments were accepted as utterances if they were characterised by a complete intonation pattern and/or any of the other criteria outlined above.

Each intelligible utterance was transcribed onto a single line with M(Mother) or C(Child) preceding it to indicate the speaker. A long monologue by the Mother, for example, may consist of several utterances demarcated by a change of topic, a downward inflection and/or a pause of two or more seconds (after Giattino and Hogan, 1975). In the situation of active dialogue, sections of the mother's speech might be interrupted by that of the child, thus affording a natural and clear cut demarcation of utterances. Appendix III gives examples of corpora as transcribed for analysis.

Scoring

1. Words and Syllables:

> The fact that a child may use a single word in two constructions (e.g., I want it, do it) indicates nothing about the independent status of the word itself. Only if he uses it alone can one be certain that it is an independent unit, and even then one cannot know whether it retains its independent status in the longer construction. These wholistic units theoretically should be considered equivalent no matter what their morpheme or word length. The problem of distinguishing them from analyzable forms remains intractable, however. . . . (Nelson, 1973, p. 25).

While Nelson cautions that a word found in a child's corpus may not necessarily correspond semantically and syntactically to a similar word in adult's corpus, she concludes that, in effect, the child must be given the benefit of the doubt and his, perhaps idiosyncratic, phonetic forms given equal status. However, the ambiguous nature of the word in early language acquisition, and consequently the potential difficulties in measurement may be circumvented somewhat by the additional calculation of the number of syllables per utterance. According to Cairns and Butterfield (1978) a strong case can be made for the view that the syllable serves as a basic organizing principle in speech production and perception, and Liberman, Cooper, Shankweiler et al. (1967) cite evidence indicating that speech is processed in syllable sized temporal units, on the order of 250 msec.

Thus, for each intelligible utterance, both the number of words and the number of syllables were calculated.

False starts, hesitations and word reformulations were ignored in this calculation, as in the following examples:

C: And (it, it goes) it's a trailer.
HC:27:3

C: Sun's white (it goes) it goes dark.
JM:30:6

C: (Can, can) Can I open this up?
HC:30:8

M: You know what you can do, you should go use these eggs and (make) cook something.
DG:27:2

2. Contractions: In the calculation of the number of words and syllables per utterance, contracted forms such as "I'm" and "What's" posed a singular problem. (English has a number of contraction transformations that combine distinct morphemes in the deep structure into single words. Appendix IV gives a full list of frequently occurring forms.) It was decided for both semantic and developmental reasons that such contracted forms would be counted as two words. This follows Braine (1963), in that any construction which could be divided into two or more parts, both of which are English morphemes that could occur independently of the others, was counted accordingly. Developmentally, this method of calculation was justified by the increased combined use of the pronoun and auxiliary in the later ages, whereas in the younger stages one or other was likely to be omitted, as in transcript SS:30:8

C: Uhuh, they eat nuts, squirrel eating there.

Here, the obligatory auxiliary morpheme "is" has been omitted.

In the case of some other contracted forms, such as "isn't" and "let's", there is no breakdown evident into the constituent morphemic forms (i.e. 'is not', 'let us' -- and generally this is only seen in highly stylized spoken and written English). Consequently, these forms were counted as one word (see Klima and Bellugi, 1966).

3. Other Special Cases: The peculiar nature of this study ensured the presence of many puerile idioms such as 'night-night', 'choo-choo' and 'ta-ta'. These were scored as one word, but two syllables. Differentiation was made between such idioms and words which occurred twice in succession, as in this case (transcript AC:18:1),

C: Aaron car-car.
(Two words/three syllables)

C: Truck truck.
(Two words/two syllables)

where the decision was based on pause and intonation considerations.

Hyphenated words (e.g., 'face-cloth', 'hot-dog') were also counted as one word/two syllables. Appendix IV gives fuller examples of these special cases.

4. Para-Linguistic and Unclear Units: When a para-linguistic unit occurred within an intelligible utterance (as opposed to constituting an utterance in and of itself — see page 136), it was transcribed but not included in the word/syllable count, as in the following example:

M: Look at the little deer. Ah! little deer, that's Bambi.
AC:24:2

Here "Ah!" as a term of endearment was excluded from the calculation.

When an unclear word occurred in an otherwise intelligible utterance, it was counted as one word/one syllable, as in these cases:

M: Are you going to dump them out? Well you (unclear) it.
AC:24:4

C: A fork, fork

M: Fork, yeah, isn't it, see the little (unclear)?
HC:21:8

Quantitative Analyses of Language Corpora

The scoring of the corpora in terms of the number of words and syllables provided the basis for the quantitative analyses now described.

1. Mother: The following six measures were performed first for the mother alone.

a) Exclusions: The percentage number of para-linguistic and unclear utterances out of the total number of utterances was calculated.

b) Mean Length of Utterance — Words: This was calculated by dividing the total number of words in the corpus by the total number of intelligible utterances. This gave a measure of the average number of words per utterance.

c) Mean Length of Utterance — Syllables: Calculated as for words.

d) Rate of Speech: Indicated by dividing the total number of utterances by time.

e) Rate of Speech — Words: Since there is possibly an inverse relationship between the rate of speech and the mean length of utterance, a further measure of the total number of words divided by time was calculated.

f) Rate of Speech — Syllables: As for words.

2. Child: Measures a to f were also calculated for the child alone, with measure a including a percentage number of pre-linguistic exclusions. In addition, two further measures were computed, as follows.

g) Upper Bound: This measure differentiates between the child's reliance on short utterances and what he is capable of producing. It scores the longest utterance in the corpus in both words and syllables. The utterance had to be well-formed and non-repeating, as in the following examples from transcript EW:24:5 and 6.

C: Here baby mummy.

C: There horsie, there horsie.

Although the child's corpus contained a four word utterance, this did not constitute the upper bound score since it was repetitious. In fact, the score was based on the former utterance, that is, three words/five syllables.

h) Type Token Ratio: A modified type token ratio, measuring linguistic diversity and acting as an index of expressive vocabulary, was calculated by dividing the total number of completely different utterances by the total number of intelligible utterances. A large type token ratio indicates a diverse vocabulary, a small ratio, a restricted one.

Mother and Child Ratio Measures

In addition to these above measures which were calculated for the mother and child individually, a ratio score was obtained for the mean length of utterance and for the rate of speech, whereby the mother's score was divided by that of her child's.

A ratio score greater than 1 indicated that the mother's MLU surpassed that of her child's.

Morphemic Analysis

In addition to the above quantitative measures — which assigned an equal value to all grammatical forms — an investigation of the content of the child's corpora was also carried out.

The basis for this analysis was Brown's (1973) description of the acquisition of fourteen grammatical morphemes (see Introduction, page 7. ff.)

In this study, only the child's corpus at thirty months was substantive enough to quantify the frequency of occurrence of these fourteen morphemes. Since both the acquisition of the morpheme itself, and the constraints defining linguistic obligation are acquired over time (Berko, 1958; Brown, 1973; Cazden, 1968; deVilliers and deVilliers, 1973; Miller and Ervin-Tripp, 1964), it was not surprising to find only five morphemes occurring with sufficient frequency at thirty months. It should be further noted that it could not be said of these morphemes that a 'point of acquisition' had been reached, this being arbitrarily defined when the morpheme is supplied in 90% of the obligatory contexts (Brown, 1973).

The five morphemes tallied were as follows:

a) & b) The COPULA and AUXILLIARY forms of the verb "to be". The present tense forms -- "am", "is" "are" -- together with the infinitive "be" -- are the grammatically governed allomorphs of the verb "to be". The forms are used as a main verb (Copula) and Auxilliaries of the present tense progressive. No distinction was drawn between contractible and uncontractible forms (see Brown, 1963, pp. 264).

c) The PRESENT PROGRESSIVE A finite verb may be inflected with the ending -ing, which has two allomorphs /In/ (Goin') and /Iŋ/ (Going). Gerundives ("swimming is fun") are not included in this category.

d) The <u>ARTICLE</u> 'A' which is used for nonspecific reference, and the <u>ARTICLE</u> 'THE' which is used for specific reference, are generally obligatory with a common noun.

e) The regular form of the <u>PLURAL</u> inflection -s included the three allomorphs /-s -z -ɨz /. Irregular forms (e.g., men) were not tallied. The obligatory contexts for the plural inflection include distinct grammatical processes, e.g., simple plural reference in naming; agreement with a plural determiner like 'some'; numerical determiners like 'two'; (see Cazden, 1968).

1. <u>Obligatory Contexts</u>: Since the overall frequency of use of a morpheme is subject to conversational constraints, it is thus necessary to determine whether it is supplied in obligatory contexts. This demands identifying the obligatory context, and then scoring the presence or absence of the appropriate morpheme. Brown (1973) lists four types of linguistic constraints, and they are presented now.

a) The linguistic context -- the child's utterance itself, defined the need for the morpheme.

C: This is a horse. Ma! Here table.
GLL:30:1

In this example, the <u>Copula</u> 'is' is twice required, along with an <u>Article</u>.

b) The nonlinguistic context -- the child's action may define the tense of the utterance.

C: I'm not finished reading the book.
CA:30:10

Since the child is participating in an action, the present progressive tense is required and supplied.

c) The linguistic prior context -- seen in the following example.

M: What's he doing? Tell Mummy.

C: Sleep.
TC:30:1

The Mother's question requires the Child's answer in the present progressive tense.

d) The linguistic subsequent context -- where the Mother may confirm and expand the child's utterance, for example.

Data Available for Analysis — Summary

The language samples taken at five age points between 18 and 30 months generated the following quantitative measures:

a) For the Mother Alone:

Percentage number of para-linguistic and unclear utterances.

MLU -- words and syllables.

Rate of speech -- by time, words and syllables.

b) For the Child Alone:

Percentage number of pre-linguistic, para-linguistic and unclear utterances.

MLU -- words and syllables.

Rate of speech -- by time, words and syllables.

Upper bound -- words and syllables.

Type Token Ratio.

c) Mother-Child Ratios:

For MLU and rate of speech measures.

The language sample obtained at 30 months generated the following qualitative measure for the child alone:

d) Morphemic Analysis:

Copula and Auxilliary forms of the verb 'to be'.

Present Progressive.

The definite and indefinite Articles.

Plural inflection.

e) Reynell Language Scales:

The Reynell Developmental Language Scales (1969) -- entailing an expressive and a comprehension subscale -- were administered at 18, 24 and 30 months. Scores were available for comparison with the measures obtained from the spontaneous language samples.

RESULTS

The Child's Language

These analyses were directed to clarifying the nature of the language used by the children. The question of primary interest was whether the high risk infants differed from the comparison infants on the selected parameters of linguistic performance, and whether that performance changed with the age of the child. It was also of interest to determine whether the sex and social class of the child bore any relation to that linguistic performance.

Of secondary concern was the correlation between the various linguistic measures, that is, between the quantitative, morphemic, and Reynell scores.

The Quantitative Measures

1. High Risk Versus Comparison — Main Effects: The ANOVA (group X age) test for significant differences between the high risk and comparison group means showed no main effects ($p > .05$) for the rate of speech measures, that is, the number of utterances per minute ($p < .63$) (table VII ; figure 2), and the number of words per minutes ($p < .42$) (table X ; figure 3), and the number of syllables per minutes ($p < .34$) (table: XI ; figure 4).

The ANOVA (group X age) results for the mean length of utterance (MLU) measures showed no significant main effect for MLU words ($p < .07$) (table XIV ; figure 5), but a significant main effect for MLU syllables ($p < .03$) (table XV ; figure 5).

The percentage number of different utterances did not reach conventional levels of significance ($p < .08$) (table XXI ; figure 8).

The upper bound measures showed significant main effects for both words ($p < .02$) (table XVIII; figure 6), and syllables ($p < .02$) (table XIX ; figure 7).

2. <u>Age Effects</u>: All the measures showed significant age effects. This was the case for the rate of speech measures (utterances per minute, words per minute, syllables per minute), MLU syllables, and for the upper bound measures (words and syllables), significant at $p < .002$ level. MLU words and the percentage number of different utterances were significant at .01 level.

Post ANØVA multiple comparison analyses (Scheffé) for the rate of speech measures showed the following significant ($p < .05$) comparisons -- the means at 30 months differed from those at 18, 21 and 24 months, and in the case of syllables per minutes from the mean at 27 months also. The means at 27 months differed from those at 18 months, and for the words and syllables per minute from 21 months also.

The Scheffé procedure showed that the MLU means at 30 months differed from those at 18 months.

For the upper bound measures, age levels 27 and 30 months differed significantly from those at 18 months, while the means at 30 months differed from those at 21 and 24 months.

The Scheffé analyses did not generate any significant comparisons for the number of different utterances measure.

3. <u>Interactive Effects — Group X Age</u>: None of the quantitative measures showed significant group X age interactive effects ($p > .05$).

This was the case for the rate of speech measures; the number of utterances per minute ($p < .48$) (table VII), the number of words per minute ($p < .90$) (table X), and the number of syllables per minute ($p < .88$) (table XI).

The significance levels for the group X age interactive effects for the MLU measures were MLU words ($p < .81$) (table XIV) and MLU syllables ($p < .53$) (table XV).

The upper bound measures showed no significant interactive effects, that is, for upper bound words ($p < .53$) (table XVIII) and upper bound syllables ($p < .54$) (table XIX).

The percentage number of different utterances showed no significant interactive effects ($p < .41$) (table XX).

Table VI

Rate of Speech Summary Statistics
Utterances per Minute
Child

	Months 18	21	24	27	30
High Risk					
Mean	4.63	6.95	7.62	9.21	13.43
S.D.	3.13	3.01	3.66	3.98	2.73
Comparison					
Mean	6.14	7.73	8.19	10.28	11.17
S.D.	3.20	3.99	5.93	3.52	1.62

Table VII

Rate of Speech Summary ANOVA
Utterances per Minute
Child

Source	df	SS	MS	F	p
Group (G)	1	3.19	3.19	0.24	.63
Age (A)	4	566.05	141.51	10.62	.001
G X A	4	46.82	11.70	0.88	.48
Residual	99	1319.69	13.33		
Total	108	1939.86	17.96		

Table VIII

Rate of Speech Summary Statistics
Words per Minute
Child

Group	Months 18	21	24	27	30
High Risk					
Mean	4.13	7.55	10.86	14.88	23.74
S.D.	5.30	5.78	8.81	8.82	9.69
Comparison					
Mean	4.20	8.65	11.31	19.19	24.27
S.D.	3.73	7.70	8.51	11.38	6.79

Table IX

Rate of Speech Summary Statistics
Syllables per Minute
Child

Group	Months 18	21	24	27	30
High Risk					
Mean	4.63	9.08	12.39	16.48	27.97
S.D.	5.97	6.78	8.68	9.19	10.15
Comparison					
Mean	4.44	9.64	13.52	21.69	28.57
S.D.	4.40	7.81	9.68	12.42	8.14

Table X

Rate of Speech Summary ANOVA
Words per Minute
Child

Source	df	SS	MS	F	p
Group (G)	1	42.52	42.52	0.65	.42
Age (A)	4	4821.07	1205.27	18.51	.001
G X A	4	67.74	16.94	0.26	.90
Residual	94	6120.11	65.11		
Total	103	11041.23	107.20		

Table XI

Rate of Speech Summary ANOVA
Syllables per Minute
Child

Source	df	SS	MS	F	p
Group (G)	1	70.35	70.35	0.93	.34
Age (A)	4	6626.32	1656.58	21.81	.001
G X A	4	90.62	22.66	0.30	.88
Residual	94	7140.02	75.96		
Total	103	13912.95	135.08		

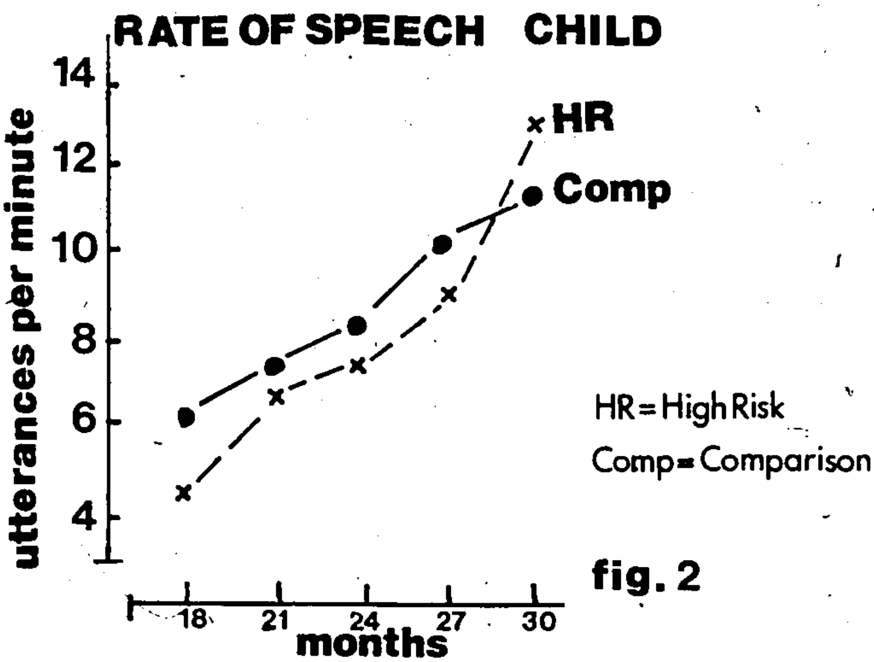


fig. 2

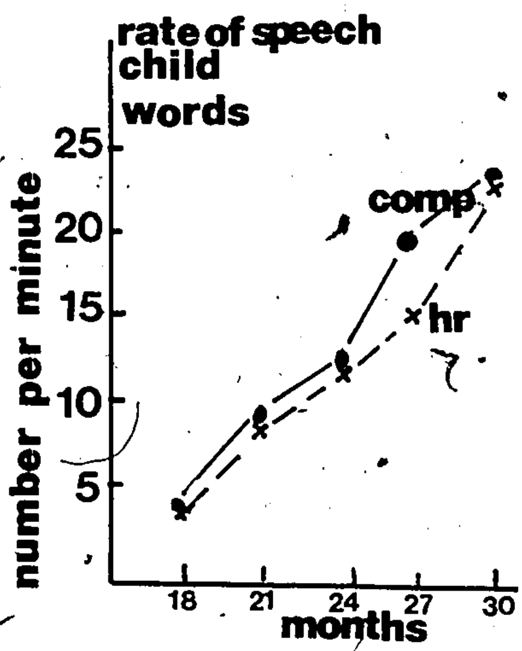


fig. 3

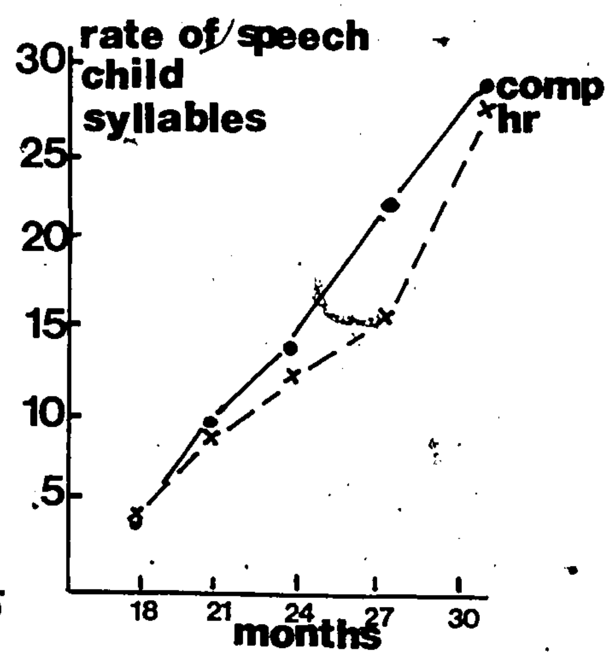


fig. 4

Table XII

Mean Length of Utterance Summary Statistics
Words
Child

Group	Months 18	21	24	27	30
High Risk					
Mean	1.59	1.68	1.77	2.05	2.13
S.D.	0.54	0.40	0.75	0.66	0.98
Comparison					
Mean	1.45	1.72	2.18	2.40	2.51
S.D.	0.32	0.43	0.79	0.82	0.42

Table XIII

Mean Length of Utterance Summary Statistics
Syllables
Child

Group	Months 18	21	24	27	30
High Risk					
Mean	1.75	2.10	2.05	2.28	2.49
S.D.	0.64	0.47	0.68	0.67	0.94
Comparison					
Mean	1.78	1.94	2.59	2.73	2.95
S.D.	0.33	0.38	0.70	0.88	0.51

Table XIV

Mean Length of Utterance Summary ANOVA
Words
Child

Source	df	SS	MS	F	p
Group (G)	1	1.55	1.55	3.36	.07
Age (A)	4	7.19	1.80	3.90	.01
G X A	4	0.73	0.18	0.40	.81
Residual	75	34.55	0.46		
Total	84	43.82	0.52		

Table XV

Mean Length of Utterance Summary ANOVA
Syllables
Child

Source	df	SS	MS	F	p
Group (G)	1	2.20	2.20	4.82	.03
Age (A)	4	8.50	2.13	4.65	.002
G X A	4	1.47	0.37	0.80	.53
Residual	75	34.29	0.46		
Total	84	46.17	0.55		

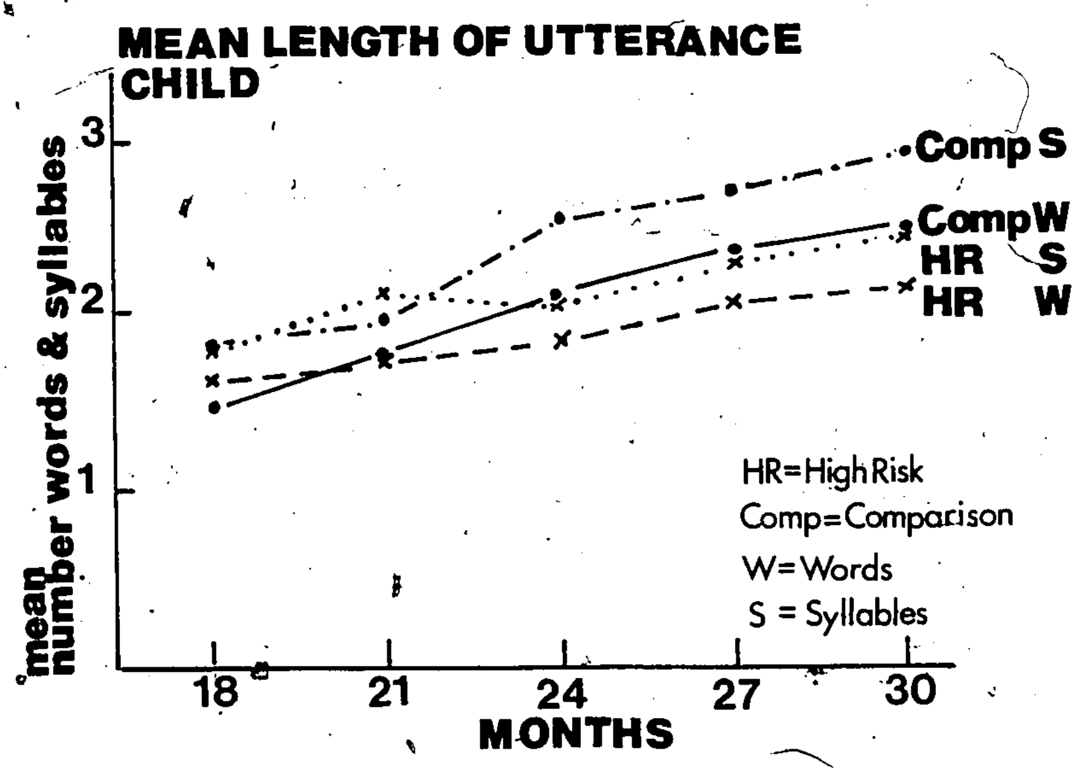

MEAN LENGTH OF UTTERANCE
CHILD
mean number words & syllables
3
2
1
Comp S
Comp W
HR S
HR W
HR=High Risk
Comp=Comparison
W=Words
S = Syllables
18
21
24
27
30
MONTHS

FIG. 5

Table XVI

Upper Bound Summary Statistics
Words
Child

Group	Months 18	21	24	27	30
High Risk					
Mean	2.88	4.50	4.27	5.64	6.90
S.D.	2.30	2.22	2.05	2.42	2.81
Comparison					
Mean	3.78	4.50	5.45	7.00	9.73
S.D.	1.99	2.65	2.70	3.32	3.12

Table XVII

Upper Bound Summary Statistics
Syllables
Child

Group	Months 18	21	24	27	30
High Risk					
Mean	3.38	4.90	4.18	6.82	7.90
S.D.	2.45	2.33	1.94	2.93	2.73
Comparison					
Mean	4.11	5.17	6.00	7.64	10.91
S.D.	2.15	2.95	2.57	3.93	3.51

Table XVIII

Upper Bound Summary ANOVA
Words
Child

Source	df	SS	MS	F	p
Group (G)	1	41.07	41.07	5.97	.02
Age (A)	4	299.87	74.97	10.90	.001
G X A	4	22.16	5.54	0.81	.53
Residual	94	646.46	6.88		
Total	103	1007.65	9.78		

Table XIX

Upper Bound Summary ANOVA
Syllables
Child

Source	df	SS	MS	F	p
Group (G)	1	46.80	46.80	5.81	.02
Age (A)	4	407.85	101.96	12.66	.001
G X A	4	25.18	6.29	0.78	.54
Residual	94	756.95	8.05		
Total	103	1234.76	11.99		

Table XX

Percentage of Different Utterances
Summary Statistics
Child

Group	Months 18	21	24	27	30
High Risk					
Mean	63.17	64.19	59.42	70.80	70.91
S.D.	20.39	19.59	14.50	12.01	11.17
Comparison					
Mean	59.84	61.48	72.20	74.36	81.27
S.D.	14.31	13.80	15.60	15.68	7.07

Table XXI

Percentage of Different Utterances
Summary ANOVA

Source	df	SS	MS	F	p
Group (G)	1	649.77	649.77	3.25	.08
Age (A)	4	2813.48	703.37	3.52	.01
G X A	4	800.00	200.23	1.00	.41
Residual	75	14995.86	199.95		
Total	84	19232.09	228.95		

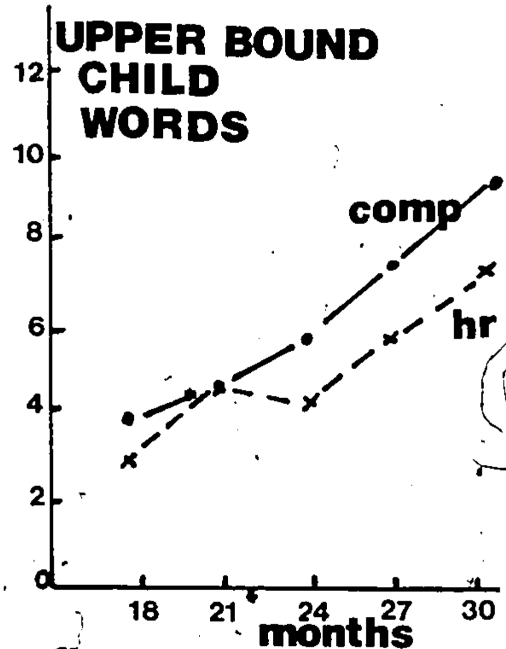


fig. 6

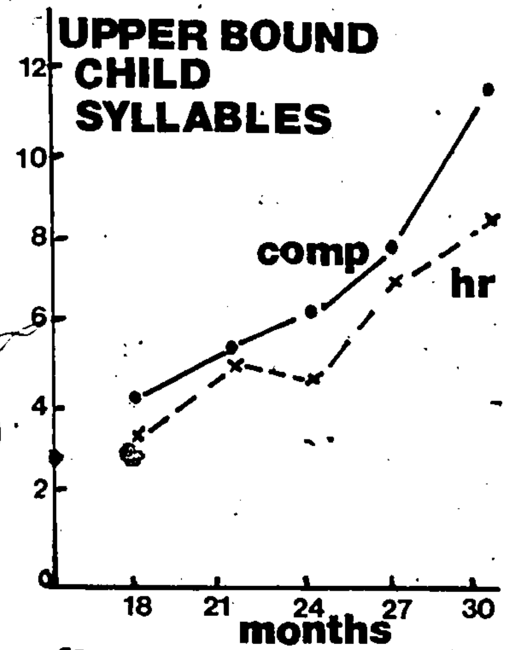
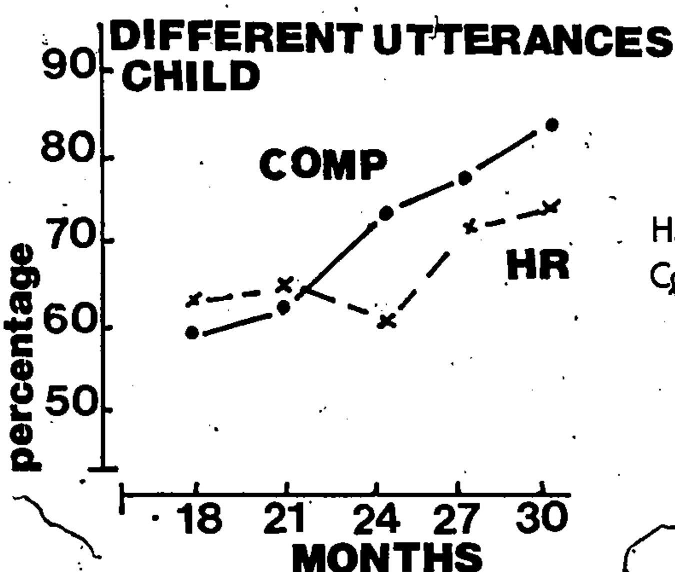


fig. 7



HR=High Risk:
Comp=Comparison

fig. 8

4. <u>Quantitative Measures — Summary Statement:</u>[1] The rate of speech, the percentage number of different utterances and MLU words measure did not show significant between group differences (p < .05).

Significant differences were found for the MLU syllables and upper bound measures, with the comparison group means generally higher than those of the high risk groups, this being particularly the case after 24 months.

All the measures had significant age related effects; the means at 27 and 30 months generally differed from those at 18 and 21 months.

There were no significant interactive effects.

Intelligible Utterances

Table XXII and figure 9 summarise the percentage number of intelligible utterances for the high risk and comparison groups at each age level.

The number, calculated as a percentage of the total number of utterances (which also includes pre-linguistic,

---

[1] Note that not all children were represented at every data point since some did not met the minimum criteria set for inclusion.

For example, the MLU measure was calculated only if the number of intelligible utterances was greater than or equal to twenty, whereas only one utterance was required to determine an upper bound measure.

These requirements for the calculation of the quantitative measures accounted for the differing degrees of freedom in the calculation of the ANOVA F ratios.

para-linguistic and unclear utterances), showed a steady increase with age, rising from 39.72% to 84.56% for th- high risk group and from 46.17% to 85.13% for the comparison group.

1. Pre-linguistic, Para-linguistic and Unclear Utterances: The difference between the total number of utterances and the percentage number of intelligible utterances was accounted for by the number of pre-linguistic, para-linguistic and unclear utterances, (table **XXIII**, figure 10).

The percentage number of unclear utterances ranged from 2.92% to 8.56% of the total number of utterances.

The percentage number of pre-linguistic utterances diminished over age from 51.70% to 4.88% for the high risk group, and from 44.89% to 3.99% for the comparison group.

The percentage number of para-linguistic utterances was fairly constant over age, ranging from 2.18% to 6.02% of the total number of utterances.

Sex of the Child and Linguistic Performance

To address the question of whether female and male children scored similarly on the linguistic measures, t tests were used to determine differences between the sample means at each age level.

None of the quantitative measures showed significant ($p > .05$) differences between female and male linguistic

Table XXII

Intelligible Utterances Summary Statistics

Child

Group	Months 18	21	24	27	30
High Risk					
%	39.72	57.25	69.56	78.47	84.56
Comparison					
%	46.17	66.67	68.00	72.69	85.13

Table XXIII

Pre-linguistic, Para-linguistic & Unclear Utterances

Summary Statistics

Child

Group	Months 18	21	24	27	30
High Risk					
Unclear %	3.39	5.10	8.56	6.35	6.40
Pre-Ling. %	51.70	33.33	17.13	13.00	4.88
Para-ling. %	5.19	4.31	4.76	2.18	4.16
Comparison					
Unclear %	2.92	3.62	6.51	7.30	5.86
Pre-ling. %	44.89	24.67	12.11	15.66	3.99
Para-ling. %	6.02	5.04	4.11	4.36	5.01

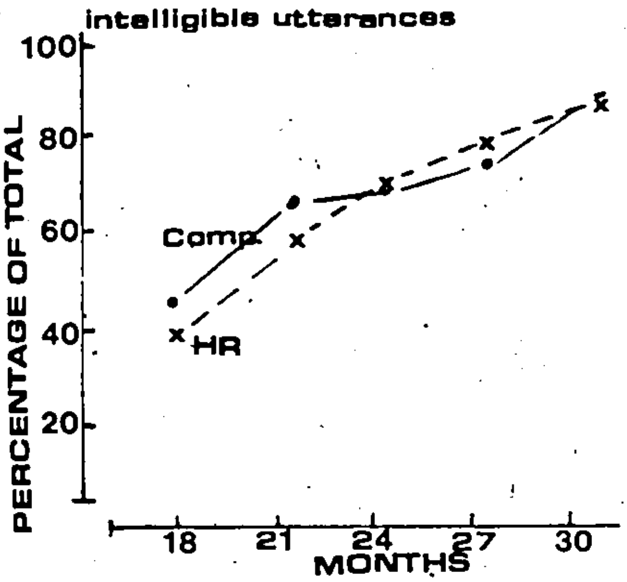


FIG. 9

HR=High Risk
Comp=Comparison

pre-ling=pre-linguistic
para-ling=para-linguistic

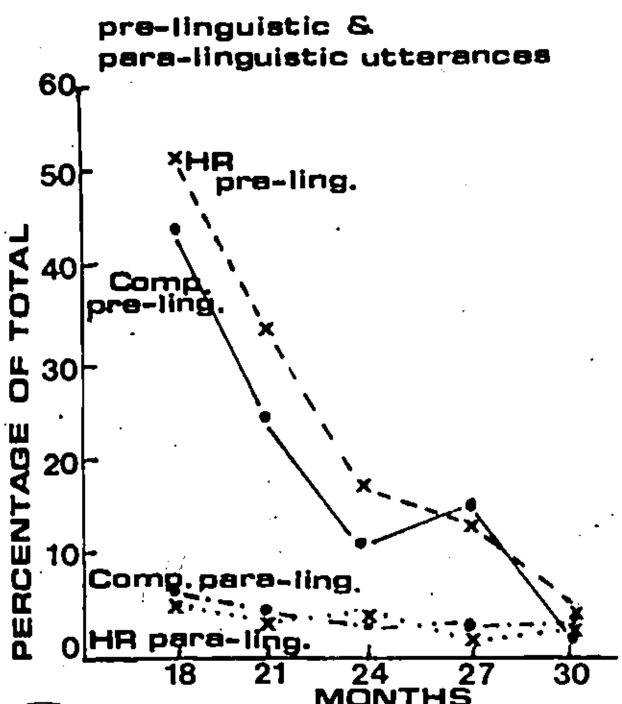


FIG. 10

performance. This was the case for the rate of speech measures (utterances per minute, words per minute and syllables per minute), MLU measures (words and syllables), upper bound measures (words and syllables) and for the percentage number of different utterances.

Tables XXIV ff give the summary statistics.

Social Class and Linguistic Performance.

To determine whether social class bore any relationship to the manner in which the children performed, a post-ANOVA, non-parametric procedure -- the Mann Whitney U -- was applied to the data which were collapsed and dichotomised into two social class groups, 1/2 and 3/4/5, based on the Hollingshead Scales. The Mann Whitney U was chosen because of the unequal sample sizes, there being 4 children in social class 1/2 and 20 in class 3/4/5.

None of the quantitative measures showed significant ($p > .05$) differences between those children in social class 1/2 and those in social class 3/4/5. This was the case for the rate of speech measures (utterances per minute, words per minute and syllables per minute), MLU measures (words and syllables), upper bound measures (words and syllables) and for the percentage number of different utterances.

Tables XXXII ffgive the summary statistics.

Table XXIV

Rate of Speech Summary Statistics
Utterances per Minute
Child

Group	Months 18	21	24	27	30
Male					
Mean	4.78	6.53	6.51	9.55	12.45
S.D.	3.03	2.62	2.83	3.70	2.26
Female					
Mean	6.10	8.26	9.68	9.98	11.97
S.D.	3.42	4.20	6.21	3.90	2.79

Table XXV

Rate of Speech Summary Statistics
Words per Minute
Child

	Months				
Group	18	21	24	27	30
Male					
Mean	3.81	7.20	9.39	15.31	23.60
S.D.	5.20	6.41	7.86	7.01	8.50
Female					
Mean	3.19	8.45	12.21	19.11	24.58
S.D.	2.67	7.48	9.60	13.15	7.96

Table XXVI

Rate of Speech Summary Statistics
Syllables per Minute
Child

	Months				
Group	18	21	24	27	30
Male					
Mean	4.34	8.58	11.29	17.49	27.47
S.D.	5.79	7.19	8.25	7.59	9.29
Female					
Mean	3.78	9.68	13.83	21.00	29.39
S.D.	3.25	7.39	10.56	14.28	8.82

Table XXVII

Mean Length of Utterance Summary Statistics
Words
Child

Group	18	21	24	27	30
			Months		
Male					
Mean	1.59	1.74	1.96	2.13	2.19
S.D.	0.45	0.47	0.36	0.67	0.59
Female					
Mean	1.25	1.58	1.81	2.46	2.51
S.D.	1.12	0.37	0.66	0.83	0.92

Table XXVIII

Mean Length of Utterance Summary Statistics
Syllables
Child

Group	18	21	24	27	30
			Months		
Male					
Mean	1.85	2.03	2.36	2.36	2.55
S.D.	0.52	0.46	0.77	0.73	0.61
Female					
Mean	1.46	1.91	2.07	2.72	2.98
S.D.	1.21	0.40	0.70	0.88	0.92

Table XXIX

Upper Bound Summary Statistics
Words
Child

Group	18	21	24	27	30
	Months				
Male					
Mean	3.25	4.46	4.69	5.77	8.00
S.D.	2.80	2.93	2.43	1.83	3.46
Female					
Mean	2.25	4.00	4.60	7.10	8.89
S.D.	1.16	1.95	2.88	3.84	3.14

Table XXX

Upper Bound Summary Statistics
Syllables
Child

Group	18	21	24	27	30
	Months				
Male					
Mean	3.67	4.83	5.08	6.58	8.75
S.D.	3.06	3.04	2.60	2.50	3.82
Female					
Mean	2.50	4.82	4.60	8.00	10.56
S.D.	1.07	2.60	2.67	4.27	2.88

Table XXXI

Percentage of Different Utterances Summary Statistics
Child

Group	18	21	24	27	30
	Months				
Male					
Mean	66.37	69.70	67.13	71.16	76.54
S.D.	15.52	9.07	16.56	14.71	10.28
Female					
Mean	54.17	58.41	63.63	74.67	76.06
S.D.	13.95	19.32	16.15	13.56	11.30

Table XXXII

Rate of Speech Summary Statistics
Utterances per Minute
Child

Group	Months 18	21	24	27	30
S.E.S. 1/2					
Mean	6.10	8.50	6.65	7.90	9.46
S.D.	4.01	3.93	3.46	3.81	0.35
S.E.S. 3/4/5					
Mean	5.11	6.81	8.15	10.15	12.61
S.D.	3.05	3.76	5.04	3.66	2.57

Table XXXIII

Rate of Speech Summary Statistics
Words per Minute
Child

Group	Months 18	21	24	27	30
S E S 1,2					
Mean	5.13	9.63	11.05	17.43	20.66
S.D.	5.15	4.85	8.50	12.07	7.81
S E S 3,4,5					
Mean	3.17	7.41	10.51	16.95	24.81
S.D.	4.15	7.21	8.80	10.11	8.17

Table XXXIV

Rate of Speech Summary Statistics
Syllables per Minute
Child

Group	Months 18	21	24	27	30
S E S 1,2					
Mean	5.80	11.95	13.95	19.88	24.56
S.D.	5.32	5.13	9.93	13.40	8.47
S E S 3,4,5					
Mean	3.69	8.36	12.06	18.91	29.17
S.D.	4.80	7.63	9.27	10.83	9.04

Table XXXV

Mean Length of Utterance Summary Statistics
Words
Child

Group	18	21	24	27	30
			Months		
S E S 1,2					
Mean	1.50	1.59	2.38	2.86	2.17
S.D.	0.46	0.44	0.81	0.68	0.60
S E S 3,4,5					
Mean	1.41	1.67	1.82	2.13	2.36
S.D.	0.37	0.41	0.76	0.73	0.79

Table XXXVI

Mean Length of Utterance Summary Statistics
Syllables
Child

Group	18	21	24	27	30
			Months		
S E S 1,2					
Mean	1.81	2.11	2.98	3.27	2.59
S.D.	0.48	0.50	0.63	0.69	0.62
S E S 3,4,5					
Mean	1.62	1.94	2.11	2.39	2.77
S.D.	0.45	0.41	0.69	0.76	0.81

Table XXXVII

Upper Bound Summary Statistics
Words
Child

Group	18	21	24	27	30
	Months				
S E S 1,2					
Mean	3.75	3.75	5.25	7.00	10.00
S.D.	3.50	2.06	4.27	4.69	4.24
S E S 3,4,5					
Mean	2.63	4.42	4.53	6.17	8.00
S.D.	2.00	2.65	2.22	2.55	3.04

Table XXXVIII

Upper Bound Summary Statistics
Syllables
Child

Group	18	21	24	27	30
	Months				
S E S 1,2					
Mean	4.50	5.00	6.25	8.25	11.50
S.D.	3.87	1.83	4.50	5.12	3.87
S E S 3,4,5					
Mean	2.88	4.79	4.61	7.00	9.00
S.D.	2.06	2.97	2.12	3.07	3.28

Table XXXIX

Percentage of Different Utterances Summary Statistics
Child

Group	18	21	24	27	30
			Months		
S.E.S. 1,2					
Mean	50.59	58.01	84.24	84.02	77.94
S.D.	8.15	19.31	7.40	7.63	15.00
S.E.S 3,4,5					
Mean	66.13	64.71	62.00	70.77	75.96
S.D.	15.89	16.14	14.73	14.04	9.67

Quantitative Scores: Correction for Prematurity

The collection of language samples at three monthly intervals allowed the determination of an approximate correction for prematurity on certain of the quantitative linguistic measures.

Scores from the 21 month old high risk premature language corpora were matched for statistical purposes with those of the 18 month old comparison group, and so on, giving four age comparisons for the corrected score. It is noted, however, that this procedure over-corrects for prematurity since the range of weeks post gestation for the high risk premature infants was 26 to 35 (mean 31.2), (excluding two high risk infants not designated as premature). Consequently, in the majority of cases the language scores should have been adjusted for only one or two and a half months prematurity, but the data werenot collected within these intervals. However, since the results show that the high risk premature infants "catch-up" to their comparison group counterparts using the three monthly adjustment, it can be concluded that this result also holds for corrections of less than three months.

Those language measures showing between group differences with a significance level of $p < .10$ were corrected for prematurity. These were the MLU, percentage number of different utterances and upper bound measures. ANOVA (group x age) tests for significant differences between the corrected high risk and comparison groups were carried out, with the following results.

As with the uncorrected scores all the measures showed significant age related effects ($p < .05$) and no interactive effects ($p > .05$). Of primary interest however, was the between group effects, which unlike the uncorrected scores showed no significant differences, ($p > .05$). This was the case for MLU words ($F_{1,75} = .07$; $p < .80$), MLU syllables ($F_{1,75} = .19$; $p < .67$), the number of different utterances ($F_{1,75} = .17$; $p < .69$) and upper bound words ($F_{1,83} = .05$; $p < .83$) and syllables ($F_{1,83} = .10$; $p < .76$).

Thus, when a generous correction for prematurity is calculated, observed differences between the high risk and comparison group children's language performance as measured by MLU, upper bound and the number of different utterances in the corpora disappear.

<u>The Child's Language: Qualitative (Morphemic) Measures</u>

While the previous quantitative analyses attributed equal value to all grammatical forms, the qualitative analyses were undertaken to specify the modulation of meaning through morphemic development.

As discussed in the method section (page 148) five morphemes -- the copula and auxilliary forms of the verb "to be", the present progressive, the definite and indefinite articles and the plural form -- were chosen for investigation.

To test for high risk and comparison group similarities in the application of these morphemes in the 30 month corpora, it was necessary first to identify clear-cut obligatory contexts where the morpheme was both grammatically and contextually demanded. Table XL gives the summary statistics with the numbers above indicating the number of obligatory contexts noted for the particular morpheme, and the succeeding number indicating the percentage number of times the morpheme was correctly supplied. Note that only those corpora containing five or more obligatory contexts for the specified morpheme were included for data anlysis. This restriction accounts for the differing degrees of freedom associated with the t statistic used to determine differences between group means, as now reported.

Determination of the t statistic to measure the significance of differences between the group means for the specified morphemes indicated the following results. Four of the morpheme forms did not reach significance, ($p > .05$); this was the case for the copula ($t_{18} = 1.36$), the auxilliary forms ($t_5 = 1.82$), the present progressive ($t_{13} = 0.13$) and the plural form ($t_{11} = 1.01$).

Table XL

Obligatory Morphemes in 30 Month Corpora
Summary Statistics

Group	Copulas	Auxiliaries	Present Progressive	Articles	Plural	Summed Morphemes
High Risk						
Number Obligatory Contexts	173	62	99	267	56	657
Percentage Supplied	63.58	74.19	87.88	25.09	78.57	54.34
Comparison						
Number Obligatory Contexts	189	32	75	393	88	777
Percentage Supplied	70.90	78.13	84.00	56.49	92.05	67.70
Total						
Percentage Supplied	67.40	64.23	83.70	43.94	85.12	60.00

The group differences for the articles and summed morphemes, while not reaching conventional levels of significance, were significant at $p < .10$ level, ($t_{19} = 1.84$) and ($t_{19} = 1.87$) respectively.

1. Order of Acquisition: If it can be argued that a child's mastery of a morphemic form is reflected in the percentage number of times the morpheme is supplied in obligatory contexts, then table XL may indicate developmental patterns in the facility of usage. The overall pattern shows that the plural and progressive forms are the most likely to be supplied, followed by the copulas, auxilliaries and articles.

It is further noted that the mastery of these forms is not related to the frequency of their respective obligatory contexts within the corpora, since, for example, there were 660 opportunities for the use of the article forms (the greatest number of obligatory contexts) but these were supplied the least number of times.

Sex of the Child and Morphemic Scores

To address the question of whether the female and male children similarly supplied the specified morphemes in obligatory contexts, the summed morphemic score was used. This score disregards the type of morpheme and gives an overall score for the percentage number of times any of the morphemes were correctly supplied in obligatory contexts.

No significant differences were found between the mean scores for the female and male children ($t_{19} = 0.94$; $p > .05$).

Social Class and Morphemic Scores

The summed morphemic scores were also used to determine whether social class bore any relationship to the facility with which the children supplied obligatory morphemes.

Due to the disparity in numbers (there being only four children in the high social class grouping), the non-parametric Mann Whitney U was applied to the data which was collapsed and dichotomised into two social class groupings 1/2 and 3/4/5, based on the Hollingshead Scales.

No difference was found between the high and low social class groupings in the use of obligatory morphemes ($p > .05$).

Morphemic Measures: Their Correlation with Quantitative Measures

To determine whether the morphemic measures bore a relationship to the quantitative measures, a non-parametric Kendall's Tau — a coefficient of correlation — was used comparing the ranked summed percentage number of morphemes (table XL) supplied in obligatory contexts to those quantitative measures. The summing of morphemes assumes that all morphemes have similar growth curves and maintain roughly the same relative ranking at each stage (Brown, 1973; Cazden, 1968; deVilliers and deVilliers, 1973).

A significant positive correlation was found between the percentage number of morphemes supplied in obligatory contexts and the scores for MLU words (Tau = 0.69; $p < .01$), MLU syllables (Tau = 0.65; $p < .01$), upper bound words (Tau = 0.56; $p < .01$) upper bound syllables (Tau = 0.50; $p < .01$) and for the percentage number of different utterances (Tau = 0.40; $p < .01$).

Thus, those children scoring higher on the quantitative measures were more likely to supply the appropriate morphemes in obligatory contexts.

The Reynell Language Scales

The Reynell Language Scales provide data on the high risk and comparison children's linguistic performance as measured by a standardised procedure. As with those measures derived from the language corpora, the data were analysed to determine group and age effects, as well as the importance of sex and social class factors.

Unless otherwise stated, the raw scores have been converted into standard scores for computation. The standard scores give the deviation from the mean of a particular score at a particular age.

1. <u>Between Group Effects</u>: Tables XLIf and figures 11, 12 give the summary statistics for the standardized scores on the Reynell Language Scales, which were administered at 18, 24 and 30 months of age.

The ANOVA (Group X Age) (table XLIV) test showed significant differences between the high risk and comparison means for the Comprehension sub-scale ($p < .04$). Differences between the means for the Expressive sub-scale did not reach conventional levels of significance, ($p < .07$). For both sub-scales, the comparison group means exceeded those of the high risk group.

2. <u>Age Effects</u>: The conversion of the raw scores into standard form masks age related effects, since while performance on the Reynell may improve over age, scores may still retain the same deviation from the mean at different age levels. Consequently, to measure the significance of the age related effects raw scores were used.

Both the expressive and comprehension sub-scales showed highly significant age related effects ($p < .001$) Post ANOVA multiple comparison analyses (Scheffé) indicated that all age groups differed significantly from one another ($p > .05$).

3. <u>Interactive Effects (Group X Age)</u>: No significant interactive effects were found for either the raw or standardized scores ($p > .05$). This was the case for

Table XLI

Reynell Language Scales Summary Statistics
Expressive
Standard Scores

Group	Months 18	24	30
High Risk			
Mean	-0.64	-0.22	-0.36
S.D.	1.35	1.00	1.36
Comparison			
Mean	-0.03	0.25	0.30
S.D.	1.45	1.31	1.16

Table XLII

Reynell Language Scales Summary Statistics
Comprehension
Standard Scores

Group	Months 18	24	30
High Risk			
Mean	-0.62	0.18	0.19
S.D.	1.25	1.47	1.66
Comparison			
Mean	0.15	0.83	1.33
S.D.	1.75	1.87	1.91

Table XLIII

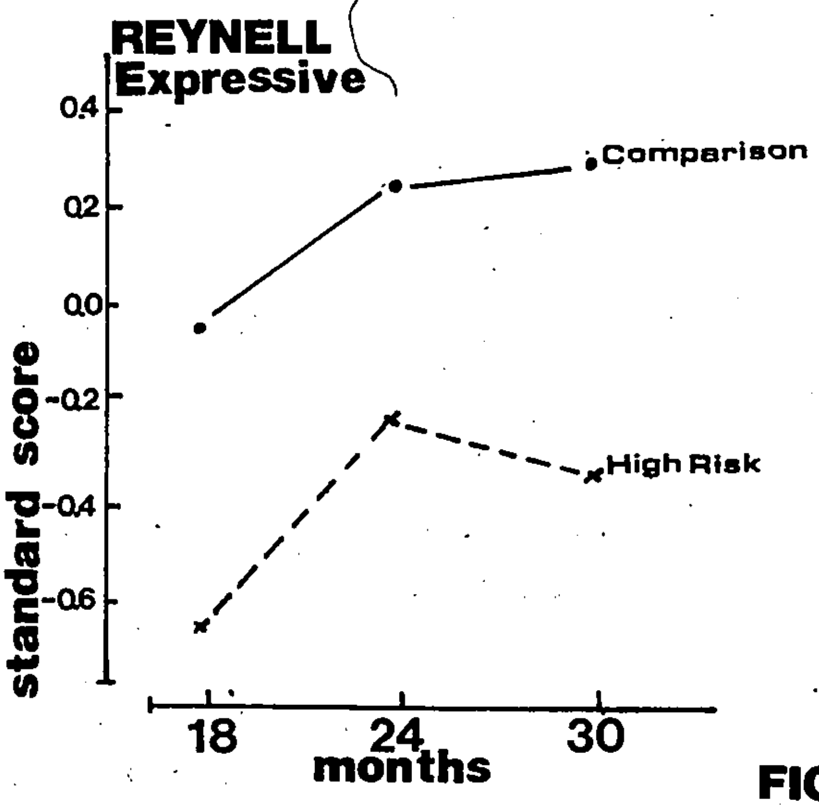
Reynell Language Scales Summary ANOVA
Expressive
Standard Scores

Source	df	SS	MS	F	p
Group (G)	1	5.75	5.75	3.50	.07
Age (A)	2	1.74	.87	.53	.59
G X A	2	.12	.06	.04	.96
Residual	63	103.55	1.64		
Total	68	111.07	1.63		

Table XLIV

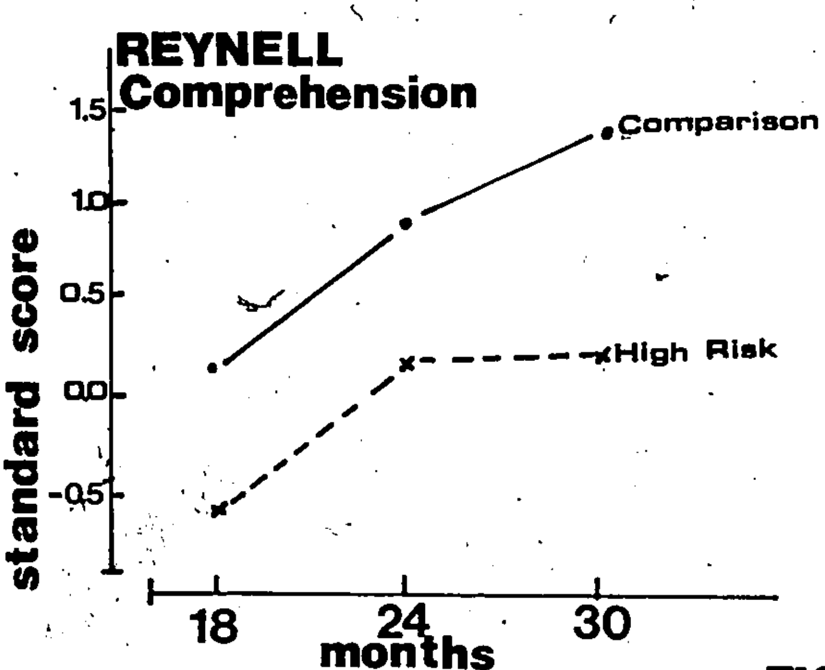
Reynell Language Scales Summary ANOVA
Comprehension
Standard Scores

Source	df	SS	MS	F	p
Group (G)	1	11.79	11.79	4.32	.04
Age (A)	2	12.63	6.32	2.32	.11
G X A	2	.86	.43	.16	.86
Residual	63	171.89	2.73		
Total	68	197.01	2.90		



REYNELL
Expressive
0.4
0.2
0.0
-0.2
-0.4
-0.6
standard score
Comparison
High Risk
18
24
30
months

FIG. 11



REYNELL
Comprehension
1.5
1.0
0.5
0.0
-0.5
standard score
Comparison
High Risk
18
24
30
months

FIG. 12

both the expressive and comprehension sub-scales.

4. Reynell Language Scales — Summary Statement: Significant between groups effects were found for the comprehension sub-scale, with significance levels for the expressive sub-scale not reaching conventional levels.

Both sub-scales had highly significant age related effects.

There were no significant interactive effects.

Sex of the Child and Reynell Language Scales

Tables XLV f give the summary statistics for the female and male children's standard scores on the Reynell Language Scales.

As determined by the t statistic, there were no significant differences between the group means at any age point. This was the case for both the expressive and comprehension subscales, ($p > .05$).

Social Class and the Reynell Language Scales

To address the question of whether social class bore any relationship to the manner in which the children performed on the Reynell Scales, the non-parametric Mann Whitney U was applied to the data which was dichotomised into two social class groupings, 1/2 and 3/4/5 based on the Hollingshead Scales.

Table XLV

Reynell Language Scales Summary Statistics
Expressive
Standard Scores

Group	Months 18	24	30
Male			
Mean	-0.28	0.02	0.17
S.D.	1.60	0.12	1.27
Female			
Mean	-0.40	-0.01	-0.27
S.D.	1.22	1.31	1.31

Table XLVI

Reynell Language Scales Summary Statistics
Comprehension
Standard Scores

Group	Months 18	24	30
Male			
Mean	-0.17	0.53	0.82
S.D.	1.94	1.75	1.82
Female			
Mean	-0.24	0.44	0.69
S.D.	0.98	1.66	1.97

Table XLVII

Reynell Language Scales Summary Statistics
Expressive
Standard Scores

Group	Months 18	24	30
S E S 1/2			
Mean	0.13	0.45	0.08
S.D.	1.65	1.43	2.03
S E S 3/4/5			
Mean	-0.43	-0.09	-0.06
S.D.	1.38	1.12	1.13

Table XLVIII

Reyenell Language Scales Summary Statistics
Comprehension
Standard Scores

Group	Months 18	24	30
S E S 1/2			
Mean	0.05	0.58	1.08
S.D.	2.11	2.31	2.57
S E S 3/4/5			
Mean	-0.29	0.47	0.69
S.D.	1.46	1.59	1.73

Children in social class 1/2 scored similarily to those children in social class 3/4/5 ($p > .05$) at each age-level, on both the raw and standard scores.

Tables XLVII f give the summary statistics.

Reynell Language Scales: Correction for Prematurity

As with the quantitative scores, it was possible to correct the Reynell Language Scales for prematurity.

Since the table of standard scores for the Reynell Scales is divided into two monthly intervals, it was possible to compute the corrected scores within this more appropriate margin. Thus, a premature male child scoring 13 (standard score -0.1) on the expressive component at 18 months of age, would be reassessed as though he were 16 months and given a standard score of 0.9. Barring the two high risk infants not designated premature, all scores were treated thus, and an ANOVA (group x age) performed on the revised data.

In contradistinction to the uncorrected Reynell scores (page 190), the corrected scores did not produce significant between group effects, ($p \leq .05$). The Anova values for the expressive sub-scale were $F_{1,61} = .50$; $p = .48$, and for the comprehension sub-scale, $F_{1,61} = .04$; $p = .85$.

There were no significant age effects. This was the case for the expressive sub-scale ($F_{1,61} = 40$; $p = .68$) and comprehension sub-scale ($F_{1,61} = 1.69$; $p = .19$).

There were no interactive effects — expressive sub-scale ($F_{1,61} = .10$; $p = .91$) and comprehension sub-scale ($F_{1,61} = .23$; $p = .80$).

In summary, when a correction is made for prematurity, observed differences between the high risk and comparison group children's language performance, as measured by the Reynell Language Scales, disappear ($p > .05$).

Reynell Language Scales: Their Correlation with Corpora Measures

To determine whether the scores obtained from the standardised Reynell Language Scales correlated with the quantitative and morphemic measures obtained from the language corporas, a non-parametric Kendall's Tau — a coefficient of correlation — was applied to the ranked scores from the expressive sub-scale.

Results indicated that MLU words correlated with the expressive scores at 18, 24 and 30 months ($p < .02$; $p < .02$; $p < .01$, respectively). Corresponding significance levels for the MLU syllables were $p < .10$; $p < .05$, and $p < .01$.

The upper bound measure correlated significantly with the expressive scores ($p < .01$) for all age points.

Table XLIX

Reynell Expressive Score
Correlation With Language Measures

	Months 18	24	30
Reynell:MLU Words			
Tau	.61	.38	.60
p	.02	.02	.01
Reynell: MLU Syllables			
Tau	.43	.31	.60
p	.10	.05	.01
Reynell:Upper Bound Words			
Tau	.66	.62	.62
p	.01	.01	.01
Reynell: Upper Bound Syllables			
Tau	.68	.54	.53
p	.01	.01	.01
Reynell:Different Utterances			
Tau	.37	.38	.43
p	.20	.02	.01
Reynell:Morphemes			
Tau			.79
p			.001

The percentage number of different utterances correlated significantly with the expressive scores at 24 ($p < .02$) and 30 months ($p < .01$).

Table (XLIX) summarises the Tau coefficients and significance levels for the above measures. Note that not all children were represented at every data point since some did not meet the minimum criteria set for inclusion (for example, the MLU was calculated only if the number of intelligible utterances was greater than or equal to twenty, whereas an upper bound measure could be based on one or two utterances). These inclusion criteria account for the differing "n" values in the calculation of the significance values for the Tau coefficient.

Finally, scores on the Reynell Expressive sub-scale were highly correlated ($p < .001$) with the summed percentage number of morphemes (table XL) supplied in obligatory contexts in the 30 month corpora.

<u>The Child's Language: Summary Statement</u>

1. <u>High Risk Versus Comparison — Main Effects</u>: For the quantitative measures, significant between group differences (reported here as $p < .05$) were found for MLU syllables and upper bound measures, with MLU words and the percentage number of different utterances not reaching conventional levels of significance. For the significant effects, the

comparison means were generally higher than those of the high risk group.

There were no significant between group differences in the application of specific morphemic forms in the 30 month corpora.

The standardised Reynell scales generated a significant between groups difference for the comprehension sub-scale, with the expressive sub-scale results again not reaching conventional levels of significance.

2. <u>High Risk Versus Comparison — Age Effects</u>: All the quantitative measures showed significant age related effects, with the means at 27 and 30 months generally differing from those at 18 months.

Both the expressive and comprehension sub-scales of the Reynell Scales showed highly significant age related effects, with all age groups differing from each other.

3. <u>High Risk Versus Comparison — Interactive Effects</u>: Neither the quantitative measures nor results from the Reynell Scales showed significant interactive effects.

Sex of the Child and Linguistic Performance

None of the quantitative measures showed significant differences between female and male linguistic performance. This conclusion also holds for the application of morphemes in the 30 months corpora, and for results on the Reynell Language Scales.

Social Class and Linguistic Performance

None of the quantitative measures showed significant differences between those children in social class 1/2 (Hollingshead Scales) and those in social class 3/4/5. The finding of no significant differences holds also for morphemic scores, and those obtained on the Reynell Scales.

Correction for Prematurity

Both the quantitative scores from the language corpora and those derived from the Reynell Language Scales allowed the determination of an approximate correction for prematurity.

A reanalysis of those quantitative scores giving significant between group differences, using corrected scores for premature high risk children, resulted in those differences disappearing, i.e., not attaining statistical significance.

When a correction for prematurity is made for Reynell scores, observed differences similarly disappear.

The Inter-Correlation of Quantitative, Morphemic and Reynell Scores

Significant positive correlations were found between the quantitative measures (MLU, upper bound and the percentage number of difference utterances) and the percentage number of morphemes supplied in obligatory contexts. Children scoring higher on the quantitative measures were more likely to supply the appropriate morphemes in obligatory contexts.

These quantitative measures similarly were positively correlated with results from the Reynell Expressive Scale — a correlation holding at all age points.

Finally, scores on the Reynell Expressive sub-scale were highly correlated with the summed percentage number of morphemes supplied in obligatory contexts in the 30 month corpora.

The Mother's Language

These analyses were directed to clarifying the nature of the language used by the mothers of the high risk and comparison children. Of primary interest was the question of whether the mothers of the high risk children differed from those of the comparison infants on the selected parameters of linguistic performance, and whether performance changed with the age of the child.

It was also of interest to determine whether the sex of the child and social class of the family bore any relation to the mother's linguistic output.

The Quantitative Measures

1. High Risk Versus Comparison — Main Effects: The ANOVA (group x age) test showed no significant between group effects, ($p > .05$).

This was the case for the rate of speech measures, that is, the number of utterances per minute ($p < .42$) (table LI ; figure 13), the number of words per minutes ($p < .09$) (table LIV ; figure 14), the number of syllables per minute ($p < .11$) (table LV; figure 14) and for the mean length of utterance (MLU) words ($p < .14$) (table LVIII; figure 15) and syllables ($p < .16$) (table LIX ; figure 15).

2. Age Effects: While the MLU measures did not yield significant age effects (words, $p < .29$; syllables, $p < .36$), the rate of speech measures did.

The number of utterances per minute, the number of words per minute and the number of syllables per minute had highly significant age related effects, ($p. < .001$).

Table L

Rate of Speech Summary Statistics
Utterances per Minute
Mother

Group	Months 18	21	24	27	30
High Risk					
Mean	10.49	9.95	10.76	10.43	16.00
S.D.	3.49	3.72	4.07	3.41	2.34
Comparison					
Mean	11.74	11.23	11.88	10.78	14.92
S.D.	1.88	4.27	5.18	3.70	2.37

Table LI

Rate of Speech Summary ANOVA
Utterances per Minute
Mother

Source	df	SS	MS	F	p
Group (G)	1	8.67	8.67	0.67	.42
Age (A)	4	352.91	88.23	6.82	.001
G X A	4	21.05	5.26	0.41	.80
Residual	99	1229.45	12.42		
Total	108	1615.07			

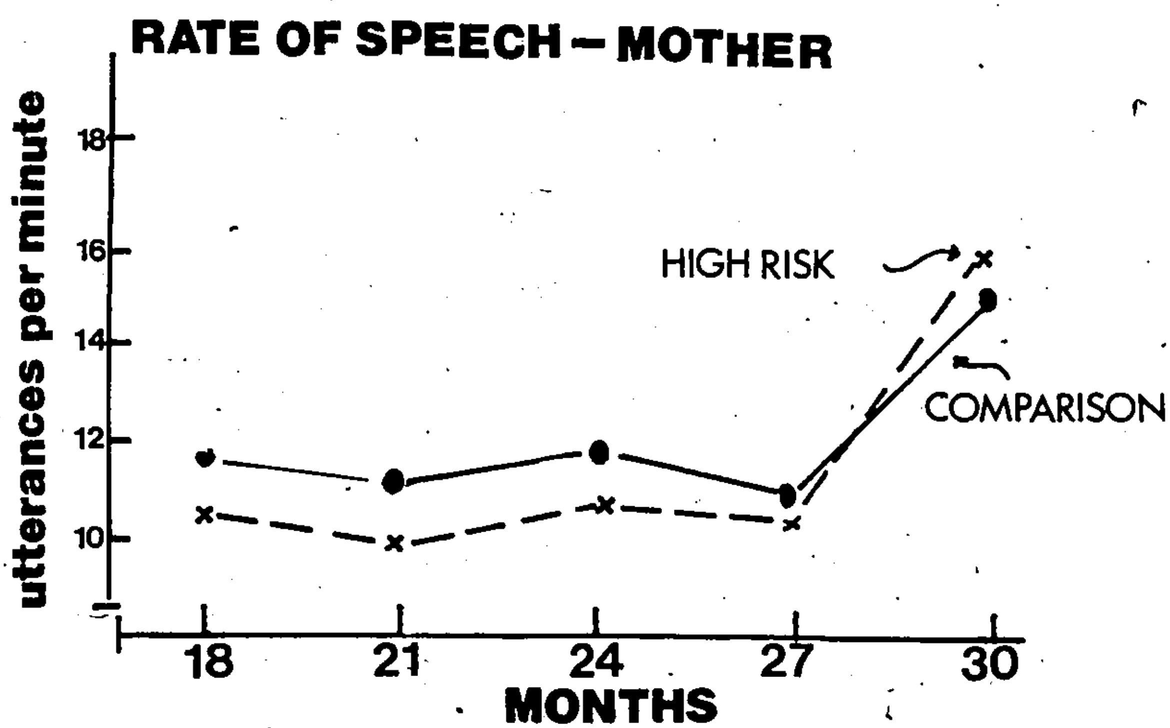

RATE OF SPEECH – MOTHER
utterances per minute
18
16
14
12
10
HIGH RISK
COMPARISON
18
21
24
27
30
MONTHS

FIG. 13

Table LII

Rate of Speech Summary Statistics
Words per Minute
Mother

Group	Months 18	21	24	27	30
High Risk					
Mean	43.15	38.15	43.31	43.29	71.28
S.D.	15.95	21.87	24.05	16.18	20.14
Comparison					
Mean	52.40	47.67	51.24	48.65	75.10
S.D.	13.39	20.38	22.20	23.88	24.13

Table LIII

Rate of Speech Summary Statistics
Syllables per Minute
Mother

Group	Months 18	21	24	27	30
High Risk					
Mean	47.87	~~41.50~~	46.65	46.38	75.90
S.D.	18.13	23.35	25.87	17.06	22.34
Comparison					
Mean	57.61	50.75	55.03	52.07	81.54
S.D.	16.31	20.86	23.49	25.85	27.79

Table LIV

Rate of Speech Summary ANOVA
Words per Minute
Mother

Source	df	SS	MS	F	p
Group (G)	1	1224.37	1224.37	2.93	.09
Age (A)	4	11974.76	2993.29	7.17	.001
G X A	4	193.81	48.45	.12	.98
Residual	99	39675.65	400.76		
Total	108	53272.38			

Table LV

Rate of Speech Summary ANOVA
Syllables per Minute
Mother

Source	df	SS	MS	F	p
Group (G)	1	1238.01	1238.01	2.68	.11
Age (A)	4	12299.99	3075.00	6.65	.001
G X A	4	204.34	51.08	.11	.98
Residual	99	43926.28	443.70		
Total	108	57864.68			

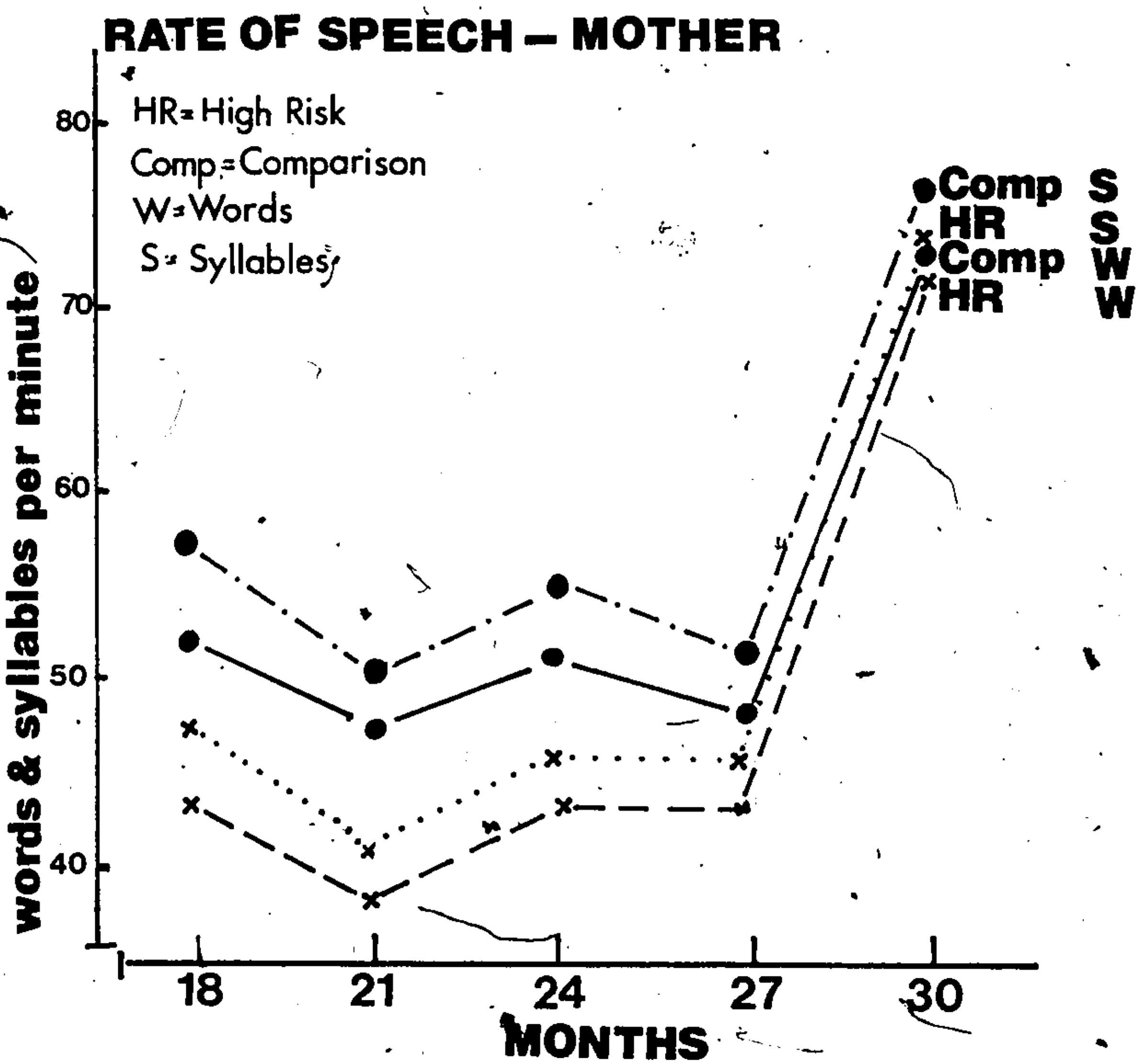

RATE OF SPEECH — MOTHER
HR = High Risk
Comp = Comparison
W = Words
S = Syllables
80
70
60
50
40
words & syllables per minute
Comp S
HR S
Comp W
HR W
18
21
24
27
30
MONTHS

FIG. 14

Table LVI

Mean Length of Utterance Summary Statistics
Words
Mother

Group	Months 18	21	24	27	30
High Risk					
Mean	4.60	4.10	4.38	4.62	4.86
S.D.	0.99	1.43	1.45	0.85	1.51
Comparison					
Mean	4.88	4.49	4.81	4.79	5.43
S.D.	1.00	1.03	1.45	1.61	1.09

Table LVII

Mean Length of Utterance Summary Statistics
Syllables
Mother

Group	Months 18	21	24	27	30
High Risk					
Mean	5.08	4.48	4.75	4.96	5.17
S.D.	1.16	1.58	1.60	0.95	1.63
Comparison					
Mean	5.38	4.83	5.20	5.14	5.88
S.D.	1.32	1.13	1.59	1.82	1.32

Table LVIII

Mean Length of Utterance Summary ANOVA
Words

Source	df	SS	MS	F	p
Group (G)	1	3.59	3.59	2.23	.14
Age (A)	4	8.10	2.03	1.26	.29
G X A	4	0.49	0.12	0.08	.99
Residual	99	152.93	1.54		
Total	108	165.31			

Table LIX

Mean Length of Utterance Summary ANOVA
Syllables

Source	df	SS	MS	F	p
Group (G)	1	4.11	4.11	2.00	.16
Age (A)	4	9.08	2.27	1.10	.36
G X A	4	0.87	0.22	0.11	.98
Residual	99	195.90	1.98		
Total	108	210.13			

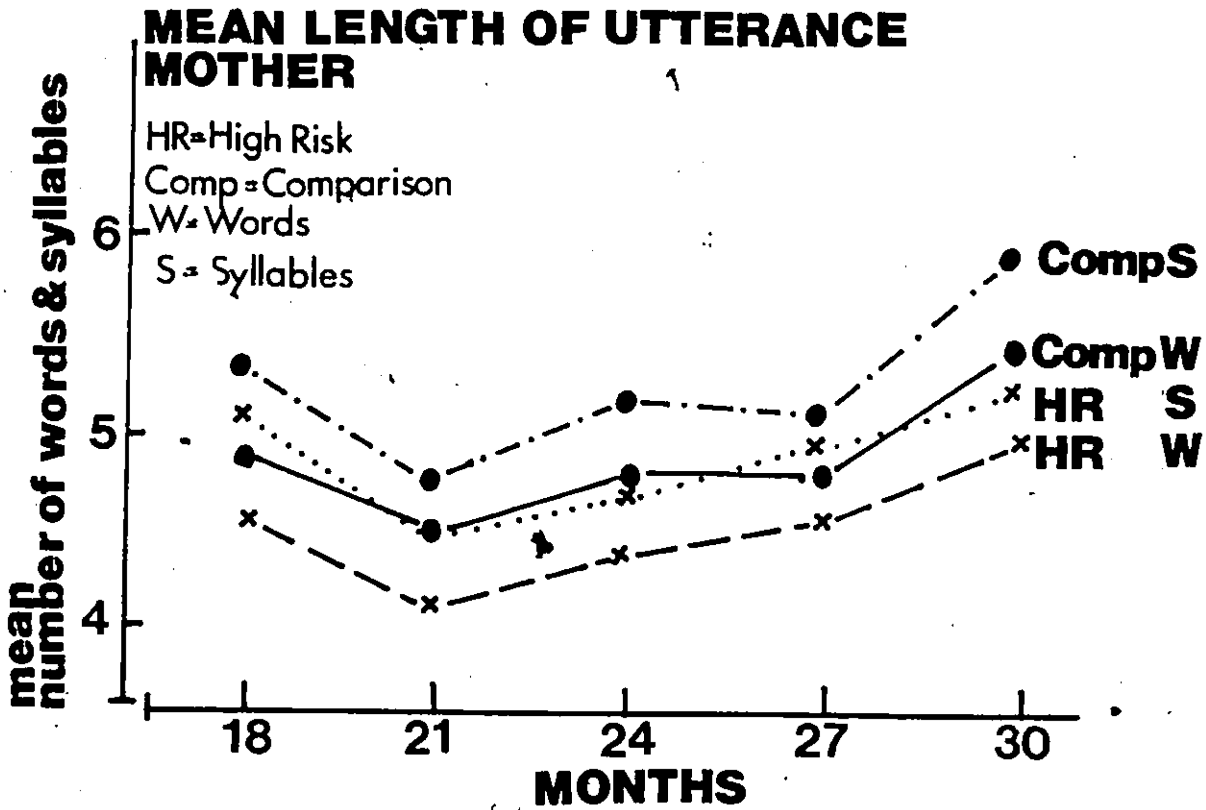

MEAN LENGTH OF UTTERANCE
MOTHER
HR=High Risk
Comp=Comparison
W=Words
S=Syllables
mean number of words & syllables
6
5
4
CompS
CompW
HR S
HR W
18
21
24
27
30
MONTHS

FIG. 15

Post ANOVA analyses using the Scheffé Multiple Comparisons procedure revealed that the mothers' rate of speech at the time their children were 30 months of age increased significantly over all the preceding age points, $(p \leq .05)$.

3. Interactive Effects — Group x Age: None of the quantitative measures showed significant group x age interactive effects, $(p > .05)$.

This was the case for the rate of speech measures, that is, the number of utterances per minute $(p < .80)$, the number of words per minute $(p < .98)$ and the number of syllables per minute $(p < .98)$.

There were no interactive effects for the MLU measures, that is for MLU words $(p < .99)$ and MLU syllables $(p < .98)$.

4. Quantitative Measures — Summary Statement: The linguistic performance of the high risk mothers, as measured by the rate of speech and MLU parameters, did not differ significantly from that of the comparison mothers.

The rate of speech measures showed highly significant age related effects, with the scores at 30 months differing from all other age points.

There were no significant interactive effects.

Paralinguistic and Unclear Utterances

Table (LX) and figure (16) report the percentage number of intelligible utterances for the high risk and comparison mothers at each age point. This number ranged from 89.92% to 93.70% of the total number of utterances spoken.

The difference between the total number of utterances and the number of intelligible utterances was accounted for by the number of paralinguistic and unclear utterances.

The percentage number of paralinguistic utterances was fairly constant over age ranging from 6.33% to 8.55% of the total.

The percentage number of unclear utterances ranged from 0.51% to 3.01% of the total.

Sex of the Child and the Mothers' Language

To ascertain whether the mothers of the female children scored similarly to those of the male children on the linguistic parameters under study, the t statistic was used to determine differences between the sample means at each age level.

None of the quantitative measures showed significant ($p > .05$) differences between the mothers of the male and female children. This was the case for the rate of speech

Table LX

Intelligible Utterances Summary Statistics
Mother

Group	Months 18	21	24	27	30
High Risk					
%	90.25	90.14	89.92	90.27	93.70
Comparison					
%	91.59	92.69	91.19	92.55	90.14

Table LXI

Para-linguistic & Unclear Utterances
Summary Statistics

Group	Months 18	21	24	27	30
High Risk					
Unclear %	2.51	2.47	3.01	2.38	0.94
Para-ling. %	7.24	7.40	7.05	7.58	5.36
Comparison					
Unclear %	1.16	0.99	1.92	1.02	0.51
Para-ling. %	7.25	6.33	6.89	6.43	8.55

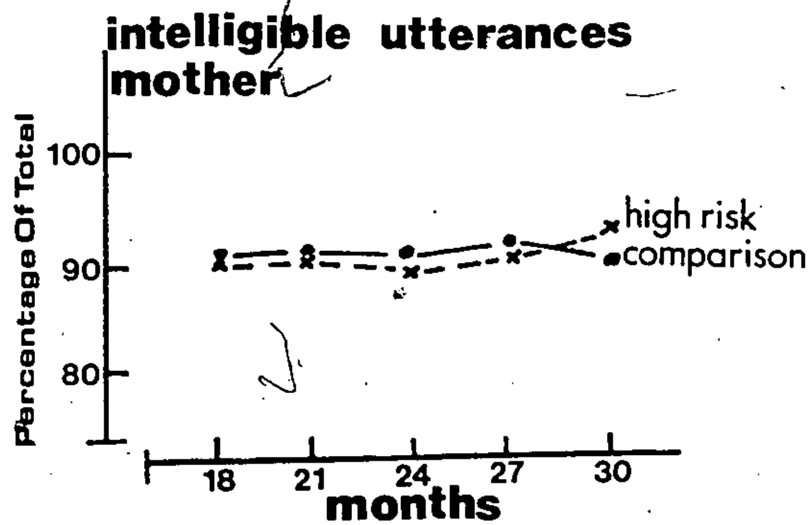

intelligible utterances
mother
Percentage Of Total
100
90
80
high risk
comparison
18
21
24
27
30
months

FIG. 16

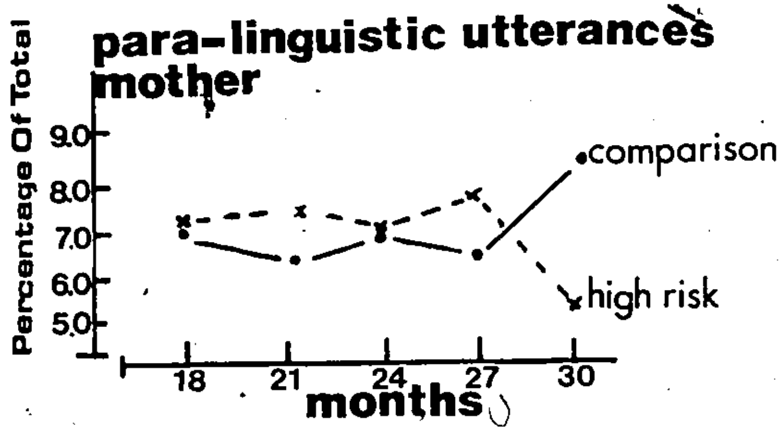

para-linguistic utterances
mother
Percentage Of Total
9.0
8.0
7.0
6.0
5.0
comparison
high risk
18
21
24
27
30
months

FIG. 17

measures (utterances per minute (table LXII) words per minute (table LXIII) and syllables per minute (table LXIV) and the MLU measures (words (table LXV) and syllables (table LXVI)).

Social Class and the Mothers' Language

To determine whether there was a relationship between the manner in which the mothers spoke to their children and social class, the subjects were dichotomised into two social class groupings 1/2 and 3/4/5 based on the Hollingshead Scales.

The unequal sample sizes required the application of the non-parametric Mann Whitney U to the data.

1. Rate of Speech: There were significant differences between the groups for the number of words and syllables per minute at 30 months ($p < .05$ and $p < .03$, respectively; tables LXVII ff.)

2. Mean Length of Utterance: There were significant differences between the groups for both MLU words and MLU syllables at 21, 24, 27 and 30 months. The significance levels were $p < .05$ at 21 and 24 months, $p < .03$ at 27 months for both words and syllables, and at 30 months they were $p < .03$ for words and $p < .01$ for syllables.

For these significant results, scores for the social group 1/2 exceeded those of social group 3/4/5. Tables LXX ff) give the summary statistics.

Table LXII

Rate of Speech Summary Statistics
Utterances per Minute
Mother

Group	Months 18	21	24	27	30
Male					
Mean	10.24	9.78	9.98	10.75	16.00
S.D.	2.50	3.15	1.99	3.01	2.28
Female					
Mean	12.53	11.40	13.05	10.43	14.68
S.D.	2.99	4.65	6.34	4.14	2.47

Table LXIII

Rate of Speech Summary Statistics
Words per Minute
Mother

Group	Months 18	21	24	27	30
Male					
Mean	48.51	40.78	45.66	48.38	75.67
S.D.	16.64	20.01	22.15	21.62	25.28
Female					
Mean	45.86	45.05	48.98	43.09	70.09
S.D.	13.24	23.08	25.23	18.81	17.53

Table LXIV

Rate of Speech Summary Statistics
Syllables per Minute
Mother

Group	Months 18	21	24	27	30
Male					
Mean	53.90	43.75	49.78	51.55	80.51
S.D.	19.56	20.86	24.17	23.89	28.39
Female					
Mean	50.05	48.49	51.80	46.43	76.62
S.D.	14.81	24.09	26.41	19.31	20.73

Table LXV

Mean Length of Utterance Summary Statistics
Words
Mother

Group	18	21	24	27	30
			Months		
Male					
Mean	4.97	4.22	4.79	4.80	4.95
S.D.	1.04	1.34	1.57	1.57	1.18
Female					
Mean	4.44	4.37	4.32	4.59	5.43
S.D.	0.93	1.18	1.26	0.82	1.48

Table LXVI

Mean Length of Utterance Summary Statistics
Syllables
Mother

Group	18	21	24	27	30
			Months		
Male					
Mean	5.51	4.57	5.24	5.12	5.26
S.D.	1.33	1.39	1.66	1.75	1.35
Female					
Mean	4.83	4.74	4.60	4.97	5.92
S.D.	0.98	1.37	1.44	0.98	1.65

Table LXVII

Rate of Speech Summary Statistics
Utterances per Minute
Mother

Group	18	21	24	27	30
	Months				
S.E.S. 1,2					
Mean	12.23	10.58	8.60	10.40	15.59
S.D.	0.72	3.01	3.09	2.15	2.14
S.E.S. 3,4,5					
Mean	10.87	10.59	11.93	10.64	15.40
S.D.	3.05	4.22	4.67	3.76	2.52

Table LXVIII

Rate of Speech Summary Statistics
Words per Minute
Mother

Group	Months 18	21	24	27	30
S E S 1/2					
Mean	60.30	50.08	46.23	59.63	92.74
S.D.	18.58	13.96	25.45	27.06	19.59
S.E.S 3/4/5					
Mean	45.12	41.32	47.24	42.94	68.70
S.D.	13.79	22.49	23.18	17.78	20.36

Table LXIX

Rate of Speech Summary Statistics
Syllables per Minute
Mother

Group	Months 18	21	24	27	30
S E S 1/2					
Mean	64.43	53.38	51.60	65.75	102.22
S.D.	22.68	12.48	29.10	30.38	20.34
S.E.S 3/4/5					
Mean	50.24	43.96	50.64	45.55	73.34
S.D.	16.44	24.62	24.52	18.26	22.97

Table LXX

Mean Length of Utterance Summary Statistics
Words
Mother

Group	Months 18	21	24	27	30
S E S 1/2					
Mean	5.42	5.07	5.57	6.15	6.36
S.D.	1.20	0.20	0.82	1.75	0.91
S E S 3/4/5					
Mean	4.61	4.12	4.36	4.38	4.88
S.D.	0.92	1.30	1.46	0.90	1.24

Table LXXI

Mean Length of Utterance Summary Statistics
Syllables
Mother

Group	Months 18	21	24	27	30
S E S 1/2					
Mean	5.78	5.49	6.17	6.78	7.05
S.D.	1.54	0.55	1.00	1.99	0.99
S E S 3/4/5					
Mean	5.12	4.47	4.59	4.77	5.19
S.D.	1.17	1.42	1.57	1.42	1.37

The Mothers' Language : Summary Statement

The only language measures available for the mothers of the high risk and comparison children were derived from the language corpora, and consisted of quantitative scores.

1. High Risk Mothers Versus Comparison Mothers — Main Effects: No significant between group effects were found for the rate of speech and MLU measures, ($p > .05$).

2. Age Effects: The rate of speech measures had highly significant age related effects ($p \leq .001$), with the mothers' rate of speech at the time their children were 30 months of age increasing over all the preceding age points.

3. Interactive Effects: None of the quantitative measures showed significant group x age interactive effects.

Sex of the Child and the Mothers' Language

As measured by rate of speech and MLU the female and male mothers' language did not differ from one another.

Social Class and the Mothers' Language

There were no social class differences in the rate of speech, but were for the number of words and syllables per minute at the 30 months level, ($p < .05$).

The MLU measures gave significant differences between the mothers in social class 1/2 and those in social class 3/4/5, at the 21, 24, 27 and 30 month levels.

For these significant findings, scores for social group 1/2 exceeded those of social group 3/4/5.

Mother:Child Ratio Measures

The division of the mother's language scores by those of her child gives mother:child ratio measure for the rate of speech and mean length of utterance scores.

As with the previous analyses, statistics were computed to determine group and age related effects, as well as the significance of sex and social class factors.

High Risk Versus Comparison Ratios[1]

1. Main Effects: The ANOVA (group X age) test for significant differences between the high risk and comparison

[1] Differences in the number of degrees of freedom for the ANOVA tables is accounted for the exclusion of certain ratio scores.

In the case of the MLU ratio scores, it was found that child scores registering less than 1.00 (i.e., an ratio means showed no differences for the number of utterances per minute ($p < .51$) (table LXXIII), words per minute ($p < .28$) and syllables per minute ($p < .50$), (tables LXXVI, LXXVII).

The ANOVA (group X age) results for the mean length of utterance (MLU) measures showed no significant main effects for MLU words ($p < .93$) and syllables ($P < .80$) (tables LXXX, LXXXI).

2. Age Effects: All the rate of speech measures had significant ($p \leq .003$) age related effects.

Post ANOVA multiple comparison analyses (Scheffé) showed the following significant ($P < .05$) comparisons for the rate of speech measures — all the means at 18 months differed from those at 27 and 30 months; and in the case of the number of words per minute from the mean at 21 months also. The 18 months mean for the number of syllables per minute differed from those at 21 and 24 months, also.

The MLU ratio measures did not show significant age related effects, words, $p < .09$; and syllables $p < .12$.

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average of less than one word or syllable per utterance) excessively inflated the ratio (this figure being the divisor). For similar reasons, rate of speech ratios greater than or equal to 10 were also excluded from the ANOVA calculations.

Table LXXII

Rate of Speech Ratio Summary Statistics
Utterances per Minute

Group	Months 18	21	24	27	30
High Risk					
Mean	3.31	1.62	1.64	1.44	1.22
S.D.	3.25	0.68	0.92	1.04	0.27
Comparison					
Mean	2.39	1.64	1.83	1.13	1.36
S.D.	1.21	0.61	1.03	0.43	0.27

Table LXXIII

Rate of Speech Ratio Summary ANOVA
Utterances per minute

Source	df	SS	MS	F	p
Group (G)	1	0.68	0.68	0.44	.51
Age (A)	4	33.14	8.29	5.34	.001
G X A	4	4.09	1.02	0.66	.62
Residual	99	147.31	1.49		
Total	108	185.49	1.72		

Table LXXIV

Rate of Speech Ratio Summary Statistics
Words per Minute

Group	Months 18	21	24	27	30
High Risk					
Mean	5.66	3.38	4.02	3.36	3.62
S.D.	2.19	0.92	2.01	2.42	2.12
Comparison					
Mean	7.55	5.36	4.37	3.37	3.26
S.D.	2.55	2.27	1.86	2.36	1.14

Table LXXV

Rate of Speech Ratio Summary Statistics
Syllables per Minute

Group	Months 18	21	24	27	30
High Risk					
Mean	5.70	3.68	3.78	3.16	3.22
S.D.	2.38	1.66	2.30	2.18	1.83
Comparison					
Mean	6.59	5.01	3.93	3.15	3.00
S.D.	2.15	2.20	1.97	2.17	1.07

Table LXXVI

Rate of Speech Ratio Summary ANOVA
Words per Minute

Source	df	SS	MS	F	p
Group (G)	1	4.90	4.90	1.17	.28
Age (A)	4	80.87	20.22	4.82	.002
G X A	4	16.56	4.14	.99	.42
Residual	71	297.58	4.19		
Total	80	402.53	5.03		

Table LXXVII

Rate of Speech Ratio Summary ANOVA
Syllables per Minute

Source	df	SS	MS	F	p
Group (G)	1	1.84	1.84	.47	.50
Age (A)	4	71.10	17.78	4.54	.003
G X A	4	6.68	1.67	.43	.79
Residual	72	281.77	3.91		
Total	81	362.78	4.48		

Table LXXVIII

Mean Length of Utterance Ratio Summary Statistics
Words

Group	Months 18	21	24	27	30
High Risk					
Mean	2.43	2.48	2.39	2.42	2.50
S.D.	0.15	0.77	0.46	0.87	0.96
Comparison					
Mean	3.35	2.85	2.41	2.09	2.26
S.D.	1.12	0.79	0.68	0.60	0.55

Table LXXIX

Mean Length of Utterance Ratio Summary Statistics
Syllables

Group	Months 18	21	24	27	30
High Risk					
Mean	2.43	2.09	2.20	2.29	2.23
S.D.	0.21	0.38	0.40	0.77	0.85
Comparison					
Mean	2.82	2.58	2.10	1.95	2.02
S.D.	0.76	0.61	0.42	0.53	0.47

Table LXXX

Mean Length of Utterance Ratio Summary ANOVA
Words

Source	df	SS	MS	F	p
Group (G)	1	0.00	0.00	0.01	.93
Age (A)	4	4.66	1.17	2.08	.09
G X A	4	3.07	0.77	1.37	.25
Residual	73	40.89	0.56		
Total	82	48.67	0.59		

Table LXXXI

Mean Length of Utterance Ratio Summary ANOVA
Syllables

Source	df	SS	MS	F	p
Group (G)	1	0.23	0.23	0.66	.80
Age (A)	4	2.68	0.67	1.91	.12
G X A	4	2.05	0.51	1.46	.22
Residual	73	25.66	0.35		
Total	82	30.39	0.37		

3. Interactive Effects: There were no significant interactive effects, $p > .05$, for any of the ratio measures.

Sex of the Child and Mother:Child Ratio Scores

Neither the rate of speech nor the MLU measures showed significant ($p > .05$) differences in the ratio scores for the female and male mother-child dyads.

Social Class and Mother:Child Ratio Scores

Neither the rate of speech nore the MLU measures showed significant ($p > .05$) differences in the ratio scores of those mother-child dyads in social class 1/2 and those in social class 3/4/5.

Mother:Child Ratio Measures — Summary Statement

There were no main, age or interactive effects for the mother:child ratio measures of rate of speech and MLU.

There were no significant differences between the female and male mother:child ratio scores, and between those for social class grouping 1/2 and 3/4/5.

DISCUSSION

The Language of the High Risk Child

Based on the quantitative[1] measures available from the children's spontaneous language, the following conclusions may be drawn. Under conditions in which the mother interacted with her child at home, children at risk due to very low birthweight, intrauterine growth retardation, severe respiratory distress and birth asphyxia[2] talked as much as did comparison children, and used a similar amount of speech. This conclusion is based on the rate of speech measures, for which there were no between group differences ($p > .05$). However, an analysis of the structural components suggests that the language of the high risk child was less complex and less developed, as indicated by their reduced MLU syllables[3] and upper bound measures.[4]

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[1]Morphemic features are discussed on pages 257 ff.

[2]These are the primary identifying high risk features but they were likely to have coexisted with other risk factors such as hyperbilirubinemia and apnea, for example.

[3]The significant between group effect for MLU syllables ($p < .03$) but not for MLU words ($p < .07$) may be in part due to the greater variability associated with the former measure.

[4]Other measures of syntactic complexity did not reach conventional levels of significance ($p > .05$), but had probability levels of less than .08 but greater than .05.

Results from the Reynell Developmental Language Scales confirm these findings, with the mean scores for the comparison children exceeding those of the high risk group at each age level. These differences were significant for the comprehension scale, but did not reach conventional levels of significance for the expressive scale ($p < .07$).[1]

<u>The Home Setting</u>: Results from the present study accord with those in the literature indicating that high risk children are delayed in language acquisition. However, few studies have analysed spontaneous speech, and none have reported on the high risk child's language as he interacts with his mother in his own home.

Not only is linguistic performance superior in the home (Kramer, James and Saxman, 1979), but clinical settings may offer conservative estimates of productive capabilities (Prutting and Connolly, 1976). The home setting may have accounted for some between study differences noted.[2]

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[1] Other studies under clinic conditions have reported significant between group differences for both sub-scales at 2 (Siegel, Saigal, Rosenbaum et al., 1982) and 3 years (Walther and Raemakers, 1982) for high risk (VLBW and SGA respectively) and comparison children. These significant differences were for scores uncorrected for the degree of prematurity.

[2] The variation in high risk populations makes between study comparisons especially difficult.

A report of high risk and comparison children's verbosity at 2 years found highly significant between group differences on this dimension under clinic conditions (Field, 1979). In the present study, on the other hand, the groups did not differ in the amount of their speech, when they interacted with their mothers at home.

The high risk child's increased verbosity at home may have also contributed to the fact that differences on the expressive scale of the Reynell did not reach significance. Many of the items on the scale[1] concern linguistic output and the child's increased verbosity under home conditions may have served to reduce previously reported group differences on the expressive scale.

The Need for Information on Comparison Children: However, in spite of possible improved performance at home, which was reflected in some, but not all, linguistic measures, and given that comprehension[2] may play a more significant role than production in language acquisition (McNeill, 1970) a picture emerges of children with pre- and perinatal difficulties as being at risk for language delay. The extent and significance of this delay needs to be examined.

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[1]See Appendi[illegible]

[2]Between group differences for the comprehension scale were significant.

Table XIII records that the comparison group's MLU exceeded that of the high risk group's by approximately .50 syllables at 24, 27 and 30 months. Not only is this difference small, but the mean MLU measures for the high risk children (which ranged from 1.59 to 2.13 words and 1.75 to 2.49 syllables between 18 and 30 months) and the mean upper bound measures (which ranged from 2.88 to 6.90 words and 3.38 to 7.90 syllables) accord with those reported in the literature by Brown (1973) and others.[1]

Since the high risk scores were within normal range, it could be erroneously concluded that perinatal stress had no deleterious effects. However, and here the importance of appropriate comparison group information is evident, MLU

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[1]Brown (1973) delineated stages of linguistic acquistion defined in terms of MLU (morphemes). Children in the present study would be placed in stages I (mean chronological age 24 to 26 months; mean MLU 1.75) and stage II (mean chronological age 28 to 30 months; mean MLU 2.25). Upper bound measures for these stages are 5 and 7 morphemes respectively.

Seitz and Stewart (1975) reported a MLU (words) of 1.37 for a 23 month old child; Nelson, Carskaddon and Bonvillian (1973); Wilkinson, Hiebert and Rembold (1981) calculated MLUs of 1.90 (words) and 1.75 (morphemes) respectively for 24 month old children. Baldwin and Baldwin (1973) and Wilkinson, Hiebert and Rembold (1981) reported MLUs of 2.97 (words) and 2.51 (morphemes) at 30 months.

Differences in these figures which are not accounted for by population differences may be due to the criteria used for the MLU calculation.

syllables and upper bound measures were significantly lower for the high risk children. This information underlines the fact that but for the perinatal insult the language scores for this group may have been higher. The question is not only whether the high risk children performed within known norms. They did. More significantly, however, is the fact that they may have performed better.

To complete the picture, over the year of the study both the high risk and comparison children reduced their percentage number of prelinguistic utterances (which constituted between 45 and 50% of the corpora at 18 months, and only 4 to 5% in the 30 month corpora);[1] increased their rate of speech 2 to 3 times, and the mean number of words spoken by 6 to 7 times. Their MLU increased by approximately .50 to 1.00 words and .70 to 1.20 syllables, and their upper bound by between 4 to 6 words and 4.50 to 6.8 syllables.

Thus far it may be concluded that the high risk child is acquiring linguistic features, and is generally performing within known norms. However, there is indication of delay, and for this reason it is not possible to exclude the existence of sub-clinical lesions which may have a

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[1]Paralinguistic utterances remained fairly constant over age, between approximately 2 and 6% of the corpora. This figure is close to the percentage reported for maternal language in the study, 5 to 8% of the corpora.

potentially deleterious effect on the patterns of language acquisition. This will now be addressed.

The Vulnerability of the Developing Brain

The brain of the high risk infant may have been traumatised as a result of chronic insult such as malnutrition in utero, hypoxia during critical intrauterine periods, and as a result of acute perinatal trauma. The immature infant leaving the uterus in the third trimester, when brain cell division and myelination are progressing at a rapid pace (Winick, 1969) is doing so at a time when the velocity of the second spurt of brain growth is at its greatest (Dobbing and Smart, 1974), and is thus particularly vulnerable to perinatal insults such as hypoxia.

Hemorrhage: Intrauterine and perinatal insults may affect neurological changes in the brain, including the destruction of cells, the disruption of neuronal activity, changes in the composition of fiber tracts, the formation of aberrant fiber tracts, alterations in cerebrospinal fluid pressures, along with widespread changes that affect the size and cellular composition of the brain (Isaacson, 1968).

Intraventricular hemorrhage (IVH) (periventricular intracerebral) is one clinical manifestation of intrauterine and perinatal asphyxia (Amiel-Tison, 1969; Myers, 1972;

Towbin, 1970) and is the most common form of hemorrhage,[1] especially in the premature infant and in those suffering from RDS (Tsiantos, Victorin, Relier et al., 1974).[2] With the improved management of respiratory failure, IVH has become the commonest cause of death in infants of low birthweight (Reynolds and Tagizadeh, 1974), and it also exists as a sub-lethal effect. The use of computerised tomographic scans has corroborated this view – 40% of infants less than 35 weeks at birth (Ahmann, Lazzara, Dykes et al., 1980) and 50% weighing less than 1500 grams (Papile, Burstein, Burstein et al., 1978) had subependymal or

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[1] See Volpe (1977) for further details of clinical signs and pathogenesis and for details of other forms of hemorrhage including subdural, subarachnoid and intra-cerebellar.

[2] The pathogenesis is not fully understood. However, it is known that at certain times in fetal development, when hypoxic/asphyxic stress occurs, parts of the brain may hemorrhage. The site and extent of the lesion depends on the brain's maturity at the time of the insult, and the severity of the asphyxiation. There can be total bilateral necrosis, necrosis of the cerebral cortex and of the basal ganglia. Localised hemorrhage can extend into the cerebral white matter, the striatum or the thalamus. The blood often ruptures through the ependymal lining and fills the ventricular system (Volpe, 1977). Since the germinal layers disappear towards term (Towbin, 1970) the mature infant is less susceptible to, although not immune from (Fitzhardinge, 1978), such lesions.

intraventricular hemorrhage. Although not all lesions are necessarily clinically significant, "this is a dramatic and unexpected testimonial to the very high frequency of periventricular hemorrhage" (Volpe, 1978, p. 693).

There is the need for massive bleeding before neurological handicaps are seen (Fitzhardinge, 1975), and there are opportunities for catch up in cell growth into the second year (Dobbing and Smart, 1974). However, significant neurological sequelae may be expected in this population of infants (Desmond, Wilson, Alt et al., 1980). Since asymptomatic lesions are also evident in survivors, they may be implicated in less severe sequelae such as language delay (Gaiter, 1982, for example, reported that infants with evidence of IVH were inferior to controls on language, imitation, comprehension and object relation items of the Bayley Scales).

Language and the Damaged Brain

When classical speech areas[1] are damaged,[2] speech routinely shifts to the other hemisphere (Kinsbourne, 1975; Milner, 1974). Speech functions are more viably represented in the homologous areas of the right hemisphere than in other areas of the left hemisphere, since speech competes more successfully for right hemisphere neural circuits than do other functions (e.g., visuo-spatial)[3] which may already be located in the right hemisphere.

If it is the case that the young infant's brain is equipotential for language, that is, either hemisphere can

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[1] In general, the dominant Broca's area, the supplementary motor and temporoparietal regions are implicated in speech production. The semantic, syntactic and lexicon features of language can be said to be subsumed by Wernicke's area, the supramarginal gyrus and part of the angular gyrus (Geshwind, Galaburda and Lemay, 1979; Whitaker, 1971), while abstract thought and language is associated with frontal and postcentral regions.

Comprehension may be more diffusely or bilaterally represented than is the production of speech (Kumura, 1975).

[2] The most profound linguistic disturbances occur if the lesion is in the posterior speech area — the posterior temporal, inferior parietal and anterior occipital region. The more anterior the lesion, the more auditory features are affected — the more posterior the lesion, the more visual the deficit.

[3] This may possibly explain why high risk children appear to be particularly vulnerable to problems of a perceptual-motor nature (Siegel, 1982 (b)).

assume the language function in the instance of injury, how does one account for language disabilities in childhood?

Evidence from asphyxiated monkey studies (Myers, 1972) indicates that those areas affected are the central structures of the brain, and under these circumstances bilateral, rather than unilateral lesions may occur, thus interfering with the transfer of language function.

Thus, while total insult to the left hemisphere permits language function to be transferred to the right hemisphere, a partial bilateral lesion may possibly result in worse distortion of function than would occur with a complete hemi-cortical lesion (Roberts, 1966). It may be preferable to have no structure than structures which lead to disorganisation. This explanation must remain hypothetical, however, since the neuropathology of children with mild and moderate language dysfunction is unknown.

Correction for Prematurity

The other central argument to be addressed concerns the degree of prematurity. The premature infant of 18 months may have the cortical maturity of a 15 to 16 month old child. The timetable for the emergence of neurocortical milestones is largely governed by maturational factors (Saint-Anne Dargassies, 1966) and early linguistic milestones are also heavily dependent on cortical and biological maturation (Lenneberg, 1966; Krashen, 1975). Thus, the language delay associated with the high risk child may be a function either of sub-clinical lesion or simply of the immature state of the cortical system (or both).

In the present study, between group differences were reduced when corrected for the degree of prematurity. Prior studies (see Caputo and Mandell, 1970; Crawford, 1982; Goldstein, Caputo and Taub, 1976; Hunt and Rhodes, 1977; Siegel, 1979; 1982 (c); Siegel, Saigal, Rosenbaum et al., 1982 for example) also reported comparable scores for preterm and full term groups after correction, although correction for age has not been previously applied to corpora of spontaneous language samples.

Some issues need to be clarified. First, regardless of the correction for prematurity it is the gestational age, rather than the corrected age, which may be the more critical parameter when discussing and predicting later outcome for preterm infants (Siegel, 1979; 1983). In other words, while the application of the correction may suggest that the degree of prematurity accounts for between group differences, it may mask the real nature of the infant's developmental potential. According to Caputo, Goldstein and Taub (1981) the developmental delay represents a 'veridical, continuing debility' and not simply developmental lag. Correcting for age to eliminate the 'artifact'

(Hunt and Rhodes, 1977) of lower scores due to prematurity may lead to the situation where prematurity does not relate to 1 year DQ scores, but does to 8 year WISC-R scores (Caputo, Goldstein and Taub, 1981).

> As it is used now, the gestational age correction is often employed to equate the neurological, cognitive or other functioning of a baby that may or may not ever function comparably to a full-term infant with respect to the measure involved, Caputo, Goldstein and Taub, 1981, p. 381.

Secondly, it cannot automatically be assumed that gestational age alone is the only factor involved in developmental delay. Although it would be gratifying to be able to "separate normal developmental delay associated with prematurity from delay caused by central nervous system damage" (Hunt and Rhodes, 1977, p. 204), the correction for prematurity, although reducing significant between group differences in the present study, does not, in fact, clarify whether the poorer performance is due to age per se, or due to some other neuropathological distinction between the groups.

During this stage of rapid language acquisition, it is possible to argue that both underdeveloped cortical structures and cortical structures with sub-clinical lesions may similarly affect linguistic performance. But the latter would have the more deleterious long-term effects, since a discrepancy of 2 or 3 months between the groups (approximately the degree of prematurity) would become insignificant over time. (These problems are confounded by the attenuation or exacerbation of biologically determined deficits by environmental factors, some of which are addressed below).[1]

What is Known of the High Risk Child's Later Language Development?: A closer perusal of tables XII and XIII indicates that the comparison children's MLU increased by a larger increment over the year of the study,[2] as did their upper bound scores,[3] when compared with the high risk child. Bhargava, Datta and Kumari (1982) reported a similarly widening gap between the high risk and matched group on language components of the Gesell Scales, when measured yearly between 1 and 5 years.

However, clear-cut statements regarding the prognosis for the high risk child are precluded due to the contradictory evidence reported. Thus, for example, while Kelsey

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[1]See pages 253 ff.

[2]The high risk children's MLU increased by .54 words and 0.74 syllables over the year, while the comparison group's increments were calculated at 1.06 words and 1.17 syllables.

[3]A differential of 0.73 syllables at 18 months had become one of 3.01 by 30 months (table XVII).

and Barrie-Blackley (1976) found no between group[1] differences for measures based on language samples at age 3, Field (1979) did. Studies by Phillips (1968 on the ITPA) and Ehrlich, Shapiro, Kimball et al. (1973 on the PPVT, ITPA and Weschler amongst other tests) attest to the poorer performance of high risk children on standardised language tests at school age, while Siegel (1982 (b) on the verbal components of the McCarthy Scales) and Siegel (1983 on the PPVT) reported comparable high risk and matched group performance. Ungerer and Sigman (1983) similarly found that high risk populations performed as did comparison populations on the Reynell Scales at age 3, reversing a poorer performance at 22 months, on a different language scale.

Certainly between study differences (due to the nature of the risk factors, variations in significant demographic variables, and the language measures used) may account for some of these contradictions, but the lack of consistent outcome findings does not facilitate discussion as to whether there is evidence of developmental delay, which may be compensated for by environmental or

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[1]Between group refers in all cases to the index high risk group (however defined) and a matched comparison group (however defined). Further details may be found on pages 53 ff.

maturational substitutive mechanisms, or whether there is evidence of 'veridical developmental deficit'.[1]

The Mother's Language

In general, it was the mothers of the comparison children who had the higher language scores,[2] paralleling the pattern of results for their own children when compared with the high risk group. However, none of these measures was significant, precluding definitive conclusions on group differences. There were no significant between group ratio measures, suggesting that high risk and comparison mothers similarly adjusted their language in the presence of their children.

Thus, the high risk nature of the children did not affect their mothers' language, when this was measured in terms of rate of speech and MLU parameters. Certain other characteristics of the child, including age and linguistic competence (see pages 101 ff.) have been postulated to

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[1]This issue is further confused by the fact that lesions suffered at birth may lead to changes in the neurological substrates of language, but ostensibly normal patterns of language development (Lenneberg, 1967).

[2]The only exception was the total number of utterances per minute which fell below that of the high risk mothers for the 30 month session. It is interesting to note that a replicated pattern was noted for the comparison children. The 30 month data was based on a book reading session. Other peculiar patterns were noted in this context and will be addressed more fully on pages 260 ff.

affect maternal language.[1] However, results from the present study suggest that maternal language was not responsive to more sophisticated language skills, since maternal MLU, for example, did not vary over the 1 year period of the study, even though the children's MLU did. Wilkinson, Hiebert and Rembold (1981) similarly reported the mothers' speech to 2 and 2 1/2 year old children was similar. In the present study, the mother's language was neither responsive to the changing age of the child nor to the child's developing linguistic skills (both of which were covarying over time). It must be concluded that the narrowing of the ratio scores over age (table LXXII ff) reflected changes in the child's, and not the mother's, language, since it was for the child's language that there were significant age related effects.

These results support the contention of Newport, Gleitman and Gleitman (1977) that maternal language does not change in 'fine-tuned' correspondence with the child's language competence during this critical period of syntax development. The features of Motherese "arise for the purpose of here-and-now communication with a limited and inattentive listener . . ." (p. 126), and appear not to be

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[1]The maternal rate of speech measures did show a highly significant age related effect, which post ANOVA analyses determined to be due to the 30 month scores differing from all other scores. This again is related to the context for the language, i.e., book reading, and will be addressed below.

directly responsive to the physical or behavioural characteristics — including language competence — of the healthy high risk child. Even their less developed comprehension abilities (measured by the Reynell Scales) appear not to have been significant enough to affect maternal language. The child's level of comprehension has been noted to be a potent factor in maternal speech adjustments (Bohannon and Marquis, 1977; Van Kleeck and Carpenter, 1980).

Finally, although the concerns and motivations of high risk mothers naturally differentiate them from comparison mothers (Goldberg, 1977), there was no evidence to suggest that these possible differences affected the manner in which they interacted with their children under observation conditions. It is possible, however, that other interactional measures, and alternative linguistic parameters may have highlighted between group differences.

Sex and Language Acquisition

There were neither any distinctive patterns, nor significant sex differences for any of the linguistic measures, including the Reynell Developmental Language Scales.[1] This finding is in contradistinction to studies

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[1] Females had significantly higher mean scores between 3 and 5 years on the Reynell Scales (Randall, Reynell and Curwen, 1974; Silva, 1980).

of language acquisition in the toddler period, on measures comparable to those in the present study. The smaller number of children may account for this discrepancy, although female linguistic superiority has not been universally upheld (see Introduction, pages 104 ff.).

It has also been noted that clinic populations are more likely to be male rather than female (MacKeith and Rutter, 1972). Although not reported here, the number of males performing at a level of less than 1 SD below the mean on the Reynell Scales was not significantly greater than the number of females ($p > .05$; Fisher's Exact Test).

Evidence for differential maternal language as a function of the child's sex is not unequivocable (see pages 197 ff.) The present study limited analysis of maternal language to structural rather than communicative features (e.g., frequency of imperatives, imitations, etc.) and on these measures the mothers of male and female children were similar, with no differences in their speech adjustments (based on the ratio scores).

Smith and Daglish (1977) have concluded that parental behaviour towards children at this age is less a function of the child's sex and more a function of the individual characteristics of the child. Robinson (1980) argues for the pervasiveness of individual differences in language acquisition. Beckwith, Cohen, Kopp et al. (1976) in a study of preterm infants concluded that it was the more active infant who elicited greater caretaker interaction. This characteristic was not addressed in this study; however, there is evidence to suggest that maternal language does vary as a function of another characteristic, namely social class.

Social Class and Language Acquisition

No significant social class differences emerged for the children's language in this study, although there is support for differential rates of acquisition in the literature (pages 109 ff.) While these findings may in part be related to the uneven distribution of sample numbers, a further explanation centers on the relative potency of biological and environmental factors in language development, with the former being more critical in the early stages (Krashen, 1975; Lenneberg, 1967).

Although there is the need for the ambient environment to provide a minimum amount of stimulation, "perhaps only extremes of input behavior have an effect on the rate of acquisition or the quality of linguistic behavior during this period" (Menyuk, 1979, p. 97).

> The quality and probably also the quantity of linguistic stimulation that are required if . . . development is not to be hindered do in fact vary with age . . . The reduced linguistic stimulation of a low SES environment seems not

> to affect the very first stages of language development, say up to 1 1/2 years of age . . . From the age of 2 - 3 the importance of linguistic stimulation increases and the culturally and linguistically impoverished condition of low SES families increasingly hinder a child's language development.
> Parisi, 1971, p. 189

The language of a 30 month old child, while evincing basic syntactic structure is not in its final form, and features which may show the peculiarities of social class have yet to emerge. Cazden (1968) has proposed that the acquisition of grammar and the acquisition of vocabulary require different kinds of environmental assistance. The "basic grammatical structures seem to be learned despite differences in the child's linguistic environment, while how the child uses language to express ideas, may be more vulnerable to environmental variation", (p. 436).

It could be argued that the higher and lower social class children in the present study were hearing similar language from their mothers. In fact there was evidence of some maternal differences. Maternal rate of speech measures showed significant social class differences at the 30 month visit, and probably relate to the context of the language (i.e., book reading) and will be discussed on pages 260 ff. The maternal MLU measures, however, indicated more consistent social class differences with the lower social class mothers speaking in significantly shorter utterances. These reduced MLU measures may be indicative of language patterns which will begin to exert an effect as the lower social class child develops further linguistic competence.

Outcome studies for high risk populations also suggest that the importance of social class is confined by the age of the child. Beckwith, Cohen, Kopp et al. (1976) concluded that development at 1 year (including vocal output) was predicted more accurately from perinatal measures than from social class and maternal features. Eaves, Nuttall, Klonoff et al. (1970) demonstrated a direct correlation between birthweight and development in low birthweight infants at 18 months, and found that SES did not exert an influence until the children were 2 1/2 years. Hunt (1981) and Siegel (1983) similarly found that the environmental determinants of IQ and language scores were more obvious at the older ages.

Thus the finding of no social class differences on language measures in the present study between 18 and 30 months is supported by arguments on two sides. First, the emergence of language is largely governed by maturational (neurocortical) factors, and secondly, by the fact that birthweight/gestational age and perinatal status may be the more significant determinant of outcome in the early stages of ontogenesis. This is not to deny the import of SES which, in conjunction with other perinatal and reproductive variables has been consistently predictive of cognitive and linguistic outcome in high risk children (Siegel, 1982 (a); 1982 (b); 1983; Siegel, Saigal, Rosenbaum et al., 1982) but rather to suggest that the role of SES is to compensate for, or exacerbate, the delayed acquisition of language which is initially under maturational control.

Language Analysis

In this final section, some findings pertinent to the methodology associated with language analysis will be discussed.

Correlations amongst the Language Measures

The present study found significant positive correlations between measures derived from spontaneous language corpora (such as the MLU, upper bound and type token ratio measures), and the scores on the expressive component of the Reynell Developmental Language Scales, which have not been previously reported in the literature.

While language samples undoubtedly provide a richer and more accurate representation of the child's language competence, it is not always possible to obtain these with accuracy in clinical or research settings, and their analysis is complex and time consuming. These correlations suggest that the Reynell Developmental Language Scales can adequately tap measures which would be derived from the language corpora.

On the other hand, the positive correlations noted between the MLU and the Reynell and morphemic measures further consolidates the status of the MLU as an index of linguistic performance.

> For the purposes of relating language growth to chronological age, it appears that quantification of structural analysis of language provides no more sensitive measure than quantification of verbal output. Sharf, 1972, p. 73.

Morphemic Forms

It appears that the significant between group differences for MLU and upper bound measures at 30 months cannot be accounted for by differences in morphemic usage.[1] This contradicts the only other known study of morphemic usage in a population of high risk infants which indicated "quantifiable reduction in the ability to us morphological rules" (Wiig, Semel and Crouse, 1973, p. 461) based on results from the Berko tasks.

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[1]It is noteworthy that the two morphemes which were significant at the p < .10 level were those morphemes (articles and summed morphemes) with the greatest number of obligatory contexts. This suggests that larger sampling might indicate group differences. The language corpora at 30 months may not have sufficient variance to extract group differences.

It may be argued, however, that these differences stem in part from the source of the results. Children whose spontaneous speech rarely includes errors appear not to understand morphemic rules when they are presented in experimental tasks (deVilliers and deVilliers, 1973). Blank (1975) has argued that experimental conditions impose on the child extra demands over and above those of interest. Thus, while the young child may have mastered a linguistic structure, he may not have understood the end-task requirements, and thus answer inappropriately for that reason alone. Based on this analysis, differences for the high risk infant reflect more general cognitive rather than linguistic ones specific to morphemic usage.

In other respects, the results confirm those previously reported. Only five morphemes (present progressive; definite and indefinite articles; contractible and uncontractible copula; contractible and uncontractible auxilliary; and plural) occurred with sufficient frequency to permit analysis.[1] Stekol and Leonard (1979) with a group of normal (mean age 42 months) and language delayed (mean 62 months) children were also restricted to analysis of the first four of the above five, for the same reason.

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[1]Generally, the comparison children were more likely to supply morphemes in obligatory contexts but these differences did not reach significance.

The sequence for the emergence of these forms (based on the percentage supplied in obligatory contexts, see table XL) being plural, present progressive, copula, auxilliary and article, is consistent with other studies, (Brown, 1973; deVilliers and deVilliers, 1973; James and Khan, 1982) and the ordering for the high risk and comparison groups were similar,

One enigmatic feature remains, however. It would be expected that an increase in MLU should be accompanied by an increase in morphemic usage, and in the present study a significant positive correlation ($p < .01$) was found between the child's MLU and the frequency with which he supplied morphemes in obligatory contexts. However, the between group differences in MLU at 30 months was not paralleled by differences in the use of morphemes at this age suggesting that that difference was too small to be reflected in more sophisticated morphemic use.

In conclusion, the high risk children in the present study do not show evidence of difficulties specific to morphemic usage, as has been suggested in the case of language delayed children (Johnston and Schery, 1976; Stekol and Leonard, 1975). It has been argued that language impaired children do not see morphemes as being significant for communication. Any suggestions that larger sampling would indicate some significant between group differences in the present study would be taken to be related to the high risk group's MLU scores, rather than to difficulties specific to morphemic usage.

The Context for the Language

Some consistently noteworthy results were found for the 30 month visit, when a book was substituted for the previously used set of toys in the semi-structured observation situation.

In the case of the child, it is not clear that significant age related effects seen at 30 months relate primarily to the context, since there is evidence of developmental progress throughout the year. The most dramatic increments at 30 months are seen in the child's verbosity (rate of speech, words and syllables per minute), and these most probably do reflect changed interactional patterns with the mothers due to the book reading sessions.

A more cogent case for contextual influences on language comes from the mother's language, where the highly significant ($p < .001$) age related effects for the rate of speech measures were contributed solely by the 30 month visit.

Maternal, social class differences for the rate of speech (words and syllables per minute) measures were evident at the 30 month visit but not for any of the prior visits. Social class 1/2 mothers used more words and syllables per minute when interacting with their children in a book context.

Finally, while the language of the mothers of delayed (scoring less than 1 SD below the mean on the Reynell Developmental Language Scales) and non-delayed children did not differ at 18 and 24 months, consistent and significant differences emerged for all measures at the 30 month level ($p < .05$; Mann Whitney U).[1] The mothers of the delayed children spoke less, used fewer words and syllables and had shorter utterance lengths in the book reading context.

These results tentatively[2] suggest that maternal language is altered in a book reading context, and that

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[1]There were no significant differences for the number of delayed children in the high risk and comparison groups ($p > .05$, Fisher's Exact Test).

[2]Sample numbers are small and caution in interpretation is warranted.

Other investigators have not found differences between the mothers of normal and language disordered children for syntactic measures (Cunningham, Reuler, Blackwell et al., 1981; Lasky and Klopp, 1982).

the mothers of lower social class and linguistically delayed children interact less with their offspring in this situation.

The topic, the task and the activity, along with listener variables, are features which interact with the language sampled (Cazden, 1970; Fraser and Roberts, 1975). Language in the book reading situation has been shown to be the most complex, when compared with caretaking and fun activities (Snow, Arlman-Rupp, Hassing et al., 1976). The finding of elevated maternal language measures at 30 months supports these studies.

However, unlike a previous study which found no SES differences in a book context (Dunn, Wooding and Hermann, 1977) the present study did, more specifically for measures related to the amount of speech. The discrepancy between these studies may relate to the measures chosen. Dunn, Wooding and Hermann (1977) concentrated on communicative features, rather than on measures of verbal output.

Book reading may be one of those "maternal organizational opportunities for the use and development of language" which predicted verbal ability in pre-teen boys (Jones, 1972). Siegel (1982 (a)) reported that the HOME Inventory sub-section assessing the 'opportunities for variety in daily stimulation' which included frequency of story telling, was significantly correlated with language comprehension (Reynell Scale) at 3 years. This category of the Caldwell Inventory also differentiated language delayed from normal preschool children (Wulbert, Inglis, Kriegsmann et al., 1975). Although only suggestive, these studies, along with the present results, argue for a reduced maternal involvement with reading material in the case of lower SES and language delayed children which may reflect or be reflected in their child's linguistic competence.

Summation

There is no doubt that language disorders are of great significance for the whole developmental progress of the child. Some of the children who were born with low birthweight who were small-for-gestational age, or who were subjected to perinatal trauma such as respiratory distress and asphyxia – but who have survived without obvious major sequelae – must be counted among the 6.8% of 3 year old children exhibiting various degrees of expressive disorders (Stevenson and Richman, 1976).

The following are the main conclusions of the present study.

a) In their acquisition of early language skills, there is evidence to suggest that high risk children were delayed in both receptive and expressive skills.

b) It is the structural aspects, rather than the amount of their speech, which differentiated them from the comparison children.

c) In real terms, the differences between the high risk and comparison groups were small. The high risk children were performing within known norms of development. The importance of information on comparison children was stressed, however, since these 'small differences' were statistically significant in many cases.

d) When a correction was made for the degree of prematurity, between group differences were reduced. There is uncertainty as to the long-term prognosis for these infants, and whether they were distinguished from the comparison children by factors other than their prematurity and high risk status, for example, sub-clinical cortical lesions.

e) The language of the high risk and comparison mothers was similar, as indicated by rate of speech and MLU parameters. It was concluded that the high risk status of the children did not affect maternal language. Maternal language may differ on dimensions not measured in the present study.

f) Social class was not predictive of the child's language. This, it was argued, was due to the potency of biological and maturational factors in early language acquisition. There was evidence, however, of social class differences for maternal language.

g) The child's sex was not predictive of outcome.

h) The study confirms previous work which has stressed the importance of context for language interaction. Mothers spoke more in the book context. The mothers of lower social class and those of linguistically delayed children had lower language measures than did the mothers from the higher social class and those of non-delayed children.

i) This study offered previously unpublished comparisons of language measures derived from spontaneous samples and those derived from the Reynell Developmental Language Scales. The study also permitted the correction for the degree of prematurity to be applied to the child's spontaneous language.

j) This study has demonstrated the value of observing the child's acquisition of language in a home setting as he interacts with the person most responsible for providing an optimal linguistic environment – the mother.

<u>In Conclusion</u>

This thesis investigated a sub-lethal component of the continuum of reproductive casualty (Lilienfeld and Pasamanick, 1955), namely, early language acquisition. It may be concluded that 'healthy' high risk children acquire language in a manner similar to comparison children, and function within known norms of development. While these children are not severely delayed, there is indication of developmental lag. Whether this 'lag' is in effect a more serious deficit cannot be answered by this study. It may be possible to conclude that high risk children attain mastery later. A quote taken from Robinson (1980) is germane. (Although speaking of the effects of social class, the effects of high risk status also apply.)

> All the time children are still developing their knowledge of English grammar, there will be some features which will show up . . . differences; there are many others which would not . . . . By testing at the leading edge . . . differences can be found: testing for the already wholly mastered would yield no differences. (p. 33/34).

This thesis did test at the "leading edge". Undoubtedly, if these same children were tested at age 4 or 5 for these same features of early language acquisition, between group differences would not show up. However, it may be the case that 'healthy' high risk children may always have difficulty with emergent skills, just that in later life these skills may not be linguistic in nature.

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APPENDIX I

The Reynell Developmental Language Scales

The following is an outline of the test items. Further information on test procedures and scoring may be found in the manual accompanying the Scales.

Expressive Language Scale

Section 1 - Language Structure

The following items are scored from the child's spontaneous speech.

1 Vocalisation other than crying
2 Single syllable sound
3 Two different sounds
4 Four different sounds
5 Double syllable babble
6 One definite word
7 Expressive jargon
8 2 - 3 words
9 4 - 5 words
10 6 - 7 words
11 9 - 12 words
12 Word combinations
13 20 or more words
14 Sentences of four or more syllables
15 Words other than nouns or verbs
16 Correct use of
(a) pronouns
(b) prepositions
(c) questions other than by intonation
17 Correct order of words in sentences. No words omitted
18 Use of complex sentences

Section 2 - Vocabulary

To name the following objects:-
Ball, spoon, cup, sock, brush, doll (baby), car

To identify the following pictures by name:-
Chair, house, flower, letters (mail), window, drinking, writing

To define the following words unaccompanied by objects or pictures:-
Apple, book, dress, shop (store), sleeping, washing cold

Section 3 - Language Content

To determine how the child can use language creatively by describing five pictures concerned with:-
Laying the table; Hanging the washing; Shopping; Digging potatoes; A garden shed.

Verbal Comprehension Scale

Section 1 - Verbal 'Pre-Concepts'

The child must indicate:-
1 Selective recognition of word or phrase, e.g., "where's Daddy?"
2 Adaptive response to familiar word or phrase, e.g., e.g., "wave bye-bye"
3 Looks at one familiar object or person in response to naming

Section 2 - Comprehension of simple names

The child must select one of the following objects:-
Ball, brick (block), brush, cup, doll (baby), car, sock spoon

Section 3 - Further differentiation of concepts

The child must indicate comprehension by selection:-
Horse (gee-gee); dog (doggie), baby, cat(pussy), lady (mummy, mother), man (daddy, father), boy, girl

Section 4 - The relationship between two concepts

1 Put the doll on the chair
2 Put the spoon in the cup
3 Put the brick (block) on the plate
4 Put the car in the box

Section 5 - Attributes

The child must relate an attribute to a perceived object by selecting one from an array of many:-
Which one do we
1 Sleep in
2 Go for a ride in
3 Write with
4 Cut with
5 Cook with
6 Sweep the floor with

Section 6

Represents an advance of the same process. The child must select one from an array of objects, which includes a milkmaid with a bucket, a sitting rabbit, a feeding horse, a boat and a farmer with a gun.

Which one
1 Barks
2 Catches mice
3 Cooks dinner
4 Has the longest ears
5 Is eating
6 Is sitting down
7 Is carrying a bucket (pail)
8 Has a gun
9 Sails on the water

Section 7 - Concepts of size, colour, position and negation

1 Find the yellow pencil (crayon)
2 Show me the biggest balloon
3 Turn the little table upside down
4 Put the penny (money) underneath the cup
5 Show me which button is not done up

Section 8

Requires the child to assimilate a large number of different concepts and parts of speech together in one sentence. An array of farm animals, a farmer and a fence are set out.
1 Which horse has a collar on?
2 Put the brown hen beside the black hen
3 Show me how the man walks into the field
4 Show me the horse which is eating the grass
5 Put one of the pigs behind the man
6 Make one of the horses walk through the gateway
7 Put the little black pig beside its black mother
8 Pick up the smallest white pig and show me his eyes
9 Put the famer and one of the pigs in the field
10 Put all the pigs in the box and give me a brown horse

Section 9

The child must conceptualise a situation and carry out the sequel with the toys

1 This little boy has spilt his dinner. What must he do?
2 This little girl is nearly late for school. What must she do?
3 The little girl hits her brother. What does he do?
4 The baby has fallen and hurt his knee. What does his mother do?
5 The car is nearly running into the little boy. What must he do?

APPENDIX II

Frequently Occurring Para-Linguistic Utterances

TRANSCRIBED FORM	MEANING OR SEMANTIC FUNCTION
Ahh!	Endearment
Animal Noises Bow-Wow Neigh Quack	Note that Bow-Wow and Meow etc. were retained as words if they stood for and were used in the place of "Dog" and "Cat", or in a case such as:- C: A duck says quack (LC:27:6)
Eh? Huh? Hum?	What?
Hey!	Call To Attention
Hum	Agreement
Oh!	Call To Attention
Oh!	"I See" (Understand)
Oh!	Exclamation Of Surprize
Oh-Oh	"Oh Dear"
Oh	Expression Of Difficulty
Rmmm Zoom	Car Noises
Uhum	Affirmative Agreement
Uhuh	Negative Disagreement
Woops	Exclamation
Yuck	Disdain

APPENDIX III

Analysis Of A Language Corpus

The following is taken from the language corpus of a high risk child at 30 months of age. It represents less than 10% of that corpus.

Explanation of terms

S - Speaker

C - Child

M - Mother

Syll. - Syllables; the number of syllables in the utterance

Word - The number of words in the utterance

Morphemes The corpus was analysed for the following five morphemes:-

Copula (Cp); Articles (A); Plural (Pl); Auxilliaries (Ax); Present Progressive Form (Prog).

A line through any of these terms indicates that the morpheme was required in the utterance, but not supplied.

Words in parenthesis were not scored, for reasons outlined in the Method. Information on the scoring of these utterances will also be found in the Method.

Analysis Of A Language Corpus

S	Utterance	Syll.	Word	Morphemes
C	Which books are those?	4	4	Cp; Pl.
M	Well we'll have to see, (oh) boy, let's see, why don't you sit with mummy	16	15	
C	Where's the toys?	3	4	Cp;A;Pl.
M	Well, she didn't bring any toys today	10	7	
M	What are those?	3	3	
C	Tomatoes	3	1	Pl.
M	No, they are not a tomato, they're a strawberry	12	10	
C	No, I talk	3	3	Ax;Prog.
C	(Oh, oh,) what they eating?	4	3	Ax;Prog.
M	(Oh, they're eating) what's that boy eating? What's that boy eating?	10	10	
C	Unclear			
M	What are the cows doing?	6	5	
C	What they doing?	4	3	Ax;Prog.
M	You tell me	3	3	
C	No, I want tell you	5	5	
C	(What's) what's this doggie doing?	6	5	Ax;Prog.
M	I think he's sleeping	5	5	
C	What for?	2	2	
M	'cos he's tired	4	4	
C	(How come), how come he turn his bowl over?	8	7	
C	What's the lady doing?	6	5	Ax;A;Prog.
M	She's writing	3	3	
C	What's the lady for?	5	5	Cp;A.
M	What's the lady for? Well, she comes to see how you're doing.	14	14	

APPENDIX IV

Scoring Of Special Forms

Transcribed Form	Number Words Per Utterance	Number Syllables Per Utterance
Contracted Forms		
What's; It's I'm; I'll	2	1
Let's; Won't Can't; Don't	1	1
Childhood Idioms		
Moo-Moo; Ta-Ta; Night-Night; Choo-Choo; No-No; Bow-wow	1	2
Hyphenated Words		
Face-cloth Hot-Dog Ice-cream	1	2
Elided Forms		
Kinda; Gimme; Gotta; Wanna	1	2
Special Cases		
Oh boy Oh dear	1	2