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Annikki Riitesuo

A Preterm Child Grows

Focus on Speech and Language during the First Two Years

JYVÄSKYLÄN YLIOPISTO
JYVÄSKYLÄ 2000

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ABSTRACT

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The aim of the study was to obtain a detailed and exact picture of speech and language development of preterm infants as a part of their overall development during the first two years of life. An intensive follow-up method was used. The developmental pathways were followed as a context of perinatal risks and the assessments were made at children's homes (ecological viewpoint). The results were examined both at the corrected and chronological age. According to the literature and previous research, a delay was expected in preterm infants' development, especially if development was observed only at the chronological age. So far, such intensive follow-ups concerning different developmental domains, and especially speech and language of preterm infants during the first two years of life have not been conducted in Finland.

The study started in1990 as a part of the projects "Multidisability, family and childhood" (1.8.1990-31.5.1993) and further "Early interaction of small preterm infants and supporting parenthood" (1.6.1993-31.12.1994). The study was carried out at the University of Jyväskylä, the Department of Special Education and the preterm infants (N=24) came from three central hospital districts: Jyväskylä, Helsinki and Oulu. No term controls for these preterm infants were chosen. Test results were studied within the preterm group and compared to the standards of the applied tests and other norm data available. The Receptive-Expressive Emergent Language Scale (Bzoch & League 1991) and the Reynell Developmental Language Scales (Reynell & Huntley 1985) were applied in speech and language follow-up. Mental development was assessed by the Bayley Scales of Infant Development (Bayley 1969). The overall development was assessed by the Ages and Stages Questionnaires (Squires, Bricker & Potter 1993) and e.g. health card norms.

The degree of prematurity and the diagnosed problems showed themselves in test results.The older preterm infants (ga. 29-32) without diagnoses began to perform without the age correction between the ages of one year and one and a half years depending on the assessment device used. However, speech production tended to develop more slowly than other skills also among the older preterm infants. Many of the younger preterm infants (ga. 24-28) without diagnoses performed under the expected levels in the different areas of development still at the corrected age of two years. The Bayley, Reynell and ASQ test results correlated significantly with each other. As a group, the children with diagnoses (n=6) tended to score lower than the children without diagnoses (n=18) and especially in gross motor skills. It seems reasonable to involve the parents more closely in the children's follow-ups and because of the delays in speech production special focus should be directed to oral-motor development and its training.

Keywords: preterm infant, assessment of preterm infant, speech and language development, age correction, ecological assessment

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DEFINITIONS AND ABBREVIATIONS

Prematurity and birth weight

Preterm infant = an infant born before 37 weeks of estimated gestational age
Gestational age (ga) = estimated time since conception
In this study: younger preterm infants ga. 24-28; older preterm infants ga. 29-32

Chronological age = time since birth
Corrected age = age corrected for prematurity = chronological age in months minus prematurity months

Low birth weight (LBW)	< 2,500 g
Very low birth weight (VLBW)	< 1,500 g
Extremely low birth weight (ELBW)	< 1,000 g

AGA = appropriate for gestational age
SGA = small for gestational age
IUGR= intra-uterine growth retardation

Illnesses or conditions:

BPD = Bronchopulmonary dysplasia
CP = Cerebral palsy
IVH = Intraventricular hemorrhages
NEC = Necrotizing enterocolitis
PDA = Patent ductus arteriosus
PVL = Periventricular leukomalacia
RDS = Respiratory distress syndrome
ROP = Retinopathy of prematurity

Others:

CT = computerized tomography
IDC = individualized developmental intervention care
NICU = neonatal intensive care unit

CONTENTS

1 INTRODUCTION

Arvo Ylppö introduced the concept of a preterm infant (*keskonen*) for the first time in 1913 and suggested that a weight limit should be 2,500 g. This suggestion was approved by the American Academy of Pediatrics in 1935 and the World Health Organization (WHO) started to use the same definition as an international disease classification (Raivio & Österlund 1987). Thanks to Ylppö, the creator of a concept and the innovator of treatment practice, the Children's Castle, established in 1920's, received a treatment unit at a very early stage. The Hospital for Children and Adolescents began to take care of preterm infants in incubators in a special treatment unit in 1940's. (Raivio 1987.)

About 4% of all the newborns in Finland weigh less than 2,500 g. About 1% weigh less than 1,500 g (approximately 600 children) and 0,5% less than1,000 g (approximately 300 children). There has been about a 10 per cent growth in low birth weight (< 2,500 g) since 1987. (Finnish Perinatal Statistics 1991, 1992; Gissler, Rasimus, Ritvanen & Toukomaa 1996.) The number of preterm births is the lowest in Scandinavia and Holland (Saarikoski 1988). In the United States and Great Britain seven per cent of all the newborns weigh under 2,500 g and of this amount 10-15% weigh under 1,500 g (Wolke 1991).

Earlier, in the 1960's and 1970's in Finland, a child who was born before the 32nd week of gestation or weighed less than 1,000 g was practically considered lost (Österlund & Järvenpää 1987, 21). In a follow-up research in the years 1978 –1989 in Helsinki University Hospital the number of liveborn ELBW (under 1,000 g) infants, increased from 30 to 50 in a year during the first and last third of the follow-up (Järvenpää, Virtanen & Pohjavuori 1991). In the western countries (Wolke 1991; Vergara 1993, 18-19) over 25% of the children weighing 5,00 -7,50 g, over 50% of the children weighing 7,51 – 1,000 g, approximately 90% of the children weighing 1,001 – 1,500 g and 95% of the children weighing 1,501 – 2,499 g will survive. The reason for preterm birth is known only in half of the cases and the risk factors include e.g. problems in previous pregnancy history and socio-economic factors (Saarikoski 1988). Every third mother of a preterm infant has toxaemia and one fifth have miscarriages or earlier preterm deliveries (Österlund & Järvenpää 1987, 22).

Prematurity has been studied around the world from various aspects. Very often the point of view has been the medical one. In Finland several medical and also some psychological studies concerning prematurity have been made while e.g. speech and language development has been observed generally only from a few random aspects. The aim of this study was through an intensive follow-up to obtain a detailed and exact picture of speech and language development of preterm infants as a part of their overall development during the first two years of life. Research concerning the early stage (0–2 years) of speech and language and also mental and overall development of preterm infants (or even term infants) has hardly existed in Finland until now. This is at least partly due to missing assessment devices and norms in Finnish. In this study the assessments were made at the children's homes (ecological viewpoint) during their first two years of life. Because of the used assessment devices are not standardized in Finland the standards of these tests and other norm data available (e.g. well-baby clinics health card norms) were applied. Term peers for the preterm infants were not chosen. The comparisons were made inside the preterm group between without (n=18) and with diagnoses (n=6) groups and in respect for prematurity, birth weight and sex. Also the individual developmental pathways (0-2 years) of preterm infants were trailed. The milestones were assessed both at the corrected and chronological age.

In the theory part of this dissertation I clarify the concept of prematurity and the related illnesses and conditions. The effects of prematurity are viewed from the viewpoints of major and minor problems and separately in speech and language development. I present the models of causation (transactional model) and developmental models (synactive theory and at-risk child states) to describe the development of a preterm child. In the assessment part I highlight testing, applied devices, age correction and ecological viewpoint when assessing preterm infants' development.

2 DEFINITIONS, DISORDERS AND EFFECTS OF PREMATURITY

2.1 Definitions

The 2,500 g weight limit is still valid when defining preterm infants. Children under 2,500 g are classified as low birth weight (LBW; BW < 2,500 g), children under 1,500 g very low birth weight (VLBW; BW < 1,500 g) and those under 1,000 g are classified as extremely low birth weight (ELBW; BW < 1,000 g). Along with birth weight, another classification criterion is the length of gestation (pregnancy) at which the limit of being classified as preterm is the 37th week of gestation (Battaglia & Lubchenco 1967). Children born before the 28th week of gestation are classified as extremely preterm and nowadays a 23-week-old fetus is considered capable of living (Wolke 1991; Vergara 1993, 18).

Prematurity can be defined both on the basis of birth weight and length of gestation (Wolke 1991). Besides, it is important to observe and report the ratio between birth weight and gestation and for this reason Lukeman & Melvin (1993) and Aylward, Pfeiffer, Wright and Verhulst (1989) criticize researchers who do not do it. Birth weight can vary from 5,00 g up to 1,500 g, but in both cases the definition, very low birth weight, can be used (Mazer, Piper & Ramsay 1988). Towen (1986) suggested that VLBW infants should be classified at least in three groups: 1) extreme preterms with an appropriate birth weight (AGA); 2) less extreme preterms with a small for gestational age birth weight (SGA); 3) preterms - and occasionally a term infant - with an extreme SGA birth weight. Dunn (1986) also noted, that AGA and SGA preterm groups should be kept apart, and when talking about the SGA condition, term and preterm infants should also be separated in their own groups. The SGA condition should also be distinguished from the real intra-uterine growth retardation (IUGR) (Hollo 1999, 10). The length of gestation is actually a better predictor than birth weight, because nowadays it can be defined exactly by using ultrasound (Herrgård 1993, 13). Newborn infants can also be defined according to developmental risk while high risk infants are those who have been treated in NICUs (Vergara 1993, 19).

2.2 Disorders

2.2.1 Respiratory Disorders

Perinatal asphyxia (birth asphyxia) is often connected with high-risk pregnancies but also other unexpected complications may cause it (De Vries, Dubowitz, Dubowitz & Pennock 1990; Vergara 1993, 79). Children who have suffered from perinatal asphyxia have always low Apgar scores (Vergara 1993, 79-80; Österlund & Järvenpää 1987, 40), but e.g. preterm infants cannot be classified asphyxiated only on the basis of low scores (Kääpä 1997; Ruth & Raivio 1988).

The hyaline membrane disease or respiratory distress syndrome (RDS) is very common among preterm infants and it is caused by the lack of pulmonary surfactant in the lungs. In this illness ventilation is extremely difficult and these children need intensive breathing support varying from extra oxygen to intubation. RDS is common with preterm infants who are born before the 34th week of pregnancy. (Dabiri 1979; Kero 1997; Klaus, Fanaroff & Martin 1979; Soltesz & Brockway 1989; Vergara 1993, 80.)

Bronchopulmonary dysplasia (BDP) is the most common of chronic lung diseases among preterm infants and especially among the very low birth weight preterm infants. BPD is a chronic form of the RDS disease and a child with this condition needs long term respirator treatment as well as medical treatment e.g. surfactant treatment. (Kari & Hallman 1997; Klaus, Fanaroff & Martin 1979; Soltesz & Brockway 1989; Vergara 1993, 80; Österlund & Järvenpää 1987, 54-56.) Many preterm infants also have a pneumothorax and a disorder called "wet lung" which is believed to be caused by a delay in the reabsorption of lung liquid (Vergara 1993, 80; Österlund & Järvenpää 1987, 50-51).

2.2.2 Central Nervous System Disorders

Premature infants have fragile veins so that sudden changes in blood pressure and also stressful conditions may cause intraventricular hemorrhages (IVH). Bleeds have been classified in four grades according to their magnitude and difficulty (Papile, Burstein, Burstein & Koffler 1978). Forty to fifty per cent of preterm infants weighing under 1,500 g and 80% weighing under 1,000 g will develop some degree of IVH shortly after birth or within the 1st week. It is commonly seen with long respirator treatment and perinatal asphyxia while periventricular leukomalacia (PVL) can act as a severe form of IVH or as a separate problem. (De Vries, Dubowitz, Dubowitz & Pennock 1990; Fellman & Pihko 1997; Horwitz & Amiel-Tison 1979; Soltesz & Brockway 1989; Vergara 1993, 81-82; Clark 1989.)

2.2.3 Cardiopulmonary Disorders

Patent ductus arteriosus (PDA) is a very common disorder among preterm infants and it occurs when the fetal ductus arteriosus fails to close. In a fetus this duct connects the pulmonary artery to the aorta in order to bypass pulmonary circulation. When a child, for one reason or another gets the problem, the system reacts as if the child was still in the uterus and tries to transfer blood quickly to important places. It may open during the first living week and among very preterm infants even later. This disorder is cured by medication or surgery and restricted fluid intake. (Kääpä 1997; Vergara 1993, 81; Österlund & Järvenpää 1987, 58-60.)

2.2.4 Other Disorders

Retinopathy of prematurity (ROP) is a typical eye disease among preterm infants, especially among those with very low birth weights. It is often linked to the high contents of oxygen treatment but it is also met among preterm infants who have not been treated with oxygen. (Klaus, Fanaroff & Martin 1979; Soltesz & Brockway 1989; Vergara 1993, 82-84.)

Infections (bacteria or virus) are also very common among preterm infants, especially among those with extremely very low birth weights. These are acquired in hospitals and if an infection develops to a sepsis, a child's survival may be in a great danger. (Soltesz & Brockway 1989; Vergara 1993, 84; Österlund & Järvenpää 1987, 63-68.)

Necrotizing enterocolitis (NEC) is a serious disease, in which immature intestines are affected due to disturbances in blood circulation. These children have also suffered from other perinatal insults such as asphyxia, sepsis, hypoxia and respiratory distress. (Soltesz & Brockway 1989; Vergara 1993, 84; Österlund & Järvenpää 1987, 84-85.)

Hyperbilirubinemia (jaundice) is commonly seen in term and preterm infants. It is natural that the more premature the child the more unripe the liver is to handle bilirubin. This substance is toxic to the central nervous system (basal ganglia and hippocampus) and as neurological disorders, it can be seen in high-pitched cry or poor feeding and subsequent speech and language delays. (Clark 1989; Soltesz & Brockway 1989; Sorto 1997; Österlund & Järvenpää 1987, 69-74.)

2.3 Major disabilities

Preterm infants do not form a consistent group but a risk to be disabled is connected with the amount of prematurity and the character and difficulty of the related illnesses (Lester & Boukydis 1992). Herrgård (1993, 16-18) listed the following typical disabilities according to literature: cerebral palsy, mental retardation, visual disorders, defects of hearing and epilepsy. Lukeman and Melvin (1993) analysed literature concerning major disabilities which were diagnosed at birth or with certainty at 18 months of age. As major disabilities they named cerebral palsy, significant developmental delays and sensory deficits. They concluded that the percentage of disabilities was higher among preterm infants than among term population and this was especially true among VLBW and ELBW infants varying from 8 to 13% depending on the nature of research.

The more premature the child, the greater is the risk of death or disability. Of the intensive care unit children, who were born on the 30th-32nd week of pregnancy with birth weights maximum 1500 g, 18% died and 80% developed normally (Järvenpää & Granstöm 1987). According to these writers, permanent damages such as cerebral palsy did not increase even though preterm infants had neurological long term difficulties three times more compared to term ones. Aylward et al. (1989) concluded that improvements in neonatal care have resulted in lower mortality and decreased number of severe disabilities among low birth weight infants. Still as late as in the 1960's and 1970's in Finland, deliveries were not always managed efficiently enough, e.g. cesarean sections were not made, and as a result the child was often damaged (Österlund & Järvenpää 1987, 21).

Asphyxia increases the likelihood of neurological disorders and seizures, but it has been estimated that about 50% of children who suffer from asphyxia, do not have notable cognitive sequelae. Low Apgar scores (dealing with heart rate, respiratory effort, reflex irritability, muscle tone and color) do not necessarily predict later developmental delays: 95% of asphyxiated children with three scores or less at the age of five minutes, survived without cerebral palsy, mental retardation and neurological disorder. However, asphyxiated infants with early mild motor problems often have borderline to moderate mental retardation and delayed language development. Hypoxic-ischemic disabilities caused by asphyxia are also known to be the greatest reason of severe, nonprogressive neurological defects such as mental retardation, spasticity, choreoathetosis, ataxia and seizure disorders. (Clark 1989; Hegyi et al. 1998; Soltesz & Brockway 1989; Vergara 1993, 80.)

Research shows that lung diseases (RDS, BPD) may delay preterm infants' development. In cognitive assessments healthy preterm infants scored higher than RDS infants and further RDS infants scored higher than BPD infants (Creasey, Jarvis, Myers & Markowitz 1993). Lung diseases seemed to be better predictors of later development than socio-economic status (Myers, Jarvis, Creasey & Kerkering 1992). These diseases had impacts on mother-child relationship (Jarvis, Myers & Creasey 1989) and the degree of illness correlated significantly with some temperament characteristics (Ross 1987). BPD children also had much more infections during the first two years (63% vs. 20%), more neurological sequelae (37% vs.15%) and more eye illnesses (ROP) (12% vs. 0%) than their healthy preterm pairs with same ages (Hakulinen 1992, 86).

Preterm infants with intraventricular hemorrhages Grades I and II will usually recover with no sequelae, 80% with Grade III will have severe developmental delays and over 90% of infants with Grade IV will die or develop severe developmental delays. Although a few infants with severe IVH (e.g. Grade IV) develop normally, many infants with normal cranial ultrasounds are mentally retarded or they have problems with hearing or language development. Periventricular leukomalacia (PVL), which may result in cerebral palsy (diplegia spastica) and visuo-spatial and visuo-motor disorders, is also connected with the most difficult grades of bleeds. (Clark 1989; Vergara 1993, 82; Williams, Lewandowski, Coplan & D`Eugenio 1987.) Although the most difficult bleeds are commonly connected with developmental delays or neurological abnormalities (Ford, Han, Steichen, Babcock & Fogelson 1989) they predict central nervous system damage only to a limited degree because of the plasticity of the brains (Sostek, Smith, Katz & Grant 1987). Despite the greater amount of smaller infants, the proportion of infants without intraventricular hemorrhages increased from 50 to 85% in a study which was carried out in the years 1978 – 1989 in Finland (Järvenpää, Virtanen & Pohjavuori1991).

Hyperbilirubinemia (jaundice) can damage the basal ganglia and hippocampus and as long-term neurological outcome there can be spasticity, athetosis, sensorineural hearing loss, speech and language delay and memory and attention disorders (Clark 1989; Soltesz & Brockway 1989). According to a follow-up study (Hakulinen 1992, 63) of 612 preterm infants, there were diagnoses of cerebral palsy (2.6 %), BPD (2.6%) and ROP (0.3 %) during the first two years of life. Thirty one per cent of the children returned to hospital mostly due to infection, surgery (such as hernia) or neurological problems.

2.4 Minor disabilities

Hadders-Algra, Huisjes and Touwen (1988) defined minor disabilities as small neurological signs which were not visible and could not have traditional neurological diagnosis. Calame et al. (1986) introduced these disabilities as visuo-motor, language, fine and/or gross motor disorders or combination of two/three disabilities while language was always included.

According to Piper, Byrne, Darrah and Watt (1989) gross motor maturation of normally developing preterm infants follows rather corrected than chronological age during the first year. Very early birth was seen as an unfavourable development in fine motor maturation and it was connected with the sensorimotor system of looking (Van Beek, Hopkins & Hoeksma 1994). For this reason these researchers believe that the early sensorimotor deficiencies are in connection with later developmental differences in handedness and in cognitive and learning difficulties. Valvano and DeGangi (1986) noticed that there was a significant difference between preterm and term infants during the first year in shoulder retraction. This condition may cause problems for preterm infants to work with hands in midline which in turn may lower test results. The latest research (LeNormand, Vaivre-Douret & Delfosse 1995), however, gives some support to the hypothesis that language development is independent of motor skills as measured by formal tests.

In a prospective study Drillien (1972) trailed abnormal neurological ("transient dystonia") signs of 300 children during the first year of life and tried to find connections with later development. The incidence of transient dystonia increased with decreasing birth weight and at two and three years of age, children who had previously been dystonic were much more likely to have mental impairment and hyperactive behaviour than those who did not show abnormal neurological signs. Difficulties in concentration, impulsiveness and hyperactive behaviour in assessment situations proved to be very typical for preterm infants (Astbury, Orgill & Bajuk 1987; Astbury, Orgill, Bajuk & Yu 1990).

Olsén, Pääkkö, Vainionpää, Pyhtinen and Järvelin (1997) concluded that minor neurological disorders were more often connected with premature than with term infants. Siegel (1994) stated, that VLBW infants had among the major problems also minor learning and behaviour problems. As learning problems she mentioned especially perception and visual-motor functions and some aspects of language and reading. Therefore, research (Aylward et al. 1989) should focus on children with minor problems, such as poor visual-motor integration, spatial relations, problems in reading, language, mathematics and behaviour (hyperactivity and poor concentration). Lukeman and Melvin (1993) highlighted on the basis of literature the importance to study basic learning processes, motor development, visual-perceptual skills, language development, academic skills, behaviour and social-emotional development.

Aylward et al.(1989) analyzed 80 experimental studies, which were published in the 1970's and which studied the connection between low birth weight and later development. These follow-ups had continued at least one year and studies were carried out in North-America, Europe, Australia and New Zealand. The whole population consisted of 4006 children (1568 controls) from three different weight groups as follows: 27% < 2,500 g (low birth weight), 44% < 1,500 g (very low birth weight) and 29% < 1,000 g (extremely low birth weight). The average intelligence quotient (I.Q.) of infants with low birth weights was 98 and of controls 104. No differences were found among the two groups at two years of age, the means of low birth weight and control groups diverged from two years onwards. The control group means were approximately ½ SD above average, whereas the means of the low birth weight infants were in the average range.

2.5 Effects on speech and language development

It is believed that there is a connection between feeding skills and speech production. Infants usually do not develop movements in their sound play before they appear in feeding. Generally the movements that occur in feeding are refined for babbling several weeks or months later. All the infants born before the 35th week of gestation need tube feeding. "Clinical experience supports the view that when a child experiences difficulty with oral control in feeding, there will be similar oral control problems in sound production and speech". (Morris & Klein 1987, 308.)

The development of language, especially that of expressive language in preterm infants, seems to be delayed during the first two years of life (Montgomery et al. 1995). Preterm infants vocalize less during the first year of life and their vocalizing is monotonous (Mielo 1993; Ross 1985; Sajaniemi 1990), they increase their non-distress vocalization later (Beckwith, Sigman, Cohen & Parmelee 1977), and produce less two-syllable babbling (Eilers et al.1993; Jensen, Boggild-Andersen, Schmidt, Ankerhus & Hansen 1988) or show a tendency to produce well-formed syllables less consistently (Oller, Eilers, Steffens, Lynch & Urbano 1994) than full term infants do.

It has been shown, that at two years of age, preterm infants use verbalizations and gestures less frequently to express themselves (Landry, Schmidt & Richardson 1989), have a smaller vocabulary, less verbs and a shorter mean length of utterance (Seidman, Allen & Wasserman 1986) than full terms do. Besides the problems in expressive language, there may also be delays in verbal comprehension and symbolic development at two years of age (Cohen, Parmelee, Sigman & Beckwith 1988; Hubatch, Johnson, Kistler, Burns & Moneka 1985; Piekkala 1988, 47), and further at three years of age (Craig, Evans, Meisels & Plunkett 1991), at four years of age (Forslund & Bjerre 1990) and at five years of age (Herrgård 1993, 82; Luoma, Herrgård, Martikainen & Ahonen 1998).

Certain conditions and illnesses seem to be related to delayed speech and language development in preterm infants. Birth weight is known to be related to developmental outcomes and may greatly influence the reported test scores. The AGA and SGA -terms (AGA = birth weight appropriate for gestational age; SGA = birth weight small for gestational age) may also mislead to view different low birth weight groups in a homogenous fashion (Aylward et al. 1989). Preterm infants' speech and language development has therefore been studied from the viewpoint of VLBW and growth retardation. Although no neurological problems were identified, language and speech development of preterm infants weighing under 1000 g at birth was found to be delayed (Gonzales et al. 1997; Järvenpää et al. 1991; Menyuk, Liebergot, Schultz, Chesnick & Ferrier 1991; Portnoy, Callias, Wolke & Gamsu 1988). Certain research results (Matilainen, Heinonen & Siren-Tiusanen 1988; Martikainen 1992) identified the connection between the SGA-condition and delayed speech and language development, but in some studies the relationship was not found (Siegel et al. 1982; Vohr, Garcia-Coll & Oh 1988, 1989). In cases, where the AGA-preterms got poorer scores, the explanation was poor socio-economic status (SES) (Vohr et al. 1988, 1989) or perinatal conditions (need for longer mechanical ventilation, more incidences of birth asphyxia and apnea) (Siegel et al. 1982). Washington, McBurney and Grunau (1986) noticed that during the first year (at the ages of 3, 6 and 12 months) the SGA-preterms were better in their average language development than the AGA-preterms. However, the situation changed later so that at the age of 18 months there were no differences between the two groups and that at 4 and 6½ years of age the AGA-group was better. In van Beek's study (1993) the SGA-preterms differed most from term infants in the development of smiling and also in early mother-child interaction. According to research (Clark 1989; Majnemer, Rosenblatt & Riley 1993), preterm infants who have suffered from growth retardation in uterus were in a great risk for delayed development.

Intraventricular hemorrhage is related to preterm infants' delayed speech and language development and, especially, to expressive language (Bendersky & Lewis 1990; Byers-Brown, Bendersky & Chapman 1986; Grunau, Kearney & Whitfield 1990; Janowsky & Nass 1987; Ross, Lipper & Auld 1987). The outcome of a cerebral injury seems to depend on the type, size and location of the lesion, and to some extent, on the neuroplasticity of the developing brain. Preterm infants with small hemorrhages have a good outcome and they will develop as well as infants without any observed changes in ultra sound screening. (Fawer, Calame & Furrer 1985.)

Furthermore, lung diseases (Hubatch et al. 1985; Meisels, Plunkett, Pasick, Stiefel & Roloff 1987; Zarin-Ackerman, Lewis & Driscoll 1977) and chronic otitis media (Kenworthy, Bess, Stahlman & Lindström 1987; Pearce, Saunders, Creighton & Sauve 1988; Vohr et al. 1989) delay the speech and language development of preterm infants. A high level of noise in the early stage in incubator treatment may also damage hearing and delay subsequent language development (Clark 1989).

There are also studies that have found no differences between preterm and term infants' speech and language development. For instance, no differences were found between term and preterm infants in their phonological development and in the size of vocabulary when using either corrected or uncorrected ages or when comparing infants on the basis of risk factors (e.g. low birth weight, intraventricular hemorrhage, lung disease, chronic otitis media and socio-economic status). However, comparisons of the extremely low birth weight infants (ELBW) with term infants indicated that there was a significant difference between the two groups (Menyuk, Liebergott & Schultz 1986; Menyuk, Liebergott, Schultz, Chesnick & Ferrier 1991; Menyuk, Liebergott & Schultz 1995). Siegel et al. (1982) noticed that differences between term and preterm groups disappeared when using corrected scores at the age of two. It seems, that the differences, which can be seen in the beginning, will disappear with time (Greenberg & Crnic 1988; Mazer et al. 1988; Ungerer & Sigman 1983). Eilers et al. (1993) found that, at corrected ages, the preterm infants appeared to begin canonical babbling earlier than their fullterm counterparts. It is also suggested, that preterm infants may understand more language because they have been exposed to language for more weeks than full term infants (Stevenson, Roach, Leavitt, Miller & Chapman 1988).

A good interactional atmosphere at home and especially the quality of mother-child relationship (Beckwith et al. 1977; Crnic, Ragozin, Greenberg, Robinson & Basham 1983; Dale, Greenberg & Crnic 1987; LeBlanc 1989; Morisset, Barnard, Greenberg, Booth & Spieker 1990; Rocissano & Yatchmink 1983; Stevenson, Roach, Ver Hoeve & Leavitt 1990) and socio-economic status (Largo, Molinari, Comenale Pinto, Weber & Duc 1986; Largo et al. 1989; Stevenson et al.1988; Vohr et al. 1988, 1989) has been shown to be related to the advanced speech and language development of preterm infants. Also the mother's level of formal education has been found to have important influence on child development (Gerner 1999; Laakso 1999, 115). Early interactions provide a foundation for the development of infant's communication patterns (Field 1977) and teaching of feeding skills from the beginning in NICUs will support movements and processes considered necessary for speech production (Morris & Klein 1987, 315-318).

According to research it is possible to predict language development (Cohen et al. 1988; Largo, Graf, Kundu, Hunziker & Molinari 1990; Largo, Molinari, Kundu, Lipp & Duc 1990; McDonald, Sigman & Ungerer 1989; Siegel 1992) at school age by assessments during the first two years of life and later cognitive development by e.g. cry analysis (Lester & Boykydis 1992; Valanne, Vuorenkoski, Partanen, Lind & Wasz-Höckert 1967).

In conclusion the most common major disability of preterm infants is still cerebral palsy. Its incidence has remained stable during the past 15 years at approximately 8% among the very low birth weight group (Spitzer 1998). At school entry preterm infants are reported to have minor learning and behaviour problems which at the early years can be visible but so slight that a traditional neurological diagnosis is not compiled. Children may have at the same time fine or gross motor, visuo-motor or language delays but most importantly language is always included. Preterm infants have delays especially in speech production.

3 DEVELOPMENTAL MODELS AND ASSESSMENT

3.1 Transactional model and ecocultural theory

Sameroff and Chandler (1975) proposed a "transactional model of development", suggesting that environmental and social factors predict neurological outcomes of low birth weight infants better than perinatal events. While the medical model focuses only on the environment's impact on the organism, the transactional model adds the reciprocal effect of the organism on the environment. There is a continual and progressive interaction between the organism and its environment. The child's response is more than a simple reaction to his environment and he is actively engaged in attempts to organize and structure his world. Even under adverse circumstances the human organism tries to produce normal developmental outcomes and most infants who have suffered from perinatal problems have proven to have normal developmental outcomes. However, there are also failure-to-thrive cases where the children are often reported to be irritable, difficult to manage, to have unusually irritating cries and to be unappealing to hospital staff. It has also been shown that there is a strong connection between the course of pregnancy and the emotional state of the mother. According to the writers (Sameroff & Chandler 1975) the environment appears to have the potential power of minimizing or maximizing early developmental difficulties.

Also the ecocultural theory (Gallimore, Weisner, Kaufman & Bernheimer 1989) highlighted the importance of everyday life activities in child and family outcomes. In this theory families are not seen as objects of social and economical powers but as individuals who will prevent and change such powers by utilizing their own family values and attitudes. The components of activity settings include personnel present, values, purposes, tasks and scripts (interactional style). These ecological variables are believed to influence great on childcare and child development.

Even if the environmental and social factors alone do not explain developmental achievements or, on the other hand, delays or neurological problems of low birth weight infants (Dunn 1986) the transactional model is still well known in intensive care units (Wolke 1987; Als 1986). It has influenced the emergence of a new subdiscibline: environmental and developmental neonatology, in which a child's development is seen as an adaptation process between the internal (infant's behavior organization) and external systems (environment) (Wolke 1987).

3.2 Synactive model and neurosocial development

A synactive model describes the way, in which small preterm infants interact with their environment outside the uterus. The model includes internal and external systems in which the internal system relates to the physiological and behavioral organization of a child and the external system concerns the physical treatment environment and the handling of a child. According to the principles of the synactive theory the infant is in continuous interaction with the environment and that interaction is the basis of continued development. Behavior in any one subsystem affects the expression and development of other subsystems. The infant strives to balance between approach and avoidance behaviors in response to the stimuli. There are five subsystems of behavioral maturation which are hierarchical and thus emerge sequentially. (Als, Lester, Tronick & Brazelton 1982; Als 1986.)

The internal system explains how a newborn interacts with its environment through five behavioral systems, which are physiological (autonomic), motor, state, attention and self-regulation which in turn interact with each other (synactive development). The model describes the behavioral characteristics of newborns (FIGURE 1, Als 1986). *The physiological (autonomic) system* includes infant's respiratory pattern, heart rate, skin colour, autonomic movements such as tremors, startles, autonomic eye movements, sounds as sighs and behavioral indices of visceral control such as hiccoughing and gagging. *The motor system* includes infant's posture, movements, tonus and amount and degree of differentiation of activity. *The state system* includes eye movements, eye opening and facial expressions, gross body movements, respirations and tonus aspects to determine a child's level of consciousness (sleep and awake states). *The attentional/interactive system* includes the quality of the infant's alert state, the duration of the infant's responsiveness to animate and inanimate stimuli, and how the infant utilizes his alertness to attend to and interact with various social stimuli and inanimate objects. *The regulatory system* includes strategies which a child uses to maintain himself and to return to a balanced baseline. Infants who are born before term, often lack maturity and stability in part or all of these subsystems and they are unable to coordinate the systems to be in well adapted interaction with the environment. These behaviors serve as cues to caregivers and parents, who can through these signs understand the child better in interactional situations. By quoting Als (1986) Rossetti (1996, 171) names as self-regulatory and approach behaviors smooth respiration and pink colour, well-modulated posture and clear sleep states. On the other hand as stress and defence behaviors can be seen yawning, motor hypertonicity and crying. The design of assessment of functioning is thought to be proper throughout the life span of the organism. (Als et al. 1982; Als 1986.)

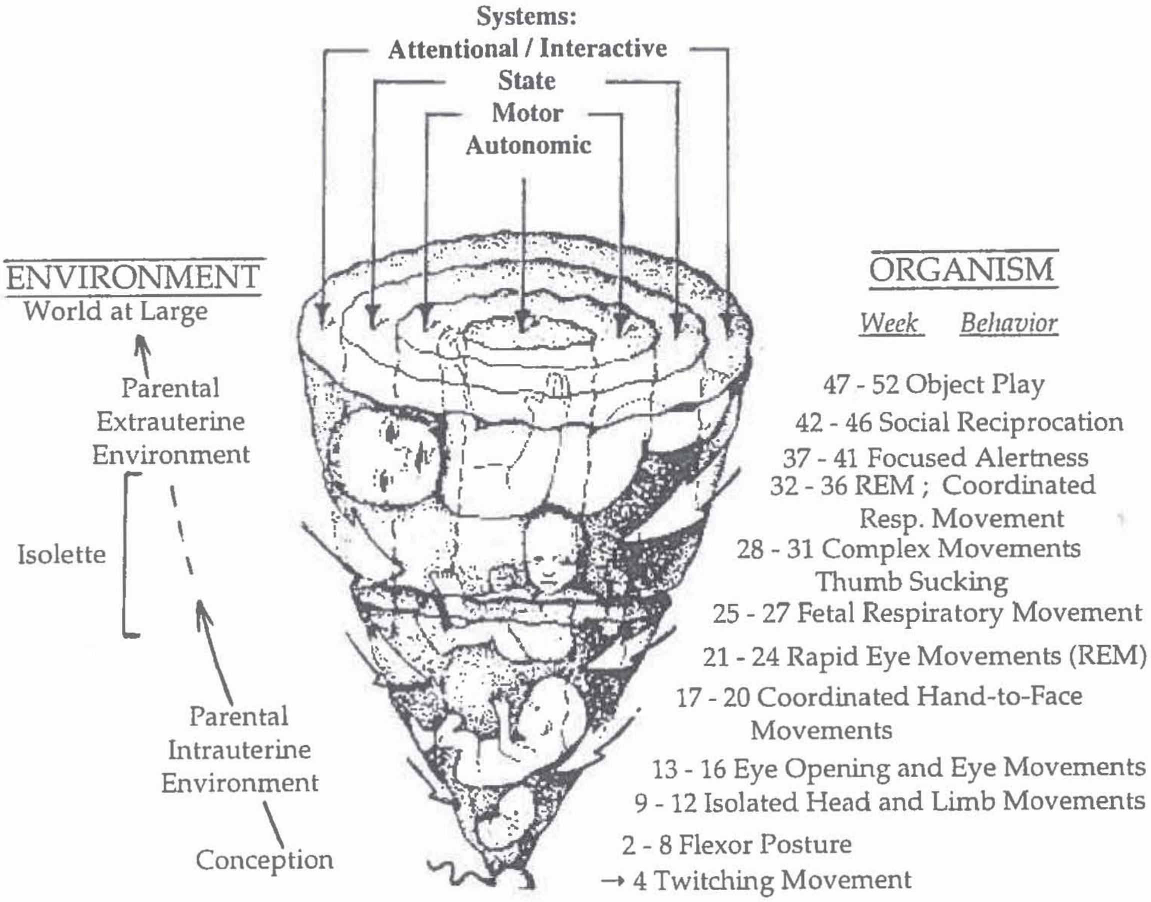

FIGURE 1 Model of the synactive organization of behavioral development (Als 1986)

Miller and Holditch-Davis (1992) studied situations where the parents were incorporated in the process of evaluating the behavior of their preterm infants in order to learn to know their child and interpret his or her cues. The results showed that nurses and parents provided different stimulation: nurses were more likely to engage in procedural care and parents more likely to hold, talk to, move and touch the infants affectionately. Infants did more sleep-wake transitions, larger body movements and jitters when with nurses and more active sleep and smiles with parents. As early as in 1979 Gorski, Davidson and Brazelton had paid attention to the neurosocial behavioral development of preterm infants. According to the authors, preterm infants progress through three developmental stages before they gain the necessary stability in the subsystems to interact effectively. The stages that have been identified are turning in, coming out, and reciprocity. Social interaction should be avoided with infants who are still in the turning-in stage (under 32 weeks of post-conceptional age), because their energies are focused on achieving physiological stability. In this stage we can influence the environment and support the family. Infants in the coming-out stage (between 32 and 35 weeks of post-conceptional age) can tolerate monitored social interaction, but caregivers must respect the infant's physiological stress signals and schedule interaction interventions around the infant's best periods. At the final stage of reciprocity (older than 36 weeks of post-conceptional age) infants are ready for, and have a good tolerance for social interaction.

The external system refers to the various aspects of the physical and caretaking environment, handling and optimal positioning of the child. It has been observed that more careful handling (individualized behavioral care) and longer resting periods can significantly reduce hypoxemia. The NICU-environments have been improved by reducing pain, stress and other harmful conditions (bright lights, unclear day-night cycle, noise) that may have adverse short- or long-term effects on infants. It has been estimated that the noise level in a child's incubator can be as high as 85 decibels so that it disturbs the child's dream and may cause hearing loss (Clark 1989). Preterm infants are also offered different therapeutic experiences in the form of water mattresses, sheepskin, "nesting", swaddling blankets, massage, music or other auditory stimulation (mother's heart beat or voice) and opportunity to suck during and between gavage feedings. During tube feeding the children can suck a specially designed "suckel" and feeding takes place in a quiet corner without simultaneous talking to or looking at the infant. Furthermore, non-nutritive sucking has been found to be significantly beneficial in terms of oxygenation and quieting the baby. According to the study, the utilization of individual care approach of VLBW - infants shortened e.g. respiratory treatment 24 days and tube feeding 30 days compared to controls (Als 1986.)

When there is a balance between the internal and external systems, the development of a child progresses well, but if the balance is missing development can be deviant. Fortunately, due to the plasticity of the central nervous system and the adaptability of a child's internal system, an infant can deal with a number of reproductive or environmental hazards. (Wolke 1987.) In conclusion, it is believed that through changes in the physical and care taking environment it is possible to decrease the most common minor problems of preterm infants: language disorders, behavioral problems (hyperactivity and attention disorders), poor visual-motor integration, and deficits in spatial relations (Als et al. 1986; Aylward et al. 1989; Blackburn 1998; Buehler & Als 1995; Lawhon & Melzar 1988; Miller & Holditch-Davis 1992; Mouradian & Als 1994; Schwartz, Moody, Yarandi & Anderson 1987; Wolke 1987).

3.3 Applied devices

Als et al. (1982) developed an instrument for the Assessment of Preterm Infants' Behavior (APIB) on the basis of the Brazelton Behavioral Assessment Scale (1973 1984). This device assesses such behavioral systems as the physiological, motor, state, attention and self-regulation of newborns. The functioning of the systems is observable without technical instrumentation. After the newborn period preterm infants' development is assessed by term infants' scales and tests. According to a comprehensive study (Aylward et al. 1989) the most widely used assessment device outside hospitals to measure mental (including language) and/or motor development of preterm infants during the first two years of life has been the Bayley Scales of Infant Development (1969). The test is, however, standardized for healthy term infants and it does not take into account the developmental problems of preterm infants. In recent years there have been efforts to evaluate and validate the Bayley Scales of Infant Development-II with regard to its use with premature infants (Ross & Lawson 1997). Vietze (1988) wrote, that traditional tests are based on estimations whether the child passes or fails certain items. They do not measure mental processing or the ability to learn and none of them is specialized in testing disabled infants or those at risk of developmental disabilities. As comparative research has shown consistently that the neurological maturity of preterm infants takes place later than that of term infants' (Manfredi & Poropat 1987), the skill-area estimations should clearly specify and focus research on motor and language skills separately when comparing the development of preterm and term infants (Mazer et al. 1988).

Zelazo (1989) criticized, that only a few test developers even try to separate verbal and physical expression from the central processing ability of the brain. During the first 1½ years, the majority of mental items of the Bayley Scales (1969) for example, require age appropriate neuromotor skills either directly as in neuromotor items (" reaches for a dangling ring") or indirectly as measures of imitation ("pushes car") and in language comprehension items ("points to shoes"). Moreover, the writer continues that a child's success in conventional tests requires good cooperation with a strange examiner. A difficulty on any of these areas – neuromotor skills, speech production or co-operation with a stranger – will affect performance and may lead to an underestimation of the child's mental ability, which may in turn influence negatively on the parents' attitudes.

In the information processing approach (Zelazo 1989) it is possible to bypass the traditional body-mind dichotomy which has ruined many studies on prematurity. In contrast to traditional intelligence tests, the approach requires a minimum amount of movement and no speech production (McDonough 1988). In process-oriented research the focus is on visual attention and habituation to novel stimuli (ability to encode, extract and retain information) and visual preferences (Fagan, Singer, Montie & Shepherd 1986; Kopp & Vaughn 1982; Landry & Chapieski 1988; Lewis & Brooks-Gunn 1981; Rose 1983; Sigman, Cohen & Forsythe 1981; Sigman & Parmelee 1974) and auditory processes (Fox & Lewis 1983; Kurtzberg, Stapells & Wallace 1988; Wallace, Escalona, McCarton-Daum & Vaughan 1982). While using process-oriented assessment, it is possible to detect delays in the early stage and to start interventions earlier with more specific therapy procedures (Fagan 1988; Manfredi & Poropat 1987; Lukeman & Melvin 1993; Ruff 1988; Zelago 1989). According to many writers, research should focus on preterm infants' basic learning processes, language, visual-motor integration and visual-spatial relations and behavioral problems (attention and hyperactivity) (Astbury, Orgill, Bajuk & Yu 1983; Aylward et al. 1989; Calame et al 1986; Lukeman & Melvin 1993).

Until today we have lacked reliable, easy-to-use assessment tools for parents for detecting infants at risk at the early stage. More lately, Squires, Bricker & Potter (1990, 1993) developed the Ages and Stages Questionnaires at the University of Oregon on the grounds of the well known norm-referenced tests. The primary goal was to develop an economic and accurate screening device to find children, who need further research and on the other hand, to identify those children, who will survive without any intervention.

3.4 Age correction

It has been shown that the development of preterm and term infant is equal if the appropriate age correction is made (chronological age minus prematurity). There is not, however, complete consensus whether correction for prematurity should be used or not, and what its degree would be. Siegel (1983) stated, that the use of correction may be appropriate in the early months, because then, the degree of maturity has the most influence on test results. Both corrected and uncorrected ages should be used when assessing first-year development, especially in very premature children (Matilainen 1987; Siegel 1994). According to the research (Blasco 1989; Lems, Hopkins & Samsom 1993), mental and motor functions should always be separated and full or partial (e.g. half) correction used. Full correction should be used in the assessment of mental development of relatively healthy preterm infants during the second half of the first year, but for the motor development during the same period a partial correction would seem to be more appropriate (Lems et al. 1993). Blasco (1989) concluded, that in the early months of infancy (probably up to four months) full correction in any developmental domain is an over-correction, none is too little and half correction appears to be the best compromise. The writer continues that after six months of age partial or no correction for language and partial correction for visual-motor skills seems to be the most appropriate strategy. Belcher and Gittlesohn (1997) noticed that uncorrected scores of Clinical Linguistic and Auditory Milestone Scale (1986) correlated best with psychometric test results (e.g. Bayley). These writers suggest, however, that partial correction during the first year should be further evaluated. On the basis of their research Menyuk et al. (1995) reported that there was no need for age correction in language comprehension and speech production during the second year. It has been argued that age correction should be continued up to the age of two years and in some studies it seemed to be influential even in middle childhood (Aylward 1988; Aylward et al. 1989).

While using corrected ages there is a danger, that developmental difficulties may not be apparent at an early age and that children therefore may be discharged too early to the healthy group and therapy will start too late (Lems et al. 1993; Lukeman & Melvin 1993). In conclusion, the question of age correction is very complicated, because preterm infants are born into an environment where they are poorly adapted (DiPietro & Allen 1991). While analysing 80 studies concerning prematurity Aylward et al. (1989) noticed that age correction was applied in 59% of the studies, whereas chronological age was used in 20%. Use of correction was not specified in 21% of the investigations.

3.5 Ecological assessment

Ecological assessment techniques include informal observation methods as well as formal assessment approaches and a child is appreciated in test situations more as an active partner than an object. The child is assessed in different environments and in different activities, and, moreover, the families' culture, socio-economic status and values are also observed. It is possible to carry out the assessments by professionals and/or by parents in familiar home environments. (Fewell 1991; Thurman & Widerstrom 1990, 191-206.) Rossetti (1996, 102, 134) points out that because the assessment should identify the child's current level of functioning (strengths) it makes sense that the most naturalistic environment for assessment is the child's home. During the past ten years the parents are used as experts in language inventories (e.g. Fenson et al. 1993; Rescorla 1989) and in questionnaires concerning overall development (Squires, Bricker & Potter 1990, 1993). In the latter case the parents assess their at-risk infants' (e.g. preterm infants') development in communication, gross and fine motor, adaptive and personal-social skills at 4, 8, 12, 16, 20, 24, 30 and 36 months of age (nowadays also at 6, 18 and 48 months) at home and send the questionnaires to the follow-up centers.

For various reasons it is valuable to use the parents as experts. Squires, Nickel and Bricker (1990) state that parents have information often unavailable to professionals (e.g. the characteristics of the child, behaviour in home environment). The extra information given by the parents enlarges the knowledge about the child's skills and increases the validity and the reliability of developmental testing. On the other hand, the parents may increase their knowledge about child development and increase their participation in the intervention program. The contribution of the parents in the assessment system can also be a cost saving manoeuvre. In the United States it is ruled by the law that the parents and the professionals co-operate while working with the children (Squires, Nickel & Bricker 1990.) However, the real co-operation between the parents and the professionals cannot be fruitful only on the basis of the law but on the basis of true interest in parents (Ferguson & Ferguson 1987). Squires et al. (1990) regret that many doctors trust clinical assessment more than the questionnaire assessment made by the parents at home. They mention that through the questionnaires the parents could actively participate in the discussions concerning their child's development and the professionals would learn to know the parents' opinions better. It has also been proved, that the parents presence during the administration of infant assessment and their participation in the child's rehabilitation as program realizers have positive developmental effects on a child (Constantinou & Korner 1993; Katona 1988; Resnick, Amstrong & Carter 1988; Riesch & Munns 1984).

In conclusion the ideas of preterm infant care have changed radically during the last forty years: earlier e.g. deliveries were not always managed efficiently enough and as a result the child was often damaged. Transactional, synactive and state (neurosocial development) models have revolutionized the old ideas. A preterm child is seen in these models as a human being from the beginning and not an object for new technical advances in infant care. With the help of these models we can also learn to read infants' cues for their comfort and discomfort. Research (Buehler & Als 1995; Mouradian & Als 1994) has convincingly proved that individualized developmental intervention care improves dramatically the outcome of preterm infants. The results of these improvements are then possible to see e.g. in later school achievement (Blackburn 1998). It is very likely that those improvements also diminish later speech and language problems. Until these days we have lacked assessment tools for older preterm infants. Now there are efforts to validate the Bayley-II also for the use with premature infants (Ross & Lawson 1997), and the parents have received e.g. ASQ (Squires, Bricker & Potter 1993) for assessment of their preterm and at-risk infants. Unfortunately in Finland we still lack Finnish versions with standards on these tests. In the question of age correction there is not complete consensus.

4 RESEARCH QUESTIONS AND METHODS

The aim of this study was through an intensive follow-up to obtain a detailed and exact picture of speech and language development of preterm infants as a part of their overall development during the first two years of life. The developmental pathways were followed in the context of perinatal risks at birth and in an everyday life course from birth up to the corrected age of two years. An ecological viewpoint was applied: assessments, interviews (also telephone interviews) and video recordings were made at children's homes.

More specifically, the following research questions were addressed:

1. How did preterm infants with and without diagnoses develop during the first two years of life in different domains: speech and language development, mental development and overall development?

2. How did preterm infants with and without diagnoses develop during the first two years of life as assessed by different devices at corrected and chronological age?

3. How did prematurity, birth weight and sex appear in the assessment results?

4. How did risk score at birth and cumulative risk score at two years of corrected age appear in the assessment results?

4.1 Project

The study started in1990 as a part of the bigger projects *Multidisability, family and childhood* (1.8.1990-31.5.1993) and *Early interaction of small preterm infants and supporting parenthood* (1.6.1993-31.12.1994). There were several researchers involved in this project while three of them concentrated on preterm population: development of parenthood (Virpiranta-Salo), communication of the families with health professionals (Laukkanen 1995) and preterm infants' development (this study). The licentiate thesis of logopedics (Riitesuo 1995) "Achievements of the speech and language and motor and mental development of small preterm infants from the expected time of delivery to one year of corrected age" was written for the University of Oulu. The projects were carried out at the University of Jyväskylä, in the Department of Special Education. The selection criteria of the target group were negotiated with the hospitals and the conclusion was: children who will participate in this study should be born on the 33rd week of pregnancy or earlier and their maximum birth weight should be 1500 g. The strict weight limit was later abandoned because the weight of a child can rise for various reasons (e.g. mother's medication). All the children of the follow-up (N=24) were born before the 33rd week of pregnancy and three of the children weighed more than 1500 g. Other selection criteria were not chosen. The hospitals gave the information letters to parents, who then contacted the researchers if interested.

4.2 Subjects

This research included 24 small preterm infants (13 girls and 11 boys) who came from three hospital districts in Finland: Central Hospital in Jyväskylä (n=9; intensive follow-up group), Helsinki University Hospital (n=9) and Oulu University Hospital (n=6). The children were born in the years 1991 and 1992. Every year approximately 3000 children are born in the Central Hospital in Jyväskylä and 0,5 % weigh less than 1500 g. In 1991 14 children weighing less than 1500 g (seven weighed less than 1000 g) were born in the Central Hospital in Jyväskylä (153 in Helsinki and 57 in Oulu) and in 1992 the number was 17 when ten weighed less than 1000 g (139 in Helsinki and 51 in Oulu). In 1991 there were 14 preterm infants weighing less than 1500 g born in the Kuopio University Hospital and in 1992 there were seven, whose treatment was continued in Jyväskylä according to their parents' area of residence. Thus there could have been 52 candidates for the intensive follow-up in Central Finland, but only nine of the families contacted the project on the basis of information letters and they were included in the follow-up. (Perinatal Statistics 1991, 1992.)

In the group there were preterm infants with different starting points including from subtle problems to severe conditions and diseases (e.g. asphyxia, cerebral haemorrhage, difficult lung disease) at birth. In my licentiate thesis (Riitesuo 1995) I examined the development of three preterm infants during the first year of life at the corrected and chronological age. These infants had good starting points (e.g. Apgar 9/9) and they were free from serious illnesses.

Term controls were not chosen while the data from test standards and literature was applied. In the beginning there were discussions about the controls but this design was difficult to carry out because of the amount of bureaucracy it would have required. According to today's viewpoint (van Beek 1993), instead of comparisons between term and preterm groups, research should also focus on different subgroups inside the preterm population.

4.3 Subject characteristics

The preterm infants of the project (N=24; 13 girls and 11 boys) were born on the 24-32 week of pregnancy (average 28). Prematurity varied from 50 to111 days (average 81). The lowest birth weight was 530 g and the heaviest child weighed 2280 g (average 1066 g). The average birth height was 36 cm. There were two children who were not intubated at all whereas the other children's respiratory treatment varied from one day to 68 days (average 19). Tube-feeding time varied from 21 to 107 days (average 59 days) and the children spent 29 - 158 days (average 79 days) in hospitals. The Apgar scores at birth varied from high (9/9) to low (1/5). (See Appendix 1.)

Besides prematurity and low birth weight or severe SGA-condition (n=1), the children had other conditions and diseases typical for preterm birth. The most common was lung disease, while RDS was diagnosed in 13 and BPD in nine children. Two children did not have lung disease at all. Nine of the children had PDA, ten hyperbilirubinemia, seven infectio neonatorum or sepsis and two ROP. Three children had one or two diagnoses at birth, 12 children had 3-5 diagnoses and nine children had six or more diagnoses. During the first two years there were twelve children who visited the doctors' consulting hours several times, eight children who had a few visits and four children who had no visits. These visits mainly concerned breathing and ear infections because 15 of the children had an ear infection and 11 had four or more of these. After the early stages two of the children needed bigger surgeries (heart, intestines/NEC) and a few children needed smaller operations for problems such as hernia. During the first two years 13 children received for physiotherapy (dystonia musculorum or CP diagnosis was cancelled from four children at one year of corrected age), seven for lung therapy (emptying), four for occupational therapy and two children for feeding therapy. Ten of the children were diagnosed to have a shoulder retraction.

Children, who were diagnosed to have motor delay still at the age of two (n=1) or CP-injury (n=5) formed the group with diagnoses of this dissertation. They all had findings either in ultra sound of the head or in EEG. Among these children there was, however, one CP-child who had a finding in ultra sound in the beginning but later there were no findings and the CT result was normal as well (Apgar 8/9). Two of the children had a cerebral haemorrhage (Apgar 3/7; Apgar 6) and those three children, who were diagnosed as asphyxiated, had Apgar scores as follows: 2/7, 5/7 and 6/8. The children mentioned above (n=6) were born in the 32nd (weight 2280 g), 29th (weight 915 g), 27th (weight 970 g), 25th (weight 885 g), 24th (weight 820 g) and 24th (675 g) week of pregnancy. In the group without diagnoses there were 18 children in this dissertation. Seven of these children had 1-minute Apgar scores four or under (4/3; 4/5; 4/8; 2/6; 2/6; 2/7 and 1/5) and three had suspected abnormal ultra sound findings in the beginning. The method of categorizing infants into with and without diagnoses groups was retrospective. (See Appendices 1 and 2.)

In eight of the cases the mother had toxaemia and in three of the cases a twin pregnancy was connected with premature birth. Other conditions connected with premature birth were infections, problems with the uterus or placenta, contractions or discharge of the amniotic fluid. In two cases the reason was not reported. Thirteen of the children were delivered by cesarean section.

Seventeen of the children were born as firstborns. In six families the child had one or two siblings and in one family there were four siblings. During the second follow-up year, four of the children were at daycare outside home and some of the children had a babysitter at home if the mother was at work. Two of the children belonged to a bi-lingual family in which the parents spoke their own native language to the child. Excluding one family (the father lived abroad), in all other families the child had two parents at birth. The marital status was either married or cohabitation. During the follow-up three couples got divorced. When the child was born, the mother was 29 years old on the average (the youngest was 19 and the oldest 38) and the father was 28 years old on the average. Ten of the mothers and eight of the fathers had high school diplomas and the rest had passed the grammar school or the comprehensive school. All the fathers had occupation and they worked outside home or in their own businesses. During the follow-up, four of the fathers were unemployed for short periods. The mothers had occupations or they studied. Three of the mothers were so young that they were just planning their studies. The variety of occupations of the parents was rich. Fourteen of the families had, according to their own announcement, good incomes, eight families had medium incomes and two families' incomes were below the average. The children lived in the country side, in a major population center or in the city with their families.

4.4 Data collection

The data collection started in spring 1991 and ended in summer 1994. The children (born in years 1991 and 1992) were observed from the date they were expected to be born to the corrected age of two years. The data included video recordings on the children (except for one child), field notes on observations and the parents' interviews (also telephone interviews), test results and hospital documents. In addition, the parents kept diaries on their child's development concerning gross and fine motor milestones, speech production and language comprehension during the follow-up period. The parents received copies of the video recordings during the whole follow-up.

Children born in the Jyväskylä area (n=9) formed the intensive follow-up group of the study. I visited homes (one telephone interview) once a month during the first year by timing the first visit to the expected day of birth, if the child was already at home or the families had contacted us. During the second follow-up year I contacted these children every two months. I started the follow-up with six children at the corrected age of zero months (expected date of birth) and with three children at the corrected age of one month. I managed to contact (home visit or telephone interview) eight infants according to the schedule at their corrected ages through the whole follow-up. The visits of the 7th, 8th, 9th,10th months of one child were missed because the child was not in Finland. The last visit on this child took place at the corrected age of 26 months because of the reason mentioned above. One visit at the corrected age of 5 months, five visits at the corrected age of 20 months and four visits at the corrected age of 22 months were carried out as telephone interviews. Altogether there were 153 visits and 10 telephone interviews during the two-year follow-up in different parts of Central Finland. (See Appendix 3.)

Children born in the Helsinki and Oulu areas (N=15) were met as a rule at the corrected age of 0-2 (as soon as they were returned from the hospital) 9, 18 and 24 months and the families were interviewed by phone about the children's development at the corrected age of 12, 16 and 20 months. There were 63 personal visits and 41 phone interviews in the Helsinki and Oulu areas. There were also 32 video recordings available on these children (e.g. the corrected ages of 4 and 6 months) made by the family researcher Maija Virpiranta-Salo. In the Jyväskylä, Helsinki and Oulu areas there were together 216 personal visits and 51 telephone interviews. (See Appendix 3.)

4.5 Applied assessment devices

The idea was to get a comprehensive figure of the development of preterm infants even though the main focus was on speech and language. The measures were chosen on the basis of the literature between the widely used tests and scales. Research dealing with the very early stage (0 – 2 years) and especially that of speech and language development of preterm infants (or even term infants) hardly existed in Finland until this. Therefore, one of the side objectives of this study was to introduce tests developed for this early stage. As the applied assessment devices were not standardized in Finland, the original standards of these tests and other norm data available (e.g. the well-baby-clinics health card norms and literature) were used. (See Table 1.)

TABLE 1 Applied developmental tests and scales

Device	Age Corr / Chron
The Ages and Stages Questionnaires: A Parent-Completed, Child Monitoring System (*ASQ*) Revised Edition (Squires, Bricker & Potter 1993).	Corr: 4, 8, 12, 16, 20, 24 Chron: 4, 8, 12, 16, 20
The Bayley Scales of Infant Development (Bayley1969)	1-12; 14, 16, 18, 24 Corr / Chron
The Receptive-Expressive Emergent Language Scale (REEL-2) Second Edition (Bzoch & League 1991)	1-12; 14, 16, 18, 24 Corr / Chron
The Reynell Developmental Language Scales Second Revision (Reynell & Huntley 1985)	Corr 18, 24
Other milestones (child's health card, literature)	during visits Corr /Chron

4.5.1 Ages and Stages Questionnaires (ASQ)

These questionnaires were developed at the University of Oregon (Squires, Bricker & Potter 1990, 1993) on the basis of the well known norm-referenced tests such as the Bayley Scales of Infant Development (1969), the Revised Gesell Developmental Schedules (Knobloch, Stevens & Malone 1980) and the Ordinal Scales of Psychological Development (Uzgiris & Hunt 1975).

This device estimates the development of at-risk children, especially of preterm infants at 4, 8, 12, 16, 20, 24, 30 and 36 months of age (nowadays also at 6, 18 and 48 months). The primary goal was to develop an economic and accurate screening device to find children, who need further research and, on the other hand, to identify those children, who will manage without any intervention. The parents assess their children's development at home by using the questionnaires which they send to the follow-up centers. Each of the eight questionnaires includes 30 questions from five domains: communication, gross and fine motor, adaptive and personal-social skills. There are six easy-to-understand questions in each domain and at the end of each questionnaire there is space for general comments dealing with, e.g. language and hearing. The items can be scored yes (one point), sometimes (0.5 points) and not yet (no points). Cutoff points vary according to the domain and the age of the infant. In this study different developmental domains were assessed at the chronological ages of 4, 8, 12, 16 and 20 months and at the corrected ages of 4, 8,12, 16, 20 and 24 months by the researcher using all available information: straight and video observation, straight and telephone interviewing, byproducts of other scales and tests (See also Riitesuo 1993). At that moment there were no translations in Finnish and for this reason the researcher filled out the questionnaires.

4.5.2 Bayley Scales of Infant Development

The Bayley Scales of Infant Development (BSID) (Bayley 1969) are the most widely used and most carefully standardized measures of infant development (0-30 months). The Mental Scale consists of 163 items that assess sensory discrimination, eye-hand coordination, object permanence, vocal ability, verbal knowledge, and elementary problem solving (Gibbs 1990). In the assessment the child receives a certain number of raw scores which can be read in tables as Mental Developmental Index (MDI) while the mean is 100 regardless of age, and standard deviation 16. Three intensive follow-up group children were assessed monthly during the first year and further at the corrected ages of 14, 16, 18 and 24 months during the second year. The other children in the intensive follow-up group were assessed every two months during the first 18 months and further at the corrected age of 24 months. The children from the Helsinki and Oulu areas were assessed during the visits at the corrected ages of 9, 18 and 24 months. The raw scores were checked according to corrected and chronological ages.

4.5.3 Receptive-Expressive Emergent Language Scale

The Receptive-Expressive Emergent Language Scale, Second Edition (REEL-2) (Bzoch & League 1991) measures the development of speech production and language comprehension from birth to three years of age by observing the children and interviewing the parents. The checklist (132 items) includes phonemic, morphemic, syntactic and semantic levels and the items will be scored as typical, emerging or not observed behaviour, and the ceiling interval is found when the child receives at least 2 plus (+) item scores in the highest level. The achievement levels can be presented as ratios which are obtained by dividing the language age (in months) by the child's chronological age (in months) and multiplying it by 100. The ratios were counted according to corrected and chronological ages.

4.5.4 Reynell Developmental Language Scales

The Reynell Developmental Language Scales (Reynell & Huntley 1985) estimate general receptive and expressive language skills between the ages one and seven years. The child identifies pictures and objects and handles objects according to given orders. In the expressive items the child is scored on the expressive use of language with objects and pictures. In both parts the child receives a certain number of raw scores which can be read as equivalent verbal comprehension and expressive language ages (years and months) in the Reynell scoresheet. The levels of normal performances for comprehension for 18-month-old children are 12-7 points (- 1 SD) and for production 14-9 points (- 1 SD). Respectively for 24-month-old children the levels for comprehension are 20-13 points (- 1 SD) and for production 22-15 points (- 1 SD). The scales are intended only for use by experienced examiners who must strictly follow the instructions while testing. Preterm infants in this follow-up were assessed by this device at the corrected ages of 18 and 24 months.

4.5.5 Other measures

Data concerning the so-called health card milestones was collected in co-operation with the parents (diaries) and the researcher. The Finnish form of a child's health card was developed on the basis of well known norm-referenced tests and scales in 1980 (Vakkilainen 1994). The other norms applied to describe separate gross and fine motor (see Appendix 4) and speech-communication skills (see Appendix 5) were derived from the Sequenced Inventory of Communication Development (Hedrick, Prather & Tobin 1984) and literature Hellbrügge & von Wimpffen (1973), Largo, Molinari, Weber, Comenale Pinto & Duc (1985), Oller (1980) and Stark (1980).

The milestones when children begin to vocalize or coo or begin to produce canonical babbling (health card) or comprehend 100 words or produce 50 words (Menyuk et al. 1995) were checked. The connection between steady sitting and putting words together (Lenneberg 1968) was assessed. The children were also classified according to the rate of the vocabulary growth as early fast, late fast and slow developers (Menyuk et al. 1995). In this connection the ability to produce long sentences (more than 2-3 words) and to articulate clearly at two years of corrected age was observed. The milestones were checked at the corrected and chronological ages (vocabulary growth only at chronological age).

4.6 The validity and reliability of applied devices

Validity refers to the degree of how well a test measures the ideas it is intended to measure. However, this general definition does not take into account the fact that there is more than one kind of test validity. Reliability is the consistency with which an instrument measures a phenomenon over time and between different valuers. (Borg & Gall 1989, 249-257.) Thurman & Widerstrom (1990, 165-190) stated that the validity of infant assessment can be considered good also on the basis that the test developers have borrowed items from each other. The writers continue that the reliability of infant tests is usually considered adequate, but with at-risk children the same reliability levels as with normally developing children may not be reached. The at-risk children can be bad-tempered, get tired more easily and the level of their activity can be higher and the level of the attentiveness may be lower compared to other children.

The validity and reliability of the ASQ has been found to be good in many different studies. The ability of the questionnaires to find children who will develop normally is significant, but their ability to find those who will develop abnormally is lower. The developers of the questionnaires suppose that one reason for that might be the small number of abnormally developing children in each age group. The device has been found to be economic, accurate and appropriate both for the use of professionals and parents in finding children who need further research. (Bricker & Squires 1989a, 1989b.)

The validity and the reliability of the questionnaires has been examined in two different studies (Squires, Bricker & Potter 1993) where the assessments made by professionals using the Revised Gesell Developmental Schedules (Knobloch, Stevens & Malone 1980) and the Bayley Scales of Infant Development (1969) were compared to the assessments made by parents using the ICMQ (nowadays ASQ). In the first study the agreement varied from 79% (four months) to 94% (16 months) and from 85% (30 months) to 91% (12, 20, 36 months) in the second study. The interobserver agreement in the first study was 97% and in the second study 87% between the parents and professionals. In the repeated assessments (test-retest reliability) the parents estimated their children's development equal in 99% in the first study and in 91% in the second study. Kim and O'Connor (1996) wrote that the agreement between parental assessment of developmental status using the IMQ (new name ASQ) at 4, 8, or 12 months' corrected age and the professional assessment by a multidisciplinary team at the same ages was poor in the first year of life. More lately the ASQ were revised and the analyses indicated high test-retest reliability, interobserver reliability and internal consistency (Squires, Bricker & Potter 1997).

According to Gibbs, (1990) the Bayley Scales of Infant Development has still maintained its value and it is one of the best standardized tests in infant assessment, but there are, however, some deficiencies in the test. The writer states that it seems to overestimate the mental skills of children when concerning normal development, and, on the other hand, exceptional motor development may lower the scores. Further, the test gives only a little information about the adaptive skills of the children, and the applications for disabled children are missing. Although the Bayley test includes many "mental" items with a strong motor component, there are items that appear promising with premature infants: object permanence, release of objects, social responsiveness and imitation and verbal behaviour (Nelson 1979). Aylward et al. (1989) speculated on a review of 80 studies that statistically significant differences in intelligence quotient/ developmental quotient scores (MDIs) may exist between low birth weight children and control subjects but these differences are of minimal clinical importance.

Bzoch and League (1991) reported the reliability and the validity of the Receptive-Expressive Emergent Language Scale, Second Edition (REEL-2) to be good. The test has also been criticized and Roth (1990) argued that its reliability and validity were not adequate. There were deficiencies in the item selection and the standardizing sample was poorly defined and too small to allow generalization of the results. The scoring was too common and it left too much space for subjectivity. According to Roth (1990) the test, however, acts as a good screening device for further research. Thurman and Widerstrom (1990, 180) stated that it is one of the most widely used tests among children under three years of age in speech production and language comprehension.

The validity and reliability of the Reynell Developmental Language Scales have been found to be good in many different studies (Reynell & Huntley 1985). The writers point out that the norms may not be quite similar for children coming from other areas of England or foreign countries. At the moment the Reynell is the most well-known assessment device used in the estimation of speech production and especially language comprehension in Finland even though the final norms are missing. The older infants (in sentence level) receive 2-3 points better scores in speech production than the norms report, because the Finnish children will receive extra scores in the subject use. The shy infants and children with concentration problems may score lower than expected, because the testing has to be carried out strictly according to the test instructions. With bilingual children it is possible to use parents as interpreters (adapted also in this study) but then the results should be treated with caution.

The students of special education, Leander and Mettälä, (1999) estimated the developmental domains of nine preterm infants of this follow-up group with the ASQ at the corrected age of six months (on the basis of video recordings made by the researcher) and ended up with an interobserver agreement of 80%. When comparing the students' estimations (three groups; n=24; n=29; n=39) to the researcher's estimations in the Reynell verbal comprehension of three follow-up children (on the basis of video recordings of the Reynell assessments made by the researcher) at the corrected age of 18 and 24 months, high agreements were found. In a few cases there was a difference of three points while the researcher had scored the level to be lower. In the classification of the children's early vocalization of this follow-up group (on the basis of video recordings made by the researcher) an agreement of 80 % between the researcher and the student (Mielo 1993) was reached in 1991. An adaptation of the method of Koopmans-van Beinum and van der Stelt (1986) was applied. The students in these estimations concerning Reynell and early vocalizations studied logopedics in the University of Oulu.

The developmental milestones of infants in this follow-up were assessed with many devices and in generally these tools have proved to be valid for their purposes even if there can be some deficiencies as shown above. The results of this study can be considered reliable because the estimations (e.g. the Bayley and the Reel) were repeated regularly month by month at the children's corrected ages (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12) during the first year and every two months during the second year (14, 16, 18, 20, 22 and 24) with the intensive follow-up group. Also with the rest of the families and children the agreements on the visits (0-2, 9, 18 and 24) and telephone interviews (12, 16 and 20) worked well. The researcher became familiar with the children and the assessments were carried out in the children's familiar home environments. The researcher could also complete her knowledge on the children's development by observing and interviewing parents in unclear cases. Through repeated visits and interviews the parents also learned to focus on emerging developmental skills and they also kept diaries on their findings.

4.7 Statistics

Term controls were not chosen when the achievements in developmental milestones were compared to test standards and literature. No final Finnish standards for these tests are available and that is why the foreign standards were used. In the beginning there were discussions about the controls but this design was abandoned because it would have involved too much bureaucracy. According to more recent views (van Beek 1993) research should also focus on different subgroups inside the preterm population because there are a lot of studies on comparisons between term and preterm groups.

The group mean values and individual performances at corrected and chronological ages were presented as figures and tables. Comparisons inside the follow-up group were made in respect to diagnoses (with or without), prematurity, birth weight and sex. The individual achievements were also inspected in the light of risk scores at birth and cumulative risk scores at two years of corrected age. Because of the small number of infants (N=24) in this follow-up it was possible to apply only a few statistical methods. More precisely, three such methods, namely, the Mann-Whitney U test for infant group comparisons, the Wilcoxon matced-pairs signed-ranks test for changes between different measurements in time (Easton & McColl 1999) and the Spearman rank order test for correlations between the results of different tests (Nummenmaa, Konttinen, Kuusinen & Leskinen 1997, 156) were chosen.

By the ASQ the assessments were made at real corrected and chronological ages and children's achievements were compared to cutoff points in each domain in different age check points (4, 8, 12, 16, 20 and 24). By the REEL and Bayley the assessments were made during the home visits in certain intervals while the ratios (REEL) were counted and MDIs (Bayley) were checked according to corrected and chronological age. By the Reynell the assessments were made at the corrected age of 18 and 24 months. The rest of the results (overall and speech and language milestones) were presented at corrected and chronological age but the vocabulary growth (early fast, late fast and slow developers) only at chronological age to better describe the development of production. The means and standard deviations of the Bayley, Reynell and ASQ are presented in Appendix 7.

5 RESULTS

5.1 Preterm infant's overall development

5.1.1 Gross and fine motor skills

At the corrected age *the preterm infants* without diagnoses (n=18) achieved all the other skills except "the midline skill: pat-a-cake" (12) and "walks alone" (17) earlier than the norms presuppose. They began to walk at the average corrected age of 13.5 months while the average chronological age was 16.2 months. At the chronological age respectively they achieved all the other skills except "crawls" (16) and "imitates simple action" (19) later than the norms presuppose. (See Figure 2 and Appendix 4: Gross and fine motor milestones.)

At the corrected age *the preterm infants with cp diagnoses (n=4) and motor delay (n=1)* achieved most of the skills later than the norms presuppose. However, four skills "holds his head steady while pulled from hands" (1), "reaches toys" (3), "picks up a toy" (6) and "imitates simple action" (19) were achieved at the corrected age earlier than the norms presuppose. "Steady sitting" (11) came very late (at 18 months of corrected age) and only two of these five children began to walk before the corrected age of two years (at 17 and 20 months of corrected age). At the chronological age they achieved all the other skills except "imitates simple action" (19) later than the norms presuppose. The child with tetraplegia spastica was excluded from this figure because her gross and fine motor skills were mostly missing. (See Figure 3 and Appendix 4: Gross and fine motor milestones.)

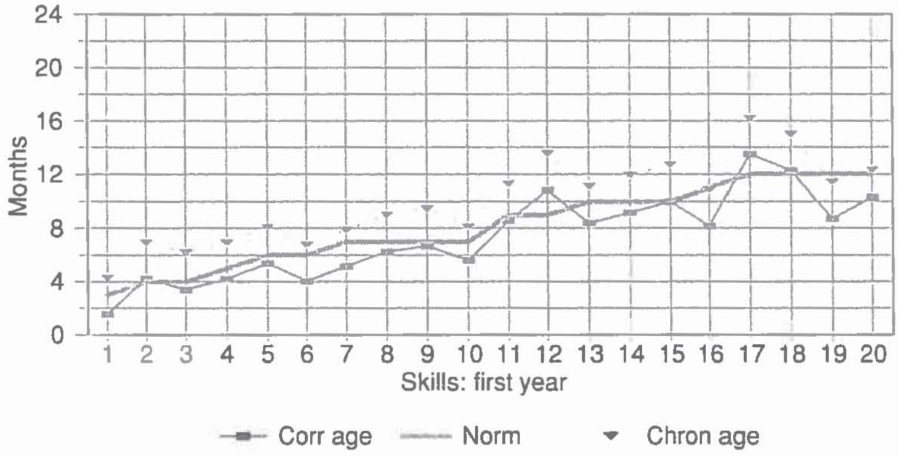

FIGURE 2 Early gross and fine motor skills of infants without diagnoses at corrected and chronological age (n=18)

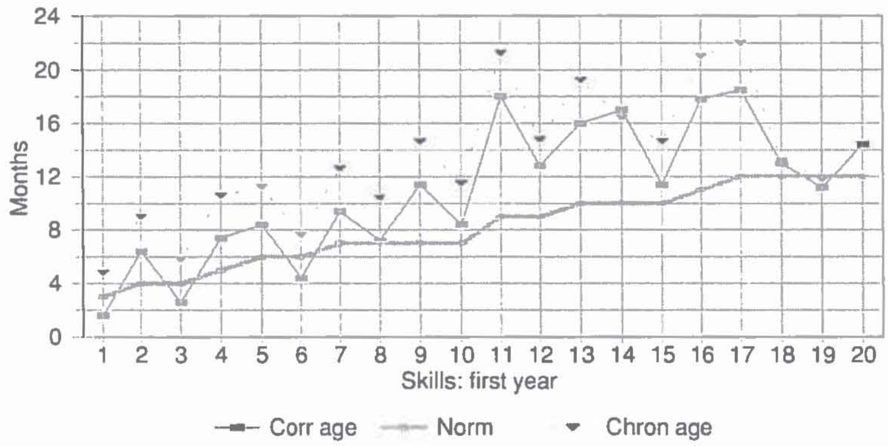

FIGURE 3 Early gross and fine motor skills of infants with diagnoses at corrected and chronological age (n=5)

5.1.2 ASQ results

Infants without diagnoses: corrected age

At the corrected ages the questionnaires for the intensive follow-up group children (n=8 and for the non-intensive follow-up group children (n=10) were completed by using straight observation or video tape recordings. The 12-, 16- and 20-month questionnaires were completed on the non-intensive follow-up group children on the basis of telephone interviews. The corrected ages were even (4, 8, 12, 16, 20 and 24) but the 8-month questionnaire was completed on eight children when they were at their corrected ages + 1 month when compared to the target age.

The infants without diagnoses (n=18) as a group exceeded very clearly the statistically derived cutoff point at their *corrected ages* in all domains (communication, gross motor, fine motor, personal-social, and adaptive skills and in all age checkpoints from four to 24 months. There were, however, eight infants whose performance on the questionnaires was classified as screened. In these cases the infant's point total fell at or below the cutoff point in the domain in the given age checkpoint. These infants were born three or four months premature but in the domain of gross motor skills on the 4-month questionnaire there were, however, three infants who were born only two months premature. On the 20- and 24-month questionnaires two children with three months prematurity fell below the cutoff point: one had difficulties in communication and the other in fine motor and adaptive skills. The latter child had a diagnosis of small for gestational age (SGA) at birth. In the domain of gross motor on the 24-month questionnaire all the infants without diagnoses received full points. (See Figure 4 and Appendix 6: Cutoff points.)

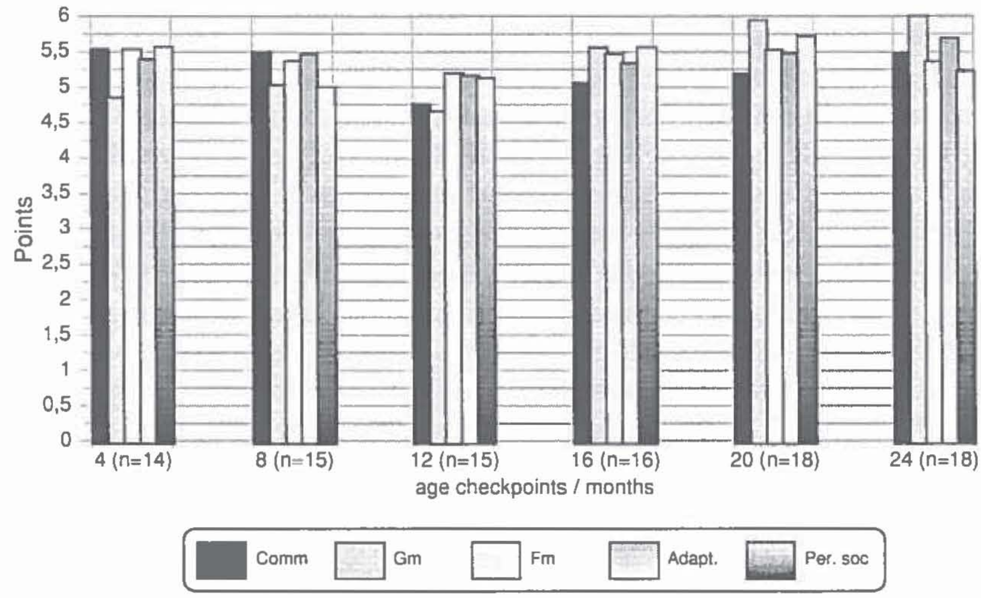

FIGURE 4 ASQ performances of infants without diagnoses at corrected age

Infants without diagnoses: chronological age

At the chronological ages the questionnaires were completed by using straight observation or video tape recordings. The chronological ages were even (4, 8, 12, 16 and 20) with the intensive follow-up group children except in some cases when the children were +1 month when compared to the target age. With the rest of the children the questionnaires were completed when the ages were even or the children were +1 or +2 months when compared to the target age. In cases where the children were two months too old for the target age, they were, however, born with four months prematurity and the screening fell between the corrected and chronological age.

At the *chronological age* the infants without diagnoses (n=18) as a group exceeded the statistically derived cutoff point on the 4-month questionnaire in communication, on the 8-month questionnaire in fine motor and adaptive skills and on the 12-, 16- and 20-month questionnaires in all five domains. In gross motor skills the most difficult one was the 8-month questionnaire (infants' average points 1.2/cutoff 2.3) and only two infants exceeded the cutoff point. On the 20-month questionnaire the average points in gross motor skills were already very high (5.8) and there were only two children who scored below the maximum. On the 20-month questionnaire the biggest delay was in communication.

As mentioned above infants without diagnoses as a group performed the 12- 16- and 20-month questionnaires in all five domains without difficulties when compared to the cutoff points. There were, however, infants whose performance on the questionnaires was classified as screened. This was true most often on the 12-month questionnaire (10 infants) and there were two infants who missed the cutoff points in four or five domains. Only four children were classified as screened on the 16-month questionnaire and three infants on the 20-month questionnaire. These were the infants who had problems also on the 12-month questionnaire. The infants who were as screened on the 20-month questionnaire were born three or four months premature. Those children who exceeded the cutoff points on the 12-month questionnaire (n=7) in all domains continued to develop without difficulties (except one child who did not exceed the cutoff point in gross motor skills on the 16-month questionnaire) in the later months. The chronological age of 20 months turned out to be a border where the children had no more big difficulties although four or three months premature children tended to score lowest. There were three children who received almost the maximum points on the 16-month questionnaire and whose good achievement had been obvious since the 4-month questionnaire. This continuum seemed to be real because these three children received a very high total score (29, 29 and 30) at two years of corrected age on the 30-month questionnaire. (See Figure 5 and Appendix 6: Cutoff points.)

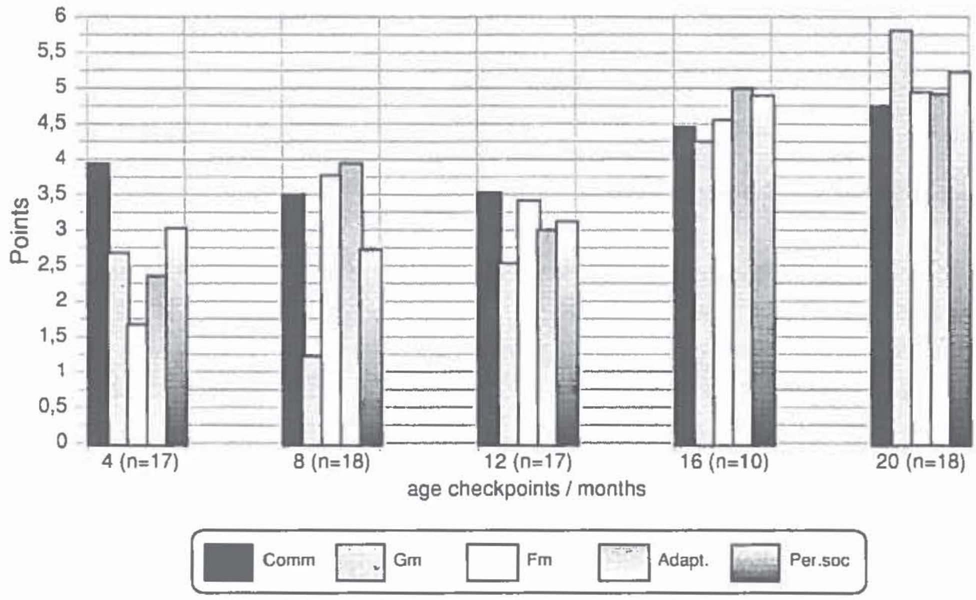

FIGURE 5 ASQ performances of infants without diagnoses at chronological age

Infants with diagnoses: corrected age

At the corrected ages the questionnaires were completed by using straight observation or video tape recordings. The 12-, 16- and 20-month questionnaires were completed on the non-intensive follow-up children on the basis of telephone interviews. The corrected ages were even or +1 month when compared to the target age.

Figure 6 shows that infants with a cp diagnoses (n=4-5) and motor delay (n=1) as a group exceeded the statistically derived cutoff point at their *corrected ages* in all other domains (communication, fine motor, personal-social, and adaptive skills) except gross motor skills and this was the situation in all age checkpoints from four to 24 months. On the 4-month questionnaire the children's gross motor development as a group was, however, rather near the cutoff point. As a group these infants performed well in communication, although there was one child who was very delayed on the16-month questionnaire. On the 24-month questionnaire, however, he already received 3.0 points which exceeded the cutoff point. This child had still many delays in the other domains and he did not exceed the cutoff points in these. There was also a child who received nine points (maximum 30) on the 4-month questionnaire and was excluded from the other questionnaires, because it was possible to use only the 4-month questionnaire during the rest of the follow-up (total points at two years of age 14.5 points/4-month questionnaire). (See Figure 6 and Appendix 6: Cutoff points.)

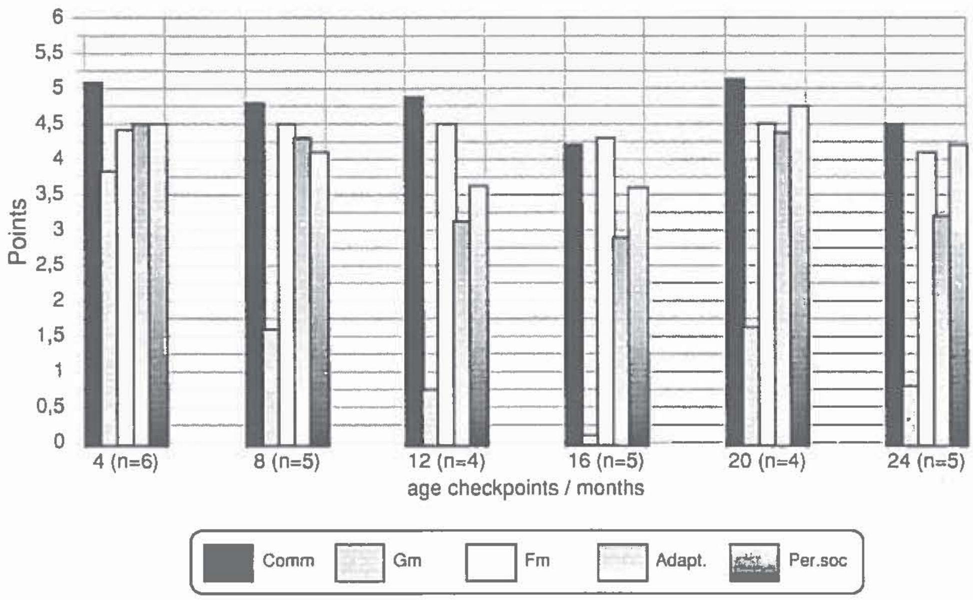

FIGURE 6 ASQ performances of infants with diagnoses at corrected age

Infants with diagnoses: chronological age

At the chronological ages the questionnaires were completed by using straight observation or video tape recordings. The chronological ages were even or +1 or +2 months when compared to the target age. In cases where the children were two months too old for the *target age, they were, however, born with four months prematurity and the screening fell between the corrected and chronological age.*

At the *chronological age* the infants with cp diagnoses (n=4-5) or motor delay (n=1) as a group exceeded the statistically derived cutoff point on the 12-month questionnaire in communication, on the 16-month questionnaire in communication, in fine motor and in personal-social skills and on the 20-month questionnaire in communication and in adaptive skills. In summary, these infants had difficulties to reach the cutoff points on the 4-, 8- and 12-month questionnaire and also later on the 20-month questionnaire. The 16-month questionnaire seemed to be easy when compared to the other questionnaires. Communication was the strongest area in all the age checkpoints. The child (tetraplegia spastica) who was excluded from the 8-, 12-, 16- and 20-month questionnaires received five points (maximum 30) on the 4-month questionnaire at her chronological age. (See Figure 7 and Appendix 6: Cutoff points.)

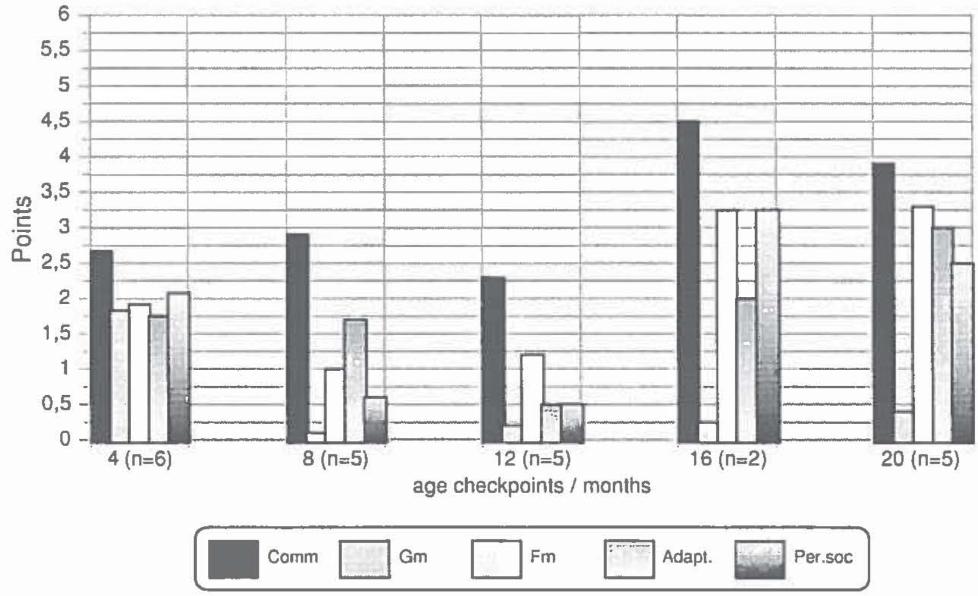

FIGURE 7 ASQ performances of infants with diagnoses at chronological age

ASQ total points: first 2 years

At the corrected ages the questionnaires were completed until 24 months (4, 8, 12, 16, 20 and 24) but at the chronological age the questionnaires were completed until 20 months (4, 8, 12, 16 and 20) because there were only a few visits which were completed at the 24 months of chronological age.

At their *corrected ages the infants without diagnoses (n=18)* received very high total scores as a group in all domains at different age checkpoints. The scores were placed between 25 and 28 when the 12-month questionnaire was the most difficult one. There was a significant difference in achievements on the level of 0.05 between the questionnaires of 8 and 12 months (.041) and between the questionnaires of 12 and 16 months (.012). In the first one the change was negative (the point total fell) and in the second one positive (the points total rose).

At their *chronological ages the infants without diagnoses* as a group received about half of the points possible on the 4-, 8-and 12-month questionnaires but after that there was a leap and the curves (corrected/chronological) began to approach each other on the 16- and 20-month questionnaires. On the 20-month questionnaire the infants without diagnoses as a group received very high score in each domain and in gross motor skills almost the maximum.

At their *corrected ages the preterm infants with cerebral palsy (n=5) or motor delay (n=1)* performed very well on the 4-month questionnaire but after that the curve fell except for the 20-month questionnaire because the child with the motor delay was not included. The poor achievements were mostly due to gross motor delays because the infants as a group performed above the cutoff points in all other domains and in all age checkpoints. The child with the motor delay received the point total 8.5 (maximum 30) on the 24-month questionnaire when the other children's points were placed between 17 and 22. The child with the very severe cp disability was excluded after the 4-month questionnaire (the point total 9) because the older children's questionnaires proved to be too difficult.

At their *chronological ages the preterm infants with cerebral palsy or motor delay* achieved the developmental milestones poorly in the early months and especially on the 8- and 12-month questionnaires but on the 16- and 20-month questionnaires the curves began to rise. When comparing the children's performances as a group to the cutoff points, communication skills were rather good on the 12-month questionnaire and after that but gross motor skills were almost totally missing in all the age checkpoints. The child with the motor delay received a point total of four (maximum 30) on the 20-month questionnaire when the other children's points were placed between 10.5 and 20.5. (See Figure 8.)

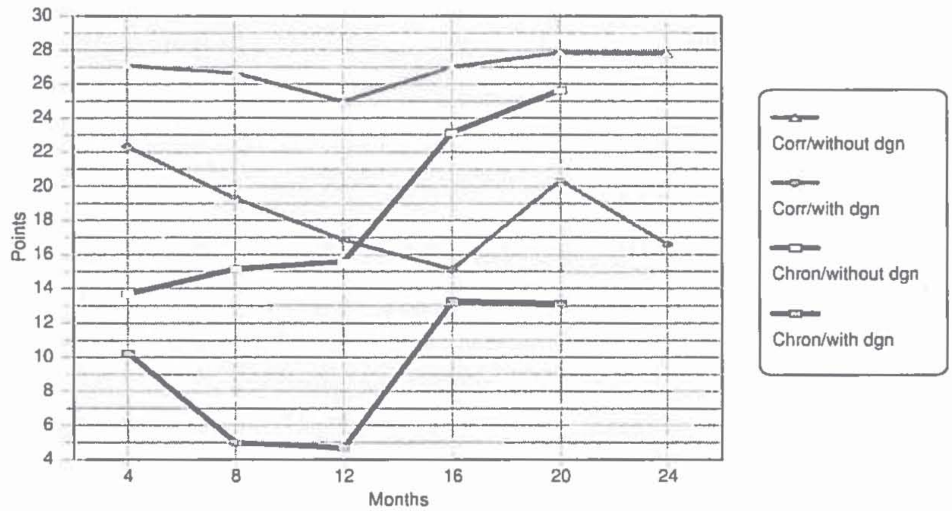

FIGURE 8 ASQ total points of infants with and without diagnoses as a group at corrected and chronological age during the first two years

ASQ total points at two years of corrected age

The figure 9 shows in summary all the infants' (n=24) points total in all domains at the *corrected age* of 24 months. The preterm infants with cp diagnoses (n=5) or motor delay (n=1) received points total from zero to 22. The infants without diagnoses (n=18) received points total from 23.5 to 30. The infants without diagnoses who received the lowest points (23.5) were very high risk infants at birth. The developmental picture inside the cp group was very similar except for the first two children in the list: the first one was excluded from the 24 months questionnaire and the other child received zero points both in gross motor and in adaptive skills. The cp child (hemiplegia) who achieved 22 total points received 3.5 points in gross motor skills when the other three children with rather equal points otherwise received only 0-0.5 points in this domain. (See Figure 9.)

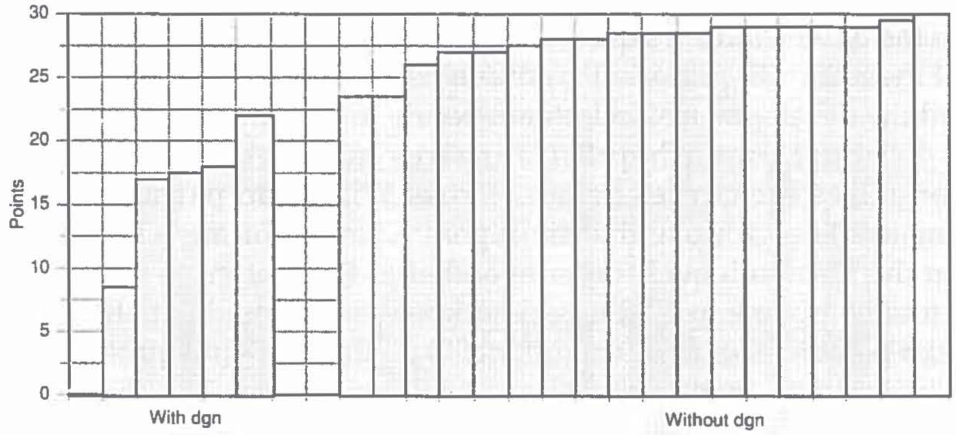

FIGURE 9 ASQ total points of individual infants (n=24) with and without diagnoses at two years of corrected age

Missing items at corrected age

In summary, the infants without diagnoses had delays during the first year and especially on the 12-month questionnaire in gross motor skills (walking) and during the second year in communication (word production and putting words together). On the 24-month questionnaire half of the infants could not use at least two words like "me", "I", "mine" and "you" correctly (communication) or call herself/himself "I" or "me" more often than use her/his own name (personal-social skills).

All the infants without diagnoses (n=18) could eat and drink according to the 24-month questionnaire but only one child with a cp diagnosis. Three of the children with diagnoses managed partly but the child with the very severe cp disability and the child with motor delay could not eat themselves. Nineteen of the 22 children used their right hands while eating. Most of the infants began to explore things with their mouth at their corrected ages of four months and stopped it at their corrected ages of 18 months. The children with cp diagnoses and the child with a motor delay continued to do so also at their corrected ages of 24 months.

5.2 Mental development: BAYLEY results

Infants without diagnoses: first 2 years

At the age checkpoints of 6, 10, 18 and 24 months there were 18 children in each and at the other age checkpoints there were 7-8 infants. At the age checkpoint of 10 months the children were at their corrected ages even (n=8) or +1 month (n=10) when compared to the target age (at the other age checkpoints the ages were even). Based on standardized norms for the Bayley Scales of Infant Development (BSID), it was predicted that the Mental Developmental Index (MDI) score would be 100 regardless of age.

Assessments were performed at the corrected ages of 2, 4, 6, 8, 10, 12, 14, 16, 18 and 24 months using the Bayley Mental Scale (BMSID). The infants without diagnoses, as a group, performed about one standard deviation above the expected 100 MDI level at the *corrected age* during the follow-up. When the raw scores were checked according to the *chronological age*, the children as a group received mental ages which were one to two standard deviations below 100 during the first year but at the age checkpoint of 16 months the group average exceeded 100 (102). However, the younger infants (ga. 24-28) scored lowest and at the age checkpoint 24 they still tended to score under 100 when the raw scores were checked according to the chronological age. There was, however, one exception when a child scored very high at the age checkpoints of 18 and 24 regardless of three months prematurity (ga. 25). The older infants (ga. 29-32) tended to score over 100 at the age checkpoints of 18 and 24 when the raw scores were checked according to the chronological age. At the chronological age there were rough developmental leaps from four to six months and from 10 to 12 months. Both differences were significant on the level of 0.05 (the first .012 and the second .028).

Six of the infants without diagnoses had difficulties to "build a tower of 6 cubes": they succeeded with 4-5 blocks. Three of the infants could not "imitate strokes: vertical and horizontal" and four children could do it only to one direction (mostly vertical). At two years of age most of the children preferred their right hand while eating (there were two children who used both hands). (See Figure 10.)

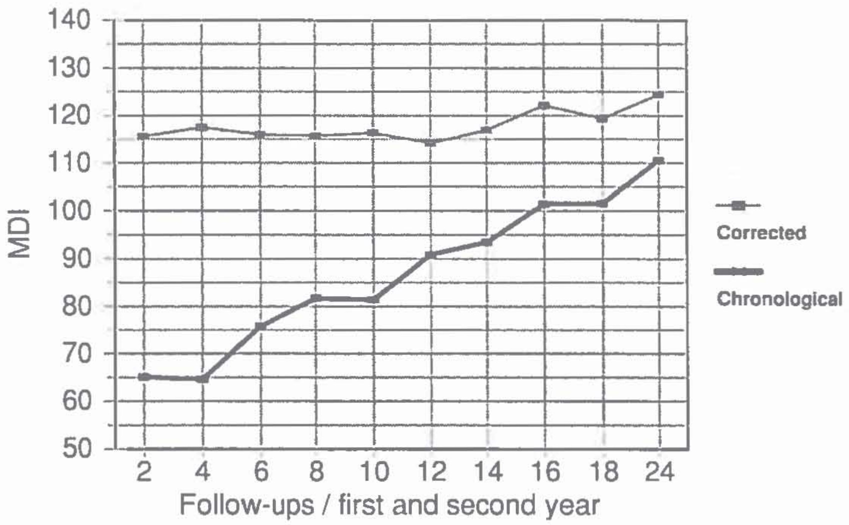

FIGURE 10 Bayley MDIs of infants without diagnoses (n=18) at corrected and chronological age during the first two years

The effects of prematurity and birth weight

When the criterion was *prematurity* the older preterm infants (ga. 29-32) scored higher than the younger preterm infants (ga. 24-28) both at the corrected ages of 18 (MDIs 124/113) and 24 (MDIs 134/112) months. All the older children (ga. 29-32) scored above the expected 100 MDI level at both age checkpoints except for the SGA (small for gestational age) child. Three of the younger (ga. 24-28) preterm infants scored under 100 at the corrected age of 18 and four at the corrected age of 24 months.

When the criterion was *birth weight*, the heavier preterm infants (> 1000 g/avg 1330 g) scored higher than the extremely low birth weight preterm infants (< 1000 g/avg 816 g) both at 18 (125/117) and 24 (132/121) months corrected age. The SGA (small for gestational age) child was excluded from this figure. (See Figure 11.)

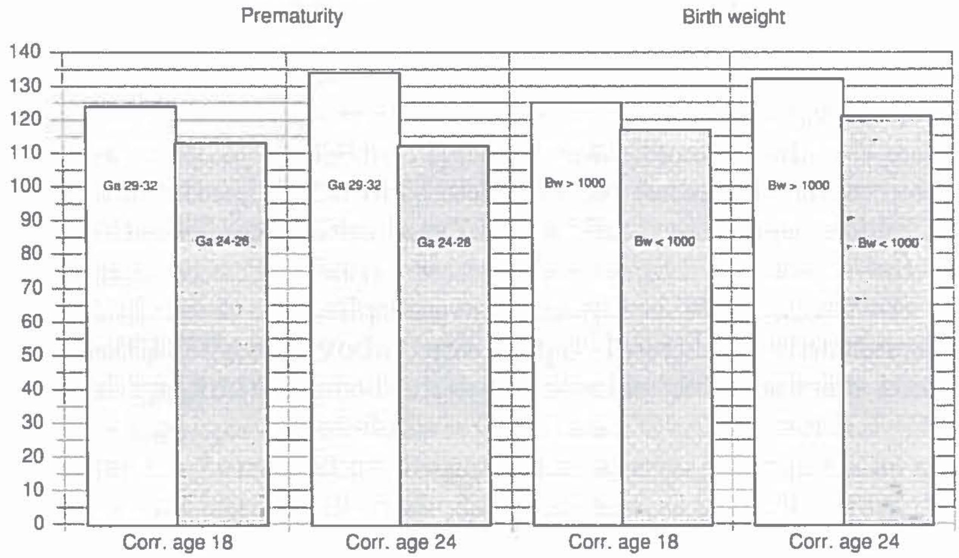

FIGURE 11 Bayley MDIs of infants without diagnoses at 18 and 24 months of corrected age according to prematurity and birth weight

The effect of sex

When the criterion was *sex*, the boys (n=7) scored higher than the girls (n=11) both at the corrected ages of 18 (128/114) and 24 (139/115) months. The latter difference was near the significant level of 0.05 (.060). At both age checkpoints all the boys exceeded the expected 100 MDI level but at 18 four and at 24 five girls failed to reach 100. The boys were born on the gestational age week 29 (average) and the girls 27 (average). (See Figure 12.)

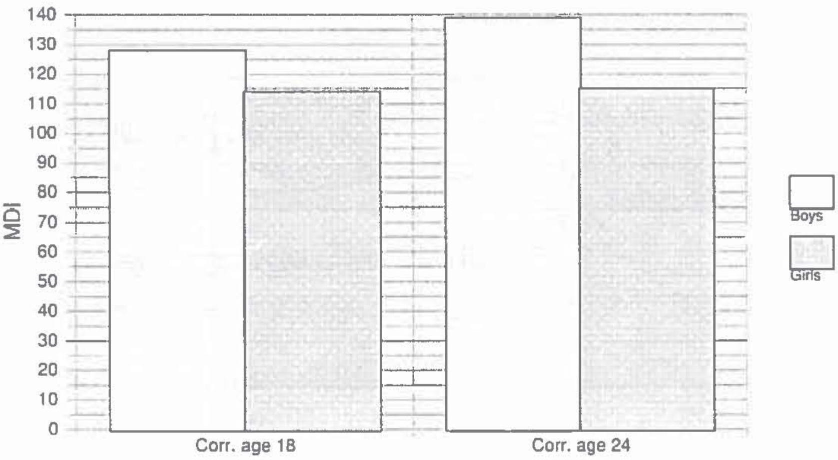

FIGURE 12 Bayley MDIs of infants without diagnoses at 18 and 24 months of corrected age according to sex

Individual MDIs / infants without diagnoses: first 2 years

The intensive follow-up children without diagnoses (n=8) were individually followed up during the first two years. When the *corrected age* (See Figure 13) was applied the older children with two months prematurity (children 1-5) performed in general above the expected 100 MDI level (child 3 fell under the level at 2, 12 and 14). Children with three (child 6 and 7) or four (child 8) months prematurity fell below the expected 100 MDI level at the age check points of 18 and 24 months. When the *chronological age* (See Figure 14) was applied the older children with two months prematurity (children 1-5) performed above the MDI 100 at the latest at the age check point 16. Children with three (child 6 and 7) or four (child 8) months prematurity did not exceed 100 during the whole follow-up.

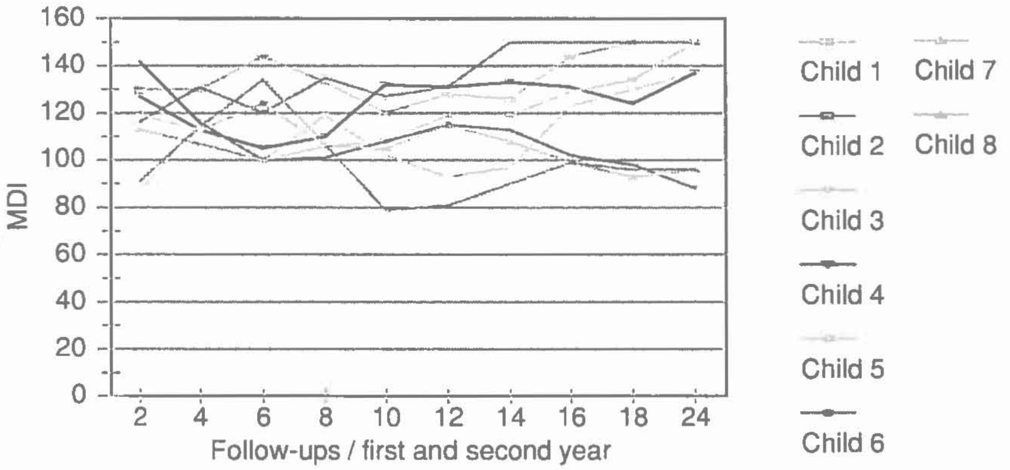

FIGURE 13 Bayley individual MDIs of intensive follow-up infants without diagnoses (n=8) at corrected age during the first two years

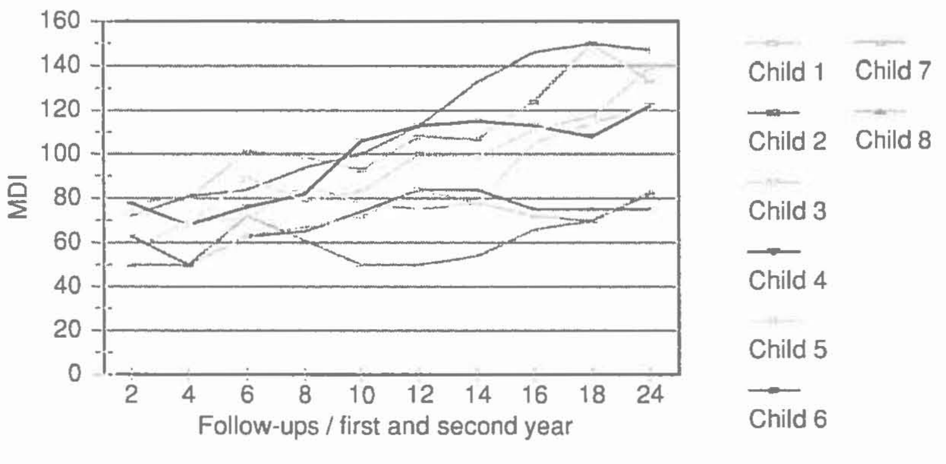

FIGURE 14 Bayley individual MDIs of intensive follow-up infants without diagnoses (n=8) at chronological age during the first two years

Individual MDIs / child with cerebral palsy: first 2 years

The child with a cp (diplegia spastica) in the intensive follow-up group did not exceed the expected 100 MDI level when the *corrected age* (except for the first age checkpoint) or *chronological age* was applied. At the age check point of 24 months the child's MDIs, however, approached 100 (corrected 98/chronological 90). Difficult items were for the child at two years of corrected age: tower, pegs, pink board, finds two objects, discriminates two: cup, plate, box, imitates strokes: vertical and horizontal, train of cubes, blue board: completes in 150 seconds, folds paper and concept one.

The other cp children's MDIs were almost identical with this child's MDIs at the age check point of 24 months but the child with the motor delay did not exceed 50 when the corrected or chronological age was applied. The child with the very severe cp disability (tetraplegia spastica) was excluded from the Bayley assessments. (See Figure 15.)

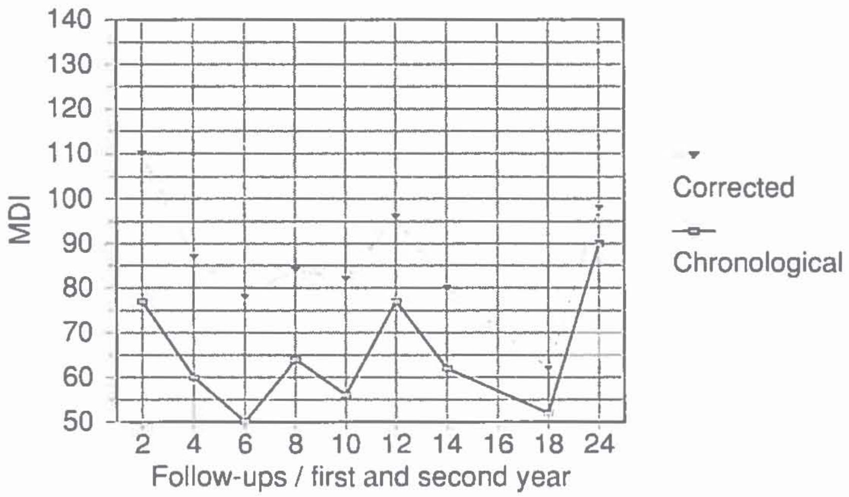

FIGURE 15 Bayley individual MDIs of the infant with a cp diagnosis at corrected and chronological age during the first two years

5.3 Speech and language development

5.3.1 Speech-communication skills

Age correction helped the infants without diagnoses (n=18) to achieve most of the so-called health card skills earlier than the norms presuppose. Only the skills "babbles" (4), "first tooth" (8), "clicks with tongue" (12) and "canonical babbling" (13) came later than the norms presuppose. The corrected ages for these skills were "babbles" (3.7 months), "first tooth" (7.5 months), "clicks with tongue" (8.6 months) and "canonical babbling" (7.4 months). At the chronological age respectively they achieved all the skills later than the norms presuppose. (See Figure 16 and Appendix 5: Speech-communication milestones.)

At the corrected age *the preterm infants with diagnoses (n=5) and motor delay (n=1)* achieved about one third of the skills later than the norms presuppose. The most delayed skill was "canonical babbling" (13). These infants started "canonical babbling" at the corrected age of 9.6 (chronological age 12.8) months when, according to the norm, term infants begin it approximately at the age of seven months. None of these children had a note on "clicks with tongue". At the chronological age respectively *the preterm infants with diagnoses (n=5) and motor delay (n=1)* achieved all the other skills except "phonates"(1), "growls"(9) later than the norms presuppose. The child with tetraplegia spastica was included in this figure. (See Figure 17 and Appendix 5: Speech-communication milestones.)

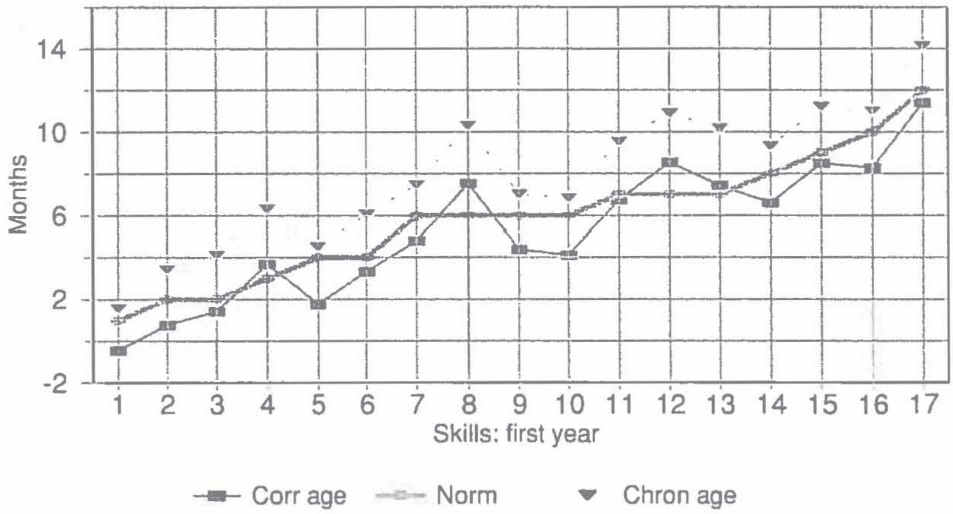

FIGURE 16 Early speech-communication skills of infants without diagnoses at corrected and chronological age (n=18)

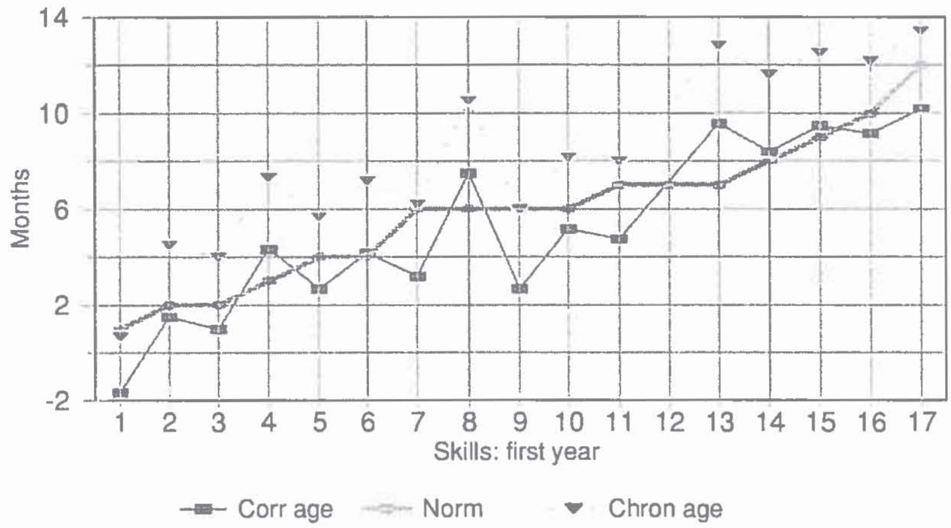

FIGURE 17 Early speech-communication skills of infants with diagnoses at corrected and chronological age (n=6)

5.3.2 From cooing to canonical babbling

The preterm infants in the intensive follow-up group (n=9) began to vocalize or coo (repetitions of sounds) at their average corrected age of 3.3 months (range from 2 to 5 months) when the average chronological age was 5.8 months (range from 5 to 7 months). The preterm infants began to produce consonant-vowel chains at their average corrected age of 7.4 months (range from 6 to10 months) when the average chronological age was 9.9 months (range from 8 to12 months). (See Table 2.)

TABLE 2 Production of cooing and canonical babbling at corrected and chronological age

Cooing (norm 2-3 months) *Repetitions of sounds* *(e.g. /aa-aa/, /ehe-ehe/)*		Canonical babbling (norm 7 months) *Not only repetitions but also consonant-vocal chains* *(e.g. /ti-ti/, /pa-pa/, /vau-vau/)*	
Average corrected age	Average chronological age	Average corrected age	Average chronological age
3.3 months	5.8 months	7.4 months	9.9 months

5.3.3 Comprehension of 100 words at 16 months

According to literature (Menyuk, Liebergott & Schultz 1995, 82) children comprehend about 100 words at the age of 16 months. In Table 3 comprehension of 100 words is presented in four categories: earlier than at 16 months of chronological age (Category 1), at 16 months of chronological age (Category 2), at 16 months of corrected age (Category 3) and later than at 16 months of corrected age (Category 4). Nine of the infants (N=24) reached the expected level at the chronological age or earlier and seven children comprehended 100 words at the corrected age of 16 months and eight children after that age. The child with the very severe cp disability did not reach that level during the two-year follow-up.

In the group of late developers in comprehension (Category 4) there were four children without diagnoses (born four or three months premature; one of them SGA) and three cp children and a child with the motor delay. In Categories 2 and 3 there was one cp child in each.

The infants (two girls and one boy) in Category 1 had low (7) or medium (16, 17) risk scores at birth. They had no haemorrhages or asphyxia diagnoses but one of the two girls had a lung disease (BPD) and the boy received physiotherapy for his motor delay during the first year. He had also ear infections at the end of the first year and he needed medication six times. (See Table 3.)

TABLE 3 Comprehension of 100 words

Category 1. Earlier than at 16 months of chronological age	Category 2. At 16 months of chronological age	Category 3. At 16 months of corrected age	Category 4. Later than at 16 months of corrected age
3 preterm infants	6 preterm infants	7 preterm infants	8 preterm infants

5.3.4 Production of 50 words at 18 months

According to literature (Menyuk, Liebergott & Schultz 1995, 82) children produce about 50 words at the age of 18 months. In Table 4 production of 50 words is presented in four categories: earlier than at 18 months of chronological age (Category 1), at 18 months of chronological age (Category 2), at 18 months of corrected age (Category 3) and later than at 18 months of corrected age (Category 4). None of the infants went to Category 1 and only one child (a boy) produced 50 words at his chronological age of 18 months (Category 2). Five infants (one boy and four girls) did this at their corrected age of 18 months (Category 3). They were all infants who understood 100 words at their corrected age of 16 months or earlier. Among these five infants there was one cp child (diplegia spastica)

Nine of 18 infants in Category 4 had an active vocabulary of 0-20 words at the corrected age of two years and two of them produced typically only the first or last syllable of the word. The child with no words or even babbling at that age had a severe cp disability.

All the infants (n=6) who produced 50 words at their corrected age of 18 months or earlier spoke sentences at two years of corrected age and one of them was bilingual. One of these children had started to stutter (age 25/23) and one's speech was not clear. Four of the 24 children spoke long sentences (more than 4 words) clearly and fluently at two years of corrected age. Three of them belonged to these early producers (above) when one child had been slightly delayed earlier but climbed to this group now.

Most of the children used 2-3 word sentences but there were also three children who had no sentences. Only one child could produce correctly both /s/ and /r/ when the others produced incorrect variations or substitutions of these sounds. There were also three children who were not mature enough even to produce words including /s/ or /r/ sounds. (See Table 4.)

TABLE 4 Production of 50 words

Category 1. Earlier than at 18 months of chronological age	Category 2. At 18 months of chronological age	Category 3. At 18 months of corrected age	Category 4. Later than at 18 months of corrected age
0 preterm infants	1 preterm infant	5 preterm infants	18 preterm infants

5.3.5 Steady sitting - putting words together

Normally, a child begins to join words together about 15 months after he is ready to sit up (Lenneberg 1968). On the average the infants without diagnoses (n=18) sat steadily *at the corrected age* of 8.6 months and the expected time of putting words together was thus 23.6 months. These infants, however, began to put words together 2.7 months earlier than that at the corrected age of 20.9 months. Respectively they sat steadily *at the chronological age* of 11.3 months when the expected time of putting words together was 26.3 months. They did this, however, 2.7 months earlier, at the chronological age of 23.6 months. The earliest speaker began to join words together at 16/14 months of age and the latest speaker at 30/26 months of age (the last visit took place two months too late for the target age of 24 months). There were altogether five infants who began to join words together at 16 months of corrected age or earlier. Individual differences were thus great.

Five of the preterm infants with cp diagnoses (n=5) or motor delay (n=1) sat steadily *at the corrected age* of 11-24 months (average 18) and three children began to put words together at the corrected ages of 16, 20 and 24 months (average 20). Respectively these children sat steadily *at the chronological age* of 14-28 months (average 21.2) and began to put words together at the chronological age of 19-28 (average 23) months. One child did not learn to sit at all and three children did not learn to put words together during the two-year follow-up. However, on an average three of the cp-children began to join words together at the same time as the children without diagnoses although they began to sit late. (See Table 5.)

TABLE 5 Steady sitting and putting words together

Infants without diagnoses (n=18)		Preterm infants/with cp diagnoses or motor delay (n=6)	
*Steady sitting ** *Corrected age* 8.6 months	*Putting words together* *Corrected age* 20.9 months (expected time 23.6 months)	*Steady sitting ** *Corrected age* 18.0 months (n=5)	*Putting words together* *Corrected age* 20.0 (n=3)
*Steady sitting ** *Chronological age* 11.3 months	*Putting words together* *Chronological age* 23.6 months (expected time 26.3 months)	*Steady sitting ** *Chronological age* 21.2 months (n=5)	*Putting words together* *Chronological age* 23.0 (n=3)

** Steady sitting: When sitting on the floor, a baby sits up straight for several minutes without using her hands for support (norm 8-9 months).*

5.3.6 Production: early fast, late fast and slow developers

Because age correction helped only one child (a girl) to achieve the level of early fast developers the results are presented only at the chronological age. According to Menyuk et al. (1995, 58) early fast developers are children who will acquire a 10-word vocabulary by their 12th month and a 50-word vocabulary within the next 4½ months. Nobody of these preterm infants went to the category of early fast developers (EFD) by their chronological age.

Eleven preterm infants went to the category of late fast developers (LFD) at the chronological age. According to Menyuk et al. (1995, 58) these are children who do not acquire 10 words until after 15 months, but then proceed to acquire the next 40 words rapidly, in less than 4½ months. Children in this category acquired a 10-word vocabulary on an average by 18.4 (range from 15 to 24) months of chronological age and a 50-word vocabulary by 21.5 (range from 18 to 28) months of chronological age.

Thirteen preterm infants went to the category of slow developers (SD). According to Menyuk et al. (1995, 58) these children acquire their first 10 words after 15 months of age and it takes more than five months to reach 50 words. In this category there were preterm infants (n=4) who acquired a 10-word vocabulary on an average by 19.5 (range from 16 to 22) months of chronological age and a 50-word vocabulary by 27.3 (range from 26 to 28) months of chronological age and those infants (n=9) who did not reach a 50-word vocabulary by 24 months of corrected age. The latter infants used actively 5-20 words by that age and one child had no words. (See Table 6.)

TABLE 6 Early fast, late fast and slow developers in 10- and 50-word production at chronological age

Early fast (EFD) *10-word vocabulary by 12 months; next 40 words within next 4½ months*	Late fast (LFD) *10-word vocabulary after 15 months; next 40 words in less than 4½ months*	Slow (SD) *10-word vocabulary after 15 months; next 40 words in more than five months*
0	11 preterm infants 10-word vocabulary at 18.4/chronological age 50-word vocabulary at 21.5/chronological age	13 preterm infants

5.3.7 REEL results

Comprehension: first 2 years

In figures 18 an 19 the levels of comprehension of infants with and without diagnoses are presented at the corrected and chronological age during the first and second years of life. In figure 19 there are only six measuring points because four of the infants belonged to the non-intensive follow-up group. At the *corrected age* the infants without diagnoses (n=18) performed above the index 100 since the age checkpoint of 9 months. At two years of corrected age the average comprehension age was 30 months (range from 20 to 36). When the *chronological age* was applied, the infants without diagnoses performed above the index 100 since the age checkpoint of 18 months. (See Figure 18.)

At the *corrected age* the infants (n=5) with cp and motor delay as a group (the child with the severe cp disability was excluded) performed above the index 100 at the age checkpoint of 24 (also at 2 and 12) months. At two years of corrected age the average comprehension age was 24 months (range from 16 to 30). When the *chronological age* was applied the group fell under the index 100 during the whole follow-up. (See Figure 19.)

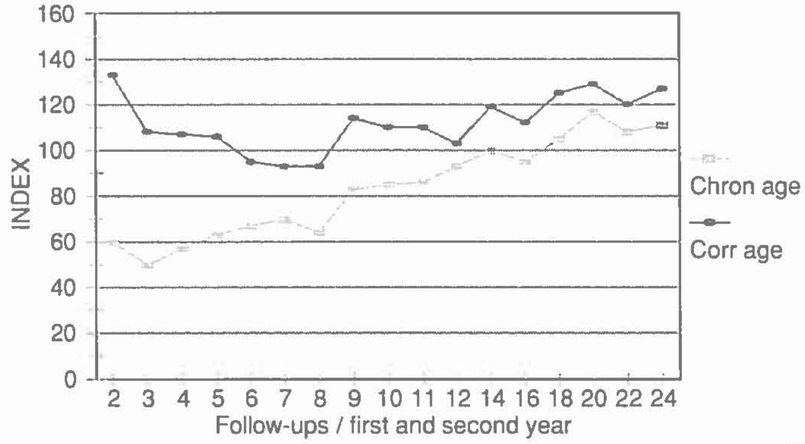

FIGURE 18 REEL comprehension indices of infants without diagnoses at corrected and chronological age during the first two years (n=18)

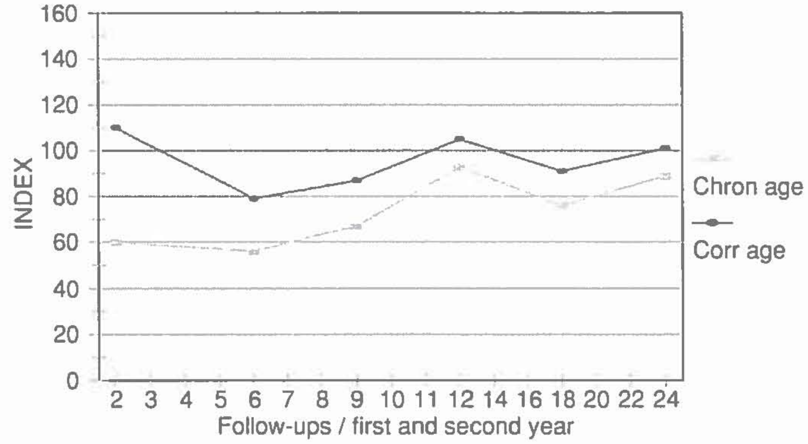

FIGURE 19 REEL comprehension indices of infants with diagnoses at corrected and chronological age during the first two years (n=5)

Production: first 2 years

In figures 20 and 21 the levels of production of infants with and without diagnoses are presented at the corrected and chronological age during the first and second years of life. In figure 21 there are only six measuring points because four of the infants belonged to the non-intensive follow-up group. At the *corrected age* the infants without diagnoses (n=18) performed above the index 100 since the age checkpoint of 20 months. At two years of corrected age the average production age was 27 months (range from 18 to 36). When the *chronological age* was applied, the infants without diagnoses reached the index 100 at the age checkpoint 24 months. (See Figure 20.)

At the *corrected age* the infants (n=5) with cp and motor delay (child with the severe cp disability was excluded) performed as a group above the index 100 at the age checkpoint of 2 and 12 months but fell under the index 100 at the age checkpoints of 18 and 24 months. At two years of corrected age the average production age was 22 months (range from 14 to 30). When the *chronological age* was applied the group fell under the index 100 during the whole follow-up. (See Figure 21.)

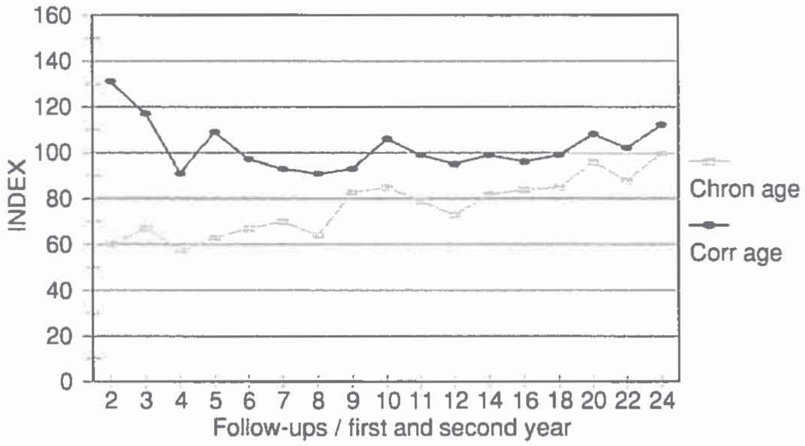

FIGURE 20 REEL production indices of infants without diagnoses at corrected and chronological age during the first two years (n=18)

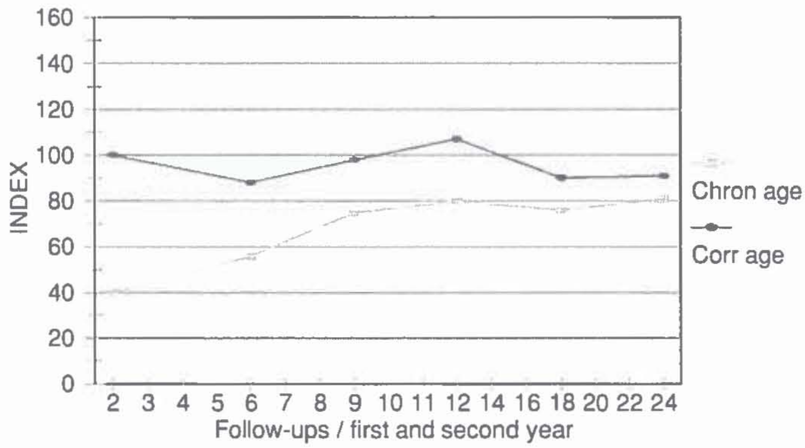

FIGURE 21 REEL production indices of infants with diagnoses at corrected and chronological age during the first two years (n=5)

Comprehension / individual indices: first 2 years

The intensive follow-up children without diagnoses (n=8) were individually followed up during the first two years. When the *corrected age* (See Figure 22) was applied the older children with two months prematurity (children 1-5) performed in general at or above the index 100 at the age check point 9 and after (child 3 and 4 fell under the level at 12). Children with three (child 6 and 7) or four (child 8) months prematurity performed at (four age check points) but mostly under the index 100 during the second follow-up year. When the *chronological age* (See Figure 23) was applied the older children (except child 4) performed at or above the index 100 at the age check point 14 and after. Children with three (child 6 and 7) or four (child 8) months prematurity fell under the index 100 during the whole follow-up.

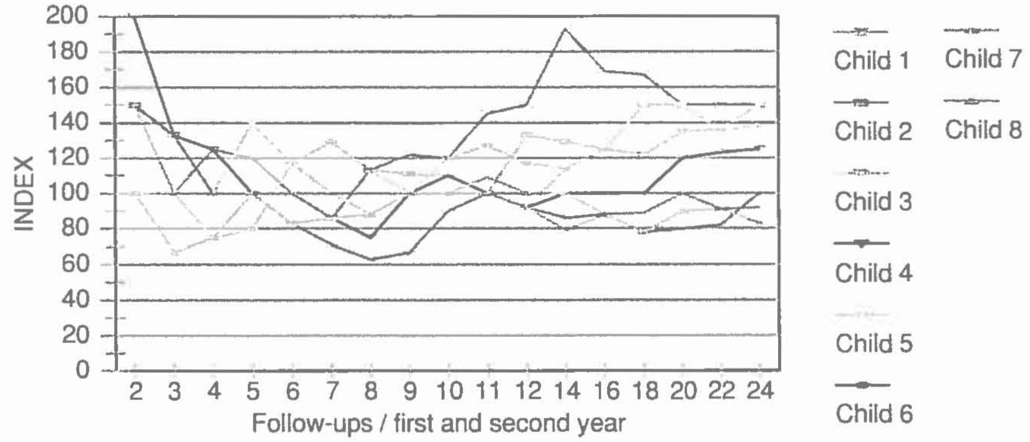

FIGURE 22 REEL individual comprehension indices of intensive follow-up infants without diagnoses (n=8) at corrected age during the first two years

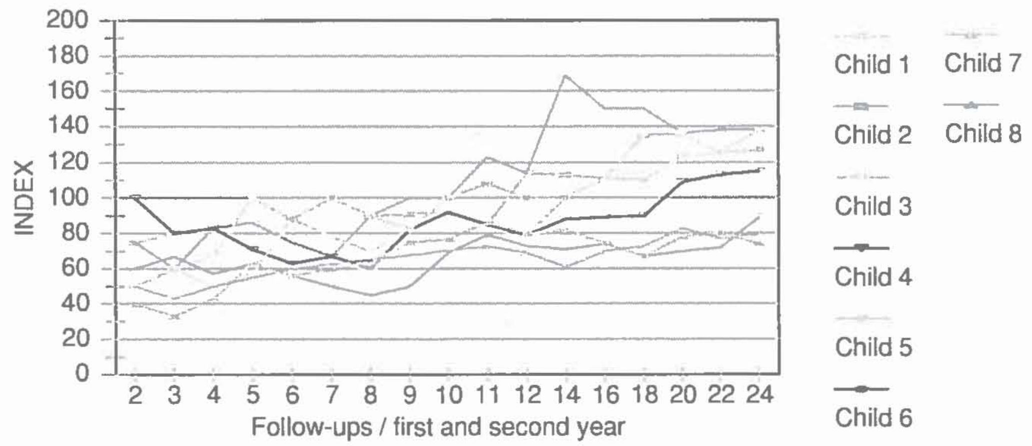

FIGURE 23 REEL individual comprehension indices of intensive follow-up infants without diagnoses (n=8) at chronological age during the first two years

Production / individual indices: first 2 years

The intensive follow-up children without diagnoses (n=8) were individually followed up during the first two years. When the *corrected age* (See Figure 24) was applied only the two older children with two months prematurity (child 1 and 2) performed above the index 100 during the two year follow-up. Only at the age check point 7 child 2 fell under the index 100. All the other children tended to perform under the index 100 at the age check point 12 and after. When the *chronological age* (See Figure 25) was applied child 1 and child 2 performed at or above the index 100 at the age check point 16 and after. All the other children tended to perform under the index 100 during the two year follow-up.

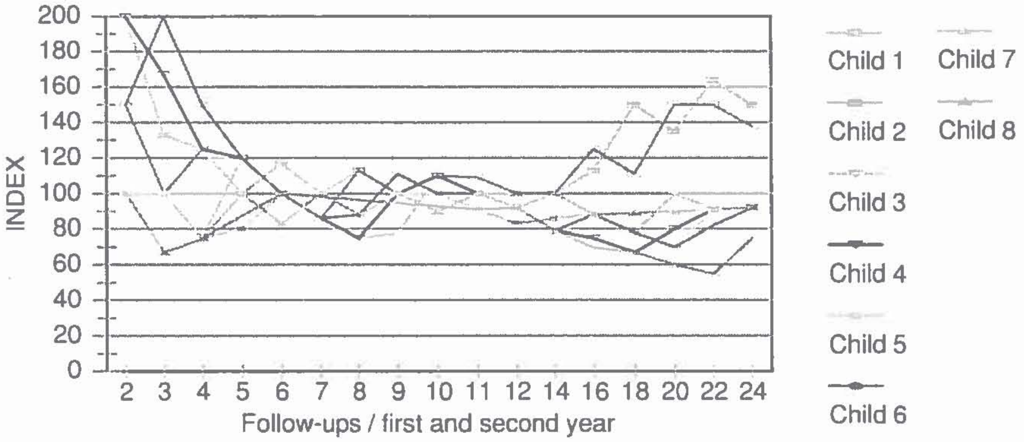

FIGURE 24 REEL individual production indices of intensive follow-up infants without diagnoses (n=8) at corrected age during the first two years

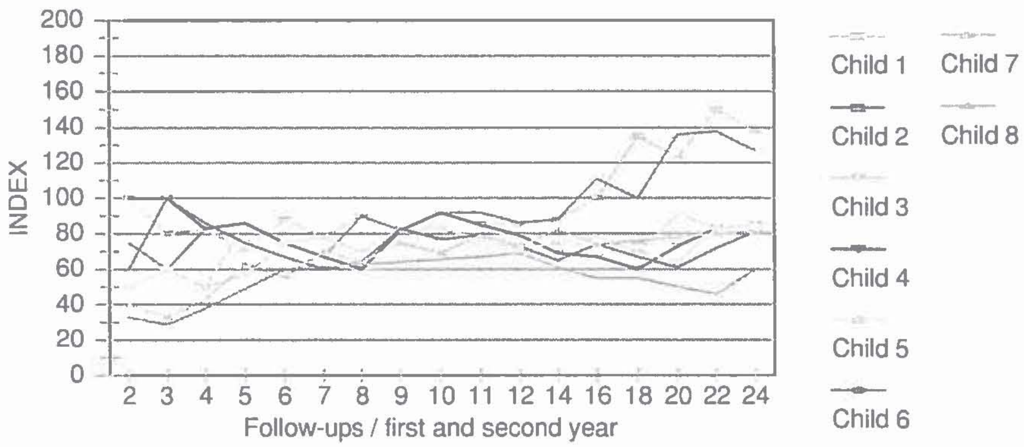

FIGURE 25 REEL individual production indices of intensive follow-up infants without diagnoses (n=8) at chronological age during the first two years

5.3.8 REYNELL results

Comprehension and production at 18 and 24 months of corrected age

At the corrected age of 18 months in *comprehension* the infants without diagnoses (n=18) as a group reached the 18-month level but the children with cp diagnoses (n=4) and motor delay (n=1) as a group did not reach it (15 months). At the corrected age of 24 months the infants without diagnoses as a group exceeded the 24-month level (29 months) but the children with cp diagnoses (n=4) and motor delay (n=1) as a group fell below it (22 months).

At the corrected age of 18 months in *production* the infants without diagnoses as a group did not reach (17 months) the 18-month level and the children with cp diagnoses (n=4) and motor delay (n=1) as a group did it neither (16 months). At the corrected age of 24 months the infants without diagnoses as a group exceeded the 24-month level (25 months) but the children with cp diagnoses (n=4) and motor delay (n=1) as a group fell below it (23 months).

The child with the severe cp disability (tetraplegia spastica) who fell below the one year level at the corrected age of 18 and 24 months in comprehension and production was excluded. (See Figure 26.)

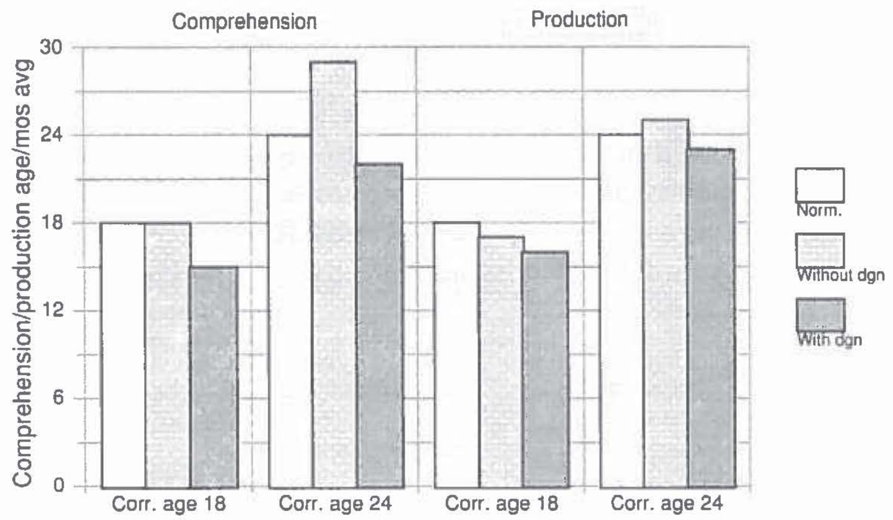

FIGURE 26 Reynell comprehension and production of infants with and without diagnoses as a group at 18 and 24 months of corrected age

Comprehension and production: prematurity ga. 24-28 vs. ga. 29-32

When the criterion was *prematurity* the older preterm infants (ga. 29-32) scored higher than the younger preterm infants (ga. 24-28) both at the corrected ages of 18 and 24 months in comprehension and production. The older preterm infants (ga. 29-32) scored below the norm only at the 18 months' production while the younger preterm infants (ga. 24-28) scored below the norm at the 18 months' comprehension and at the18 and 24 months' production. The difference between the two groups was significant on the level of 0.05 at the 18 months' comprehension (.027) and near the significant level of 0.05 (.053) at the 24 months' production. (See Figure 27.)

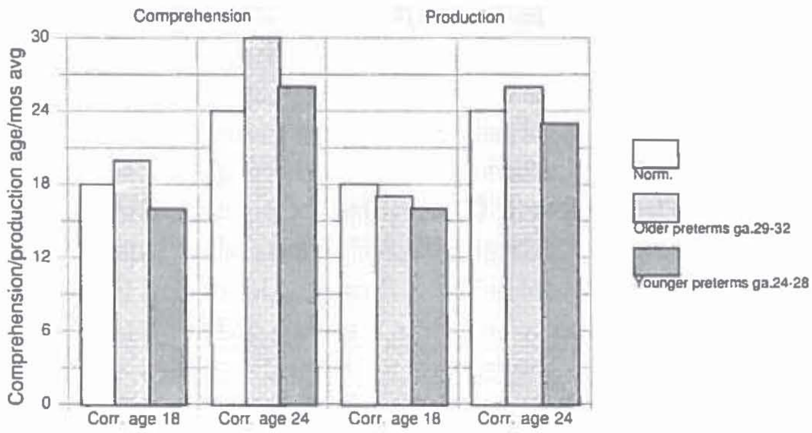

FIGURE 27 Reynell comprehension and production of infants without diagnoses at 18 and 24 months of corrected age according to prematurity

Comprehension and production: birth weight < 1000g vs. > 1000g

When the criterion was *birth weight* the heavier preterm infants (> 1000 g/avg 1330 g) scored higher than the lower birth weight preterm infants (< 1000 g/avg 816 g) at 18 months of corrected age in comprehension and production but at 24 months of corrected age the groups scored equally in comprehension and production. The SGA infant was excluded from this figure. (See Figure 28.)

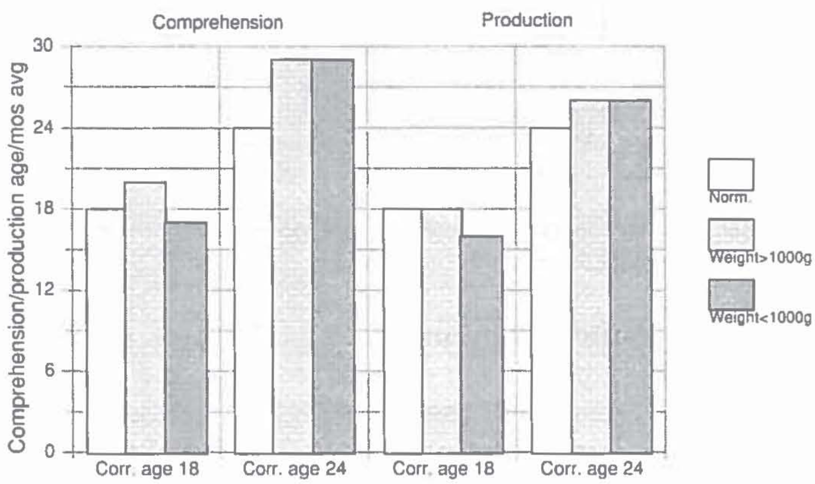

FIGURE 28 Reynell comprehension and production of infants without diagnoses at 18 and 24 months of corrected age according to birth weight

Comprehension and production: boys and girls

When the criterion was *sex*, the boys scored higher than girls both at 18 and 24 months of corrected age in comprehension and production. As a group the boys scored below the norm only at the 18 months' production while the girls scored below the norm at the18 months' comprehension and production. The difference was near the significant level of 0.05 (.059) between the boys and girls at the18 months' comprehension. The boys were born on the gestational age week 29 (average) and the girls 27 (average). (See Figure 29.)

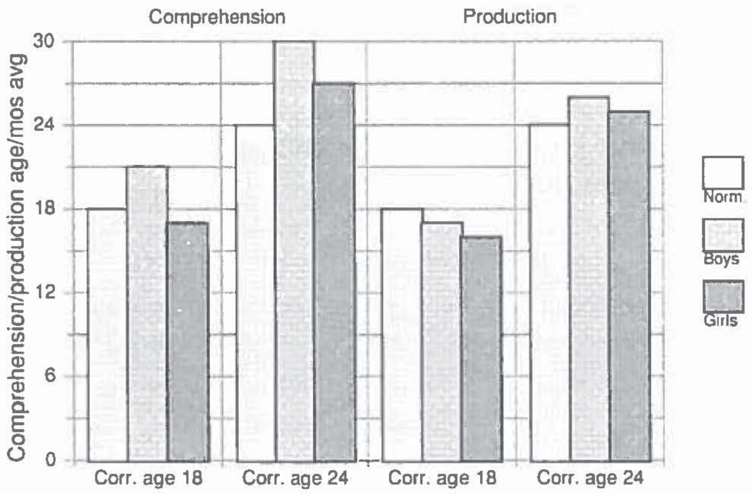

FIGURE 29 Reynell comprehension and production of infants without diagnoses at 18 and 24 months of corrected age according to sex

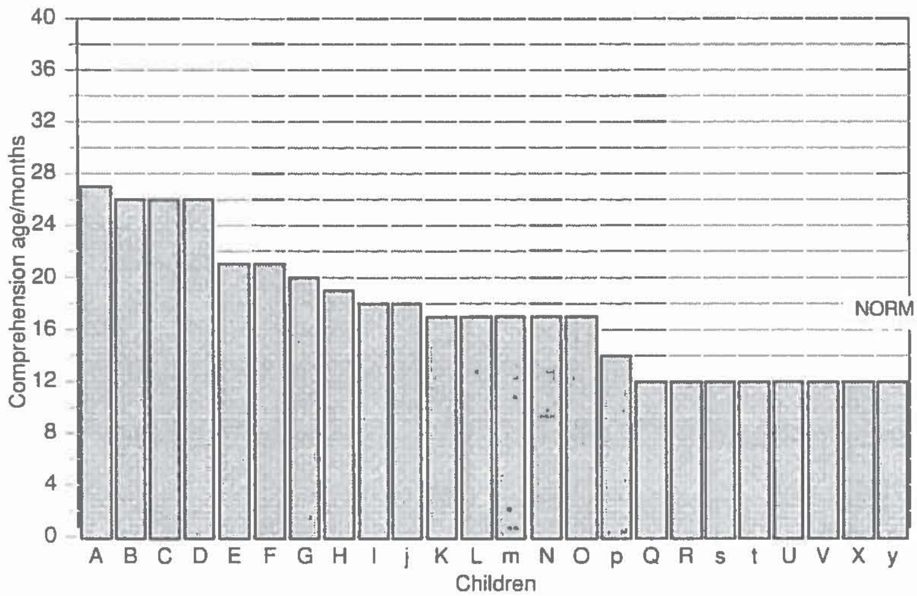

FIGURE 30 Individual Reynell Verbal Comprehension Ages at 18 months of corrected age

Individual comprehension ages at 18 months

In figure 30 the Verbal Comprehension Age for each child (n=24) is presented at the *corrected age* of 18 months. Nine infants without diagnoses and one cp child (j) reached or exceeded the18-month level. Four of the infants without diagnoses (A, B, C and D) would have exceeded the level also without the age correction (obtained ages 27, 26, 26, 26 months). These were the older preterm infants (two months premature) with one exception (three months premature). Eight children fell below the one year level (- 1 SD) (marked in figure 30 on 12 months level) in comprehension and among them there were three children with cp diagnoses or motor delay (s, t, y). (See Figure 30.)

Individual production ages at 18 months

In figure 31 the Expressive Language Age for each child (n=24) is presented at the corrected age of 18 months. Five infants without diagnoses and one cp child (e) exceeded the 18-month level and four of these infants without diagnoses (A, B, C and D) would have exceeded it also without the age correction (obtained ages 27, 22, 22, 21 months). These were the older preterm infants (two months premature) with one exception (three months premature). Altogether 22 performances were inside the normal level (- 1 SD). The child with motor delay (x) and the child with a severe cp disability (y) fell below the one year level in production (marked in figure on 12 months level).

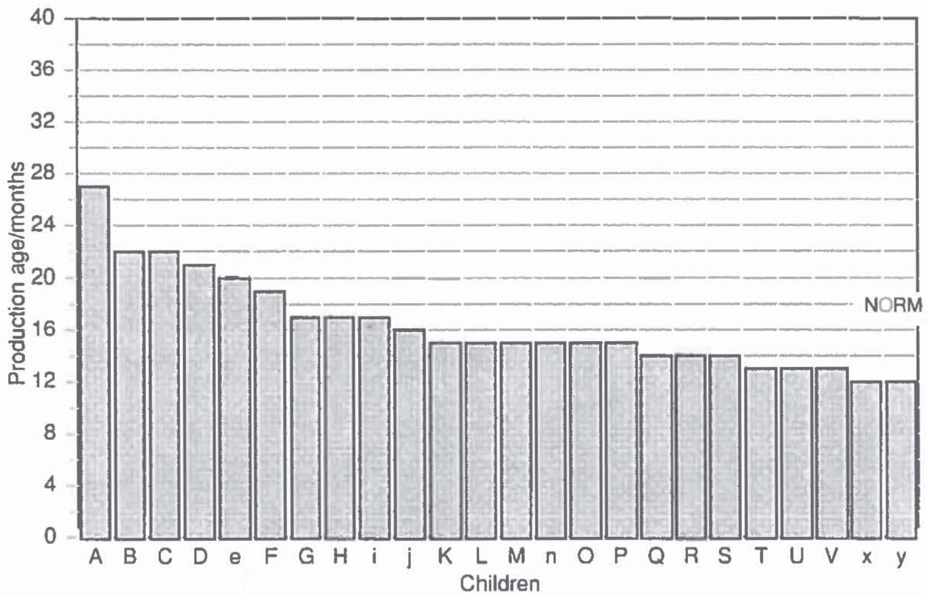

FIGURE 31 Individual Reynell Expressive Language Ages at 18 months of corrected age

Individual comprehension ages at 24 months

In figure 32 the Verbal Comprehension Age for each child (n=24) is presented at the *corrected age* of 24 months. Fifteen infants without diagnoses and one cp child (i) reached or exceeded the 24-month level. Fourteen of them (also the cp child) would have exceeded the level also without the age correction (obtained ages 26-39 months). Among these children there were now four younger (four months premature) infants. Altogether 21 performances were inside the normal level (- 1 SD). The child with a severe cp disability fell below the one year level (marked in figure 32 on 12 months level).

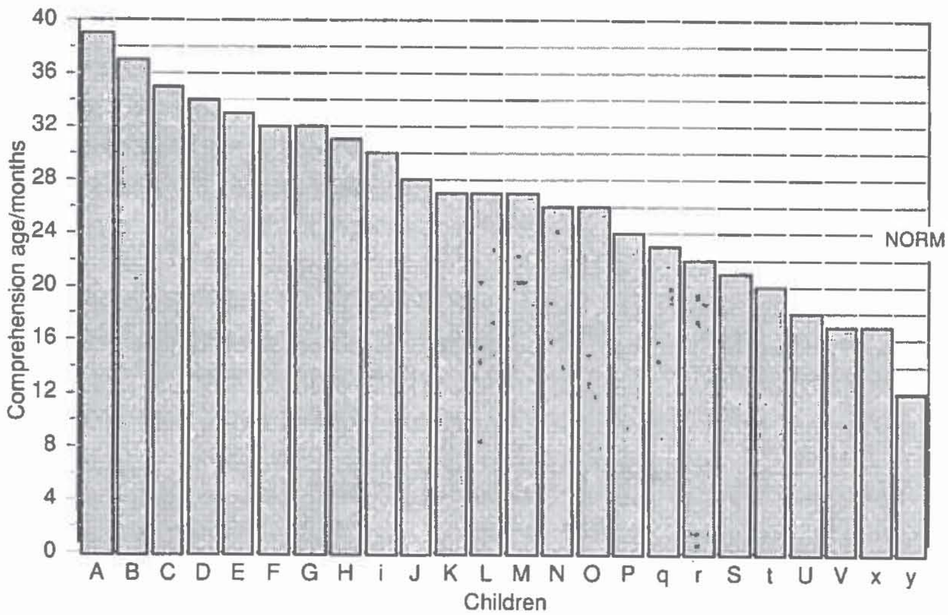

FIGURE 32 Individual Reynell Verbal Comprehension Ages at 24 months of corrected age

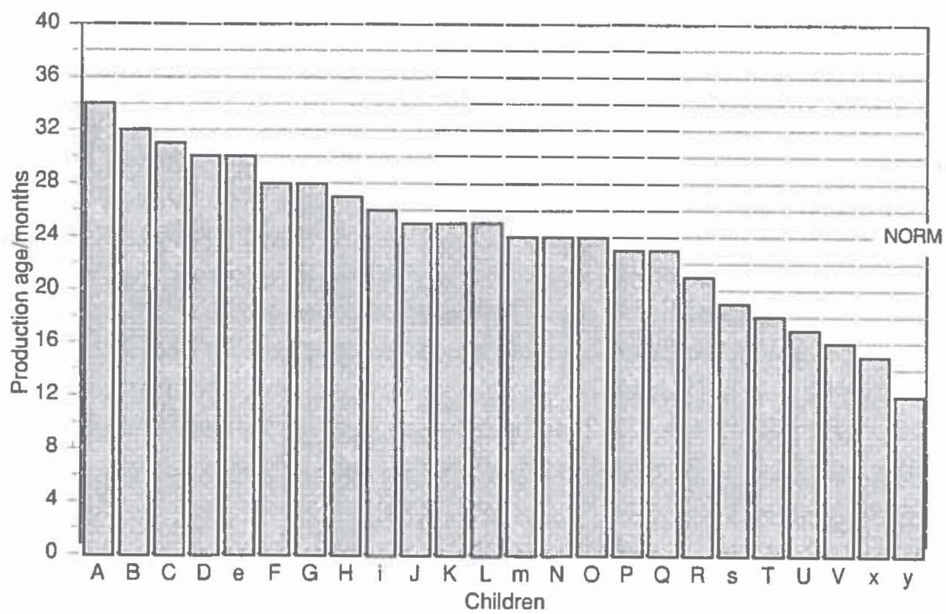

FIGURE 33 Individual Reynell Expressive Language Ages at 24 months of corrected age

Individual production ages at 24 months

In figure 33 the Expressive Language Age for each child (n=24) is presented at the *corrected age* of 24 months. Twelve infants without diagnoses and three cp children (e, i, m) reached or exceeded the 24-month level. Nine of them (two cp children) would have exceeded it also without the age correction (obtained ages 26-34 months). Among these infants there were none four months premature infants. Altogether nine children fell below the 24-month level and five of the six infants without diagnoses had 1 minute Apgar score below five (1-4). Altogether 19 performances were inside the normal level (- 1 SD). The child with a severe cp disability fell below the one year level (marked in figure 33 on 12 months level).

5.4 Test results in the light of risk score

5.4.1 Risk score at birth and test results

Risk score (See Appendix 2) was built according to the medical findings and the severity of hazards (scale 0-3). The highest birth weights, gestational age weeks and Apgar scores were scored as 1. The smallest number of diagnoses at birth, respirator treatment days, tube feeding days and hospital treatment days were scored as 1. The severity of lung disease was taken into account (0, 1 and 2). Also asphyxia, intracranial hemorrhage, ultra sound and EEG findings and apnoeas were checked. The results of children with and without diagnoses were presented as separate groups. Table 7 presents the children's Bayley, Reynell and ASQ results in the order of risk scores at corrected ages.

In the Ages and Stages Questionnaires five children without diagnoses and with low risk scores (6-10) and with 5 minute Apgar scores not less than 7, received a total score from 27 to 29.5 at two years of corrected age. Six months earlier these children had already received good total points at their chronological ages on the 20-month questionnaire (from 25 to 30 points). Among the 13 other children with medium or high risk scores (12-24) there were two children who received rather low total points of 23.5 (Apgar score 1/5; SGA; three months premature) and 24.5 (Apgar score 2/7; four months premature) at two years of corrected age. On the 20-month questionnaire these two children had received at their chronological ages low total points of 19.5 and 16.

In the Bayley Mental Scale of Infant Development all the five children with low risk scores (6-10) performed above the expected 100 MDI level at their corrected ages of 9-10, 18 and 24 months. Among the 13 other children with medium or high risk scores (12-24) there were four children who fell under the index 100 both at 18 and 24 months of corrected age. Three of these children had low Apgar scores (1/5, 2/7 and 4/5) but the fourth child had good scores (9/9). They were three or four months premature and they all had more or less difficulties to concentrate on assessment tasks or to co-operate with the examiner. These four children tended to score low also in the ASQ (23.5-27.5) and the Reynell comprehension (one over, but two months older than the others) and production (all under). On the other hand there were three children who scored high (150, 143 and 143) at two years of corrected age although they had medium (12, 16) or high (21) risk scores and low Apgar scores (4/3, 2/6 and 2/6). These children performed very well also in the ASQ (28, 28.5 and 30) and Reynell comprehension (27, 32 and 33 months). The families of these children focused their special attention on developing the infants' mental and language abilities.

In the Reynell Developmental Language Scales all the five children with low risk scores (6-10) exceeded the 24-month level in comprehension and reached (one child even) or exceeded (four children over) it in production at two years of corrected age. Among the 13 other children with medium or high risk scores (12-24) there were three children in comprehension and six in production who fell under the expected level of 24 months at two years of corrected age. In this group there were some exceptions to the rule: one child with good Apgar scores (9/9) and medium (14) risk scores received the 17-month level both in comprehension and in production and two children with low Apgar scores (2/6 both) and medium (16) or high risk scores (21) received high levels in comprehension (33, 32 months) and in production (28, 25) at two years of corrected age. However, there was a tendency that children with good Apgar scores and low or medium risk scores performed well at 24 months corrected age in comprehension and production. It is also notable that six months earlier at 18 months of corrected age many of these infants without diagnoses (n=18) fell under the expected level: nine in comprehension and 13 in production. The Reel and the Reynell assessment results were near each other and if there were different results the discrepancy was + or -2 months.

At their corrected ages *the preterm infants with cerebral palsy (n=5) or motor delay (n=1)* fell clearly behind the infants without diagnoses in the ASQ mostly due to gross motor delay (except the children with total points 0 and 8,5 with other delays, too). In the Bayley Mental Scale of Infant Development these preterm infants had difficulties to reach or exceed the expected 100 MDI level and also in comprehension in the Reynell Developmental Language Scales all except one child fell under the expected level of 24 months at two years of corrected age. However, in production three children reached or exceeded the 24-month level at the corrected age.

Table 8 presents different assessment results where the children fell under the expected level at corrected age. There were more "unders" in production than in comprehension. If a child did not produce 50 words at the corrected age of 18 months, she/he also fell under the expected level in the Reynell production at that time. When a child understood 100 words at the corrected age of 16 months, but fell under the expected level at Reynell comprehension (18 months) the reason was poor concentration and/or co-operation in assessment situation. There was also a tendency that if there were delays in the Bayley there were also delays in the Reynell comprehension. Furthermore, if there were no delays in the Bayley but delays in the Reynell (18 months) the reason was as mentioned above: poor concentration and/or co-operation The same connection could not be seen so clearly between the Bayley and production. Nine out of 18 infants without diagnoses had delays in production, although they performed very well in the Bayley. There were nine children among the infants without diagnoses in comprehension (no under-achievements after six months) and five in production who had no delays during the follow-up at corrected age. All those five infants without diagnoses who were excellent in production received good scores also at Reynell comprehension at 24 months of corrected age. Among those children who could understand language very well, there were, however, five children who had clear delays in production as measured by different tests.

In summary, there was a tendency that with increasing risk scores the infants without diagnoses showed delays in all the measured areas of development, when the delays in production seemed to occur with low, medium or high risk scores independently. All the infants who were detected by the Bayley or Reynell were also as screened by the ASQ. However, the ASQ was not sensitive enough to screen communication delays (only two rough delays) which were detected by other devices. Among the infants without diagnoses there were four infants with medium (14) or high (18, 18 and 24) risk scores with delays in all the measured areas and in different age check points.

It was possible to detect the difficulties of *cp children and the child with motor delay* by using the Bayley at 9-10 months and by using the Reel comprehension at 6 months of corrected age. Four out of six children were delayed in comprehending 100 words at 16 months and five out of six children were delayed in producing 50 words at 18 months of corrected age. In the Reynell comprehension (24 months) five out of six children and in the Reynell production three out of six children fell under expected level at corrected age. All the infants were as screened by the ASQ in one or more domains during the two-year follow-up. However, the ASQ was not sensitive enough to screen four infants with cerebral palsy at four months of corrected age in gross motor skills. Later the delays were detected at the corrected ages of 8 and 12 by using this device. Naturally, at four months of chronological age all these infants were as screened in the motor domain. One child had a very low risk score at birth but they had all been diagnosed to have findings in ultra sound (US) or in EEG at birth.

5.4.2 Risk score at two years of corrected age and test results

Risk score (See Appendix 2) was built on the basis of diagnoses, number of ear problems, number of normal child diseases at home and more severe illnesses with hospital visits, operations, findings of shoulder retraction and different therapies (physical, occupational, lung and feeding). A cp diagnosis was scored as 1, if the diagnosis was cancelled at about one year of age. If there was a diagnosis (tetraplegia, diplegia or hemiplegia) after one year of age or a child still had motor delay with therapies at two years of corrected age the score was 2.

When looking at the results with a time perspective (See Table 8), it can be seen that the first two children in column with low risk score at birth (6 and 7) and with low risk score at two years of corrected age (8 and 8) developed well. The third child in the column (risk score 10) was diagnosed to have hemiplegia (levis) soon after birth and she received physiotherapy. The diagnoses were cancelled at one year of age. She had also many ear problems (from 11 to16 months of chronological age) and some infections. An operation of the adenoids and the insertion of tubes in the ears finished the ear problems. Her speech production began to flourish after that. All these three infants spoke very clearly and understood language very well at two years of corrected age. The other two children with a risk score of 10 developed well in other areas, but they had both delays in production at 18 months. After six months, at the corrected age of 24, they, however, reached or exceeded the expected level. None of these five children had chronic lung diseases and their respirator treatment lasted only from zero (the first ones in the column) to seven days. All these infants were only two months premature.

Among the infants without diagnoses there were two children (risk score change +10 and + 11) who had a lot of problems (e.g. heart surgeries and many visits to hospitals) during the first two years. Despite that they developed so well that at two years of corrected age there were no notable delays in their test results. In speech production there were, however, problems: one had begun to hesitate and repeat words and the other had unclear and fast speech. The other two children with a risk score change +8 at two years of corrected age had many ear problems and infections during the two-year period. At 18 months of corrected age they both had delays in comprehension and production but they had overcome they delays at 24 months of corrected age. Those children (n=4) who had delays in all the areas and in many different age check points had managed with rather small changes in risk scores during the two-year period. These children (except for one) had rather a high risk score at birth and they were born with three or four months prematurity. The children with diagnoses (cp, motor delay) had high risk scores (except for one) at birth and they also had many illnesses and operations during the first two years. They also received different therapies: physiotherapy, occupational therapy, lung therapy (emptying), feeding therapy, and with one child the Delacato (1959) -method was applied.

In addition the parents were very eager to apply different methods at home to improve their children's development. The activities varied from playing traditional games, doing baby massage, singing or playing music to the child, looking at art (drawings, paintings, cards) or making art (drawing, water colouring), reading books to activities which took place outside home. Some of the families attended different mother-child (gymnastics, music) or family-child (baby swimming) groups. It was possible to see the benefits of these efforts in test results. However, speech production seemed to develop in most cases separately from mental and language skills. In general, it seemed to be advantageous for the child's development when both parents were involved in the activities. (See Appendix 9.)

TABLE 7 Test achievements at corrected age in Bayley, Reynell and ASQ for preterm infants without (n=18) and with diagnoses (n=6)/children in the order of risk score

WITHOUT DIAGNOSES

Risk score	Sex	Apgar	Premat. months	Weight	RDS/BPD	Bayley 10 MDI	Bayley 18 MDI	Bayley 24 MDI	REYNELL 18 MONTHS comprehension	REYNELL 18 MONTHS production	REYNELL 24 MONTHS comprehension	REYNELL 24 MONTHS production	ASQ 24 MOS	Screened
6	boy	9/9	2	1395	no disease	120	150	150	26 mos	27 mos	34 mos	32 mos	29,5	
7	girl	7/8	2	1090	no disease	127	150	150	26	Under (17)	37	30	29	
10	girl	8/7	2	1900	RDS	114	126	137	19	22	31	31	28	
10	boy	9/9	2	1240	RDS	102	130	137	27	Under (14)	35	25	27	
10	boy	9/9	2	1710	RDS	132	124	137	Under (17)	Under (13)	26	24	29	
12	boy	4/3	2	1125	RDS	108	134	150	20	Under (14)	27	Under (23)	28	
14	girl	9/9	3	1110	BPD	108	98	88	Under (12)	Under (14)	Under (17)	Under (17)	27,5	
15	girl	8	3	920	RDS	140	113	137	18	Under (15)	32	27	28,5	
15	girl	8/8	2	990	RDS	120	103	114	Under (17)	Under (15)	27	28	29	
16	boy	2/6	2	1240	BPD	132	123	143	21	22	33	28	30	
16	girl	8/9	3	810	BPD	120	150	150	26	21	39	34	28,5	
17	boy	6/6	3	980	RDS	150	121	112	Under (17)	Under (17)	26	24	27	
17	girl	6/8	3	900	RDS	114	119	98	Under (12)	19	24	25	29	
18	girl	4/5	3	1160	BPD	105	93	96	Under (12)	Under (15)	Under (18)	Under (21)	26	
18	girl	1/5	3	530	RDS	93	88	88	Under (17)	Under (15)	Under (21)	Under (16)	23,5	F
21	boy	2/6	4	660	BPD	114	115	143	21	Under (13)	32	25	28,5	
22	girl	4/8	4	630	BPD	117	115	114	Under (12)	Under (15)	27	Under (23)	29	
24	girl	2/7	4	640	BPD	*79	*96	*96	*Under (12)	*Under (13)	*28	*Under (18)	*24,5	at *30/26

WITH DIAGNOSES

Risk score	Sex	Apgar	Premat. months	Weight	RDS/BPD	Bayley 10 MDI	Bayley 18 MDI	Bayley 24 MDI	REYNELL 18 MONTHS comprehension	REYNELL 18 MONTHS production	REYNELL 24 MONTHS comprehension	REYNELL 24 MONTHS production	ASQ 24 MOS	Screened
9	boy	8/9	2	2280	RDS	82	62	98	Under (12)	Under (16)	Under (20)	26	17,5	G
17	girl	5/7	2	915	RDS	-	-	-	Under	Under	Under	Under	0	CGFAP
20	boy	6	3	885	BPD	83	119	100	Under (17)	20	Under (23)	30	17	GP
21	boy	6/8	4	675	RDS	83	50	50	Under (12)	Under (12)	Under (17)	Under (15)	8,5	GFAP
21	boy	2/7	3	970	RDS	86	111	100	Under (14)	Under (15)	Under (22)	Under (19)	18	G
24	boy	3/7	4	820	BPD	83	109	106	18	Under (17)	30	24	22	G

ASQ (max 30 p) C=communication
G=gross motor
F=fine motor
A=adaptive skills

TABLE 8 Under achievements at corrected age in Bayley, Reel, Reynell, ASQ, comprehending 100 words and producing 50 words for preterm infants without (n=18) and with diagnoses (n=6)/children in the order of risk score

	WITHOUT DGN																		WITH DGN					
RS/at birth	**6**	**7**	**10**	**10**	**10**	**12**	**14**	**15**	**15**	**16**	**16**	**17**	**17**	**18**	**18**	**21**	**22**	**24**	**9 cp**	**17 cp**	**20 cp**	**21 md**	**21 cp**	**24 cp**
Bay 10															u			u	u	u	u	u	u	u
Bay 18							u							u	u			u	u	u		u		
Bay 24							u						u	u	u			u	u	u		u		
Reel 6	u				u		u		u					u	u	u	u		u	u	u	u	u	u
CReel 9							u											-	u	u		u		
CReel 18							u							u				u	u	u		u	u	
CRey 18					u		u		u			u	u	u	u		u	u	u	u	u	u	u	
CReel 24														u						u		u		
CRey 24							u							u	u				u	u	u	u	u	
100comp							u							u	u			u	u	u		u	u	
50 prod		u		u	u	u	u	u	u			u		u	u	u	u	u	u	u		u	u	u
PReel 6														u	u	u	u			u	u			u
PReel 9				u												u		-	u	u		u		
PReel 18				u	u	u	u	u				u		u	u	u	u	u	u	u		u	u	
PRey 18		u		u	u	u	u	u	u			u		u	u	u	u	u	u	u		u	u	u
PReel 24				u	u	u	u							u	u	u		u		u		u	u	u
PRey 24						u	u							u	u		u	u		u		u	u	
ASQ 4					g	g				g									fa	gfap			g	
ASQ 8														g		c			gp	all	gp	cg		g
ASQ 12																		a	g	all	g	g		g
ASQ 16															a				gfa	all	g	cga	g	ga
ASQ 20							c								f				ga	all	g	ga	g	f
ASQ 24															f				g	all	gp	gfap	g	g
RS/24 mos	**8**	**8**	**19**	**12**	**15**	**14**	**18**	**18**	**23**	**26**	**20**	**25**	**28**	**21**	**24**	**25**	**28**	**28**	**19**	**29**	**29**	**28**	**33**	**32**
Change	**2**	**1**	**9**	**2**	**5**	**2**	**4**	**3**	**8**	**10**	**4**	**8**	**11**	**3**	**6**	**4**	**6**	**4**	**10**	**12**	**9**	**7**	**12**	**8**

cp = children with cerebral palsy (diplegia spastica n=2, hemiplegia n=2, tetraplegia spastica n=1)

md = a child with motor delay (dystonia musculorum?/hemiparesis?)

RS/at birth = Risk score at birth (range 6-24)
RS/24 mos = Risk score at 24 months of corrected age
Change = Risk score at 24 months of corrected age minus Risk score at birth

Bay = The Bayley Scales of Infant Development
CReel and **PReel** = The Receptive-Expressive Emergent Language Scale (C = Comprehension and P = Production)
CRey and **PRey** = The Reynell Developmental Language Scales (C = Comprehension and P = Production)
100 comp = comprehends 100 words at 16 months
50 prod = produces 50 words at 18 months
ASQ = The Ages and Stages Questionnaires
c = communication
g = gross motor
f = fine motor
a = adaptive skills
p = personal-social skills

6 SUMMARY OF RESULTS

Speech and language

The milestones of speech-motor skills followed the schedule of corrected age during the first year. Comprehension developed earlier than production during the second year and its development seemed to be very linear among the individual children. Infants without diagnoses (n=18) needed age correction as a group in speech production until the age of two years. In language comprehension there was no need for age correction after 18 months. The degree of prematurity effected a lot on test results. The older preterm infants (ga. 29-32) scored significantly higher on the level of 0.05 than the younger (ga. 24-28) preterm infants at 18 months' comprehension. At 24 months' production the difference between the two groups was near the significant level of 0.05 (the older ahead). The children with diagnoses (n=6) as a group needed the age correction during the whole follow-up both in comprehension and production.

Mental development

The preterm infants without diagnoses performed in the Bayley Scales of Infant Development about one standard deviation above the expected 100 MDI level at their average corrected age during the two-year follow-up. At their average chronological age the children performed 1-2 standard deviations under the index 100 during the first year but at the age checkpoint 16 the group average exceeded 100 (102). However, the children with three or four months prematurity tended to score under the index 100 still at two years of corrected age. At the chronological age there were rough developmental leaps from four to six months and from 10 to12 months. Both differences were significant on the level of 0.05.

The children with diagnoses did not exceed the expected 100 MDI level either at the corrected or chronological age. Items requiring spatial orientation, speed and midline skills lowered the performances of both groups but especially of the children with diagnoses.

Overall development

When assessed by the ASQ the infants without diagnoses as a group exceeded the statistically derived cutoff point very clearly at their corrected ages in all domains and in all age checkpoints from four to 24 months. There were significant changes of the level of 0.05 from 8 to 12 months with falling scores and from 12 to 16 with rising scores. Although these infants learned to walk rather late (corrected age 13.5 months; chronological age 16.2 months) they all, including the youngest ones (three or four months premature), received full points in the domain of gross motor skills at two years of corrected age. The infants with diagnoses as a group (excluding the child with very serious cerebral palsy) exceeded the statistically derived cutoff point at their corrected ages in all other domains except gross motor skills in the all age checkpoints from four to 24 months.

At the chronological age the infants without diagnoses as a group exceeded the statistically derived cutoff point on the 12-month questionnaire and after in all the five domains although there were also infants who scored as screened. The infants who were as screened still on the 20-month questionnaire were born three or four months premature. The infants with diagnoses had still many delays on and after the12-month questionnaire. Gross motor skills were mostly missing on the 8-month questionnaire and after but communication was the strongest area of all during the whole follow-up.

Age correction

Age correction was in connection to the developmental area and the applied device. The preterm infants without diagnoses needed age correction as a group in speech production until the age of two years. In language comprehension there was no need for age correction after 18 months. The infants scored above the index 100 in the Bayley Scales of Infant Development at 16 months of chronological age and after. In their overall development as measured by the ASQ, the children performed above the cutoffs on the 12-month questionnaire and after.

As a group the children with diagnoses did not achieve chronological levels in any developmental area during the two year follow-up. However, at two years of corrected age three of these children reached or exceeded the expected level in the Reynell production and one in the Reynell comprehension.

Prematurity, birth weight and sex

While the criterion was prematurity significant differences on the level of 0.05 were found. The older preterm infants (ga. 29-32) scored higher than the younger preterm infants (ga. 24-28). The heavier preterm infants tended to score higher than the extremely low birth weight preterm infants but the heavier ones were also the older ones. The boys performed better than the girls but they were also older than the girls. These very similar results were obtained at 18 and 24 months of corrected age both by the Reynell Developmental Language Scales and the Bayley Scales of Infant Development.

Perinatal risk and cumulative risk score

Children without diagnoses and with good starting points (low risk score, good Apgar scores, two months prematurity, no chronic lung disease) performed well in the Bayley, Reynell and ASQ at two years of corrected age. However, three of these older preterm infants had also failed to reach the expected level at 18 months of corrected age in production. Among the 13 other children without diagnoses there were four children with three or four months prematurity who fell under the expected levels in the Bayley or Reynell or received rather low points in the ASQ during the follow-up. Three of these children had high risk scores at birth and one had medium risk scores with good Apgar scores. All the infants with diagnoses at birth or soon after birth had a finding in ultrasound or in EEG or they were asphyxiated. These children also tended to score under the expected levels in different tests as a group or as individual performances.

When the results were looked at with a time perspective, it could be seen that the children with low risk scores at birth (six and seven) and with low risk scores at two years of corrected age (risk score change +2 and + 1) developed well. But on the other hand among the children without diagnoses there were two children (risk score change +10 and + 11) who had a lot of problems (e.g. heart surgeries and many visits to hospitals) during the first two years, but despite that they developed so well that at two years of corrected age there were no notable delays in the test results. The families' efforts to support their infants' development could be seen in the development of language comprehension but speech production seemed to develop according to the corrected age.

Correlations between different test results

There were significant correlations at the level .01 or .05 between the Bayley, Reynell and ASQ results for the infants without diagnoses (n=18). The Bayley 18 and 24 correlated with the Reynell comprehension 18 and 24 and the ASQ 24 but not with the Reynell production 18. This was due to delayed speech production at that age. There was also a great continuity of development in the Bayley and Reynell comprehension from 18 to 24 months. Also, between the Reynell production 18 and 24 there was correlation at the level .01. (See Appendix 8.)

7 DISCUSSION

Central findings. The preterm infants without diagnoses needed age correction as a group in speech production until the age of two years. In language comprehension there was no need for age correction after 18 months. However, the infants with three or four months prematurity tended to score lower than the infants with only two months prematurity in applied devices during the first two years. The heavier infants and the boys tended to score high in language and mental scales but they also belonged to the group of older preterms. The older preterm infants (ga. 29.-32.) were better than the younger preterm infants (ga. 24.-28.) at the 18-month comprehension skills. They also tended to be the better ones at the 24-month production skills. Age correction with normal limits (- 1 SD) seemed to make those children, who were at the greatest risk for speech and language delays, rise to the level of the normal group in the Reynell assessments. There were significant leaps in mental development from 4 to 6 and from 10 to 12 months of chronological age measured as the Bayley Scales of Infant Development. In the overall development measured by the ASQ, there were significant changes from eight to 12 months with falling points and from 12 to 16 with rising points. The children with diagnoses tended to score lower than children without diagnoses in all the measured areas of development. All the infants with diagnoses had a finding in ultrasound or EEG or they were asphyxiated in the beginning.

This study gave a detailed and exact picture about the speech and language development of preterm infants as a part of their overall development. The development of preterm infants followed the pathways of term infants but in a slower rate and in straight connection to prematurity. Length of gestation seemed to be a better predictor than birth weight. Birth weight may be misleading in the cases where the children are small for gestational age. When I started this study there were no assessment devices or norms for speech and language measurement (or even other areas) from birth onwards in Finnish. The foreign scales like the REEL proved to work in this preterm population very well and also with inattentive children. With this device it was possible to learn to know the real comprehension and production levels by observing children in their own home environments and by interviewing the parents. Also the important milestones of cooing, canonical babbling, comprehension of 100 words production of 50 words and putting words together, seemed to give valuable information about speech and language development even without any standardized scales and tests. Because applied tests and scales gave similar information on preterm infants' development, parallel testing seemed to be a waste of time. The overall development should be followed, e.g. with the ASQ and speech and language development with the REEL or Reynell or with the comprehensive measures mentioned above. The parents' work in developing their children's mental and language skills was beneficial for language comprehension but also the early oral-motor games would seem to be valuable for speech-motor development.

Findings in the light of literature. The preterm infants' first "home" environment is the neonatal intensive care unit in the beginning. Its task is to support the physiological and neurobehavioral organization of a preterm child. Transactional model, synactive model and state model (neurosocial development) are very fascinating models of child development. They all include the idea that the roots of the later development rest in the early days of life. This is very true with a fragile preterm child who needs special care and handling from the beginning. Rossetti (1996, 99) points out that we can modify the environment so that the child can move from in-turned state to coming-out state (states described by Gorski, Davidson & Brazelton 1979). Rossetti (1996, 7) comments also transactional model by emphasizing its probability of change over time and the reciprocal relationship between the child and the environment. The writer stresses the importance of early identification and intervention "because for many children the seeds of school failure begin quite early". According to Als (1986) the adaptation of synactive model of functioning is valid through the life span of organism. Blackburn (1998) points out that by modifying the neonatal intensive care environment we can provide a more supportive milieu for these vulnerable children. The writer continues that concerns about this environment have led to suggestions that it may be a major influential factor in the persistent incidence of behavioural and learning problems among preterm infants. Als (1986) who introduced the synactive model has continued her work with preterm infants and their parents. Mouradian and Als (1994) and Buehler and Als (1995) write about the importance of individualized developmental intervention care (IDC) which supports neurobehavioral functioning in the newborn period better than standard care. This special care has been noticed to diminish strikingly brain bleeds and severe chronic lung diseases. It appears to prevent attentional difficulties which are the possible causes of behavioural and academic disabilities. Children who received individualized care were also more stable and well regulated in autonomic and motor behaviours and showed an increase specifically in oral motor behaviours. The author of the present dissertation has also attended a course concerning the synactive theory of development, family centered care and the individual developmental care plan of preterm infants (Anzalone 1993).

The parents took part in this research voluntarily and their interest in co-operation and child development was great. The parents used a lot of time and different methods to improve their children's development but in spite of these efforts the speech production followed the pathways of corrected age during the first two years of life. In the development of comprehension the effects of home interventions could clearly be seen. The best results seemed to follow when the parents were seeking alternative ways to act and stimulate the child. When the parents got frustrated and only waited for something to happen, the results were not so good. Also animate stimuli (living interaction) seemed to work better than inanimate stimuli. White (1995, 218) studied the language development of preterm infants during the first years (birth-30 months) and concluded that the qualities of home environment and the ongoing medical factor were important predictors of language development. Also, the mothers' didactic way of acting has been found to have an effect on children's abilities. Toddlers and older infants who were more often encouraged by their mothers to attend to objects and events possessed greater verbal abilities and scored higher on intelligence tests. (Bornstein 1989.) Maternal sensitivity and different strategies with provided opportunities for communication are highlighted in research (Menyuk et al. 1995, 194; Wijnroks 1998).

There was a tendency that with increasing risk scores, delays were present in all the measured areas of development while delays in speech production seemed to occur with low, medium or high risk scores independently. When the results were looked at with a perspective of time, it could be seen that the children with low risk scores at birth and with low risk scores at two years of corrected age developed well. But, on the other hand, among children without diagnoses there were also children who had a lot of problems (e.g. heart surgeries and many visits to hospitals) during the first two years. Despite that, these children developed so well that at two years of corrected age there were no notable delays in test results. According to Wijnroks (1994, 203) the mothers of infants scoring high on a neonatal risk index acted differently when compared to the mothers of infants scoring low on the risk index. The anxious mothers were more active, scored a higher rate of the level of involvement and stimulated their infants more intensively than mothers who were reported to be less anxious.

The degree prematurity explains a lot of preterm infants' development. According to the results of this study, the children with two months prematurity were ahead of children with three or four months prematurity during the first two years. Among the infants without diagnoses there were four infants with 3- or 4-month prematurity with medium or high risk scores and with delays in all the measured areas and in different age check points. Neither high nor low Apgar scores alone explained the development. Three children scored high at two years of corrected age in the Bayley although they had medium or high risk scores and low Apgar scores at birth. These children performed very well also in the ASQ and the Reynell comprehension. The families of these children focused their special attention on developing the infants' mental and language abilities. Among the children with BPD (chronic lung disease) or with many ear problems there were both excellent speakers and those with delayed speech at two years of corrected age. According to the latest research (Roberts et al. 1998) among term infants otitis media and hearing loss modestly correlated with measures of language and cognitive skills which were, however, more strongly related to the quality of home and childcare environment. The rapid appearance of new approaches, such as the surfactant care for the lungs, has meant a revolution for development (Spitzer 1998). Despite many new approaches, the writer calls for attention to the tireless efforts of the families who work for their children's benefit.

The Reynell and the Reel measured the children's emerging skills in production and comprehension rather equally at 18 and 24 months of corrected age. If a child had concentration problems, the REEL seemed to be more reliable. The Reynell assessment requires that a child acts strictly according to the tester's orders. If a child could not concentrate properly, the assessment result seemed to measure concentration more than language skills. The older (ga. 29-32 vs. ga. 24-28) preterm infants and the boys (older than girls) scored high in the Reynell comprehension and production. However, also the older preterm infants had delays in production at 18 months of corrected age. But at the same time they were significantly (level 0.05) better in comprehension. As a group the children with diagnoses had delays in comprehension and production both at 18 and 24 months of corrected age. When the individual Reynell performances were inspected within the normal limits (- 1 SD) the children who according to the REEL index were at the greatest risk for delays rose to the normal group. Age correction is adequate, and the extra use of standard deviations only places the assessment on loose ground.

Sixteen of all these preterm infants (N=24) comprehended 100 words at the corrected age of 16 months or earlier. According to Bates, Dale and Thal (1995) the term infants comprehend on an average 200 words at 16 months of age measured by the MacArthur CDI Infant Scale (Fenson et al. 1993). Eight children did not achieve the 100 word level either at chronological or corrected age. All these infants were delayed while assessed also by the Bayley, the Reel and the Reynell but the ASQ was sensitive enough only with two children in communication. It is good to notice that in the ASQ comprehension and production are not separated from each other and they are measured under the heading, communication. Four out of eight delayed infants in comprehension had a diagnosis (CP or motor delay) and the rest four were born with three or four months prematurity. All these infants had comprehended only one word or none at the chronological age of one year.

Only six of all these preterm infants (N=24) produced 50 words at the corrected age of 18 months or earlier. These were also the six first ones in production as assessed by the Reynell at 18 months of corrected age. Six months later at the corrected age of 24 months they still tended to be the first ones. All the 18 infants delayed in production fell under the expected level of 18 months also in the Reynell production. After six months at two years of corrected age 15 out of 24 infants had already reached or exceeded the expected level in the Reynell production. At that age nine of infants still produced only 0-20 words. A gap between term and preterm infants in production seems to be great. Bates, Dale and Thal (1995) reported that on an average term infants produced 100 words at 18 months and more than 300 words at 24 months as measured by the MacArthur CDI Infant Scale (Fenson et al.1993). Also the term infants in the Finnish follow-up study (Lyytinen, Poikkeus, Leiwo, Ahonen & Lyytinen 1996) fell behind the CDI norms but reached nearly (48 words at 18 months) the numbers reported by Menyuk et al. (1995, 82). The writers conclude that the parents' instructions in their study were probably more strict in word definition than the instructions given to US parents. In the present dissertation I applied Vihman & McCune (1994) definition for word which takes into account context, vocalization shape and relation to other vocalizations which in my opinion expands the idea of word compared to former definitions. It is obvious that preterm infants are delayed in their speech production at about the age of one and a half years but a strong spurt takes place after that and six months later many of the infants have caught up the norms at corrected age. However, the Reynell results compared to the REEL results may be good because a child receives scores from naming single words although his/her language structure is still poor (no sentences).

All the infants who produced 50 words at the corrected age of 18 months spoke sentences at two years of corrected age and one of them was bilingual. The earliest speaker began to join words together at 16/14 months of age and the latest speaker at 30/26 months of age. Altogether five of the 24 children spoke long sentences at two years of corrected age. Four of these five "best speakers" also had a very short distance (6-8 months) between steady sitting and putting words together. They sat early (at the corrected age of 8-9 months) and joined words together early (at the corrected age of 14-16 months). However, on an average three of the cp-children began to join words together at the same time as the children without diagnoses although they began to sit late. Vocabulary growth at the chronological age was naturally delayed. There were no early fast developers, but 11 late fast and 13 slow developers. Late fast developers achieved a 10-word vocabulary at the average age of 18.2 months and a 50-word vocabulary at the average age of 21.5 months. Only one child could produce both /s/ and /r/ correctly at two years of corrected age. These preterm infants achieved speech-motor skills "babbling" and "canonical babbling" during the first year somewhat later than at the corrected age. None of the infants with diagnoses had a note about "clicks with tongue". There was also a tendency that delayed speakers used their mouth to discover things longer (still at two years of corrected age) than the good speakers (not after 18 months of corrected age). "The best speakers" could also use the personal pronouns "I", "me" or "you" at two years of corrected age.

Barrera, Rosenbaum and Cunningham (1987) noticed that LBW infants (> 1500 g) caught up with term infants in their cognitive abilities at the chronological age by their first birthday but VLBW (< 1500 g) infants did not. Siegel (1994) also noted that the uncorrected scores were better predictors of developmental delay than the corrected scores after the first year with VLBW infants (< 1500 g). Because there were also ELBW (< 1000 g) infants in this follow-up, the children without diagnoses achieved the chronological level as a group somewhat later than at one year of age. However, significant (on the 0.05 level) leap in development could be detected just before the first birthday. The better achievements of the boys as compared to the girls were in connection to less prematurity. The children with diagnoses did not exceed the expected 100 MDI level either at corrected or chronological age.

Many of the infants without diagnoses reached items "builds tower", "imitates strokes" and "puts cube in a cup" later than expected. Unsuccessful performances in items requiring spatial orientation, speed and midline skills lowered both groups' (with and without diagnoses) performances (e.g. tower, pegs, boards, strokes). According to LeGuire and Fellows (1990), seventy of the163 items of an older version of the Bayley require visual-motor performance. In this follow-up early physiotherapy clearly helped the children with shoulder retraction to work with hands in midline. Jones, Horn and Warren (1999) showed the increased use of communication behaviours after a neurobehavioral motor intervention in their study. Wijnroks (1994, 192) noticed that infants who had problems in postural control in the first year of life had a delay in cognitive development at the age of two. These children were also more frequently inattentive than infants without such problems. In conclusion, the special characteristics of preterm infants' development show themselves in the Bayley results and that is why it does not measure solely the mental skills of preterm infants. If the Bayley is applied, the delays should be observed in the item level and this information utilized in the possible intervention. The domain of adaptive skills and also that of fine motor skills of the ASQ would better measure the above mentioned difficulties of preterm infants.

Bricker and Squires (1989a, 1989b) wrote that the ability of the ASQ to find children who will develop normally (specifity) is significant, but its ability to find those who will develop abnormally (sensitivity) is lower. In this study the ASQ was not sensitive enough to screen the gross motor delays of four cp infants at four months of corrected age and communication delays of several infants during the follow-up. The delays of those four infants who were as screened with all the devices received rather low total scores still on the 20-month chronological questionnaire. There was a rough change (significant on the level 0.05) in this follow-up from 8 to 12 months with falling points and from 12 to 16 months with rising points. The falling points were due to missing skills in word production and walking. The infants without diagnoses learned to walk rather late (corrected 13.5 months; chronological 16.2 months) but they all, including the youngest ones with three or four months prematurity, received full points in the domain of gross motor skills on the 24-month questionnaire.

Suggestions for practice. It is possible that preterm infants' problems in speech production are at least partly due to intubation (respirator treatment) and missing sucking exercise because they were born too early. Als (1986) points out that sucking is a normal activity of a fetus from at least the fifth month on during gestation. Nutritive and non-nutritive sucking exercises as early as possible in NICUs would be very valuable for this reason for the development of preterm infants' speech-motor skills and for quieting the child. The parents should also be advised to play all kinds of oral games (speech-motor games) later with their preterm infants and both parents should be motivated to take part in these activities. According to this study, most of the preterm infants did not use any pacifiers (some did while going to bed) or bottles at the corrected age of two years. However, many of the infants with delayed speech production discovered things with their mouth still at two years of corrected age.

Mothers and fathers are normally included in NICU environments to work with the professionals for the benefits of their children. This is also called the ecological, family-centered care model (Brown, Pearl & Carrasco 1991). After discharge from hospitals it would be beneficial to include the parents more closely also in the follow-ups. The ASQ would act as a good device and the parents could fill in the age appropriate questionnaires before they come to the professionals. The parents could also keep diaries concerning the children's vocabulary growth both in word comprehension and word production and visit a speech therapist at certain intervals. Parent report inventories (Fenson et al. 1993; Koopmans-van Beinum & van der Stelt 1986; Menyuk et al. 1995; Rescorla 1989) have also shown that parents can assess their children's emerging speech and language skills reliably. The measures "understands 100 words at 16 months" and "produces 50 words at 18 months" seem very promising for screening. Menyuk et al. (1995) consider these measures quite universal on the basis of their own findings and other studies. These rough screening devices could help the parents to learn to know if there is a cause for concern or not. The parents' worries concerning their children's development should be taken seriously as early as possible. Normally, physiotherapy is started during the first year but speech therapy services are mostly missing or they start too late. The children with hazards (e.g. ultra sound finding, asphyxia) at birth need speech therapy follow-up from birth onwards. The other preterm infants should visit speech therapist at one year of age at the latest and if there are delays, at four-month intervals after that.

In this study those who were good in production were also good in comprehension at two years of corrected age. Menyuk et al. (1995) report on similar findings. On the other hand, there were many delayed children in production although their language comprehension was excellent. Especially those infants, who have a very small active vocabulary, need a special attention with regard to their later reading and writing skills. According to Merzenich, Jenkins, Johnston, Schrenier, Miller and Tallal (1996) up to 85% of those children who have an oral language impairment develop reading problems. The writers believe that the auditory inability to recognize the sounds of very short-duration of the spoken language lies in the background of this difficulty. On the basis of synactive theory you might also assume the reason lie partly in missing oral memory tracks of spoken words among delayed speakers.

All the cp infants and the child with motor delay had a finding in ultrasound or in EEG or they were asphyxiated at birth or soon after birth. As a risk factor for later cognitive and language development Siegel (1994) named e.g. asphyxia. According to Salokorpi (1999, 46) a significant risk factor for cerebral palsy among ELBW infants and also for minor neurological disorders in preterm infants with gestational ages less than 34 weeks was a finding of abnormal ultrasound. In the present dissertation there was also a child who had a finding in ultrasound in the beginning but later there were no findings and also the CT result was normal. Because also the early developmental screening devices are not sensitive enough, there is a danger that a child is moved to the "healthy" group too early. For this reason it is important that hospitals do not stop the follow-up too early. The results of this study also suggest that it is reasonable to use the ASQ and the Bayley with older infants with two months prematurity at the children's chronological age of one year and onwards but devote more time (e.g. up to 20 months) for infants with three or four months prematurity and focus especially on those infants who have delays in several domains and in successive age check points. According to Belcher and Gittlesohn (1997) and Menyuk et al. (1995) there is no need for age correction in language comprehension and in speech production during the second year. The present dissertation shows similar results in language comprehension but not in speech production. There were only two children (intensive follow-up group) in this study who did not need age correction after 16 months of age in speech production. They were the children with only two months prematurity and with the lowest risk scores (6 and 7) and with no intubation at birth.

Metodology and further research. The number of children (N=24) in this study was so small that no comprehensive conclusions could be made. However, the results of this study supported the findings of previous studies, expressive language of preterm infants is delayed and the degree of prematurity determines the speed of development during the first two years of life. Term controls were not used for different reasons. In the beginning there were discussions and also efforts to get controls but this design was abandoned because of the amount of bureaucracy involved. Twenty four term infants would have also changed the nature of this follow-up into something less intensive. Because so many earlier studies had concentrated on comparisons between term and preterm infants, I decided to trace developmental pathways inside a preterm group. In the beginning the missing assessment devices formed a very big challenge for this follow-up. When the assessment devices were found on the basis of literature and the ASQ Questionnaires were received from the University of Oregon there were still problems in the form of missing norms in Finnish. It is believed that there is an invariant sequence of milestones in development which is characteristic of all human beings. According to literature (McCall, Eichhorn & Hogarty 1977; Lasky, Klein, Yarbrough & Kallio 1981) the mental and overall development of children follows universal pathways regardless of the culture where the children live. However, in cross-linguistic comparisons concerning Finnish and some other languages (Dasinger 1997; Kunnari 2000; Weist, Lyytinen, Wysocka & Atanassova 1997) universal but also divergent trends in development have been found. On the basis of literature review it seems that more cross-cultural studies in language and other developmental domains are needed.

Many discussions were also carried out in the ADP (automatic data processing) centre on the way of presenting the results. Because the number of the children was so small, the outcome of these discussions was to present the results as figures and tables with comparisons to test norms and standards without using any statistical methods. However, in the final stage the Mann-Whitney test for infant group comparisons, the Wilcoxon test for changes between different measurements in time during the two-year follow-up and the Spearman test for correlations between the results of different tests were applied.

There were high correlations between test results obtained by the Bayley, Reynell and ASQ. The Reynell production 18 did not correlate with the other test results because speech production developed later than the other skills. On the basis of great continuity in test results and regularly repeated assessments it is reasonable to consider the results of this study reliable. According to other studies language tests seem to correlate with each other (Sherman, Shulman, Trimm & Hoff 1996) which in turn seem to correlate with the Bayley Scales of Infant Development (Costarides &Shulman 1998). Furthermore, Belcher and Gittlesohn (1997) report on an orderly, sequential development of language in preterm infants which was also the fact in the present dissertation. Also, the parents' knowledge was utilized, the assessments were made at the children's homes and the researcher learned to know the children well. With these efforts it was possible to diminish the subjective view of the researcher. The great continuum through the two-year follow-up in the individual performances was also a fact. Maisto and German (1986) speculated that during the first 18 months the measures of different developmental domains are largely redundant and this fact suggests that a child will score on the same general level on the different norm-referenced measures. On the basis of the continuum of the test results they also postulated that the assessments in 1-year intervals (since nine months) would be adequate in monitoring the most children's developmental progress. This is probably true with healthy children but follow-ups of at-risk and extremely preterm infants from birth onwards and in shorter intervals than mentioned above are needed.

In further studies especially the connection between early oral language skills and development in speech production need a more profound analysis. In this study the children's feeding and drinking behaviours were videotaped during every home visit for this purpose. Also, the detailed analysis of interaction on the basis of video recordings between infants and parents would give valuable information. From the beginning there was also a plan to continue the follow-up until the school age and the parents were asked for permissions for later follow-up. The student of education (Aaltonen 2000) at the University of Jyväskylä followed the development of the academic skills of the intensive follow-up infants (n=6) before their school entry and again one year later at the end of the first school year. Term controls for these preterm infants were selected. There are also plans to study all the follow-up infants (N=24) later in school age with regard to their school performances.

TIIVISTELMÄ

Keskonen kasvaa: puheen ja kielen kehitys kahtena ensimmäisenä elinvuotena

Tutkimuksen tarkoituksena oli saada yksityiskohtainen ja tarkka kuva keskosten puheen ja kielen kehityksestä sekä heidän mentaalisesta että kokonaiskehityksestään ekologisessa viitekehyksessä. Keskosten lähtökohdat syntyessä saatiin sairaalapapereista ja kehitystä seurattiin intensiivisesti lasten omissa kotiympäristöissä kahden ensimmäisen elinvuoden ajan. Kehityksen etenemistä tarkasteltiin sekä korjatussa että kronologisessa iässä. Kirjallisuuden ja aikaisempien tutkimusten valossa keskosten kehityksessä oli odotettavissa viivästymää varsinkin silloin, jos kehitystä tarkastellaan vain kronologisessa iässä. Tähän mennessä keskosten varhaisvaiheen (0-2 vuotta) puheen ja kielen kehityksen intensiiviset seurannat ovat puuttuneet Suomesta. Näin intensiivistä seurantaa, jossa kehitystä seurataan sekä korjatussa että kronologisessa iässä kuukausittain ensimmäisenä vuotena ja joka toinen kuukausi toisena vuotena (intensiiviseurannan lapset) ei muiltakaan kehityksen alueilta ole toteutettu. Puuttuvat suomenkieliset normitetut testit muodostavat vaikean esteen tutkimukselle.

Tutkimus alkoi vuonna 1990 osana projekteja "Monivammaisuus, perhe ja lapsuus" (1.8.1990-31.5.1993) ja edelleen "Pienten keskosten varhainen vuorovaikutus ja vanhemmuuden tukeminen" (1.6.1993-31.12.1994). Tutkimus toteutettiin Jyväskylän yliopistossa, erityispedagogiikan laitoksella ja keskoset tulivat (N=24) kolmen eri keskussairaalapiirin alueelta Jyväskylästä, Helsingistä ja Oulusta. Keskosille ei valittu verrokkeja täysiaikaisina syntyneistä lapsista. Saatuja testituloksia tarkasteltiin keskosryhmän sisällä käyttäen vertailuperusteina testien standardeja ja muuta saatavilla ollutta normitietoa. Ryhmävertailussa käytettiin Mann-Whitney -testiä (Easton & McColl1999), testisuoritusten muutosta ajassa mitattiin Wilcoxon -testillä (Easton & McColl1999) ja korrelaatioita eri testien välillä Spearman -testillä (Nummenmaa, Konttinen, Kuusinen & Leskinen 1997, 156). Puheen ja kielen kehityksen seurannassa käytettiin The Receptive-Expressive Emergent Language Scale (Bzoch & League 1991) ja the Reynell Developmental Language Scales (Reynell & Huntley 1985) -testejä. Mentaalista kehitystä arvioitiin the Bayley Scales of Infant Development (Bayley 1969) -testillä. Keskosten kokonaiskehitystä (kommunikaatio, karkea- ja hienomotoriikka, adaptiiviset taidot ja persoonallissosiaaliset taidot) arvioitiin the Ages and Stages Questionnaires (Squires, Bricker & Potter 1993) -lomakkeistolla. Myös yksilölliset karkea- ja hienomotoriset sekä kommunikaatio- ja puhemotoriset virstanpylväät (ns. neuvolakorttitiedot) kirjattiin ylös vanhempien ja tutkijan yhteistyönä.

Kaksi kuukautta liian aikaisin syntyneet keskoset, joilla ei ollut cp -vammaa tai fysioterapiaa vaativaa motorista viivästymää kahden vuoden iässä alkoivat suoriutua ilman iän korjaamista eri kehityksen alueilla yhden ja puolentoista vuoden iän välillä riippuen käytetystä testistä ja kehityksen osa-alueesta. Kuitenkin myös nämä vanhemmat keskoset (syntyneet raskausviikoilla 29.-32.) olivat viivästyneitä puheen tuottamisessa. Melkein poikkeuksetta nuoremmat keskoset (syntyneet raskausviikoilla 24.-28.) eivät yltäneet odotettuihin tasoihin eri kehityksen alueilla kahden vuoden iässä, vaikka ikä oli korjattu ennenaikaisuudella. Vanhemmat keskoset suoriutuivat nuorempia keskosia paremmin merkitsevyys-

tasolla 0.05 ymmärtämisessä 18 kuukauden korjatussa iässä. Ryhmien välinen ero puheen tuottamisessa 24 kuukauden korjatussa iässä vanhempien keskosten ollessa edellä nousi lähelle 0.05: n merkitsevyystasoa. Lapset, joiden vanhemmat olivat suorittaneet ylioppilastutkinnon, suoriutuivat keskimäärin hieman paremmin kuin muu ryhmä kielen ymmärtämisessä kahden vuoden korjatussa iässä, mutta tämä ero ei ollut tilastollisesti merkitsevä. Tulokset osoittivat, että keskosten ikää ei ollut tarpeen korjata kielen ymmärtämisessä puolen toista vuoden iän jälkeen, mutta puheen tuottamisessa ikää oli korjattava ennenaikaisuudella aina seurannan loppuun eli kahden vuoden korjattuun ikään asti käytetyissä mittavälineissä. Kun tuloksia korjatun iän lisäksi tarkasteltiin keskihajontojen valossa (Reynell) nousivat useat myös muiden testien mukaan riskiryhmään kuuluvat lapset normaaliryhmään.

Keskosilla, joilla oli cp -vamma (n=5) tai fysioterapiaa vaativa motorinen viivästymä kahden vuoden iässä (n=1), oli aluksi ultraääni- tai EEG -löydös tai heillä oli diagnosoitu asfyksiaa. Ryhmänä nämä lapset suoriutuivat eri testeissä huonommin, erityisesti karkea motoriikassa kuin lapset, joilla ei ollut diagnoosia. Toisaalta kuitenkin tämäkin tutkimus antoi viitteitä siitä, että alhaisista Apgar -pisteistä huolimatta lapset (ilman diagnoosia) vaikean alun jälkeen saivat erinomaisia testipistemääriä eri kehityksen alueilla. Enneaikaisuuden määrä ja diagnosoitu vaikeus näkyivät keskosten testisuorituksissa. Kuitenkin suurin osa lapsista kehittyi hyvin huolimatta suuresta määrästä erilaisia ongelmia kahden ensimmäisen vuoden aikana ja testisuoriutuminen kielen ymmärtämisessä ja puheen tuottamisessa edistyi hyvin 18 kuukaudesta 24 kuukauteen vartuttaessa. Vanhemmat toimivat aktiivisesti lastensa taitojen kehittäjinä ja heitä tulisikin rohkaista kehittämään erityisesti lasten tuottavan kielen taitoja. Vanhemmat tulisi myös saada mukaan sairaaloiden seurantaan kiinteämmin.

Avainsanat: keskonen, keskosen kehityksen arviointi, puheen ja kielen kehitys, iän korjaaminen, ekologinen arviointi

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APPENDIX 1

Birth characteristics and respirator, tube feeding and hospital treatment days for preterm infants without (n=18) and with diagnoses (n=6)/children in the order of risk score
(See also Appendix 2)

Sex	Weight	Height	Gestat. age weeks+ days	Born too early/ days	Apgar scores	Res-pir. treat. days	Tube fee-ding days	Hos-pital treat days
Without diagnoses								
boy	1395 g	41,0 cm	32+0	56	(9) (9)	0	31	39
girl	1090 g	38,0 cm	32+4	51	(7) (8)	0	32	51
girl	1900 g	40,0 cm	30+2	66	(8) (7)	4	29	34
boy	1240 g	39,0 cm	30+4	67	(9) (9)	7	45	48
boy	1710 g	41,0 cm	31+0	61	(9) (9)	1	21	29
boy	1125 g	38,0 cm	32+2	50	(4) (3)	5	43	47
girl	1110 g	37,0 cm	27+4	87	(9) (9)	4	47	47
girl	920 g	30,0 cm	29+0	72	-8	12	26	126
girl	990 g	38,0 cm	29+3	73	(8) (8)	5	51	59
boy	1240 g	38,0 cm	31+0	65	(2) (6)	18	63	84
girl	810 g	33,0 cm	25+5	98	(8) (9)	23	92	93
boy	980 g	37,0 cm	26+5	96	(6) (6)	13	62	67
girl	900 g	35,0 cm	25+4	99	(6) (8)	31	90	96
girl	1160 g	39,0 cm	28+3	79	(4) (5)	25	62	68
girl	530 g	30,0 cm	29+2	74	(1) (5)	7	81	84
boy	660 g	30,0 cm	24+0	111	(2) (6)	40	85	94
girl	630 g	30,0 cm	24+5	105	(4) (8)	68	106	113
girl	640 g	30,0 cm	24+0	108	(2) (7)	44	99	113
With diagnoses								
boy	2280 g	44,0 cm	32+4	52	(8) (9)	5	32	34
girl	915 g	32,0 cm	29+3	72	(5) (7)	19	56	74
girl	885 g	35,0 cm	25+5	98	(6)	25	55	119
boy	675 g	30,0 cm	24+3	107	(6) (8)	49	61	103
boy	970 g	33,0 cm	27+4	87	(2) (7)	13	107	158
boy	820 g	33,0 cm	24+6	107	(3) (7)	62	87	119

APPENDIX 2

Risk scores at birth and at two years of corrected age for preterm infants without (n=18) and with diagnoses (n=6)

Risk score at birth	6	7	10	10	10	12	14	15	15	16	16	17	17	18	18	21	22	24	9 cp	17 cp	20 cp	21 md	21 cp	24 cp
Birthweight	1	1	1	1	1	1	1	2	2	1	2	2	2	1	3	3	3	3	1	2	2	3	2	2
Prematurity	1	1	1	1	1	1	2	2	2	1	3	3	3	2	2	3	3	3	1	2	3	3	2	3
Apgar score	1	2	2	1	1	3	1	2	2	3	1	2	2	3	2	3	3	3	1	3	2	2	3	3
Number/dgn	1	1	2	2	2	2	3	2	3	3	1	3	2	3	3	2	2	3	2	2	2	2	3	3
Respirator treat.	0	0	1	1	1	1	1	2	1	2	2	2	2	2	1	3	3	3	1	2	2	3	2	3
Tube feeding	1	1	1	2	1	2	2	1	2	2	3	2	3	2	3	3	3	3	1	2	2	2	3	3
Hospital treat.	1	1	1	1	1	1	1	3	1	2	2	2	2	2	2	2	3	3	1	2	3	3	3	3
RDS/BPD	0	0	1	1	1	1	2	1	1	2	2	1	1	2	1	2	2	2	1	1	2	1	1	2
Asphyxia																				x=1		x=1	x=1	
IVH																					x=1			x=1
US finding										(x)						(x)		(x)	(x)		x=1	x=1		x=1
EEG finding																							x=1	
Apnea					x=1		x=1		x=1					x=1				x=1						
	F	R	O	M		B	I	R	T	H		UP		TO		T	W	O		Y	E	A	R	S:
CP			1									1	1		1				2	2	2	2	2	2
Ear problems	0	0	3	0	0	0	1	0	3	3	2	3	3	0	1	1	1	0	3	3	2	2	3	0
Home disease	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	2	1	1	2	2
Hosp illnesses	1	0	2	1	2	1	1	0	2	2	0	2	2	2	1	1	2	2	2	2	1	0	2	1
Operations										x=1			x=1										x=1	x=1
Physical ther.			x=1		x=1		(x)			x=1		x=1	x=1		x=1		x=1	(x)	x=1	x=1	x=1	x=1	x=1	x=1
Shoulder retrac			x=1		x=1		x=1		x=1	x=1			x=1		x=1			x=1	x=1		x=1			
Occup. ther								x=1												x=1		x=1	x=1	
Lung ther								x=1		x=1	x=1					x=1	x=1				x=1			x=1
Feeding ther													x=1							x=1			(x)	
Risk score at 2	8	8	19	12	15	14	18	18	23	26	20	25	28	21	24	25	28	28	19	29	29	28	33	32
Change	+2	+1	+9	+2	+5	+2	+4	+3	+8	+10	+4	+8	+11	+3	+6	+4	+6	+4	+10	+12	+9	+7	+12	+8

CP = cerebral palsy; md = motor delay; still therapy at two years of age

Continues 2/5

Interpretations of the risk indices at birth:		Number of children
Birth weight		
3	675g or under	n=5
2	over 675, under 1000g	n=9
1	over 1000g	n=10
Prematurity		
3	ga. 24 25 26	n=9
2	ga. 27 28 29	n=7
1	ga. 30 31 32	n=8
Apgar		
3	1/5-5/7	n=10
2	6/6-8/8	n=8
1	8/9 and 9/9	n=6
Number of diagnoses at birth		
3	6 or more	n=9
2	3-5	n=12
1	1-2	n=3
Respirator treatment days		
3	40-68 days	n=4
2	12-31 days	n=10
1	1-7 days	n=8
0	0	n=2

Tube feeding days

3	81-107 days	n=8
2	43-63 days	n=10
1	21-31 days	n=6

Hospital treatment days

3	103-158 days	n=7
2	63-94 days	n=8
1	29-56 days	n=9

RDS/BPD

2	BPD	n=9
1	RSD	n=13
0	no lung diseases	n=2

Asphyxia

X=1 (finding) n=3

Intracranial hemorrhage (IVH)

X=1 (finding) n=2

(child one: grade I sinister + grade III dexter; child two: grade II dexter)

Intracranial Ultra Sound finding

X=1 (finding); (+ 4 children first suspected, later normal finding) n=3

EEG finding

X=1 finding n=1

Apnoea

Interpretations of the risk indices during the first two years		Number of children	Continues 4/5
CP:			
2	diagnosed to have cp (n=5) or heavy motor delay (n=1); physiotherapy is needed at two years of age	n=6	
1	diagnosed to have cp or motor delay; but diagnosis cancelled at one year of age; no physiotherapy is needed at two years of age	n=4	
Ear problems during the first two years:			
3	more than 4	n=8	
2	4	n=3	
1	1-2	n=4	
0	none	n=9	
Common child diseases at home during the first two years/ no hospital treatment needed			
2	many	n=4	
1	a few	n=19	
0	none	n=1	
Illnesses: hospital treatment needed during the first two years			
2	frequently	n=12	
1	seldom	n=8	
0	newer	n=4	
Operations at hospital during the first two years			
X=1		n=4	

Physiotherapy by physical therapist during the first two years

X=1	n=13
(x) advice on how to handle the child/no therapy	n=2

Shoulder retraction (diagnosed in documents)

X=1	n=10

Occupational therapy by occupational therapist during the first two years

X=1	n=4

Lung therapy by physical therapist during the first two years

X=1	n=7

Speech and feeding therapy by speech therapist during the first two years

X=1	n=2
(x) follow-up; no therapy	n=1

APPENDIX 3

Home visits and telephone interviews at corrected age from 0 to 24 months

Months	Children Intensive follow-up group A-I (n=9); Helsinki and Oulu area J-Y (n=15)																						
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	X	Y
0	x	x			x	x	x	x			x									x	x	x		
1	x	x	x	x	x	x		x	x	x									x		x		x	
2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
3	x	x	x	x	x	x	x	x	x								x							x
4	x	x	x	x	x	x	x	x	x	x	x								x	x	x	x	x	
5	x	x	x	x	x	P	x	x	x															
6	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x
7	x	x	x	x	x		x	x	x										x				P	
8	x	x	x	x	x		x	x	x															
9	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x
10	x	x	x	x	x		x	x	x									x						
11	x	x	x	x	x	x	x	x	x															
12	x	x	x	x	x	x	x	x	x	P	P	P	P	P	P	P	P	P				x	P	P
14	x	x	x	x	x	x	x	x	x	x	P								x	P	P		P	
16	x	x	x	x	x	x	x	x	x	P	P	P			P	P	P	P		P	P	x	P	P
18	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
20	x	P	x	P	x	P	P	P	x	P	P	P	P		P	P	P	P	P	P	P	P	P	P
22	x	x	x	P	x	P	P	P	x															
24	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

x = 248 video recorded visits (216 personal visits)
P = phone interview; 51 phone interviews
Child F = last visit at 30/26

APPENDIX 4

Gross and fine motor milestones with norms and reference

Milestone	Norm/months	
1. Holds his head steady while pulled from hands (supine)	3	health card
2. Elbow support on stomach: looks around	4	health card
3. Reaches toys	4	health card
4. Rolls from stomach to back	5	Hellbrügge & von Wimpffen -73
5. Elevates self with straight hands: prone	6	health card
6. Picks up a toy	6	health card
7. Rolls from back to stomach	7	Hellbrügge & von Wimpffen -73
8. Pivots	7	Largo et al. 1985
9. Creeps	7	health card
10. Passes a toy back and forth between hands	7	health card
11. Sits steadily	9	Hellbrügge & von Wimpffen -73
12. Pat-a-cake: midline skill	9	health card
13. Stands up by furniture	10	Hellbrügge & von Wimpffen -73
14. Raises self to sitting position	10	Hellbrügge & von Wimpffen -73
15. Pellet: fine prehension (neat pincer)	10	Hellbrügge & von Wimpffen -73
16. Crawls	11	Hellbrügge & von Wimpffen -73
17. Walks alone	12	health card
18. Throws things	12	health card
19. Imitates simple action	12	health card
20. Gives toys or other objects	12	health card

APPENDIX 5

Speech-communication milestones with norms and reference

Milestone	Norm/months	
1. Phonates	1	health card
2. Smiles	2	health card
3. Vocalizes or coos	2	health card
4. Babbles	3	health card
5. Vocalizes in interaction	4	health card
6. Laughs	4	Stark 1980
7. Imitates sounds	6	health card
8. First tooth	6	well-baby-clinic
9. Growls	6	Oller 1980
10. Squeals	6	Oller 1980
11. Plays with lips	7	Hedrick et al. 1984
12. Clicks with tongue	7	Hedrick et al. 1984
13. Canonical babbling	7	health card
14. Knows his name	8	health card
15. Understands words	9	health card
16. Proto words (no meaning)	10	Oller 1980
17. Words with meaning	12	health card

APPENDIX 6

The Ages and Stages Questionnaires: Cutoff points

	4 mos	8 mos	12 mos	16 mos	20 mos	24mos
Communication	3.24	3.65	1.49	2.40	2.59	2.59
Gross motor	3.99	2.33	1.60	2.97	3.71	3.56
Fine motor	2.96	3.75	2.85	2.97	3.91	3.60
Adaptive skills	2.45	3.30	2.52	2.54	2.94	3.15
Personal-social skills	3.23	3.14	1.90	2.41	3.46	3.46

APPENDIX 7

leans and standard deviations for applied measures for infants without diagnoses ı= 7-18) at corrected (Bayley, Reynell, ASQ) and chronological age (Bayley)

leasure	N	Range	Mean	(SD)
ayley/MDI/Corrected 18	18	88-150	119	19
ayley MDI/Corrected 24	18	88-150	124	23
eynell/comprehension/Corrected 18	17	12-27	19	5
eynell/comprehension/Corrected 24	17	17-39	29	6
eynell/production/Corrected18	17	13-27	17	4
eynell/production/Corrected 24	17	17-34	26	5
ayley/MDI/Corrected 2	8	87-142	116	19
ayley/MDI/Corrected 4	8	107-131	118	9
ayley/MDI/Corrected 6	8	100-144	116	17
ayley/MDI/Corrected 8	7	101-135	116	14
ayley/MDI/Corrected 10	8	79-132	110	17
ayley/MDI/Corrected 12	8	81-131	114	18
ayley/MDI/Corrected 14	8	90-150	117	19
ayley/MDI/Corrected 16	8	99-150	122	20
ayley/MDI/Corrected 18	8	93-150	121	24
ayley/MDI/Corrected 24	8	88-150	126	27
ayley/MDI/Chronological 2	8	50-78	65	12
ayley/MDI/Chronological 4	8	50-81	65	13
ayley/MDI/Chronological 6	8	63-101	77	13
ayley/MDI/Chronological 8	7	65-99	82	13
ayley/MDI/Chronological 10	8	50-106	82	18
ayley/MDI/Chronological 12	8	50-113	91	22
ayley/MDI/Chronological 14	8	54-133	94	25
ayley/MDI/Chronological 16	8	66-146	102	28
ayley/MDI/Chronological 18	8	70-150	107	33
ayley/MDI/Chronological 24	8	75-147	113	29
SQ/Corrected 4	15	22-30	27	3
SQ/Corrected 8	15	24-30	27	2
SQ/Corrected 12	15	20-29	25	3
SQ/Corrected 16	16	22-30	27	3
SQ/Corrected 20	18	23-30	28	2
SQ/Corrected 24	18	24-30	28	2

APPENDIX 8

Spearman correlations at corrected age between Bayley, Reynell and ASQ test results for infants without diagnoses (n=18)

Measures	Bayley 18	Bayley 24	Reynell comp 18	Reynell comp 24	Reynell prod 18	Reynell prod 24	ASQ 24
Bayley 18	1						
Bayley 24	.860**	1					
Reynell comprehension 18	.798**	.866**	1				
Reynell comprehension 24	.643**	.773**	.871**	1			
Reynell production 18	0.45	0.312	0.292	0.321	1		
Reynell production 24	.654**	.691**	.715**	.737**	.705**	1	
ASQ 24	.480*	.563**	0.263	0.281	0.453	.558*	1

**. Correlation is significant at the .01 level (2-tailed)
*. Correlation is significant at the .05 level (2-tailed)

APPENDIX 9

Examples of interaction

Example 1
- firstborn/girl
- the both parents take care of the child

5/2 months
- the father's voice is very gentle, while speaking to the child
- the father gives milk to the child
- the parents say, that for them the child is now 5 months old, but on the other hand they say, that the child was really born, when she reached the day, when she ought to have been born
- they value rustic opinions in every day life
- although the child is so young she already has her own place beside kitchen table

9/6 months
- the father knows the connection between speech development and chewing
- the father says, that the child expresses now different kinds of feelings; intonation has changed; she is more lady like now
- they use "speaking" dolls, while playing with the girl (speaking hand dolls)
- from birth on the father has been singing the same song to the child and played the guitar
- the mother carries the child in a rucksack while working
- they have been abroad twice with the child

12/9 months
- the child is aware of different languages
- doll animals speak foreign languages to the child
- the parents value languages
- the child says: baba, kita(ra) (=guitar)
- the father sings and plays with the child
- the mother shows art pictures
- the child laughs and smiles; and has a good sense of humor
- the child shows verbal talent
- the oral stage is strong (things go to mouth)

23/18 months
- "small" is beautiful in the mother's opinion
- the mother does not want to offer too much stimulation to the child (only important things of home); this was true especially during the early months of life
- the mother feels, that nature is important; they show animal books and flower books to the child

- the mother is worried about the child's speech production: the child uses about 20 words
- no two-word sentences

27/24 months
- they use a lot of imagination games, when they play with the child (there is the child's turn and the mother's turn)
- two-word sentences are emerging
- the child can speak five words in a foreign language
- the parents and the child enjoy reading good night stories
- they also value traditional games
- the child can play with a mouth organ
- the parents often speak about the child's own rhythm in development
- Reynell comprehension: on the level of chronological age
- Reynell production: on the level of corrected age

Example 2
- firstborn/girl
- the mother and the father take care of the child; during every visit also the father is at home and plays with the child
- the child will be bilingual: the father and the grandmother speak their own languages and the mother her own language to the child

3/0 month
- many kisses (father/child; mother/child)
- according to the father, they have waited and waited, that the child would contact and now this has happened
- the father speaks to the child's ear and tries to get contact
- the mother is depressed, because she cannot breastfeed; however, she keeps the child on her chest (skin contact)
- the mother "reads" the child's cues very well and says, that they are so close to each other

12/9 months
- according to the father, the child is not afraid of strange people and the father is proud of that
- the father wants to know, what I will ask more and what I have done with the child, because she is so tired
- in the father's opinion, the girl hesitates and has a short attention span, but the mother disagrees
- the girl is a real father’s girl
- the father speaks his native language (mother her own) to the child and tries to find words which are near each other in both languages
- the girl babbles very nicely
- screams, when wants to have things to her
- brings things to her mouth (discovers things)

21/18 months
- the father believes, that the child cannot concentrate during our session, but she can
- the father acts as interpreter during language tests
- two word sentences
- comprehends language very well

27/24 months
- the father is very surprised, when the child concentrates so well; says that we should visit every day
- the father acts as interpreter during language tests
- the mother and the father tell that the child masters two languages now
- the parents think, that they have to begin to use the third language, because the child understand all, what they are speaking about
- the child likes books very much (they also read a lot) and photographs and the father's tools (nails, hammer)

Reynell comprehension: on the level of chronological age
Reynell production: on the level of chronological age

Example 3
The firstborn, a boy. He has a younger sister, who was also born prematurely. The boy's concentration skills are good and he cooperates very well with the researcher. He is a very happy boy.

The both parents take care of the child, although the father travels often. The mother is very interested in this research and has written down the words and episodes concerning the child's speech development. Also the grandmother has a special role in teaching the child. She has taught the child old traditional games, rhymes and also the rhythm. The family has a special language, when they speak with the children. They use it, when they want to speak to the children in a gentle way. The word "darling" is often used in this family.

18/15 months
The child has learned to walk. The mother reads and speaks to the child very much and teaches him how to form words with the lips. The child's first word was "vettä" (water), he tries to say "au(rinko)" (sun) and tries to describe a phenomenon "wind" to his mother. He also likes flowers and wants to sniff their scent.

21/18 months
The boy babbles very beautifully. He is pointing at things with his finger and says "öh-öh". According to the mother the child tried to say words two months ago, but when he did not succeed in it, he stopped and began to use gestures. The child can "sing" some songs and "play" the piano and can imitate the grandmother with the tambourine. The mother is very “disappointed”, when the child does not speak

words. According to the mother the child can say: "äiti auttaa" (mother helps). T mother takes care, that the child can also rest during and after our games.

27/24 months
The boy speaks now two word sentences, asks questions and can use word "min (mine). The mother takes care that the boy also has time to rest. The mother says that the children take all her time; she takes time for herself from nights. The children sleep with their mother, when the father is away on business.
Reynell: on the level of chronological age
Reynell production: on the level of corrected age (According to the REEL a coup of months higher)

Example 4
- firstborn/boy
- the both parents take care of the child
- the father is busy, works a lot

6/3 months
- the mother does not want to compare her baby to other babies

9/6 months
- the mother says: the child considers us strange; however, the child smiles at u
- the child vocalizes a lot according to the mother
- the mother speaks to the child a lot and plays different games
- the mother keeps TV open a lot for the child
- the mother is worried about the child's motor development
- the mother has books about infants' development

12/9 months
- the mother is worried about the child sleeping too much
- the mother is worried about that the father and the child have only half an hc together each day: the father reads the morning paper with the boy; the child tears papers to pieces
- the child does not always want eye contact
- the child is afraid of strange voices
- the mother is stressed and feels ill
- the mother has very bad experience on long travelling: the child cried all the time and was afraid of people
- the mother says that she has received good hints from the occupational thera how to act with the child
- the mother says: the child needs time for developing
- the mother knows, when the child wants to play
- the oral stage is strong (discovers things with mouth)
- the mother wants to know how the child acted with me compared to other children

/18 months
the child goes to kindergarten; gets physiotherapy there
the mother tells the father what the child has learned to day
the mother wants to give time to the child so that he can develop in his own tempo
the child chatters to her mother and also bites
the mother says that because this is their first child it is difficult to know how to act with him
the child interacts a lot with inanimate things (telephones, videos)
the child is afraid of strange voices
according to the father, the child says "mama" and "papa" in his own way and produces two-syllable babbling; they have not tried to make the child to imitate (mother tries now but there is no success)
according to the mother, the child speaks more than the father says
the father and the child play with a ball
the child likes a toy telephone although he is afraid of it when it rings

/24 months
the mother is grateful for the physiotherapy given to the child at the day care center
the mother is grateful for the day care center: the child can now play with the other children
the child bites; the mother comments that the child is frustrated when he cannot see what is asked
the child has developed in his gross motor and personal-social skills
the child has developed a lot in comprehension and production but does not achieve corrected levels