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# LANGUAGE IN ACQUISITION.
## Early Lexical Development and Associations between Lexicon and Grammar — Findings from Full-Term and Very-Low-Birth-Weight Finnish Children

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**ABSTRACT**

**Language in Acquisition. Early Lexical Development and Associations between Lexicon and Grammar – Findings from Full-Term and Very-Low-Birth-Weight Finnish Children.**

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The aim was to analyse the growth and compositional development of the receptive and expressive lexicons between the ages 0,9 and 2;0 in the full-term (FT) and the very-low-birth-weight (VLBW) children who are acquiring Finnish. The associations between the expressive lexicon and grammar at 1;6 and 2;0 in the FT children were also studied. In addition, the language skills of the VLBW children at 2;0 were analysed, as well as the predictive value of their early lexicon to their later language performance. Four groups took part in the studies: the longitudinal (N = 35) and cross-sectional (N = 146) samples of the FT children, and the longitudinal (N = 32) and cross-sectional (N = 66) samples of VLBW children. The data was gathered by applying the method of structured parental rating (the Finnish version of the Communicative Development Inventory), through analysis of the children´s spontaneous speech and by administering a formal test (Reynell Developmental Language Scales).

*The FT children* acquired their receptive lexicons earlier, at a faster rate and with larger individual variation than their expressive lexicons. The acquisition rate of the expressive lexicon increased from slow to faster in most children (91%). Highly parallel developmental paths for lexical semantic categories were detected in the receptive and expressive lexicons of the Finnish children when they were analysed in relation to the lexicon size, as described in the literature for children acquiring other languages. The emergence of grammar was closely associated with expressive lexical growth. *The VLBW children* acquired their receptive lexicons at a slower rate and had weaker language skills at 2;0 than the full-term children. The compositional development of both lexicons happened at a slower rate in the VLBW children when compared to the FT controls. However, when the compositional development was analysed in relation to the growth of lexicon size, this development occurred qualitatively in a nearly parallel manner in the VLBW children as in the FT children. Early receptive and expressive lexicon sizes were significantly associated with later language skills. The effect of the background variables (gender, length of the mother's basic education, birth weight) on the language development in the FT and the VLBW children differed.

The results provide new information on the early language acquisition by Finnish FT and VLBW children. The results support the view that the early acquisition of the semantic lexical categories is related to lexicon growth. The current findings also propose that the early grammatical acquisition is closely related to the expressive lexicon growth. In addition, the findings suggest that the language development of the VLBW children should be followed in clinical work.


Key words: early language development of Finnish children, lexical development, associations between lexicon and grammar, early language development of VLBW children

**ABSTRAKTI**

**Language in acquisition. Early lexical development and associations between lexicon and grammar – findings from full-term and very-low-birth-weight Finnish children.**

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Tutkimuksen tavoitteena oli saada tietoa täysiaikaisina ja pieninä keskosina (syntymäpaino ≤ 1500 g) syntyneiden suomalaislasten ymmärtävän ja ilmaistun sanaston määrällisestä ja koostumuksen kehityksestä ikävälillä 0;9 ja 2;0, sekä ilmaistun sanaston ja varhaisen kieliopin välisestä suhteesta täysiaikaisilla lapsilla ikäpisteissä 1;6 ja 2;0. Lisäksi tutkittiin pienten keskosten kielellisiä taitoja kahden vuoden iässä, ja varhaisen sanaston ennustearvoa myöhempiin kielellisiin taitoihin nähden. Tutkimuksissa oli neljä tutkittavien ryhmää: täysiaikaisten lasten pitkittäinen (N = 35) ja poikittainen (N = 146), sekä pienipainoisten keskosten pitkittäinen (N = 32) ja poikittainen (N = 66) otanta. Aineistoa kerättiin normitetun, strukturoidun vanhempien arviointimenetelmän (Varhaisen kommunikaation ja kielen kehityksen arviointimenetelmä), spontaanipuheen analyysin ja muodollisen testin (Reynellin kielellisen kehityksen testi) avulla.

*Täysiaikaisina syntyneet lapset* omaksuivat ymmärtävää sanastoaan aiemmin ja nopeammin, ja omaksumisessa oli huomattavampaa yksiköllistä variaatiota verrattuna ilmaistun sanaston omaksumiseen. Ilmaistun sanaston omaksumisnopeus muuttui hitaasta nopeaan suurimmalla osalla (91 %). Kun ymmärtävän ja ilmaistun sanaston koostumuksen kehitystä analysoitiin suhteessa sanaston kokoon, semanttisten sanakategorioiden kehityskäyrät muistuttivat kirjallisuudessa kuvattuja, muita kieliä omaksuvien lasten kehityskäyriä. Varhaisen kieliopin ilmaantuminen oli läheisesti ja yksityiskohtaisella tavalla sidoksissa ilmaistun sanaston kehitykseen. *Pienipainoisina keskosina syntyneiden lasten* ymmärtävän sanaston kehitys oli hitaampaa ja kielelliset taidot heikommat kuin täysiaikaisina syntyneiden lasten. Kummankin sanaston koostumuksen kehitys tapahtui pienipainoisina keskosina syntyneillä hitaammin kuin täysiaikaisina syntyneillä lapsilla. Kuitenkin, kun sanaston koostumuksen kehitystä analysoitiin suhteessa sanaston kokoon, kehitys oli laadullisesti lähes samantyyppistä kuin verrokeilla. Varhaisen sanaston koko ennusti merkitsevästi kielellisiä taitoja kahden vuoden iässä. Taustamuuttujien (sukupuoli, äitien peruskoulutuksen pituus, syntymäpaino) yhteys sanaston kehitykseen erosi täysiaikaisten ja keskosten ryhmässä.

Tulokset tuovat uutta tietoa täysiaikaisina ja pieninä keskosina syntyneiden suomalaislasten varhaisesta kielenkehityksestä. Tulokset tukevat näkemystä, jonka mukaan varhaisten semanttisten sanakategorioiden kehitys tapahtuu suhteessa sanaston määrälliseen kehitykseen, sekä näkemystä, jonka mukaan kieliopin ilmaantuminen on läheisesti sidoksissa ilmaistun sanaston määrälliseen kehitykseen. Tulokset ehdottavat lisäksi, että pienipainoisena syntyneiden lasten kielellisten taitojen kehittymistä tulisi seurata kliinisessä työssä.


Avainsanat: suomalaislasten varhainen kielenkehitys, sanaston kehitys, sanaston ja kieliopin välinen suhde, pienipainoisten keskosten varhainen kielenkehitys

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Turku, April 2009

*Suvi Stolt*

## Abbreviations

| | |
|---|---|
| BSID | Bayley Scales of Infant Development |
| BPD | bronchopulmonary dysplasia |
| CDI | Communicative Development Inventory |
| CP | cerebral palsy |
| CS | cross-sectional sample |
| FinCDI | Finnish version of the Communicative Development Inventory |
| FT | full-term children |
| IVH | intraventricular hemorrhage |
| LT | longitudinal sample |
| MDI | Mental Developmental Index of Bayley Scales of Infant Development |
| RDLS III | Reynell Developmental Language Scales III |
| SGA | small for gestational age |
| VLBW | very-low-birth-weight children |

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## List of original publications

This dissertation is based on the following articles which are referred to in the text by their Roman numerals:

I    Stolt, S., Haataja, L., Lapinleimu, H. and Lehtonen L. (2008). Early lexical development of Finnish children – a longitudinal study. *First language*. 28:3, 259-279.

II   Stolt, S., Haataja, L., Lapinleimu, H.. and L. Lehtonen, L. (in press) Associations between lexicon and grammar at the end of the second year in Finnish children. *Journal of Child Language*.

III  Stolt, S., Haataja, L., Lapinleimu, H., and Lehtonen, L. (2009). The early lexical acquisition and its predictive value to language skills at two years in very-low-birth-weight children. *Journal of Communication Disorders,* 42, 107-123.

IV   Stolt, S., Klippi, A., Launonen, K., Munck, P., Lehtonen, L., Lapinleimu, H., Haataja, L. and  the Pipari studygroup (2007). Size and composition of the lexicon in prematurely born-very-low-birth-weight and full-term Finnish children at two years of age. *Journal of Child Language*, 34, 283-310.

# 1    Introduction

Although there is a long history of research in the field of child language acquisition (Ingram, 1999), some open questions remain. For Finnish children, earlier studies provide descriptions of the different aspects of early linguistic development (e.g. Kunnari, 2000; Laalo, 2002 and 2003; Lyytinen, 1988 and 1999; Nieminen, 1991; Savinainen- Makkonen, 2001; Toivainen, 1997). However, what has not been studied is the question related to the acquisition of the lexical semantic categories in relation to the vocabulary growth. Neither have the associations between the expressive lexicon and grammar at the end of the second year analysed in detail. Moreover, there is very little information concerning the change in the growth rate in early vocabulary development in Finnish children (see however Kunnari, 2000; Nieminen, 1991). Yet it is the specific information of the typical linguistic growth that is essential in the clinical work to recognise those children needing support for their language development. From the cross-linguistic perspective, it is also important to gather information about the early language acquisition of children acquiring different target languages to fully understand how children acquire competence in their native language.

In the clinical context, one group of children needing the services of a speech and language pathologist is the group of the prematurely born (before 37 gestational weeks) very-low-birth-weight (VLBW; birth weight ≤ 1500 g, and/or born < 32 gestational weeks) children. During the year 2006, 5.9 % of the children were born prematurely (before 37 gestational week), and 0.8 % of the children were born as VLBW children in Finland (Stakes, Statistical summary 30/2008). This group of VLBW children is particularly vulnerable to developmental problems. The incidence of language problems for these children has also been shown to be higher (e.g. Wolke et al., 2008). However, despite this known risk, there are only a few studies providing information on the early (i.e. the first two years) linguistic growth of VLBW children (see, however, Jansson-Verkasalo, 2003; Menyuk, Liebergott, Schultz, Chesnick & Ferrier, 1991; Menuyk, Liebergott & Schltulz, 1995; Riitesuo, 2000; Rvaschew et al., 2005). Furthermore, the number of the VLBW subjects included in the studies has also been small. Specific information on the early language development in VLBW children is important to be able to recognise those with problems in language development. One main objective of the present work was to obtain detailed information of the early language acquisition in this group.

Although the focus of the present work is in the emergence of the lexicon and grammar, it is clear that language is not acquired in isolation, and that many matters influence this development. This aim is touched upon in the present work: the effect of gender on the

lexical acquisition of full-term and VLBW children will be analysed. Another factor in a child´s language development is that it is supported in early interactions by the parent and a child (Clark, 2003; Laakso, 1999; Paavola, 2006). The mother-child interactions of the 35 full-term and 32 VLBW children were videotaped four times (at 0;6, 1;0, 1;6 and 2;0) during the two-year follow-up period, and the analysis of the spontaneous speech used by full-term children at 1;6 and at 2;0 in these videotaped interactions is included in the present work. Furthermore, watching these interactions while videotaping them gave a picture of how children acquire their language with the support of their mothers. Some information related to the analyses of these interactions is reported elsewhere (e.g. Korja et al, 2008). These interactions also provide a database for further studies. In the present work, the information on the background variables that affect language development was obtained from an analysis of the effect of the length of the mothers' basic education on lexical growth.

The present dissertation is based on four separate studies: two of them focus on the early language acquisition of full-term children, and two on the early language acquisition of VLBW children. The following summary is divided as follows: the theoretical background is presented first, followed by the research questions, and the methodology used. The main findings of the individual studies are presented after that. The last section covers the discussion of how the present results are related to the findings in the literature.

## 2 Review of the literature

### 2.1 Early lexical development

#### 2.1.1 Quantitative growth of the receptive and expressive lexicons

Children show the first signs of word comprehension at the end of their first year, and the receptive lexicon is acquired rapidly after that. Few studies focus on the quantitative growth of early receptive lexicon. According to the normative study of the vocabulary checklist method, the MacArthur Communicative Development Inventory (CDI, Fenson et al., 1994), in which the data of over 1800 children acquiring English between the ages of 8 and 30 months was analysed, the mean value of the receptive lexicon size was 36 (median 17) words at 0;8, 67 (median 41) words at 0;10, and 191 (median 169) words at 1;4. For Finnish children, there are only a few studies that provide information on early receptive lexical growth. In the standardisation study of the Finnish version of the CDI (FinCDI, Lyytinen, 1999), the mean

value of the comprehended words of 95 full-term healthy Finnish children was 89 words (SD 63, median 67) at 1;0, and 164 words (SD 83, median 159) at 1;2.

Children produce their first words around the age of one year. The expressive lexicon is then acquired slowly during the first months of the second year, but the growth rate accelerates during the second part of the second year. Dromi (1999) divides the early expressive lexical acquisition into two phases. During the first, which is referred to as the preparatory period, children learn each word as a special case. At this point, idiosyncratic word extensions may occur, and the word acquisition rate is slow. The second phase is characterised by more effective lexical learning, and what is called ´lexical spurt` (see definition below) often occurs during this phase. Part of this process is that children attach words to underlying concepts immediately and they also show a context-free use of words more often than during the preparatory phase. The findings of different studies support the division proposed by Dromi. In Nelson's (1973) early study (N = 18), English children acquired their early 50 words slowly: the first 10 words were acquired at 1;3 (age range 1;1-1;7), and the first 50 words at 1;8 (age range 1;3– 2;0). Kunnari (2000) reported that the ten children whose lexical acquisition was followed in that study produced their first words at 11 months and 5 days (range 8.9 – 13.9), and had acquired their first 50 words at 17 months and 7 days (13.2 – 22.7). In the normative study of the CDI (Fenson et al., 1994) a similar, slow acquisition rate at the beginning of the lexical acquisition was detected. The mean expressive lexicon size was 10 words (median 6) at 1;0 and 64 words (median 40) at 1;4. However, at 2;0, the mean value of the lexicon size had increased to 312 words in this large sample of children acquiring English (range 89-534 words; Bates, Dale & Thal, 1995). In other words, the expressive lexical acquisition rate was much faster during the second part of the second year than during the first part. The presented values are comparable to those detected in the normative study of the FinCDI (at 1;0: mean 7, SD 9, median 4; at 1;6: mean 70, SD 25, median 34; at 2;0: mean 278, SD 163, median 269 words; Lyytinen, 1999).

The issue often related to the acquisition of early expressive vocabulary is a rapid acceleration in the growth rate at the end of the second year which is often called a ´vocabulary spurt` or ´vocabulary burst`. Barret (1995) defined a spurt as a sudden acceleration of the lexicon acquisition rate. In addition, children needed to acquire at least eight new words in a week within the time frame of two or three weeks. The definition used for spurt in different studies varies however (e.g. Goldfield & Reznick, 1990; Mervis & Bertrand, 1995). Further, some researchers relate the beginning of the spurt to lexicon size. If so, the spurt is usually reported to occur when children have acquired approximately 20-40 words in their expressive

vocabulary (e.g. Barret, 1995). However, a vocabulary spurt has not been found in all children, and there is discussion as to whether this spurt actually exists, whether it occurs in considerably fewer children than often thought, or whether it happens later in some children than in others (Bates, Dale & Thal, 1995; Dromi, 1999; Ganger & Brent, 2004; Goldfield & Reznick, 1990 and 1996; Mervis & Bertrand, 1995; Tomasello, 2003). Moreover, Bates et al. (1995) have suggested that the acceleration in the growth rate of the expressive lexicon may be best described as smoothly accelerating with no single ´take-off point` as assumed by the definitions of spurt. In Finnish children, the vocabulary spurt has not been studied intensively. However, Kunnari (2000) reported that all ten children in the study demonstrated a spurt in their expressive lexical acquisition, and for most of them this happened when the expressive lexicon size was from 20 to 30 words (see also Nieminen, 1991).

The meaning of the vocabulary spurt has been explained as a change in cognitive growth, that is, by the realisation that words refer to things and / or that all things have names (Reznick & Goldfield, 1992). Plunket (1993) suggested that the spurt happens when the word segmentation problem has been solved: the ability to pick up words from running speech makes it possible to produce new words at a faster rate. This notion of a spurt has also been connected to word-retrieval abilities (Dapretto & Bjork; 2000), and to the ability to sort objects into groups based on a category membership (e.g. Gopnik & Meltzoff, 1987). Whether or not a spurt-like acceleration occurs in the acquisition of the receptive lexicon is even less clear. Reznick and Goldfield (1992) found a spurt in comprehension scores for some but not all children between ages of 1;8 and 1;10. This comprehension spurt was associated with the presence of the production spurt.

2.1.2 Compositional development of the receptive and expressive lexicons

The issues of what type of words children acquire in early lexical acquisition, in what order this acquisition occurs as well as why, have a bearing on how human beings organise the world into semantic concepts and how children acquire this parsing (Gentner & Boroditsky, 2001). One central claim related to these questions is the hypothesis put forth by Gentner (1982) that children universally acquire more nouns than verbs in their early lexical acquisition. This *noun bias* -hypothesis was proposed based on the comparisons between the relative frequency of nouns and verbs in the early lexicons of children acquiring English, Japanese, German, Kaluli, Chinese and Turkish. It was found that nouns constituted the largest word class and that verb acquisition lagged behind that of nouns in the lexicons of the children

acquiring the mentioned target languages. Gentner (1982) hypothesised that this occurred because nouns often refer to concrete objects, and thus the mapping between language and the conceptual world is more transparent in nouns than in the verbs which refer to actions and events. The other reason for early noun - dominance may be, as proposed by Gentner (1982), that predicates show a more variable mapping from concepts to words than nouns. Languages have more degrees of freedom in lexicalising the relations between coherent objects than in lexicalising the objects themselves (Gentner, 1982). Several findings from children acquiring different target languages support the early noun-bias –hypothesis (Bates et al., 1994; Bornstein et al., 2004a; Caselli et al., 1995; Jackson- Maldonado et al., 1993; Maital et al., 2000).

Not all the researchers have accepted Gentner's original noun-bias –hypothesis. Specifically, the findings derived from children acquiring Korean (Choi & Gopnik, 1995) and Mandarin (Tardif, 1996), have challenged this claim of Gentner. Choi and Gopnik (1995) presented data from nine Korean and eight English subjects analysed from early mother-child - interactions, and reported that Korean children had both verbs and nouns that were dominant categories at the single-word stage. In addition, Korean mothers used more action verbs, but less nouns than American mothers in the videotaped interactions with their children. In addition, Tardif (1996) reported that children acquiring Mandarin used more verbs than nouns in their spontaneous speech. Researchers proposed that the differences in the linguistic input may lead to differences in cognitive focus, and subsequently to differences in the acquisition of nouns and verbs. However, some studies report findings that contradict these results. For example, Kim, McGregor and Thomson (2000) presented data that they gathered using the structured parental rating method from eight children acquiring Korean and eight acquiring English, and reported that both groups had significantly more nouns than verbs in their early lexicons (i.e. the first 50 words). Still, the Korean children had acquired more verbs than the English children. Tardif, Gelman and Xu (1996) reported that 24 children acquiring Mandarin and 24 acquiring English produced more nouns than verbs in their spontaneous speech. Yet, there was a tendency for the children acquiring Mandarin to produce more verbs than the children acquiring English. Another important factor was the context which also had a significant effect on the number of nouns and verbs in children's speech in both groups. Both groups produced more nouns in book-reading situations, but they used more verbs than nouns while playing with toys. Moreover, Bornstein et al. (2004a) presented a cross-linguistic data of the early lexical acquisition of children acquiring Spanish, Dutch, French, Hebrew, Italian, English and Korean children, which was gathered using the structured parental rating method.

They reported that all children, except those just learning to talk, had greater proportions of nouns than other words in their vocabularies. To conclude, the reported findings from the children acquiring Korean and Mandarin are mixed. They do not exclude the universality of the noun-bias hypothesis, although it seems that these children acquire verbs more readily than, for example, children acquiring English (see also Genter & Boroditsky, 2001). Some findings also propose that the methodology used affects the findings (e.g. Clark, 2003; Tardif, Gelman and Xu, 1999).

In their later work Gentner and Borodistky (2001) further developed the noun bias – hypothesis and proposed that words belonging to the open and closed classes have different cognitive and linguistic dominance, and because of that the acquisition of the different types of words differs. The distinction of open and closed class words is a classic one (e.g. Gentner & Boroditsky, 2001; Hakulinen et al., 2005; Itkonen, 1997). An open class is a large lexical category (e.g. nouns, adjectives and verbs), which readily accepts new members, whereas the closed-class category is a small category (e.g. prepositions, determiners and conjunctions) in which new members are rarely added (Gentner & Boroditsky, 2001). The words in the former have more denotational functions, but those in the latter serve grammatical and relational functions. The role of the closed-class words is to provide linguistic connections among those in the open-class. Closed-class words have several properties that are different from those of the open-class words: closed-class words are often high frequency, they are rarely borrowed in language contact, are not easily translated, and their interpretation is context-sensitive (Gentner & Boroditsky, 2001). In addition, closed-class words often appear stress-less in adult language, and therefore they are not as easily perceived from the linguistic input as are the open-class words (e.g. Peters, 1995). This distinction between open and closed class words has often been considered a dichotomy, but Gentner and Borodistky (2001) propose that it should be seen as a continuum. Concrete nouns lie at the other end of this continuum. Nouns follow the cognitive and perceptual dominance: they can be inferred cognitively with minimal linguistic experience. At the other end are the closed class words that have a strong linguistic dominance: the meanings of these words do not exist independent of language. Verbs lie somewhere in the middle, because although verbs refer to the context, they also rely on their arguments to denote their meaning fully. Gentner and Boroditsky (2001) suggest that different types of words behave differently in the language acquisition process. Nouns are acquired easily, because their referents are easily grasped. Thus, part of the children's task in language acquisition (i.e. finding word-referent connections) is easily solved: children have only to determine the correct linguistic label. When acquiring verbs or other relational terms, a child has to isolate the word

from the speech stream, and to discover what conceptual element (e.g. movement, change, agency or causality in verbs) serves as the referent of the verb or word in her / his language (Gentner & Boroditsky, 2001).

Based on their analyses of children acquiring English and Italian (Bates, Bretherton & Snyder, 1988; Bates et al., 1994; Caselli et al., 1995; Caselli, Casadio & Bates, 1999), Bates et al. have expanded Gentner´s original noun-bias -hypothesis, and have argued for a sequence for the acquisition of lexical categories. Bates et al. (1994) reported a finding of three developmental waves in the composition of the early vocabularies of 1803 children acquiring English. There was a strong increase in the percentage of common nouns (i.e. the names of the common objects, the names of people excluded) in the lexicon sizes from 0 to 100 words followed by a decrease as the vocabulary sizes grew. The percentage of predicates (i.e. verbs and adjectives) in the lexicon increased slowly and linearly, making the greatest gains in the lexicon sizes between 100 and 400 words. Lastly, no proportional development occurred for the closed-class words (i.e. prepositions, pronouns, quantifiers, question words and connectives) in the lexicon sizes between 0 and 400 words, but a sharp increase in the percentage of these words happened between the lexicon sizes of 400 to 600 words. Bates et al. (1994) interpreted these developmental waves to reflect a shift from reference to predication and to grammar in early lexical acquisition. In the comparison studies of the lexical compositional development between English and Italian children, Caselli et al. (1995) and Caselli, Casadio and Bates (1999) found a parallel developmental shift in relation to the lexicon size in Italian children. They also reported about those words that children acquire at the very beginning of their lexical acquisition, that is, the words belonging to the categories of the names of people, onomatopoetic expressions and words connected to routine situations (i.e. social terms). The percentage of these words was very high in small lexicons (i.e. < 50 words), but decreased rapidly as the children`s lexicon sizes grew. These very first words are used in varying ways, and they are difficult to classify under any semantic category of adult language. Caselli, Casadio and Bates (1999) propose that these early verbal routines should be best viewed as speech acts or performatives. Bates et al. (Bates et al., 1994) and Caselli et al. (Caselli et al., 1995; Caselli, Casadio & Bates, 1999) suggest that this shift from reference to predication and to grammar in early lexicon is based on the cognitive growth, for example, on the growth of the perceptional acuity and/or memory skills. They also suggest that this shift in early vocabulary acquisition reflects universal developments in the logical and conceptual substrates of meaning. The parallel developmental shift in early lexicon in relation to the growth of lexicon size has been reported in English and Italian children (Bates et al., 1994;

Caselli, Casadio & Bates, 1999), and in children acquiring Spanish (Jackson-Maldonado, 1993) and Hebrew (Maital 2000; compare Bornstein et al., 2004a; Kauschke, & Hofmeister; 2002; Kern, 2007b).

Those few studies comparing the acquisition of the lexical categories in the receptive and expressive vocabularies suggest that a parallel developmental shift, which is related to the growth of lexicon size, can be detected in the receptive lexicon (Caselli et al., 1995; Kern, 2007b). However, it seems that children acquire verbs faster in their comprehended vocabularies than in their expressive ones. Caselli et al. (1995) analysed the compositional development of receptive and expressive lexicons in large samples of English and Italian children, and reported that the acquisition order of the words belonging to different lexical semantic categories was highly parallel in both vocabularies in both languages. The children began to acquire verbs earlier for the receptive vocabulary in both languages. Kern (2007b) reported a more active acquisition of predicates (i.e. verbs and adjectives) in the receptive than in the expressive lexicons of children acquiring French. In addition, Benedict (1979) explored the distribution of the semantic categories of the first 50 words in receptive and expressive lexicons of the ten children acquiring English, and found that in both vocabularies, the group of nominal words was the largest and the group of action words the second largest. Another finding was that the group of modifiers (i.e. attributes, states, locatives and possessives) was smaller than the groups of nominal and action words. In addition, action words were acquired more readily in the receptive lexicons than in expressive vocabularies (compare also Menyuk, Liebergott & Schultz, 1995). Furthermore, the findings of Harris, Yeeles, Chasin and Oakley (1995) suggested other kinds of symmetry between the early comprehended and productive lexicons: the contextually flexible words in production tended to also be flexible in comprehension, and the words that were context-bound were likewise bound in both modalities.

Few studies focus on the acquisition of lexical categories of Finnish. In the follow-up study of Nieminen (1991; N = 10), the first words understood were the names of people, the names of usual objects (i.e. toys, animals, household items and food) and the verbs describing concrete actions. The first words that children produced were very much the same as those they understood. Reinikainen (1977; N = 25, between 1;1 – 2;1) analysed the word classes of Finnish from spontaneous speech samples in relation to the growth of the mean length of utterance (MLU; Brown, 1973, reported in Ingram, 1999). Here the percentage of nouns was high in the speech of children with a small MLU value, but this percentage decreased as the MLU value grew. The percentages of verbs and adjectives increased in relation to the growth

of MLU value. Nevertheless, in none of the studies which were mentioned, the compositional development of the lexicon was analysed in relation to the growth of the vocabulary size. It is not known whether it is possible to detect a parallel developmental shift from reference to predication and grammar in relation to the lexical growth in the vocabularies of Finnish children as reported for the children acquiring different target languages (e.g. Bates et al., 1994; Caselli, Casadio & Bates, 1999). The question of whether children with different target languages acquire their lexical categories in a manner that is parallel or different is interesting, because if this acquisition is comparable despite the target language, it proposes that other (e.g. cognitive matters) than specific morpho-syntactical matters influence the early development of semantic lexical categories.

2.2 Emergence of grammar at the end of the second year

2.2.1 Emergence of word combinations

The first signs of grammar are detected in children's expressive language during the second year. One sign of early grammatical growth is the emergence of first word combinations. In the normative study of the CDI (Fenson et al., 1994) in a large sample of children acquiring English, 57 % of the parents reported that their child combined words at the age of 1;6. At 2;1, nearly all parents reported that their child used word combinations, although some (19 %) still reported that word combinations were only occasionally detected in their child's language (Bates et al., 1995). Thus, the often used clinical criterion of failure to combine words by 2;0 years corresponded roughly to the lowest 10 % of the CDI distribution in this large sample of children acquiring English (Bates et al., 1995). In this study (Fenson et al., 1994), the early word-combinations were not analysed further in detail. However, due to the very large sample size (N = 1130), it is predictable that the values illustrate well the trend that word combinations emerge.

Some findings related to the emergence of early word combinations have been reported for Finnish children. Nieminen (1991) found that most of the ten children studied began to combine words between the ages of 1;2 and 1;3. At 1;6, children used mostly two-word phrases, and at 2;0, all except one used three-word phrases or longer utterances. Ström and Parre (1988) reported that in a sample of 95 Finnish children, 83 % produced sentences including at least three words at 2;0.

2.2.2 Morphological development

In addition to the emergence of word combinations the first signs of morphological development, in expressive language can be detected during a child´s second year. Bittner, Dressler and Kilani-Schoch (2003) divide the morphological acquisition into three periods: pre- and protomorphology and morphology proper. In the present work, the focus is on the linguistic growth during the second year, and thus the short description of the first two periods will be presented. During the pre-morphological period, a child has not yet acquired a grammatical system. At this stage, children use only forms which are single, unmarked or which are morphologically very simple. One form is used for each word (Bittner, Dressler & Kilani-Schoch, 2003; Clark, 2003; Peters, 1995). These early forms that are first learned by rote are different in different languages. For instance, in some languages the early forms are for verbs: the infinitive or the 3rd person singular (S) present form, either inflected with a person marker (e.g. Dutch, German), or with the stem vowel (e.g. Lithuanian) or completely uninflected form (e.g. Turkish; Bittner, Dressler & Kilani-Schoch, 2003).

When children´s active morphological growth begins in their expressive language, they increase their use of inflectional types within a relatively short period. Children also start to extend the use of those inflectional types they have already used (Bittner, Dressler & Kilani-Schoch, 2003). Slightly later in their morphological development, children use over-regularisation errors (Marchman & Bates, 1994; Clark, 2003). The emergence of these errors has been interpreted as a sign of productivity, meaning that children are not using rote-learned forms only, but are processing the rules behind the morphology (e.g. the past tense; Marchman & Bates, 1994; Marcus, 1996), and are then applying these rules too widely (e.g. every time they want refer to the past; e.g. Tomasello, 2003). Approximately at the same time that the first signs of a child´s use of active morphological processing are detected, the first signs of syntactical growth are also noticed. Some authors consider the overcoming of the one-word period as a prerequisite for the onset of morphological development (review in Bittner et al., 2003). This view is not shared by all, however, but it has been proposed that children master several inflectional affixes before they produce word combinations (review in Clark, 2003). Roughly at the same time as the appearance of active morphological growth, children also show an increase in lexical diversity with respect to word classes, and also with respect to noun, verb and function word types (Bittner et al., 2003). The main characteristic of this transition from the pre- to the protomorphological period is, nevertheless, the quantitative enrichment of morphological diversity and the emergence of the first generalisations on

morphological structures. The protomorphological period begins when the first inflectional contrasts become regular and when a child applies the respective forms to new lexemes. At this point, the grammatical system is dissociated into noun and verb domains (Bittner et al., 2003).

At least three contributors affect the acquisition order of inflectional types and grammatical morphemes (Clark, 2003; Ingram, 1999). Firstly, some inflections are semantically more complex than others (Clark, 2003). For example, in English, there are inflections carrying elements of meanings that are also carried by other inflections (e.g. the past –*ed* marks ´earlier in time`, the auxiliary *were* includes ´earlier in time` and ´the number`). The greater the semantic complexity of a grammatical morpheme, the later it is acquired (e.g. the English past –*ed* is acquired earlier than auxiliary, *were*). Furthermore, the formal complexity to express particular distinctions varies between languages. For example, the concept of number (i.e. one versus more than one) is generally acquired between the ages of 1;6 and 2;3. However, as described by Clark (2003), number can be expressed differently in different languages. Some languages use only one inflection to mark plural on nouns and have some exceptions learnt by rote. On the other hand, other languages may have more complicated ways to mark plurality. In Russian, for example, plural nouns fall into subtypes depending on the gender and phonological form of the noun. Although the concept of number is acquired quite early, it may take a longer period before a child can express this concept properly with appropriated forms on each noun type for each gender and case (Clark, 2003). Frequency may also affect the acquisition. Children are more sensitive to those forms that appear on the largest number of stem-types and tend to master the more often used forms earlier than those used less in the target language (Bittner et al., 2003; Clark, 2003; Ingram, 1999).

*Short description of the morphology of Finnish.* Finnish is an agglutinative Finno-Ugric language in which grammatical and case relationships are expressed primarily by suffixes (Dasinger, 1997; Karlsson, 2006; Toivainen, 1997). The morphology of Finnish is very rich and includes extensive nominal, verbal inflectional and derivational systems (see the short description of Finnish morphology in Appendix A).There are 15 case forms used for inflecting nominal words, a fixed order of nominal suffixes (STEM + NUMBER + CASE + POSSESSIVE) and no grammatical gender marking in Finnish. In verbal inflections, there is a system of subject-verb agreement. In addition, the morphology for the finite verbs can express voice (active, passive), mood (indicative, imperative, conditional, potential) and tense (past, non-past). The suffixes are added to the stem in the following order: STEM + TENSE/MOOD + PERSON / NUMBER (Dasinger, 1997).

*Morphological acquisition of Finnish children.* The morphological acquisition of Finnish children has been studied quite intensively (e.g. Laalo, 2002, and 2003; Lyytinen, 1988 and 1999; Nieminen, 1991; Nieminen, 2007; Toivainen, 1980 and 1997). The first, early basic forms Finnish children use at the very beginning of the morphological acquisition are the lightly marked ones. In the nominal words (i.e. the nouns, pronouns, adjectives and numerals), they are the unmarked nominative (*talo,* house) and partitive *(vettä,* water, used for uncountables) the singular forms, and in the verbs, the 2S imperative (*anna,* give) and the 3S indicative (*nukkuu,* sleeps), both in the present tense (Laalo, 2002 and 2003; Toivainen, 1980). In addition, in nominal words, children may also use the illative (*kotiin,* home) early. Typically, only one form is used for a given nominal word or verb (Laalo, 2002 and 2003). According to Laalo (2002 and 2003), the active morphological processing begins by the formation of the genitive-accusative in the nominal inflections that children contrast with nominatives, and by the formation of the past tense in verbal inflections. Toivainen (1980 and 1997) analysed the morphological development in a sample of 25 children aged between the ages of 1;0 and 3;0 (from 5 to 15 children analysed between ages 1;0 and 2;0; Toivainen, 1980), and suggested the following acquisition order of the nominal inflectional types of Finnish: the partitive, adessive adverb (*siellä,* there), illative nominal, inessive adverb (*missä,* where), allative adverb (*tolle,* to that), adessive nominal, genitive, inessive nominal, accusative (-n), allative nominal, elative adverb (*mistä,* where -from), illative adverb (*tohon,* there), ablative adverb (*miltä,* where –from), elative nominal and ablative nominal (Toivainen, 1980). The findings of both Toivainen (1980) and Laalo (2002) suggest that Finnish children use most local case endings in local adverbs first, and only later do they use them in the nominals (see also Dasinger, 1997). The acquisition order of verbal inflections in Toivainen´s sample was after the two early, basic forms (the 2S imperative and 3S indicative): the past tense (preterite), the negative construction, the 1st person singular, the passive, the perfect 3rd singular, and the 3rd infinitive illative. Nieminen (1991) reported that the ten children in the study used the partitive, genitive and some local cases, mostly the inessive and adessive at 2;0. Some of the children also used the elative and ablative at this age. In addition, Lyytinen reported (1982; N = 107 between ages 1;8 and 2;8) that when measured using a formal test Finnish children at 2;0 mastered best the inessive and illative forms from the nominal inflections, and the active indicative present from verbal inflections. In the normative study of the Finnish version of the CDI (N = 95), the mean value of the inflectional types was 2.0 (min. 0, max. 13) at 1;6, and 9.3 (min. 0, max. 16) at 2;0 (Lyytinen, 1999). Nieminen (2007) analysed the morphosyntantic

development of Finnish children slightly later, when the children were 2;6, and reported a high variation between the children at that age.

Whether Finnish children acquire nominal or verbal inflectional types first is not clear. Nieminen (1991) mentioned that the ten children in the study seemed to acquire verb inflectional suffixes slightly later than nominal inflections. On the other hand, Laalo (2003) concluded that children acquired verb and the nominal suffixes in a balanced way. Nevertheless, in neither of these two studies the difference between the nominal and verb inflectional types was tested statistically. The question related to the acquisition order of the nominal and verbal inflectional types is especially interesting due to the intensive inflectional system of Finnish. The acquisition order of the different inflectional systems cannot be as clearly tested in languages with less intensive morphological systems.

2.2.3 MLU as an index of early grammatical growth

The early grammatical growth has traditionally been measured using a value referred to as the mean length of the utterance (MLU, counted from morphemes, Brown, 1973). Brown (1973 reported in Ingram, 1999) followed longitudinally the language development of three children from the beginning of their use of multiword sentences until their language was further developed. To measure and describe grammatical development, Brown developed the MLU value as an index. The MLU is counted from a large number of utterances (100) produced by a child using strict rules (Brown, 1973 reported in Ingram, 1999). This value has been used actively in the field of child language research. The application of the MLU is also included in the widely used structured parental rating method, the CDI (Fenson et al., 1994; Lyytinen, 1999): mothers are asked to report the three longest utterances that they have heard their child recently say and the mean value of the morphemes is counted from these utterances (i.e. the mean length of the three longest utterances; M3L). Both the MLU and the M3L provide a rough index of grammatical development covering the emergence of early morphology and syntax.

Nieminen (2007) analysed the morphosyntactic complexity of Finnish children who had a genetic risk of dyslexia (N = 20) and their controls (N = 20) at 30 months of age using the MLU and the value called the index of productive syntax, and found a high variation in both the values between children at both ages. The values gave highly parallel (the correlation co-efficient value between the measures, r = 0.92), but qualitative slightly different information. Furthermore, the normative study of the FinCDI provides information of the development of

the M3L in Finnish children at the end of the second year (at 1,8: mean 1.8, SD 1.4, median 1;0; min. 0, max. 8;0; at 2;0: mean 5.7, SD 3.0, median 5,7, min. 0, max. 15.3; Lyytinen, 1999).

The use of the MLU has been criticised because it does not give information concerning the semantics or language use, or that the situational matters may affect the value (Karjalainen, 1998; Nieminen & Torvelainen, 2003; Nieminen, 2007). On the other hand, the M3L value has been shown to provide parallel information from children's language as the formal tests. For example, there was a strong positive correlation between the M3L value and the result of the expressive score in the RDLS at 1;6 (r = 0.75, $p \leq .001$), and between the M3L and the mental developmental index (MDI) in Bayley´s test (BSID, Bayley, 1993; r = 0.71, $p \leq .001$) at 2;0 in the normative study of the FinCDI (Lyytinen, 1999). Thus, it seems that the M3L value is a useful indicator of the early grammatical development at the end of the second year in the clinical context.

2.3 Are lexicon and grammar acquired separately or in association with each other?

It is not clear why grammar emerges or what starts this development. Different theoretical approaches have been presented in an attempt to explain the emergence of grammar (see reviews e.g. in Barret, 1999; Bittner, Dressler, Kilani-Schoch, 2003; Ingram, 1999; Bates & Goodman, 1997 and 1999). Bates and Goodman provide an overview of the different theoretical approaches (1999; see also Ingram, 1999). According to the nativist view, the fundamental aspects of grammar are inborn, and experience operates by filling in the preformed categories. A major proponent of this view has been Chomsky and his theory of universal grammar, which is the collection of universal principles determining the form of any human language. These principles are innate, and part of the genetic programme a child is born with (Ingram, 1999). Within this view, the modularity and domain specificity, as well as the autonomy of grammar, is underlined and the emergence of grammar is seen as a result of pre-set principles. The opposite view underlining the central role of learning in the language acquisition process can be called an interactionist view, and a stronger form of this account as constructivism or emergentism. According to this theoretical orientation, the emergence of language is a result of problem-solving task. In other words, there is something in the human brain that makes language acquisition possible, but this something is not necessarily a special-purpose, domain-specific device as proposed by Chomsky (Bates & Goodman, 1999). One proponent of this view is Tomasello (2000 and 2003), who argues for the usage-based model of

grammar. According to this model, children acquire their linguistic competence gradually during the course of development, beginning from the more concrete linguistic structures based on particular words and morphemes, and then building up to more abstract and productive structures based on the different types of linguistic categories, constructions and schemas. This process involves the most basic skills of cognition (e.g. pattern-finding, intention-reading) and social interaction only, but no hard-wired language instinct is needed (see also Tomasello & Brooks, 1999; Barret, 1999). Bates and Goodman (1997, 1999) provide another emergentist approach to grammar in which they emphasise the strong union between grammar and lexicon. Based on their findings, they argue that the acquisition of grammar is strongly associated with the growth of an expressive lexicon size at the end of the second year. They also suggest that the case for the modular distinction between the lexicon and grammar has been overstated. This means that the heterogeneous set of linguistic forms (i.e. words, morphemes, phrase structure types) can be acquired under a common set of activation and learning principles.

A primary question in the discussion of the possible association between the lexicon and grammar in language acquisition is whether these language domains develop separately with different onset times and developmental rates, or whether they develop together, that is, the grammatical growth is related to lexical growth (Thordardottir, Weismer & Evans, 2002). According to the dual mechanism view, the specific grammatical rule-based mechanism that is independent of lexicon, mediates the use and the acquisition of inflectional morphology (e.g. Marcus, 1996; Pinker, 1991). In contrast, according to the single mechanism view, the lexical items are stored, the regularities between them detected, and then organisation takes place. Furthermore, there are no explicit rules behind the acquisition of morphology, but the morphological growth is associated with lexical growth (Bates & Goodman, 1997, 1999; Marchman & Bates, 1994; Marchman, Plunket & Goodman, 1997; Thordardottir et al., 2002). In particular, the finding detected in English, Italian and German children that there is a nonlinear growth (i.e. little or no effect of lexicon size on the growth of grammar in small lexicons, visible acceleration in the growth of grammar in large lexicons) of grammatical measures in relation to the lexical growth has been considered to be evidence of a single mechanism view (Bates & Goodman, 1997, 1999; Caselli et al., 1999; Marchman & Bates, 1994; Szagun, Steinbrink, Franik & Stumper, 2006; Thordardottir et al., 2002). This finding has been interpreted to mean that children need to acquire a ´critical mass` of lexical items first before the regular patterns of grammatical inflections can be detected. After that, grammatical inflections can be acquired at an accelerated rate (Bates & Goodman, 1997, 1999; Marchman & Bates, 1994; Thordardottir et al., 2002).

The empirical findings in the field of child language acquisition have suggested that the lexicon and grammar develop in close association with each other at the end of the second year, at least in children acquiring English. The first empirical finding of this strong link was that the best and the strong predictor of grammar (i.e. a MLU analysed from spontaneous speech) at 28 months was a lexicon size at 20 months (r = 0.83, *p* = .01, Bates, Bretherton, & Snyder, 1988). This result was replicated in the normative study of the CDI in which a similar, strong correlation was found (r = 0.84, *p* = .0001) between lexicon size and sentence complexity (Fenson et al., 1994). Moreover, the emergence of word combinations was associated with the lexicon size. These children acquiring English started to combine words when they had acquired a lexicon size of between 50 and 200 words which was measured using the CDI (Bates & Goodman, 1997). It was also detected that the best predictor of grammatical growth was the expressive lexicon size, not age: the expressive vocabulary size predicted 32 % of the variance in the grammar scores in the CDI when the effect of age was controlled, whereas the age only 1 % when the effect of lexicon size was controlled. Further evidence for the close association between the lexical and grammatical growth in English children has been reported in twin studies (Dionne et al., 2003), and in atypical populations (early and late talkers, children with focal brain injury, William's syndrome; Bates & Goodman, 1997 and 1999; Bates et al., 1995; Thal, Bates, Zappio & Oroz, 1996; Thordardottir et al., 2002). In children acquiring a language other than English, there are findings of the strong link between the expressive lexicon size and the acquisition of grammar in children acquiring Italian (Caselli et al., 1999), Hebrew (Maital et al., 2000), Icelandic (Thordardottir et al., 2002) and German (Szagun, Steinbrink, Franik & Stumper, 2006) as their first language. Conboy and Thal (2006) also reported that the grammatical growth of 20-30 month-old children who grew up bilingual (English and Spanish) was related to the same language vocabulary development, but not to broader lexical-conceptual development.

In most studies focusing on the association between the lexicon and grammar, relatively broad indexes have been used, such as the lexicon size, the M3L value, or the sentence complexity score on the CDI (Bates & Goodman, 1997, 1999; Caselli et al., 1999; Fenson et al., 1994; Maital et al., 2000). However, as suggested by Bates and Goodman (1997), since it is known that different grammatical structures emerge at different points in development, it is possible that individual grammatical forms display different degrees or different types of lexical dependence. Or, it is possible that different structures need a critical number of lexical items within a specific class to emerge. Marchman and Bates (1994) studied the association between the lexicon and grammar in detail in their analysis of the past tense verb inflection and

its relation to the verb lexicon size in English children and found that the number of verbs learned resulted in the qualitative growth in verb morphology. Thordardottir et al. (2002) analysed the associations between the total lexicon size and the verb lexicon size, and the sentence complexity and the emergence of the verb inflectional morphology, in Icelandic and English children at 2;0, and found a non-linear relationship between the lexicon size and the emergence of verb inflection and the growth of sentence complexity in both groups. Icelandic children required a larger critical mass (i.e. lexical items learned), however, than those acquiring English before the grammatical regularity was found. Thordardottir et al. (2002) interpreted this finding as being related to the more complex inflectional system of Icelandic as compared to English.

In Finnish children, the association between the lexical growth and the emergence of the early grammar has not been analysed earlier in detail. Lyytinen et al. (e.g. 1996, 2001, 2004) have reported high correlation co-efficient values between the lexicon size and the number of inflectional types and / or the M3L value measured using the FinCDI at the end of the second year, when presenting the correlation co-efficient values between the different measures used in the longitudinal study of the children with a familial risk for dyslexia. However, they do not compile a detailed analysis of the association between the lexicon and grammar or provide a discussion concerning this issue (see also Lyytinen, 1988). It is important to test and describe the lexical-grammatical relationships in the early acquisition in the different languages to determine whether the structure of the target language influences this association, and if so, how. The question of whether grammar emerges separately or in association with the lexical growth is also interesting from the clinical perspective. If the early grammar (i.e. emergence of early word combinations, morphological growth) really were tied to the growth of lexicon at the end of the second year, it would underline the role of early lexicon in language acquisition. This would also give predictability for early linguistic development and, in this way, offer more knowledge for those working in the clinical practice. One aim of the present work was to analyse the possible associations between lexical and grammatical development at the end of the second year in Finnish children in detail. Because of its intensive inflectional system Finnish is a good candidate to analyse the associations between the lexicon and grammar in a detailed manner.

2.4 Early language development of the very-low-birth-weight children

Prematurely born children can be divided into subgroups according to their birth weight (low-birth-weight, LBW, birth weight ≤ 2500 g; very-low-birth-weight, VLBW, birth weigth ≤ 1500g; extremely-low-birth-weight, ELBW, birth weight ≤ 1000g, ICD-10, 1999; e.g. Tommiska, 2003; Yliherva, 2002), or according to the gestational age the child is born at (born between 32-36 weeks of gestation, between 28-31 weeks gestation and between 22-27 weeks of gestation). In the present work, the early language acquisition of the VLBW children is analysed. In Finland, during the year 2007, 421 VLBW children were born alive (Stakes, Statistical summary 30/2008).

Prematurely born VLBW children have a higher incidence for speech and language problems than full-term children. Wolke and Meyer (1999) reported that in their geographically based whole-population sample of preterm children, the VLBW children scored significantly lower than the full-term controls at 6;0 on the measures of cognitive and language skills. Furthermore, when compared to full-term children, VLBW children exhibited impairments in speech articulation and pre-reading skills that were three to five times more frequent (see also Wolke, Samara, Bracewell & Marlow, 2008). Mikkola et al. (2005) reported in a study of all ELBW children born alive in Finland during the two-year period 1996 - 1997, that language measures in developmental neuropsychological assessment (NEPSY test; Korkman, 1997) at 5;0 were significantly poorer for the ELBW children when compared to the normal population means (see also Luoma, Herrgård, Martikainen, & Ahonen, 1998; Yliherva, 2002).

2.4.1 Quantitative growth of the receptive and expressive lexicons

The early receptive lexical growth of VLBW children has only been analysed in a few studies. Menyuk et al. (1991) followed the receptive vocabulary growth of the 26 prematurely born children including 12 VLBW children, and compared this growth to that of 27 full-term controls. As a group, prematurely born and full-term children did not differ from their receptive lexical acquisition, but when the receptive lexical development of the 12 VLBW children was analysed separately, the VLBW children acquired their first ten comprehended words significantly later than the full-term controls. No other difference was detected between the groups in the receptive lexicon growth (Menyuk et al., 1991; compare also Menyuk et al., 1995). Moreover, Riitesuo (2000) followed the early language development of 24 prematurely

born (21 VLBW children) children during the first two years and reported that 16 out of 24 prematurely born children had acquired their first 100 comprehended words at 16 months of a corrected age (i.e. the age counted from an expected date of delivery).

The expressive lexical growth of the VLBW children has been studied more than the development of their receptive vocabulary. Menuyk et al. (1991) reported no difference in the expressive lexical acquisition between the groups of 27 full-term and 26 prematurely born children, and Riitesuo (2000) found that 18 of the 24 prematurely born children produced their first 50 expressed words later than at 18 months of corrected age. Rvachew, Creighton, Feldman and Sauve (2005) found that those VLBW children (n = 13) with bronchopulmonary dysplasia (i.e. children received at least 28 days of supplemental oxygen following birth) had a significantly smaller expressive lexicon sizes at 1;6 than children who were healthier preterm (n = 8) and full-term (n = 10). Foster-Cohen et al. (2007) reported that there was a linear association between the children's gestational age at birth and their later expressive vocabulary size. In addition, Kern (2007a) found a significant difference in the lexicon size at 2;0 between the prematurely born (< 32 weeks of gestational age) and the full-term controls. On the other hand, in a recent Finnish study (Jansson-Verkasalo, 2003), no significant difference in the expressive vocabulary size between the VLBW and full-term children at 2;0 was found, although the mean value of the lexicon size for the VLBW group was lower than that of the full-term children.

The compositional development of the early expressive lexicon in the VLBW children has been compared to that of the full-term children in only one earlier study. Kern (2007a) reported that the VLBW children as a group had less nouns, predicates and grammatical function words in their lexicons, but more words typical of very early lexical acquisition (i.e. onomatopoetic expressions, names of the people, words related to daily routines) in their expressive lexicons when compared to other prematurely born and full-term children at 2;0. Nevertheless, Kern (2007a) did not analyse the composition of the expressive lexicon in relation to the growth of lexicon size (see also Menyuk et al., 1995). There are no earlier studies providing information of the compositional development of the receptive lexicon of the VLBW children.

2.4.2 Linguistic skills at two

The studies focusing on the language structures report a significant difference between children who are VLBW and full-term at 2 years of age or earlier. Foster-Cohen et al.

(2007), Jansson-Verkasalo (2003) and Kern (2007a) all found that the VLBW children had significantly shorter M3L values than the full-term children at 2;0. Jansson-Verkasalo (2003) reported that the VLBW children performed significantly poorer on the comprehensive scale of the RDLS than their matched controls at 2;0. Casiro et al. (1990) found that the VLBW children were less likely to understand simple questions or to follow simple commands at 12 months of age than the full-term children. In the study of Vohr, Coll & Oh (1988) the language development was delayed in the 28 % of the 50 VLBW children at 2;0. In addition, the gestational age, socio-economic status and eight-month neurological score all had a significant cumulative effect on language development.

2.4.3 Factors affecting the language development of VLBW children

There are many matters that affect the language acquisition of the VLBW children. Biological factors (birth weight, gestational age, whether the child is born small in relation to his/her gestational age according to the age and sex specific growth charts, i.e. small for gestational age, SGA) have been shown to be related to later linguistic growth in this group. Vohr et al. (1988) found that the gestational age associated significantly with the results of the language test in a group of 50 VLBW children at 2;0, and Casiro et al. (1990) that the language quotients of the 28 VLBW children were associated with the gestational age of a child at 1;0. Also in the study by Foster-Cohen et al. (2007) a clear, linear relationship between the gestational age at birth and language outcomes measured at 2;0 years of corrected age was found in a regional cohort of 90 prematurely born children (born at gestational age < 33 and / or birth weight < 1500 g). These associations persisted after a statistical control for family factors (ethnicity, socioeconomic status, maternal education). Moreover, the SGA has been reported to have a negative effect on the language skills in the prematurely born children at least in some studies. Mikkola et al. (2005) found that the verbal IQ and other language measures were particularly poor in the SGA group in a sample of 172 ELBW Finnish children at 5;0. This negative effect of the SGA on children´s language skills has not been found in all studies (e.g. Casiro et al., 1990; Vohr et al., 1988).

Due to their very early birth, VLBW children have a higher risk of early brain damage (e.g. periventricular leukomalasia, intraventricalur hemorrhage). These early pathological findings are often associated with the later cognitive and linguistic outcomes of the children. In addition, the VLBW children often have prolonged breathing problems which are diagnosed as bronchopulmonary dysplasia (BPD) and these difficulties have been found to

be associated with later linguistic problems. Lewis et al (2002) reported that those VLBW children (n = 89) with diagnosed BPD at an early age demonstrated reduced articulation, receptive language skills and a performance IQ at 8 years of age when compared to those VLBW children without BPD (n = 71). Thus, due to the early developmental risks, the overall cognitive outcome of the VLBW children as a group is usually found to be lower than in the group of the full-term children (e.g. Mikkola et al., 2005; Wolke & Meyer, 1999; Wolke et al., 2008; Wood et al., 2000). The major neurological disabilities, such as cerebral palsy or severe hearing impairments, are also diagnosed more often among the VLBW than in the full-term controls (Tommiska, 2003; Mikkola et al., 2005).

The problems in speech and language development in VLBW children are often associated with a low overall cognitive outcome or with severe neurological diagnoses. Nonetheless, it seems that the problems in the linguistic development of the VLBW children are not associated with developmental problems only. Aram et al. (1991) reported that in a study of 249 VLBW children (the mean gestational age of the children 29.7 gestational weeks, SD +2 and -2 weeks) and 363 controls, the mean performance in the majority of the speech and language measures (e.g. Token test, RAN, WISC-R verbal IQ) was still significantly lower for VLBW children than for the controls, after the children with major neurological abnormalities (children with cerebral palsy, hydrocephalus, Tourette´s syndrome, severe hearing loss) were excluded from the analysis. Luoma, Herrgård, Martikainen and Ahonen (1998) also found in their study of 55 VLBW children and the control group (full-term children) at 5;0, that when the children with major neurological disabilities (i.e. cerebral palsy, mental retardation IQ < 70, bilateral hearing loss ≥ 40 dB for speech frequencies, severe visual impairment, epilepsy) were excluded, the VLBW children still had significantly lower scores on four of the nine specific language measures and on two composite IQ scores. The best measures for differentiating the groups were the RAN tests (Colors / time, Objects / time), the comprehending of relative objects and the naming of tokens in the NEPSY test. Thus, the low overall cognitive outcome or severe neurological diagnose do not explain all the variance detected in the linguistic development of the VLBW children.

2.5 Effect of gender and maternal education on the language development

The most typically reported factors associated with the variability in early language development in both the full-term and prematurely born children are gender and parental education, or the socio-economic status of the family. The female advantage in the early lexical

acquisition in full-term children has been established in many studies (e.g. Fenson et al., 1994; Bornstein, Hahn & Haynes, 2004; Bornstein & Haynes, 1998; Bornstein, Haynes & Painter, 1998; Bornstein, Leach & Haynes, 2004). This advantage has been detected both in the receptive and in expressive vocabularies (Fenson et al., 1994), and in the linguistic skills in general (Bornstein, Hahn & Haynes, 2004).

For the VLBW children, the finding of a gender difference is not as constant as in the full-term population. Sansavini et al. (2006) reported that the prematurely born boys (birthweight < 1601g) had a significantly smaller lexicon size than girls at 2;6, and Menyuk et al. (1995) that prematurely born boys scored lower than girls in the early two-word comprehension task. However, Casiro et al. (1991) did not find gender difference in the language skills analysed in a sample of 28 VLBW children at 1;0 and at 3;0. Jennische & Sedin (1999) also reported that boys born at <32 gestational weeks scored higher than girls in the imitation of articulation patterns, the imitation of sentences of differing grammatical complexity, and in the word repetition task at 6;6. Moreover, in their later study (Jennische & Sedin, 2003), the language development of the VLBW boys was less influenced than that of the VLBW girls. In addition, the neonatal factors (e.g. apgar scores, respiratory distress syndrome, small for gestational age, pathological cerebral ultrasound) associated differently with the low language scores of the VLBW girls than to those of the VLBW boys. Largo et al. (1986) reported that preterm boys born at 27-36 weeks of gestation performed slightly better than girls in sentence completion and on a grammar test at 5;0.

Maternal education has been shown quite constantly to have a positive effect on a child's lexical and early language growth. For example, Dollaghan et al. (1999) reported a significant positive association between maternal education level (less than high school graduated, high school graduated, college graduated), and the measures analysed from spontaneous speech (MLU, word types and tokens) and the results of the formal test (the Peabody Picture Vocabulary Test) in a sample of 240 full-term children at 3;0. Hoff (2003) analysed the quality of the maternal speech in 63 mothers with high and mid socio-economic status (SES), and the associations of the variables detected in the maternal speech and in the children's language. Mothers with a high SES produced more utterances, used more word tokens, had higher MLU values and used more topic-continuing replies than mothers with mid-SES. The number of word types and the MLU values in maternal speech were associated with the number of word types used by a child in the videotaped interactions. The effect of maternal education level on the language of a child in full-term children has not been found in all studies, however. For example, Pan, Rowe, Spier & Tamis-LeMonda (2004) reported that the

maternal education level did not associate with the lexicon size in a large sample of 105 full-term children at 2;0.

The positive effect of the maternal education has also been reported in the VLBW children (e.g. Klebanov, Brooks-Gunn & McCormick, 1994), as the effect the SES has on the language skills of the children. Landry et al. (2002) analysed the effect of the socio-economic status on the development of the language skills in a large sample of the VLBW children, and found that the lower SES was negatively associated with language outcomes in both the high- and low-risk VLBW children in a parallel manner as in the control children. Sansavini et al. (2006) reported, nevertheless, that the parental education level was not associated with the lexicon or grammar scores in a sample of 73 prematurely born children (<1601 g) at 2;6.

## 2.6 Predictive value of early language

Early language development has been shown to have a predictive value for later linguistic skills. When the receptive lexicon is considered, Bates et al. (1988) found that the parental reports of the words their full-term children understood at 1;2 correlated significantly with the result of the formal test measuring the receptive lexicon at 2;6. Lyytinen (1999) observed that the receptive lexicon size at 1;2 measured using the FinCDI associated significantly with the receptive score of the RDLS at 18 and at 30 months of age. Moreover, Lyytinen, Eklund and Lyytinen (2005) found that the early poor receptive language skills were significantly associated with the reading and spelling skills at 5;5 in children with a genetic risk for dyslexia.

The early expressive vocabulary development has also been reported to predict later linguistic performance. Bornstein and Haynes (1998) compared the vocabulary competence of 184 full-term children analysed using different methods (by formal test, observational measure, the structured maternal rating method) at 20 months to the verbal performance IQ at 48 months, and found a positive, significant correlation between the early vocabulary competence and later verbal IQ. Lyytinen et al. (2001) reported a significant association between the size of a child´s expressive lexicon at 2;0, and later language performance which was measured by language tests (the RDLS at 30 months, BNT and PPVT at 42 months). Rescorla (2005) noted that the expressive vocabulary score of the structured parental rating method, the Language Development Survey, at 2 years was a significant predictor of vocabulary, grammar, verbal memory and reading comprehension at 13 years in the full-term children identified as late talkers between the ages of 24 and 31 months. The predictive value of the early expressive

lexical growth for language skills may also differ in normally developing full-term children if compared to those at risk for language problems. Lyytinen, P. et al. (2001 and 2005) and Lyytinen, H. et al. (2001) reported that the late talkers (i.e. small expressive lexicon size at 2;0) in a group of children having a familial risk for dyslexia were still delayed in language comprehension and production at 3;5, while the late talkers in the control group performed at age-level expectations. Furthermore, the recent findings of a tight association between expressive lexical and grammatical development at the end of the second year at least in children acquiring English (Bates & Goodman, 1997 and 1999), proposes that the expressive vocabulary development during the second year is a strong basis for later linguistic development.

The early morphological acquisition has also shown to have a predictive value for later language skills. For example, Lyytinen & Lyytinen (2004) reported that the morphological composite score (i.e. the number of inflectional types and the M3L in the CDI and in spontaneous speech) at 2;0 was the most significant predictor of language skills at 5;0 in the group of children with a genetic risk for dyslexia.

## 2.7 Methodological issues

There are different types of methods to collect information from a child´s early language, namely the structured maternal rating methods, or parental diaries, the spontaneous speech analysis and formal tests (e.g. Lyytinen, 2001). One central method to study early lexical acquisition has been a word diary kept by the mother of a child (Ingram, 1999). Currently a widely used method, the structured maternal rating method, the Communicative Development Inventories (CDI; Fenson et al., 1994), was developed based on this tradition. The development of the CDI was based on many studies over 20 years, in which the data was gathered through free laboratory observations, the analysis of the videotaped sessions, formal tests and different types of parental reports (Bates et al., 1988; Fenson et al., 1994). Through the analysis of this collected information, it became evident that parents can provide reliable information of the early linguistic development on their child, especially when the questions are focused the recognition instead of on the recall (Bates et al., 1988; Fenson et al., 1994). The reliability and validity of the CDI has been demonstrated, as the correlations between the laboratory measures and the inventory scores are substantial, ranging from 0.33 to 0.85 in different studies (Fenson et al., 1994; see also Pine, Lieven & Rowland, 1996; Ring & Fenson, 2000). The studies comparing the CDI syntax measures (sentence complexity, M3L,

morphological endings) and the laboratory-assessed MLU show that nearly all reliable variance in the MLU is captured by the CDI toddler syntax measures (Fenson et al., 1994; see also Dale, 1991; Thal, Jackson-Maldonado & Acosta, 2000; Thal, O´Hanlon, Clemmons, Fralin & LaShon, 1999).

The CDI has been standardised in Finnish (FinCDI; Lyytinen, 1999). During this process, all items in the word lists were screened for linguistic and cultural relevance. The FinCDI has been shown to provide parallel information as formal tests. In the normative study of the FinCDI, the association between the receptive lexicon size at 1;2, and the receptive score in the RDLS at 1;6 was good, r = 0.43, $p \leq 0.001$, and the correlation between the expressive lexicon size in the FinCDI and the expressive scale of the RDLS at 1;6 were excellent, r = 0.85, $p \leq 0.001$. The correlation between the M3L and the result of the expressive scale in the RDLS, and the one between the number of reported inflectional types and the result of the expressive score of the RDSL at 1;6 were both good, r = 0.75, $p \leq 0.001$, and r = 0.74, p $\leq$ 0.001, respectively (Lyytinen, 1999; see also Lyytinen & Lyytinen, 2004). Moreover, the correlation co-efficient values between the lexical and grammatical measures of the FinCDI and the MDI value in BSID II (Bayley, 1993), were all good at 2;0 in the normative study of the FinCDI (lexicon size, r = 0.70, $p \leq 0.001$, number of inflectional types, r = 0.61, p $\leq$ 0.001, M3L, r = 0.71 , $p \leq 0.001$; Lyytinen, 1999).

The vocabulary checklist methods offer an opportunity to obtain representative information on children's early language. This representativeness is not always clear in observed behaviour, where the willingness of a very young child to interact with an unfamiliar adult in an unfamiliar context is influenced by many factors (Fenson et al., 1994). Mothers have the opportunity to see their child in different situations and consequently they can provide representative information on their child's language. It has been proposed that the structured parental reports give information of what a child knows (i.e. *lexical knowledge*), whereas the analysis of a speech sample used in one situation only provides information on how a child uses this knowledge in specific situations (i.e. *lexical use;* Bates et al., 1988; Caselli et al., 1999). Furthermore, although the checklist methods have been designed to capture the majority of the words in the early vocabularies, they might not capture all the words. The checklist methods may underestimate the vocabulary size, especially in the large lexicons (Robinson & Mervis, 1999). If more representative information is needed, parents can be asked to also report those words their child uses but are not included in the lists (compare Benedict, 1979). The other shortcoming of the structured parental ratings is that the parents may either underestimate

or overestimate their children's language skills (e.g. Lyytinen, 1999). This can be reduced by providing the parents with the criteria of the word.

The structured parental rating methods do not provide information on how children use their early words. However, the acquisition of the word meanings is a developmental process (Dromi, 1999; Clark, 2003) and at the very beginning of the lexical acquisition, children may use their first words in a variety of ways. Due to this variability in the use and meanings of early words, one relevant question concerns the type of information about a child´s early language that is obtained by using the structured parental rating methods. However, regularities have been detected in the acquisition of the semantic lexical categories analysed from the information gathered using the CDI (e.g. Bates et al., 1994; Caselli et al., 1999). As long as regularities can be found, they can be interpreted to reflect the changes in children's ability to receive and handle different types of words in the adult language that is used around them (e.g. Bates et al., 1994; Caselli et al., 1995). Thus, in the studies focusing on the development of the semantic lexical categories based on the data gathered using the structured maternal rating methods, the semantic lexical categories are taken as summaries of the child's linguistic input. As long as children treat nouns, verbs or closed-class words differently in their language acquisition, it can be assumed that they are affected by the differences of these words in adult language (Bates et al., 1994; Caselli et al., 1995; Caselli et al., 1999). Moreover, although the focus in these studies is in the analysis of the acquisition of semantic lexical categories of adult language, it is not assumed that children have parallel linguistic representations of the semantic lexical categories (i.e. nouns, verbs etc.) in their minds as adults do. The exact knowledge of the lexical categories is acquired little by little, and the analysis of whether children consider nouns or verbs in a parallel or different manner than adults, requires a different methodology (Caselli et al., 1995; Tomasello, 2003).

The information of early language development can also either be analysed from the spontaneous speech from videotaped interactions or be assessed by means of formal tests. Both methods provide valid and reliable information. The shortcoming of these methods is the representativenes of the gathered information when the focus is on the child´s early language. In addition, the spontaneous speech analysis is slow, and therefore only small samples can be used (Fenson et al., 1994). However, especially in parallel use, different methods provide valid and representative information of a child's language (Pine, Lieven & Rowland, 1996).

3 Aims of the present work

The present work aimed to gain knowledge of early language acquisition of Finnish children between the ages of 0;9 and 2;0. There were three main goals. The first was to obtain information on the early lexical (receptive and expressive) acquisition of the full-term Finnish children. An analysis was made of both the possible change in the acquisition rate and the compositional development. Specifically, it was studied whether it is possible to detect a parallel developmental shift from reference to predication and to the grammar in Finnish children´s lexicons as described in the literature on those children acquiring other languages. The second main objective was to study and describe in detail the possible associations between the expressive lexicon and early grammar. The purpose of this part of the study was to analyse whether there is a parallel, close association between these two language domains in the full-term Finnish children as reported in other languages and if so, to describe that association in detail. Moreover, the aim was also to explore whether the two inflectional systems of Finnish (i.e. nominal, verbal inflections) are acquired in a close association with the lexicon in which they are used, which would support the single mechanism view, or if not, it would support the dual mechanism view. It was also analysed whether it could be possible to detect the different onsets and / or developmental trajectories between the nominal and verbal inflectional systems when analysed in relation to the corresponding lexicon. If so, this would lend support for the hypothesis by Bates and Goodman (1997:524) that different grammatical structures display different degrees or types of lexical dependency. The third main aim was related to the early language acquisition of the VLBW children. The goal was to get information of the growth and compositional development of their receptive and expressive lexical acquisition, their language skills at 2;0, and the predictive value of their early lexical acquisition to the later linguistic skills. In addition, an analysis was undertaken for both groups to determine the effect of the background variables on the linguistic growth. The specific research questions are described below.

Questions related to the lexical development:

1.  How do the receptive and expressive lexicon sizes develop between the ages of 0;9 and 2;0 in the full-term children acquiring Finnish? Is it possible to detect a change in the expressive lexical acquisition rate in all children during the second year? Is there also a change in the growth rate in the receptive vocabulary? (Study I)

2.  In what order do Finnish full-term children acquire the semantic lexical categories in their receptive and expressive lexicons? Is the compositional development associated with the growth of lexicon size? Is the compositional development parallel or different in the children´s receptive and expressive lexicons? (Studies I and IV)

Questions related to the associations between the expressive lexicon and grammar:

3.  Is the emergence of grammar (i.e. the development of morphological inflectional types and M3L, the emergence of the word combinations) associated with the expressive lexical growth at the end of the second year in Finnish children? Is it possible to detect an association between the acquisition of inflectional types (i.e. nominal, verbal inflectional types) and the lexical growth in which these inflectional types are mainly used (i.e. nominal lexicon, verbs)? Are the nominal and verbal inflectional types acquired in a comparable or different manner when analysed in relation to the respective lexicon growth? (Study II)

Questions related to the early linguistic development of VLBW children:

4.  Does the quantitative growth or the compositional development of the receptive and / or expressive lexicon in the VLBW children differ from those of the full-term children during the second year? (Studies III and IV)

5.  What kind of language skills do the VLBW children have at 2;0 as compared to the full-term children? What is the predictive value of  the early lexical growth to the language skills at 2;0 for the VLBW children ? (Study III)

Questions related to the background variables:

6.  What is the effect of gender, the length of the mother's basic education and birth weight on the acquisition of the expressive lexicon in the VLBW children and those who were born full-term? (Studies I and IV) Does the growth retardation (small for gestational age, SGA, birth weight < -2 SD from the mean of the Finnish growth charts) affect the lexicon growth of the VLBW children (Study IV)?

The description of the studies included in the present work is presented in Table 1.

Table 1. Description of the studies included in the dissertation.

| Study | Description | Focus | Subjects | Methods |
|---|---|---|---|---|
| *Study I* | A longitudinal follow-up study of early lexical development from 0;9 to 2;0. | 1. The quantitative growth of receptive and expressive lexicon<br><br>2. The compositional development of the receptive and expressive lexicon | 35 full-term children | FinCDI and reported extra words<br><br>RDLS III |
| *Study II\** | A detail analysis of the emergence of grammar in relation to the expressive lexical growth at 2;0. | Associations between expressive lexicon and grammar at 2;0 | 35 full-term children at 1;6 and at 2;0<br><br>146 full-term children at 2;0 | FinCDI<br><br>Analysis of spontaneous speech<br><br>Co-analysis<br><br>BSID II / MDI |
| *Study III* | A longitudinal follow-up study of early lexical development of VLBW children from 0;9 to 2;0 | 1. The quantitative growth of the receptive and expressive lexicon<br><br>2. The compositional development of the receptive and expressive lexicon<br><br>3. Predictive value of early lexicon | 32 VLBW children<br><br>The comparison group: 35 full-term children | FinCDI<br><br>RDLS III |
| *Study IV* | A comparison study of the expressive lexical development at 2;0 in two cross-sectional samples. | The size and composition of lexicon in full-term and VLBW Finnish children at 2;0 | 87 full-term children<br><br>66 VLBW children | FinCDI |

FinCDI = Finnish version of the Communicative Development Inventory, RDLS = Reynel Developmental Language Scales, BSID II = Bayley Scales of Infant Development, MDI = mental developmental index

* Findings of 35 and 146 at 2;0 are presented as one group in the original study. The summary part of the dissertation divides the findings into two groups and these are presented separately. Further, for the longitudinal sample, the findings at 1;6 are also presented, although they are not included in the original article.

## 4 Material and methods

### 4.1 Subjects

Four groups of children participated in the studies included in the present work (Table 2). All the children participated in the multidisciplinary follow-up study, the PIPARI study (*Pienipainoisten riskilasten käyttäytyminen ja toimintakyky imeväisiästä kouluikään*; *The development and functioning of the very-low-birth-weight children from infancy to school-age*; Lehtonen, Haataja, Lapinleimu and the PIPARI study group).

*The first group* consisted of a longitudinal sample of the 35 full-term children (18 males, 17 females) born in the Turku University Central Hospital during November, 2001 and April, 2002. An invitation to the study was presented to the monolingual Finnish-speaking families at the maternity ward having a firstborn, singleton, full-term (i.e. born at $\geq 37^{th}$ gestational week), healthy (i.e. no admission to the intensive care unit) baby. Of 44 families who agreed to participate, the language development of 36 children was followed intensively up to two years of age using different methods. One child had serious myocarditis at the end of the second year, and the data of this child was excluded. All 35 children were developing normally (Table 2). A child´s hearing was studied separately only if a he or she scored poorly on the RDLS III (i.e. the standard score $< 85$; Edwards, et al., 1997; Finnish version Kortesmaa, Heimonen, Merikoski, Warma & Varpela, 2001) at 2;0. One child was sent to the audiologist who verified normal hearing ability. The data of the 35 full-term children is presented in Studies I - III.

*The second group* consisted of a large cross-sectional sample of randomly selected full-term children. The children invited to participate in this group were the first healthy (i.e. no admission to the neonatal intensive unit), full-term (born at $\geq 37^{th}$ gestational week) girl and boy of the week born between November, 2001 and March, 2004 in the Turku University Central Hospital. In this manner, a sample of 200 children was collected. The findings of this group are presented in two studies of the present work (Study IV, Study II). In study IV, the data of 87 children out of the total sample of 200 children is analysed and presented. Between November, 2001 and March, 2003, 119 children had been recruited to the study. Of these 119 children a psychologist met 117 when they were 2;0 (two children dropped out during the two-year follow-up period) and the FinCDI (Fenson et al., 1994; Lyytinen, 1999) was given to the family with a cover letter (Appendix B). Parents were asked to complete the inventory and to return it by post within two weeks. Of 117 inventories, 99 (86%) were returned. Of those, 11

were excluded form the analysis because a language or languages other than Finnish was used in the family and one because the FinCDI was not properly completed. The final sample consisted of 87 inventories of full-term children growing up in Finnish-speaking monolingual families. The mean age of the children was 2 years and 13 days (SD 12 days) at the time the FinCDI was completed. In Study II, the data of 146 children out of the total sample of 200 children is presented. The total sample of 200 children had been collected between November 2001, and March, 2004. The psychologist met 193 (98 %) of the children when they were 2;0. The FinCDI and the cover letter were given to the family to be completed and returned by post within two weeks. The inventories of 164 (85 %) children were returned. Of those, 16 were excluded because a language or languages other than Finnish was used in the family and two because they were not properly completed. The final sample consisted of 146 inventories of children who were growing up in monolingual Finnish-speaking families (Table 2). The mean age of the children was 2 years 12 days (SD 11 days) at the time the FinCDI was completed.

*The third group* consisted of a selected cohort of 32 VLBW children (20 males, 12 females). An invitation to participate in the study was presented to all monolingual Finnish-speaking families at the neonatal intensive care unit having a firstborn, singleton, preterm (born at < 37 gestational week) very-low-birth-weight (birth weight ≤ 1500 g) baby, born between November, 2001 and July, 2005. From the 37 families who agreed to participate, the language development of the 32 VLBW children (one child died, four children dropped out during the two-year follow-up period) was followed intensively up to two years of age. At 2;0, three out of the 32 VLBW children had a CP diagnosis, and one a bilateral hearing loss (Table 2). In Study III, the lexical development of the VLBW children is compared to that of the longitudinal sample of the 35 full-term children. There was no significant difference between the groups of the 55 full-term and 32 VLBW children in the gender distribution ($\chi2(1) = .84$, $p = 0.36$), in the basic education of their mothers ($\chi2 (1) = 0.74$, $p = 0.39$) or their fathers ($\chi2 (1) = .37$, $p = 0.55$). However, the MDI value measured using the BSID II (Bayley, 1993) of the VLBW children was significantly lower than that of the full-term children ($t(65) = -4.2$, $p = .000$).

*The fourth group* consisted of a cross-sectional sample of all the surviving prematurely born VLBW children born in the Turku University Central Hospital between January, 2001 and December, 2002. The inclusion criteria were the following: 1. the birth weight of the child ≤ 1500 g, 2. the parent understands Finnish or Swedish well enough to be able to complete the follow-up forms, and 3. the families live in the catchment area of Turku University Central hospital. All the VLBW children born between January, 2001 and

December, 2002 were invited to participate in the study and all the families participated. From the total sample of 100 children, 17 died and 4 dropped out from the study during the two-year follow-up. A psychologist met the children at 2;0 and the FinCDI with the cover letter was given to the family to be filled in and returned by post within two weeks. Of the 79 inventories, 73 (92%) were returned. From those, 7 were excluded from the analysis because a language or languages other than Finnish were used at home. The final sample consisted of 66 inventories of the VLBW children growing up in Finnish-speaking monolingual families. The mean corrected age of the children was 2 years and 11 days (SD 17 days), and the mean chronological age (i.e. the age counted from the actual birth date) was 2 years 3 months 1 day, SD 23 days) at the time the FinCDI was completed. Twelve children belonging to the selected sample of the VLBW children (N = 32) were also included in this large sample of the VLBW children (N = 66). At 2;0, two VLBW children out of the 66 had a CP diagnosis, and one child with CP also had a symmetrical hearing impairment (Table 2). The expressive lexicon size and composition of the 66 VLBW children was compared to that of the 87 full-term children in Study IV. The groups did not differ in terms of gender distribution ($\chi^2$ = 2.30, df = 1, $p$ = .13), of the basic education of the mothers ($\chi^2$ = 0.65, df = 1, $p$ = .42), or of the fathers ($\chi^2$ = 2.43, df = 1, $p$ = .11).The MDI value in the BSID II at 2;0 was lower in the VLBW children than in those who were full-term ($Z$ = -2.34, $p$= .02).

The procedures of the PIPARI study were approved by the Ethical Committee of the Hospital District of Southwest Finland in November, 2001 (Groups I and III), in September, 2001 (Group II), and in December, 2000 (Group IV).

Table 2. Background characteristics of the children.

| | FT children N = 35 | | VLBW children N = 32 | |
|---|---|---|---|---|
| | Mean (SD) | Min. – Max. | Mean (SD) | Min. – Max. |
| Birth weight (g) | 3560 (407) | 2790 - 5040 | 1032 (273) | 525 - 1500 |
| Gestational age in weeks | 40 (1) | 37 – 42 | 28 (2) | 23 – 34 |
| Apgar 5 min. (median) | 9 | 7 – 10 | 7 | 3 – 9 |
| MDI in BSID II | 113 (8) | 86 - 126 | 98 (18) | 60 - 124 |
| Females /males | 17 (49 %) / | | 12 (38 %) / | |
| | 18 (51 %) | | 20 (62 %) | |
| Cerebral palsy | 0 | | 3 | |
| Hearing impairment | 0 | | 1 | |
| Severe visual impairment | 0 | | 0 | |
| *Mother´s education* | | | | |
|   < 9 years | - | | - | |
|   9-12 years | 9 (26 %) | | 11 (34 %) | |
|   > 12 years | 26 (74 %) | | 20 (63 %) | |
| *Father´s education* | | | | |
|   < 9 years | - | | 1 (3 %) | |
|   9-12 years | 15 (43 %) | | 15 (47 %) | |
|   > 12 years | 19 (54 %) | | 15 (47 %) | |

| | FT children N = 146 | | VLBW children N = 66 | |
|---|---|---|---|---|
| | Mean (SD) | Min. – Max. | Mean (SD) | Min. – Max. |
| Birth weight (g) | 3663 (446) | 2790 - 4980 | 1052 (279) | 400 - 1500 |
| Gestational age in weeks | 40 (1) | 37 - 42 | 28 (3) | 23 - 35 |
| Apgar (median) | 9 | 7 -10 | 7 | 1 - 9 |
| MDI in BSID II | 111 (11) | 84 - 128 | 104 (16) | 50 - 128 |
| Females / males | 75 (51 %) / | | 26 (39 %) / | |
| | 71 (49 %) | | 40 (61 %) | |
| Cerebral palsy | 0 | | 2 | |
| Hearing impairment | 0 | | 1 | |
| Severe visual impairment | 0 | | 0 | |
| *Mother´s education* | | | | |
|   < 9 years | - | | - | |
|   9-12 years | 53 (36 %) | | 23 (35 %) | |
|   > 12 years | 86 (59 %) | | 40 (61 %) | |
| *Father´s education* | | | | |
|   < 9 years | 7 (4 %) | | - | |
|   9-12 years | 66 (45 %) | | 44 (67 %) | |
|   > 12 years | 57 (39 %) | | 20 (30 %) | |

N = number of subjects, MDI = mental developmental index in Bayley's test, BSID II = Bayley´s Scales of Infant Development II. The percentages of the mother´s and father´s education were computed from the information available.

4.2 Methods

The different types of methods (i.e. the structure parental rating method, the spontaneous speech analysis, the formal test) were used to collect information on the children's language to obtain as representative data as possible. The data was gathered using the Finnish version of the MacArthur Communicative Development Inventory (CDI, Fenson et al., 1994; FinCDI, Lyytinen, 1999), an analysis of the words and inflectional types in the children's spontaneous speech and the Reynell Developmental Language Scales (RDLS III, Edwards et al., 1997, the standardised Finnish version, Kortesmaa et al., 2001).

*The FinCDI* is a standardised structured parental rating-method shown to be reliable and valid (e.g. Fenson et al., 1994; Lyytinen, 1999; see also Lyytinen & Lyytinen, 2004). There are two versions in the FinCDI: the Infant form (*Words and Gestures*) to collect data from the children aged between 8 and 16 months, and the Toddler form (*Words and Sentences*) to collect the data from the children aged between 16 and 30 months. Both versions include word lists that are modified to be representative indexes for early lexicons. The Infant form has 380 items and the Toddler form has 595. The words on the forms are organised under semantic categories. Both versions of the FinCDI organises nouns into ten categories (animals, vehicles, toys, food and drink, clothing, body parts, small household items, furniture and rooms, outside things and places to go, people), Verbs are grouped under the title ´action words`. In addition, one category is designed for onomatopoetic expressions, one for adjectives (´descriptive words`), and one for early routine words. There are four categories for grammatical function words in the Infant form of the FinCDI (pronouns, question words, prepositions and locations, quantifiers) and there is one more category (connecting words) for grammatical function words in the Toddler form. There is also one category for words about time in both versions. The mothers are asked to mark on the word lists all the words her child understands, as well as those words her child says (Infant form). For the Toddler form, only those words a child says are marked.

The toddler form of the FinCDI has three sections measuring grammatical complexity. The first section measures the nominal inflectional types and is called ´*The plural ending and case forms*`. There are 9 subsections, each reflecting the single, most typical morphological inflection (the plural ending, genitive, partitive, inessive, elative, illative, adessive, ablative and allative) of the nominal words (i.e. nouns, pronouns, numerals and adjectives) in Finnish. The second section ´*Verb inflections*` has 7 subsections, each asking about the use of a single verb inflection (the 2nd person singular imperative, negative

construction, 3S indicative present tense, 1S indicative present tense, the 3S indicative preterite, passive, and the 3S indicative perfect). Each subsection presents a suffix, gives examples of its use and asks parents to indicate whether their child uses the suffix ´never`, ´sometimes` or ´often`. The third part of the grammar section uses yes/no question to evaluate whether the child combines words. In addition, parents are asked to write out the three longest utterances they have heard their child say recently. The M3L value is counted from these examples. For the spontaneous speech analysis, the details are provided below.

*The Reynell Developmental Language Scales* (RDLS III, Edwards et al., 1997; the standardised Finnish version Kortesmaa et al., 2001) is a well-known language test that has two scales, one for the receptive and one for the expressive language. This test contains 62 items focusing on the different structural aspects of language. The Finnish version of the RDLS III is standardised for children between the ages of 1;10 and 7;0.

4.2.1 Data collection

*Receptive lexicon.* The data of the receptive lexical growth of the 35 full-term and the 32 VLBW children was gathered at 0;9, 1;0 and at 1;3 (the age calculated from the expected day of delivery, i.e. the corrected age for the VLBW children) using the Infant form of the FinCDI (Studies I and III). The mothers were asked to mark on the FinCDI form all those words their child understood. A word was accepted as understood if a child showed repeatedly a clear, immediate and correct response to a word (Benedict, 1979). The criteria for an understood word were established at the appointment before the FinCDI was completed for the first time when a child was 0;6. Each mother and a child were met at each age data collection point, and the FinCDI form was reviewed with the mother to verify that the criteria for an understood word were met. For the group of 35 full-term children, the checklist data was supplemented by extra words (i.e. words not included in the FinCDI wordlists) reported by the mother (Study I) to get as valid information as possible from the children´s receptive lexical acquisition. For the VLBW children, only the checklist data is presented (compare Caselli et al., 1995), because the checklist values provide the most applicable information for clinical work.

*The expressive lexicon.* The data of the expressive lexicon of the 35 full-term and 32 VLBW children was gathered at five age points: at 0;9, 1;0 and at 1;3 using the Infant form, and at 1;6 and 2;0 using the Toddler form of the FinCDI (Studies I and III; the corrected age was used for the VLBW children). The mothers were asked to mark all the words that their

child expressed on the FinCDI form. The criteria for an expressed word were: 1. spontaneous, not just imitated, use of the word, 2. the word is connected repeatedly to the same referent (Lyytinen, 1999). Each mother and child were met at each data collection point, and the FinCDI was reviewed with each mother to ensure that the criteria for an expressed word were met. In addition, the mothers were asked to provide as much information as possible about the lexical development of their child. They were encouraged to write down all the words a child used as accurately as possible in order to obtain suggestive information about the phonological representation of the word. In a group of the 35 full-term children, the checklist data was supplemented with the reported extra words (Study I). For the VLBW children, only checklist data is presented (Study III; compare Caselli et al., 1995).

From the cross-sectional samples of the full-term children (Study II: n = 146, Study IV: n = 87) and the VLBW children (Study IV: n = 66), the data of expressive lexicon was gathered using the Toddler form of the FinCDI. The FinCDI form and the cover letter (Appendix B) were given to the family by the psychologist when the children reached the age of 2;0 (the corrected age for the VLBW children). The families were asked to complete the inventory and to return it by post within two weeks.

The data of the expressive lexicon of the 35 full-term children was analysed from the spontaneous speech in the video-taped mother-child interactions when the child was 1;6 (unpublished data) and 2;0 (Study II). These interactions were videotaped for 20 to 30 minutes in a quiet room at a private pediatric clinic. The room was made comfortable and equipped with age-appropriate toys and a soft carpet to play on. The mother was instructed to spend the time with her child as she wished. The video camera that was used was a high quality digitalised mini DV camera equipped with an external high quality microphone. All meaningful speech that a child used in a ten-minute sample (the most talkative period) was transcribed following the guidelines given in the CHAT transcription format (MacWhinney, 2006). The criteria for a word that was used in the transcription process were the following: 1. the word resembles a target word, and 2. the word is used in a plausible context. If the word status was unclear, then confirming criteria were used such as the maternal identification, whether the word was marked in the FinCDI form, or whether the word was used more than once (compare Vihman & McCune, 1994; Kunnari, 2000).

*The grammatical data.* The information of the grammatical development (the number of the inflectional types, M3L, the use of word combinations) was gathered from 35 full-term children at 1;6 (unpublished data) and 2;0 (Study II), and from 146 full-term children at 2;0 (Study II) using the FinCDI.

The use of morphological endings by the 35 full-term children was analysed from spontaneous speech (see details below) that was videotaped when each child was 1;6 (unpublished data) and 2;0 (Study II). The use of morphological inflections was analysed from the same transcribed section that was used for the analysis of the lexical data.

The language skills of the 35 full-term and the 32 VLBW children were assessed using the RDLS III at 2;0 (+ 2 weeks, corrected age for the VLBW children; Studies I and III). The language skills of the children in the cross-sectional samples (the full-term children N = 146, the VLBW children N = 66) were not tested by administering the formal language test. Instead, their cognitive development was tested by a psychologist using the MDI value in the BSID II (Bayley, 1993) at 2;0 (a corrected age was used for the VLBW children).

4.2.2 Analysis of the values of the full-term children

*Analysis of the lexical data gathered using the FinCDI.* To analyse the quantitative growth of the receptive and expressive lexicon of the 35 full-term children in the longitudinal sample (Study I), the number of all understood and expressed words, both the words marked in the FinCDI and the reported extra words, were calculated for each child at each point. To obtain information on the possible change in the growth rate in the acquisition of the receptive and expressive vocabularies, the value used in the studies focusing on the vocabulary spurt (10 new words in two-week interval; D`odorico et al., 2001; Mervis & Bertrand, 1995) was applied (i.e. in the present study: ≥ 60 new words per each three-month period or ≥ 120 new words per six-month period). Thus, it was analysed of how many new understood or expressed words each child acquired during each three-month / six-month period, whether there was a change in the growth rate (i.e. ≥ 60 new words per each three month period or ≥ 120 new words per six- month period were acquired), and if so, when. Because of the rather long data collection intervals, it was not possible to use the same definition criteria used in the earlier studies for a lexical spurt, and the value was consequently applied.

To study the compositional development of the receptive and expressive lexicons during the second year, all the gathered receptive and expressive lexicons of the 35 full-term children were analysed using the combined values (i.e. both the checklist and the extra words were analysed; Study I). All children had comprehended words at each of the three age points that the data collected, and thus, the total number of the collected receptive vocabularies was 105. Not all the children had expressed words at each of the five age points that the data

gathered, and the total number of collected and analysed expressive vocabularies was 142 (26 children had no words at 0;9, 6 children had no words at 1;0, 1 child had no words at 1;3). The procedure adopted from Bates et al. (1994; see also Caselli et al., 1995; Caselli, Casadio & Bates, 1999) was followed in the compositional analysis. First, the words that were marked in the different lexical semantic categories at each age point were counted for each child, for their receptive and expressive lexicons separately. The categories used in the study were: *social terms* (i.e. the words belonging to the following categories in the FinCDI: onomatopoetic expressions, the names of people, routine words; Infant form: 47 items, 12 % of the checklist words; Toddler form: 59 items, 10 % of the checklist words), *nouns* (i.e. all nouns serving a clear naming function, thus the words belonging to the following categories of the FinCDI: animal names, vehicles, toys, food and drink, clothing, body parts, furniture, household items; Infant form: 183 items, 48 %; Toddler form: 255 items, 43 %; ´the names of people` and ´outside things and places to go` were excluded; Bates et al., 1994), *verbs* (Infant form: 60 items, 16 %; Toddler form: 106 items, 18 %), *adjectives* (Infant form: 26 items, 7 %; Toddler form: 54 items, 9 %) and *grammatical function words* (Infant form: 32 items, 8  %; Toddler form: 71 items, 12 %). The reported understood and the expressed extra words were analysed under the proper headings (e.g. any reported expressed verbs were counted under the heading of the expressed action words).

After calculating the number of words in each lexical semantic category in each lexicon, the compositional analysis was carried out in two stages, for the receptive and expressive lexicons separately. First, the number of the social terms, nouns, verbs, adjectives and the grammatical function words in the receptive and expressive lexicons at each age point were described at a group level for each point the data was gathered. Then, the percentages of the words in the mentioned semantic lexical categories were calculated from the total number of words in the lexicon in each lexicon and for each child. These percentages were then described in relation to the lexicon size (Bates et al., 1994; Caselli et al., 1995; Caselli, Casadio & Bates, 1999). To accomplish this, the gathered vocabularies were arranged into subgroups according to the vocabulary size (Bates et al., 1994; Caselli et al., 1995, Caselli, Casadio & Bates, 1999). The subgroups and the number of the lexicons in each subgroup are presented in Table 3.

Table 3. The lexicon size subgroups, numbers of the lexicons in each subgroup and the age points when the data was collected for the receptive and expressive lexicons of the 35 full-term children. The lexicon-size subgroups presented were used in the analysis in Study I.

| Receptive lexicon | | Expressive lexicon | |
|---|---|---|---|
| *1-20 words:* | *101-200 words:* | *1-20 words:* | *101-200 words:* |
| 20 lexicons | 27 lexicons | 71 lexicons | 8 lexicons |
| 19 at 0;9 | 2 at 0;9 | 9 at 0;9 | 7 at 1;6 |
| 1 at 1;0 | 9 at 1;0 | 28 at 1;0 | 1 at 2;0 |
| | 16 at 1;3 | 26 at 1;3 | |
| | | 8 at 1;6 | |
| *21-50 words:* | *201-300 words:* | *21-50 words:* | *201-300 words* |
| 21 lexicons | 13 lexicons | 14 lexicons | 11 lexicons |
| 10 at 0;9 | 1 at 0;9 | 1 at 1;0 | 2 at 1;6 |
| 10 at 1;0 | 4 at 1;0 | 6 at 1;3 | 9 at 2;0 |
| 1 at 1;3 | 8 at 1;3 | 7 at 1;6 | |
| *51-100 words:* | *301-400 words:* | *51-100 words:* | *301-400 words:* |
| 18 lexicons | 6 lexicons | 15 lexicons | 10 lexicons |
| 3 at 0;9 | 6 at 1;3 | 2 at 1;3 | 10 at 2;0 |
| 11 at 1;0 | | 11 at 1;6 | |
| 4 at 1;3 | | 2 at 2;0 | |
| | | | *> 400 words:* |
| | | | 13 lexicons |
| | | | 13 at 2;0 |

The size and composition of the children´s expressive lexicon in the cross-sectional sample at 2;0 was analysed in Studies IV and II. In Study IV, the percentages of the semantic lexical categories in the lexicons of the 87 full-term children were analysed in relation to the lexicon size by using the parallel procedure described above. The number of the words in the different lexical semantic categories (i.e. social terms, nouns, verbs and adjectives, grammatical function words; Bates et al., 1994, Caselli, Casadio & Bates, 1999) was first counted for each child. Then, the percentages of the words in each lexical semantic category were calculated from the total number of words in the lexicon for each child. These percentages were then described in relation to the lexicon size. This was done by dividing the children into subgroups according to their lexicon size. The subgroups and the numbers of the children in each subgroup are presented in Table 11 (page 56). In Study II, the raw values, not the percentages, of the lexical semantic categories were described in the vocabularies of different sizes (see Tables 16, 17 and 18 on pages 64 – 66 for the lexicon size subgroups and

for the numbers of the subjects in each subgroup). Moreover, since the main focus in Study II was to analyse and describe the possible associations between the expressive lexicon and the emergence of grammar, a group of nominal words was created. As there are no numerals in the FinCDI, the nominal word category included all nouns, pronouns and adjectives marked on the FinCDI form for each child at 1;6 and at 2;0.

   *Analysis of the spontaneous speech lexical data.* After the transcription, all the words in the spontaneous speech data gathered at 1;6 and 2;0 were classified into Finnish language word classes (nouns, verbs, adjectives, pronouns, adverbs, pre- / postpositions, particles, numerals; Hakulinen et al., 2005) by a team consisting of two native speakers of Finnish (one a professional in the Finnish language, the other a professional in child language). Unintelligible speech was not included in the analysis. After an item-by-item analysis, the words were classified according to the classification system of Bates et al. (1994) and Caselli et al. (1995, 1999) to obtain parallel information from the different measures (i.e. the FinCDI and spontaneous speech). The following categories were used: 1. All word types (i.e. all different words used by a child in a ten-minute sample), 2. Noun types (i.e. common nouns, e.g. *pallo,* a ball; the names of people were excluded; Bates et al., 1994), 3. Verb types (i.e. different words classified as verbs; the verbs with auxiliaries were counted as a one word-type, e.g. *on mennyt,* has gone = one verb type), and 4. the closed-class word types. The closed-class word category was parallel to the FinCDI data, and included the following words (Hakulinen et al., 2005; Itkonen, 1996): 1. Pro-words (i.e. pronouns and local pro-adverbs, e.g. *tässä,* in here, *missä,* where), 2. pre- and postpositions and local adverbs (e.g. *ylös,* up, *takana,* behind), 3. quantifiers (Hakulinen & Karlsson, 1979; Hakulinen et al., 2005), and 4. particles (Hakulinen et al., 2005; interjections were not included in the particles; Bates et al., 1994). The pronoun and local pro-adverb types were counted according to their position in a sentence: the different pronoun forms (*tähän* kirjaan, into this book, *tässä* kirjassa, in this book) were considered to be different inflected forms of the same word type. The local pro-adverbs were counted as different word types (*tähän minä sen laitoin,* I put it in here, *tässä se on,* here it is). When the word *ei* (no) appeared alone, it was categorised, parallel with the FinCDI data, as a routine word, under the category of social terms. The number of all word types, noun, verb, adjective and closed-class word types used by the children in spontaneous speech at 1;6 and 2;0 were calculated and described in relation to the lexicon size measured using FinCDI at both age points (see Tables 16 and 17, pp. 64 and 65, for the lexicon size subgroups and the number of the children in each subgroup). The information analysed from the spontaneous speech was also compared to that gathered using the FinCDI. Only the word types were selected to be

analysed from the spontaneous speech since they are more comparable to the FinCDI data than the word tokens (compare Tardiff, Gelman & Xu, 1999).

An independent researcher, a student of Finnish, transcribed and analysed 14 % of the randomly selected videotaped data from the spontaneous speech (five interactions at 1;6, five interactions at 2;0). The intra-class correlation coefficient values (ICC (2,1); Shrout & Fleiss, 1979) between the two independent analyses for the lexical measures were the following: all word types 0.986, noun types 0.928, verb types 0.963, closed class word types 0.974, nominal word types 0.965, respectively.

*Analysis of the grammatical data gathered using FinCDI.* The grammatical data gathered by using the FinCDI was analysed in both samples of the full-term children. In the first two parts of the grammar section (*The plural ending and case forms, Verb inflections*), the answers were coded as ´no` (= not yet) and ´yes` (= sometimes, often), and the number of yes-answers was counted. Each child had a number of case-form types (the plural form included) which could vary between 0 - 9, and a number of the verb inflection types which could vary between 0 - 7 for individual children. The mean value of the morphemes (M3L) was counted for each child from the three longest sentences reported by the parent according to the procedure stipulated in the FinCDI (Lyytinen, 1999). Frozen phrases (songs, counting, etc.) were excluded from the analysis. Whether the child combined words (yes / no) was coded.

*Analysis of the grammatical spontaneous speech data.* All the case-form and the verb inflectional types used by the 35 full-term children at 1;6 and at 2;0 in their spontaneous speech during the ten-minute sample of the videotaped interaction were analysed by the same two-member team mentioned above. Unintelligible speech was not included in the analyses. If a child used the plural form (in any case form), this was counted as one morphological inflectional type and included in the total number of case-form types. The accusative (nominative- or genitive-accusative) was analysed as one form. As it is known that Finnish children practice locality in the local pro-adverbs first (Laalo; 2002; Toivainen, 1980), and in the nominal words only after, the use of case endings in the local pro-adverbs was analysed as case forms (e.g. ABL: *tuolta,* from there; ADE: *täällä,* here) as has been done in earlier studies (Laalo, 2002; Toivainen, 1997). The only exception was the demonstrative adverbs not having an inflectional suffix in modern Finnish (i.e. the *–nne*-forms, e.g. *tonne,* there, *tänne,* here), which were excluded from the analysis of the case-form types (compare Laalo, 2002; Toivainen, 1997). All the passive forms were analysed as passives. No interpretation was made whether a child used them with the meaning of the passive or in the meaning of the 1st person plural form (compare Nieminen, 2007; Nieminen & Torvelainen, 2003). Based on the video

analysis, each child received the following values: 1. the total number of case form types, and 2. the total number of verb inflectional types used in spontaneous speech at 1;6 and 2;0.

An independent researcher, a student of Finnish, transcribed and analysed 14 % of the randomly selected videotaped spontaneous speech data (five interactions at 1;6, five interactions at 2;0). The intra-class correlation coefficient values (ICC (2,1); Shrout & Fleiss, 1979) between the two independent analyses for the morphological measures were: the case - form types 0.953, the verb inflection types 0.976.

*Analysis of the associations between expressive lexicon and grammar.* The emergence of grammar (i.e. the number of the case form and the verb inflectional types in the FinCDI and in spontaneous speech, the ML3, whether a child had word combinations or not) was analysed and described in relation to the lexicon size measured using the FinCDI in both samples of the full-term children. This was done by dividing the children into subgroups according to their expressive lexicon size on the FinCDI (Tables 16 - 18, p. 64-66). The associations between the lexical and grammatical measures were also analysed statistically.

The emergence of the two inflectional systems of Finnish (i.e. the nominal and the verb inflectional types) were analysed in detail, in relation to the growth of the lexicon in which they are mainly used: the emergence of nominal inflectional types in relation to the growth of nominal lexicon size, and the verb inflectional types in relation to the growth of the verb lexicon size as measured by the FinCDI. Three children in the cross-sectional sample at 2;0 had no nominal words in their expressive vocabularies, and one child in the longitudinal sample at 1;6 and eight in the cross-sectional sample at 2;0 had no verbs. The data of these children were excluded from the analysis. In the analysis, the children were first divided into subgroups according to their nominal and verb lexicon size on the FinCDI (Table 4). An analysis and description was made of the number of the nominal / verbal inflectional types measured by the FinCDI and analysed from spontaneous speech in each nominal / verb lexicon size subgroups. Next, a calculation was made of the percentage of those children using only the basic case form types (i.e. nominative, partitive; Laalo, 2002 and 2003) in each nominal lexicon subgroup, and correspondingly, the percentage of the children using only the basic verb inflectional types (the 2S imperative, the 3S indicative present; Laalo, 2003; Toivainen, 1980) in each verb lexicon size subgroup. The purpose of this analysis was to obtain information on the emergence of morphology in relation to the corresponding lexicon growth. The findings related to the emergence of grammar in relation to the lexical growth for the longitudinal sample of the 35 full-term children at 1;6 are presented as unpublished data in the present summary. In addition, the findings related to the emergence of grammar in relation to the

growth of the lexicon size in two samples of the full-term children at 2;0 (N = 35, N = 146) are reported separately in the present summary, but as one group in Study II (N = 181).

Table 4. Nominal and verb lexicon size subgroups and the numbers of the subjects in each subgroup for the longitudinal sample (LT) of 35 full-term children and for the cross-sectional (CS) sample of 146 full-term children.

|  | Nominal lexicon-size subgroups | Verb lexicon-size subgroups |
|---|---|---|
| At 1;6 | < 51 words: LT 23<br>51-100 words: LT 9<br>101-200 words: LT 3<br>201-300 words: - | 1-9 words: LT 28<br>10-25 words: LT 5<br>26-50 words: LT 1<br>51-75 words: -<br>> 75 words: - |
| At 2;0 | < 51 words: LT 2, CS 27<br>51-100 words: LT 1, CS 18<br>101-200 words: LT 12, CS 41<br>201-300 words: LT 20, CS 57 | 1-9 words: LT 3, CS 26<br>10-25 words: LT 4, CS 15<br>26-50 words: LT 5, CS 24<br>51-75 words: LT 12, CS 31<br>> 75 words: LT 11, CS 42 |

4.2.3 Analysis of the values of the VLBW children

*Analysis of the lexical data gathered using the FinCDI.* The quantitative growth of the receptive and expressive lexicon sizes of the VLBW children was compared to those of the 35 full-term children (Study III). This analysis was undertaken in two stages. First, the values of the total group of the VLBW children (N = 32) were analysed. Then, the values of those VLBW children without major neurological disability (NoDis; n = 27) were studied separately. A major neurological disability was defined as CP, mental retardation (MDI <70), bilateral hearing loss (≥ 40 dB) or severe visual impairment (e.g. Luoma, et al., 1998; Wolke & Meyer, 1999) diagnosed before or at 2;0. The analysis involved two stages to obtain information from both groups (i.e. the total cohort, the VLBW children without major neurological disability). Further, in Study IV, the values of the VLBW children were also analysed in the two groups: the values of those with MDI value > 85 in BSID II at 2;0 years of corrected age (i.e. children with normal cognitive development) and those with the MDI value < 85 in BSID II were analysed separately.

The compositional development of the receptive and expressive lexicon of the 32 VLBW children was compared to those of the 35 full-term children in Study III. The analysis was carried out in a parallel manner for both lexicons as follows: first, the raw values of social terms, nouns, verbs, adjectives and grammatical function words in the lexicons (Bates et al., 1994) of the VLBW children were compared to those of the full-term children at a group level at each age point the data was collected; next, the percentage of the social terms, nouns, verbs, adjectives and grammatical function words was calculated from the total number of words in the lexicon for each child at each age point. The percentages of the VLBW children were then compared to those of the full-term children with the vocabularies of similar sizes (Caselli et al., 1995). This was done by grouping the lexicons into subgroups according to lexicon size (Table 5). The first lexicon attained by a child and belonging to the vocabulary-size subgroup in question was included in the analysis. Due to the rather long distances between the data collection points it was not possible to get the vocabulary from each child for every lexicon-size subgroup.

To gather information of the compositional development of the expressive lexicons of the VLBW children in the cross-sectional sample at 2;0 (Study IV), percentages of the words in each lexical semantic category (social terms, nouns, predicates and grammatical function words; Bates et al., 1994) were calculated from the total number of words in the lexicon for each child. The percentages of the VLBW children were then compared to those of the full-term children in the cross-sectional sample with the lexicons of similar sizes (see Table 11, page 56 for the lexicon size subgroups used in the analysis and the numbers of the children in each subgroup).

*Analysis of the language skills at 2;0 and the associations between early lexicon and later language performance.* The language performance of the 32 VLBW children measured by the RDLS III at 2;0 was compared to that of the 35 full-term children. In addition, an analysis was made of the associations between the early receptive and expressive lexicon sizes and the language skills at 2;0 (Study III). For the cross-sectional samples of the full-term and the VLBW children the associations between lexicon size at 2;0 and the MDI value on the BSID II were calculated.

Table 5. The lexicon-size subgroups including the numbers of lexicons in each subgroup and the age points when the data was collected for the receptive and expressive lexicons of 32 very-low-birth-weight children (VLBW) and 35 full-term (FT) controls. The subgroups were used in the analysis in Study III.

Receptive lexicon

Expressive lexicon

*1-9 words:*

*100-249 words:*

*1-9 words:*

*100-249 words:*

VLBW: 19 lexicons
  16 at 0;9
  3 at 1;0

VLBW: 18 lexicons
  4 at 1;0
  14 at 1;3

VLBW: 27 lexicons
  4 at 0;9
  18 at 1;0
  3 at 1;3
  2 at 1;6

VLBW: 9 lexicons
  1 at 1;3
  3 at 1;6
  5 at 2;0

FT: 12 lexicons
  12 at 0;9

FT: 29 lexicons
  3 at 0;9
  9 at 1;0
  17 at 1;3

FT: 27 lexicons
  7 at 0;9
  18 at 1;0
  2 at 1;3

FT: 15 lexicons
  7 at 1;6
  8 at 2;0

*10-49 words:*

*> 250 words:*

*10-49 words:*

*> 250 words:*

VLBW: 25 lexicons
  12 at 0;9
  11 at 1;0
  2 at 1;3

VLBW: 3 lexicons
  3 at 1;3

VLBW: 26 lexicons
  5 at 1;0
  7 at 1;3
  8 at 1;6
  6 at 2;0

VLBW: 14 lexicons
  2 at 1;6
  12 at 2;0

FT: 24 lexicons
  16 at 0;9
  8 at 1;0

FT: 8 lexicons
  1 at 1;0
  7 at 1;0

FT: 27 lexicons
  1 at 0;9
  3 at 1;0
  15 at 1;3
  8 at 1;6

FT: 24 lexicons
  1 at 1;6
  23 at 2;0

*50-99 words:*

*50-99 words:*

VLBW: 21 lexicons
  1 at 0;9
  13 at 1;0
  7 at 1;3
FT: 17 lexicons
  4 at 0;9
  10 at 1;0
  3 at 1;3

VLBW: 10 lexicons
  3 at 1;3
  5 at 1;6
  2 at 2;0
FT: 14 lexicons
  2 at 1;3
  10 at 1;6
  2 at 2;0

In the data analysis, the lexicon size subgroups measured using the FinCDI were used. This procedure was adopted  from that of used in the earlier studies focusing on the development of lexical composition (Bates et al., 1994; Caselli et al., 1995; Caselli, Casadio & Bates, 1999; D´odorico, Carubbi, Salerni, & Calvo, 2001; Jackson-Maldonado et al., 1993; Koster et al., 2005; Maital et al., 2000), and on the associations between the expressive lexicon and grammar (e.g. Bates, Thal & Dale; 1995; Bates & Goodman, 1997 and 1999; Caselli, Casadio & Bates, 1999). In general, the aim was to use the same lexicon-size subgroups as those used in earlier studies. However, the final decision as to which vocabulary size subgroups to use was based on the available data in each individual study.

4.2.4 Analysis of the effect of background variables

The associations between the expressive lexicon size at 2;0 and the following background variables were studied (Study IV) for the full-term and the VLBW children in the two cross-sectional samples: gender, the length of the mother's basic education and birth weight. In addition, the influence of growth retardation during gestation (small for gestational age, SGA, birth weight < -2 SD from the mean of the Finnish growth charts at birth) on the lexicon growth was studied for the VLBW children (Study IV). The effect of gender on the lexicon growth during the second year was also analysed for the longitudinal sample of the 35 full-term children.

4.2.5 Statistics

When analysing the growth of the children´s nominal inflectional types in relation to the growth of their nominal lexicons, and the growth of the verb inflectional types in relation to the growth of their verb lexicons, combined morphological measures (the combined case form and verb inflectional types) were used. The combined morphological measures are the mean values of the morphological inflectional types calculated from the value derived from the FinCDI and spontaneous speech. These combined measures were used to take into consideration both the linguistic knowledge and the use of this knowledge in spontaneous speech.

Testing whether there was a significant difference in the number of the case form and the verb inflectional types in spontaneous speech at 1;6 and at 2;0 was carried out by using

the paired samples t-test. The independent samples t-test was used to compare whether the performance in the RDLS III and the MDI values between the VLBW and the full-term children at 2;0 differed in Study III, and to make comparisons between the normally distributed variables in Study IV. The Mann-Whitney U-test was used for the non-normal distributions in Study IV. In addition, the Wilcoxon's two sample test was used to make comparisons between the two continuous variables in Study III, and to analyse the difference in the lexicon size between those children combining words and those who did not (Study II, unpublished data). The significant differences in the categorical variables between the VLBW and full-term children were tested by the Chi Square Test.

A logistic regression analysis was used to study the effect of the growth of the nominal and verb lexicon size on the emergence of other than basic inflectional types in the morphology (unpublished data, Study II). To analyse the effect of gender on the lexicon growth in the second year in the longitudinal sample of the 35 full-term children (Study I), and to compare the receptive and expressive lexicon sizes of the VLBW in the longitudinal sample to those of the full-term children, the poisson regression analysis was used (Study III). The generalised estimating equations were used in both analyses. When analysing the effect of gender on the lexicon growth in the longitudinal sample of the full-term children, gender and age were used as independent variables, and the lexicon size as a dependent variable. When a significant age by gender interaction occurred in the repeated-measures analysis, the individual age points were examined separately. When the effect across individual age points was similar, only the result of the repeated-measures analysis was reported. Furthermore, when comparing the lexicon sizes of the VLBW children to those of the full-term children, the group, age and the interaction between the group and age were used as the independent variables, and the lexicon size as a dependent variable. If there was a significant lexicon size by age -interaction, the individual age points were analysed separately. If the effect of the group across the individual age points was similar, only the result of the repeated-measures analysis was reported.

For all children, the associations between the continuous variables were studied using the correlation co-efficient values. The use of Spearman and Pearson's correlation co-efficient values is specified in the text and in the tables. The differences were considered to be significant if the $p$-value was $< 0.05$. All significance tests were 2-tailed. The Statistical analyses were performed using the SPSS for Windows (13.0 or 14.0, SPSS Inc.) or the SAS for Windows (9.1, SAS Institute, inc.).

## 5.0 Results

5.1 Early lexical development of the full-term children

5.1.1 Quantitative growth and a change in the growth rate of the receptive and expressive lexicons

*Receptive lexicon.* All the 35 full-term children (Study I) were reported to have words in their receptive vocabularies already at 0;9. The receptive lexicon grew rapidly right from the beginning. At a group level, the acquisition rate accelerated slightly in relation to time: the mean value of the acquired new words in the receptive lexicon was 64 (SD 42, median 59) in the three-month period from 0;9 to 1;0, and 94 words (SD 47, median 88) in the period from 1;0 to 1;3. There was a high variation between individual children in the number of acquired new comprehended words in both three-month intervals: the number of new words acquired by individual children varied from 8 to 157 words in the period from 0;9 to 1;0, and from 17 to 220 words in the period from 1;0 to 1;3.

For most children (n = 26, 74 %), the number of acquired new words in the receptive lexicon was higher in the latter three-month period than in the former. The lexical acquisition rate of nine children (26 %) slowed down in the period from 1;0 to 1;3 when compared to the earlier period. Sixteen children (46 %) acquired at least 60 new words during the first three-month period, and 14 of these children also continued to acquire at least the same number of new words during the second follow-up period. In addition, 12 children (35 %) acquired 60 new words or more for the first time during the period from 1;0 to 1;3. The mean value of the receptive lexicon size for these 28 children at the age point before the strong growth in the acquisition rate occurred for the first time was 44 words (SD 35, median 35, min. 9, max. 114) at 0;9, and 46 words (SD 18, median 49, min. 22, max. 81) at 1;0. The receptive lexicon sizes at each age point the data collected are presented in Table 6.

*Expressive lexicon (FinCDI data).* Nearly all 35 full-term children (n = 34, 97 %) had produced their first words at 1;3 (Study I). The expressive lexicon grew slowly at first, but the growth rate accelerated. At a group level, the mean value of the acquired new words was 4 (SD 5, median 2) in the period from 0;9 to 1;0, 14 words (SD 14, median 11) in the period from 1;0 to 1;3, 58 words (SD 56, median 44) in the period from 1;3 to 1;6, and 266 words (SD 96, median 274) in the last six-month period, from 1;6 to 2;0. The variation between individual children in the number of acquired new words was not wide at the beginning, but grew over

Table 6. The lexicon sizes of all study groups at each data collection point (FT = full-term children, VLBW = very-low-birth-weight children).

*Receptive*

|  | 0:9 | | 1;0 | | 1;3 | |
|---|---|---|---|---|---|---|
|  | Mean (SD) | Min.-Max. | Mean (SD) | Min.-Max. | Mean (SD) | Min.-Max. |
| FT (N = 35) | | | | | | |
| Checklist | 33 (42) | 1-205 | 94 (68) | 12-262 | 184 (78) | 28-333 |
| Extra words | 1 (2) | 0-8 | 4 (7) | 0-33 | 8 (9) | 0-41 |
| Combined | 34 (43) | 2-212 | 98 (73) | 12-271 | 192 (82) | 29-343 |
| VLBW (N = 32) | | | | | | |
| Checklist | 13 (14) | 0-55 | 56 (44) | 7-193 | 130 (79) | 13-295 |

*Expressive*

|  | 0:9 | | 1;0 | | 1;3 | |
|---|---|---|---|---|---|---|
|  | Mean (SD) | Min.-Max. | Mean (SD) | Min.-Max. | Mean (SD) | Min.-Max. |
| FT (N = 35) | | | | | | |
| Checklist | 1 (2) | 0-14 | 4 (6) | 0-32 | 17 (18) | 0-80 |
| Extra words | 0 (0) | 0-1 | 0 (1) | 0-6 | 2 (3) | 0-16 |
| Combined | 1 (3) | 0-15 | 4 (7) | 0-38 | 19 (20) | 0-96 |
| VLBW (N = 32) | | | | | | |
| Checklist | 0 (1) | 0-6 | 5 (7) | 0-32 | 19 (28) | 0-136 |

|  | 1;6 | | 2;0 | |
|---|---|---|---|---|
|  | Mean (SD) | Min.-Max. | Mean (SD) | Min.-Max. |
| FT (N = 35) | | | | |
| Checklist | 69 (63) | 4-261 | 324 (118) | 60-532 |
| Extra words | 8 (8) | 0-39 | 18 (13) | 0-63 |
| Combined | 76 (68) | 5-275 | 342 (120) | 70-548 |
| VLBW (N = 32) | | | | |
| Checklist | 53 (77) | 0-292 | 198 (167) | 8-468 |
| FT (N = 146) | | | | |
| Checklist | | | 276 (164) | 5-581 |
| VLBW (N = 66) | | | | |
| Checklist | | | 247 (175) | 4-574 |

time: the number of acquired new words varied from 0 to 23 words in the period from 0;9 to 1;0, from 0 to 58 words in the period from 1;0 to 1;3, from 1 to 205 words in the period from 1;3 to 1;6, and from 50 to 454 words in the last six-month period. At 2;0, there was a high variation in the lexicon size between individual children (Table 6). Even so all 35 children had acquired a lexicon larger than the first 50 words at 2;0.

For most children (n = 29, 83 %), the acquisition rate of new words was the fastest during the last six-month follow-up period (Study I). There were six children, however, whose growth rates slowed down during this latter period when compared to the period from 1;3 to 1;6. None of the children acquired 60 words or more during the first two follow-up periods. The acquisition rate of the expressive lexicon changed for most children (32 children, 91 %). During the period from 1;3 to 1;6, 14 children acquired 60 words or more, and from these, 13 children acquired at least 120 new words during the last six-month period. In addition, 18 children acquired at least 120 new words for the first time during the last follow-up period. The mean value of the expressive lexicon size at the age point before the strong growth occurred for the first time was 31 words (SD 26, median 27, min. 3., max. 96) at 1;3, and 35 words (SD 21, median 33, min. 5, max. 74) at 1;6. Table 6 presents the expressive lexicon sizes at each age-point that the data was collected.

The mean value of the lexicon size for the cross-sectional sample (N = 146) at 2;0 was slightly lower than the one detected in the longitudinal sample (Table 6). A parallel, high variation in the vocabulary size between individual children was found in the cross-sectional sample as detected in the longitudinal sample. From the total sample of 146 children, 86 % had acquired a lexicon larger than 50 words. Ten percent of the children had lexicons smaller than 40 words at 2;0.

*Expressive lexicon (spontaneous speech data).* At 1;6, most of the 35 children in the longitudinal sample used only some word types in their spontaneous speech during the 10 minute videotaped interaction (Table 7). The mean value of the different word types used in the spontaneous speech grew considerably during the six-month follow-up period. There was a high variation in the number of word types used by individual children at both age points.

Table 7. The number of all the word types and the number of the words in the different semantic lexical categories used in spontaneous speech in the videotaped interactions by 35 full-term Finnish children at 1;6 and at 2:0. The mean values, standard deviations and minimum - maximum values are presented.

| Measures | At 1;6 Mean (SD) | Min. - Max. | At 2;0 Mean (SD) | Min. - Max. |
|---|---|---|---|---|
| All words types | 11 (9) | 0 - 39 | 49 (17) | 9 - 74 |
| Social term -word types | 4 (2) | 0 - 10 | 8 (3) | 2 - 15 |
| Noun word types | 4 (4) | 0 - 13 | 15 (6) | 1 - 29 |
| Verb types | 1 (2) | 0 - 8 | 10 (6) | 1 - 22 |
| Closed-class word types | 2 (2) | 0 - 10 | 14 (8) | 1 - 31 |

5.1.2 Compositional development of the receptive and expressive lexicons

*Receptive lexicon.* At a group level, all semantic lexical categories (i.e. social terms, nouns, verbs, adjectives and function words) were already represented in the receptive lexicons at 0;9 (Table 8; Study I). The social terms and nouns were the largest groups at 0;9 and at 1;0. During the six-month follow-up period, the nouns were acquired the most rapidly, but the verbs were also acquired fast. The adjectives and grammatical function words were acquired at a slower rate than the social terms, nouns and verbs. At 1;3, the receptive lexicon of the group of 35 full-term children consisted of 51 % nouns, 17 % verbs, 17 % social terms, 6 % grammatical functions words and 5 % adjectives.

When the compositional development of the receptive lexicon was analysed in relation to the vocabulary size (Figure 1, Table 9), the percentage of the social terms calculated from the total number of words in the lexicon was high in the small vocabularies, but decreased rapidly as the child´s lexicon size grew. The growth trajectory of the nouns increased in the small lexicons, was very high when the lexicon size was between 100 and 200 words, and started to decrease slightly after that. The percentage of verbs increased from the small to large lexicons, as did the percentage of the adjectives. Adjectives were acquired slower than verbs. The proportion of the grammatical function words stayed nearly the same in all the lexicon sizes, but the variation between individual children in each lexicon size subgroup decreased as the lexicon size grew (see Table 9 for the standard deviations of the lexicon size subgroups). This stabilisation happened in the acquisition of all the semantic lexical categories.

Table 8. The composition of the receptive lexicon at 0;9, 1;0 and 1;3 in the longitudinal sample of 35 children. The mean values and standard deviations are presented. The presented values are combined values (the checklist and extra words values are combined).

|  | 0;9 | 1;0 | 1;3 |
|---|---|---|---|
| Social terms | 10 (7) | 20 (9) | 30 (9) |
| Onomatopoetic | 2 (2) | 6 (4) | 9 (4) |
| People | 4 (2) | 6 (3) | 9 (3) |
| Routines | 4 (4) | 8 (5) | 12 (4) |
| Common nouns | 14 (20) | 47 (37) | 98 (42) |
| Predicates | 7 (14) | 21 (19) | 43 (21) |
| Verbs | 5 (11) | 16 (14) | 32 (15) |
| Adjectives | 2 (4) | 5 (6) | 10 (6) |
| Function words | 2 (3) | 6 (6) | 12 (7) |
| Pronouns | 0 (0) | 1 (1) | 1 (2) |
| Prepositions | 1 (2) | 3 (3) | 6 (4) |
| Question words | 1 (1) | 2 (1) | 3 (2) |
| Quantifiers | 0 (0) | 1 (1) | 2 (2) |
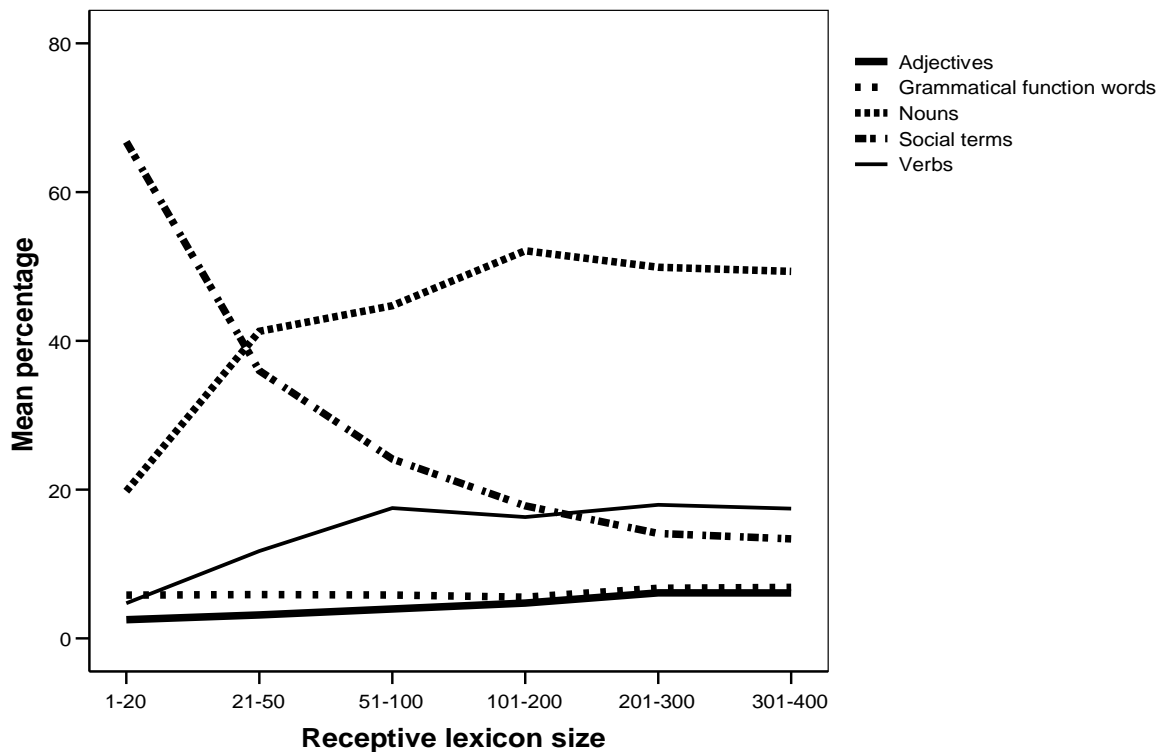


Figure 1. The composition of the receptive lexicon as a function of the vocabulary size in the longitudinal sample of 35 full-term children.

Table 9. The composition of the receptive and expressive lexicons as a function of the lexicon size in the longitudinal sample of 35 full-term children (Study I). The mean percentages, standard deviations and minimum – maximum percentages of each subgroup are presented.

| | Receptive lexicon | | Expressive lexicon | |
|---|---|---|---|---|
| | Mean (SD) | Min. – Max. | Mean (SD) | Min. – Max. |
| | *1 - 20 words, n =20* | | *1 - 20 words, n = 71* | |
| Social terms | 67 (26) | 0 - 100 | 74 (24) | 0 - 100 |
| Common nouns | 20 (18) | 0 - 53 | 20 (23) | 0 - 100 |
| Verbs | 5 (9) | 0 - 33 | 3 (5) | 0 – 20 |
| Adjectives | 3 (11) | 0 - 50 | 0 (1) | 0 – 8 |
| Function words | 5 (11) | 0 - 50 | 0 (2) | 0 – 10 |
| | *21 - 50 words, n =21* | | *21 - 50 words, n =14* | |
| Social terms | 36 (8) | 20 - 50 | 54 (18) | 25 - 93 |
| Common nouns | 41 (11) | 26 - 58 | 32 (16) | 0 - 57 |
| Verbs | 12 (9) | 0 - 30 | 7 (4) | 3 - 14 |
| Adjectives | 3 (3) | 0 - 9 | 1 (2) | 0 - 4 |
| Function words | 6 (4) | 0 - 16 | 2 (3) | 0 – 7 |
| | *51 - 100 words, n =18* | | *51 - 100 words, n = 15* | |
| Social terms | 24 (6) | 17 - 37 | 35 (7) | 24 - 47 |
| Common nouns | 45 (7) | 32 - 57 | 47 (10) | 33 - 64 |
| Verbs | 18 (4) | 11 - 26 | 4 (2) | 2 – 8 |
| Adjectives | 4 (2) | 0 - 9 | 3 (3) | 0 – 9 |
| Function words | 6 (3) | 0 - 11 | 4 (3) | 0 - 9 |
| | *101 - 200 words, n =27* | | *101 - 200 words, n = 8* | |
| Social terms | 18 (3) | 11 - 24 | 20 (5) | 11 - 26 |
| Common nouns | 52 (6) | 42 - 64 | 55 (8) | 42 - 64 |
| Verbs | 16 (4) | 9 - 25 | 10 (7) | 4 - 25 |
| Adjectives | 5 (3) | 1 - 13 | 4 (1) | 1 - 5 |
| Function words | 6 (2) | 3 - 11 | 5 (3) | 1 - 10 |
| | *201 - 300 words, n = 13* | | *201 - 300 words, n = 11* | |
| Social terms | 14 (2) | 11 - 19 | 16 (3) | 11 - 22 |
| Common nouns | 50 (5) | 40 - 57 | 57 (5) | 48 - 64 |
| Verbs | 18 (3) | 15 - 26 | 11 (4) | 4 - 18 |
| Adjectives | 6 (2) | 4 - 9 | 5 (2) | 2 - 7 |
| Function words | 7 (2) | 3 - 10 | 6 (2) | 3 - 9 |
| | *301 - 400, n = 6* | | *301 - 400, n =10* | |
| Social terms | 13 (1) | 12 - 16 | 13 (2) | 11 - 17 |
| Common nouns | 49 (5) | 43 - 57 | 49 (2) | 45 - 53 |
| Verbs | 18 (2) | 14 - 19 | 18 (2) | 15 - 19 |
| Adjectives | 6 (1) | 5 - 7 | 6 (1) | 4 - 8 |
| Function words | 7 (2) | 4 – 10 | 8 (2) | 6 - 10 |
| | | | *> 400, n = 13* | |
| Social terms | | | 11 (2) | 9 - 14 |
| Common nouns | | | 47 (2) | 45 - 51 |
| Verbs | | | 19 (2) | 15 - 22 |
| Adjectives | | | 7 (1) | 6 - 9 |
| Function words | | | 8 (2) | 6 - 10 |

*Expressive lexicon (FinCDI data).* At 0;9 and at 1;0, the children had only a few words in their expressive vocabularies (Table 10, Study I). These words belonged most often to the category of social terms. At 1;3 the expressive lexicons consisted mainly of social terms and common nouns. In addition, some children (N = 17, 49 %) had verbs in their expressive lexicons at that age, but the numbers of verb types was small (min. 1, max. 3). The children started to acquire verbs, adjectives and grammatical function words more actively only during the second half of the second year. At 2;0, the expressive lexicon of the group of 35 full-term children consisted of 50 % common nouns, 16 % verbs, 15 % social terms, 7 % grammatical function words and 6 % adjectives.

Table 10. The composition of the expressive lexicon at 0;9, 1;0, 1;3, 1;6 and 2;0 in the longitudinal sample of 35 children. The mean values and standard deviations are presented. The values presented are combined values (the checklist and extra words are combined).

|  | 0;9 | 1;0 | 1;3 | 1;6 | 2;0 |
|---|---|---|---|---|---|
| Social terms | 1 (2) | 3 (4) | 9 (7) | 21 (10) | 44 (9) |
| Onomatopoetic | 0 (1) | 2 (2) | 4 (4) | 8 (4) | 13 (2) |
| People | 0 (1) | 1 (2) | 3 (2) | 8 (4) | 16 (5) |
| Routines | 0 (1) | 0 (1) | 2 (2) | 5 (4) | 16 (5) |
| Common nouns | 0 (0) | 1 (3) | 7 (10) | 39 (44) | 169 (54) |
| Predicates | 0 (0) | 0 (0) | 1 (2) | 9 (11) | 80 (40) |
| Verbs | 0 (0) | 0 (0) | 1 (1) | 6 (8) | 58 (29) |
| Adjectives | 0 (0) | 0 (0) | 0 (1) | 3 (4) | 22 (12) |
| Function words | 0 (0) | 0 (0) | 0 (1) | 3 (4) | 26 (12) |
| Pronouns | 0 (0) | 0 (0) | 0 (0) | 1 (1) | 4 (3) |
| Prepositions | 0 (0) | 0 (0) | 0 (0) | 2 (2) | 11 (5) |
| Question words | 0 (0) | 0 (0) | 0 (0) | 0 (1) | 4 (2) |
| Quantifiers | 0 (0) | 0 (0) | 0 (0) | 1 (1) | 5 (3) |
| Connectives | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 2 (2) |

When the compositional development of the expressive lexicons of the 35 full-term children was analysed in relation to the lexicon size (Table 9, Figure 2), the percentage of social terms was high in the small lexicons, but decreased as the children acquired more words. The growth trajectory of the common nouns increased in the vocabularies between 1 – 200 words, was very high when the lexicon sizes were between 100 - 300 words and started to decrease thereafter. In contrast, the percentage of verbs increased slowly. The adjectives were acquired slower than the verbs. The growth trajectory of the grammatical function words was nearly comparable to that of the adjectives. The lexical composition stabilised as the vocabulary size grew (the standard deviations for are presented in Table 9).
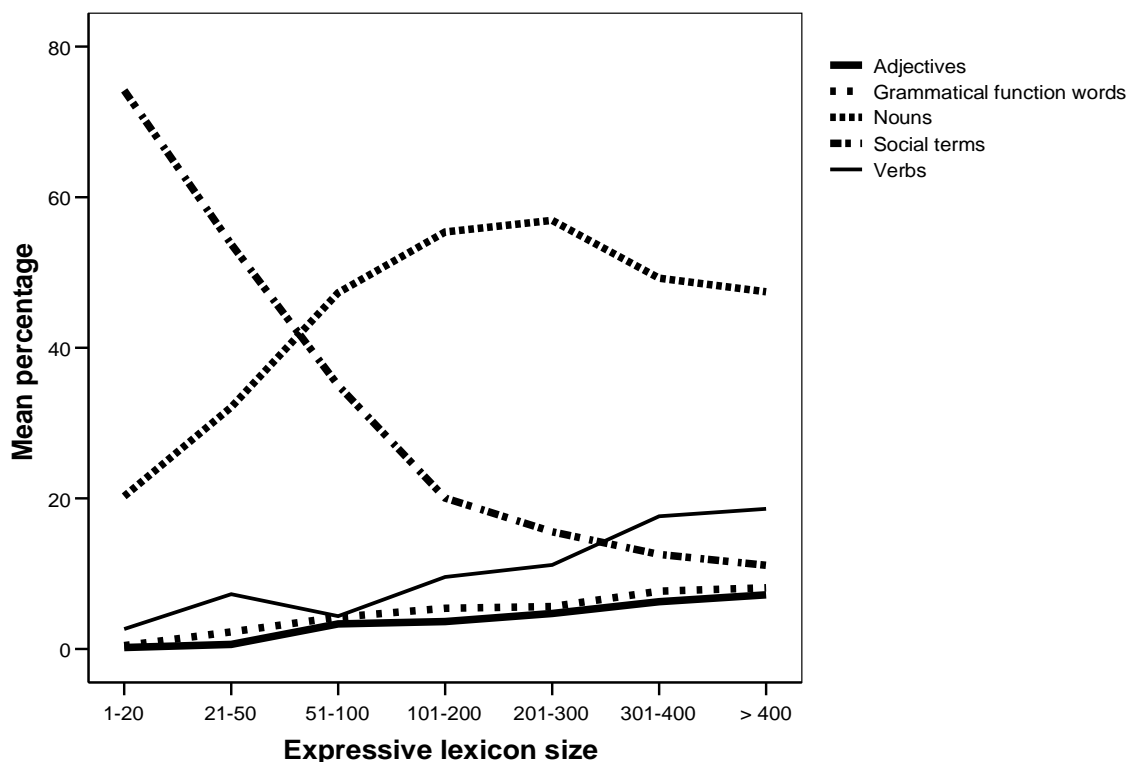
Figure 2. The composition of the expressive lexicon as a function of the vocabulary size in the longitudinal sample of the 35 full-term children.

At 2;0, the expressive lexicon of the cross-sectional sample of the full-term children (N = 146) consisted of 48 % the nouns, 15 % of the verbs, 19 % of the social terms, 7 % of the grammatical function words and 5 % of the adjectives.

Highly parallel growth trajectories for semantic lexical categories were found in the expressive lexicons of the full-term children in the cross-sectional sample at 2;0 when analysed in relation to the expressive lexicon size, as detected in the longitudinal sample (Table 11, Figure 3; Study IV).

*Expressive lexicon (spontaneous speech data).* At 1;6, the children used mostly social terms and nouns in their spontaneous speech during the ten-minute sample of mother-child interactions (Table 7, page 51). Only a few children used verbs and grammatical function words. At 2;0, the number of verbs and grammatical function words that the children used in spontaneous speech was considerable higher than six months earlier. At both age points, there was a high variation in the number of different word types used by individual children.

Table 11. The composition of the expressive lexicon as a function of lexicon size in the cross-sectional samples of full-term (FT) and very-low-birth-weight (VLBW) children at 2;0 (Study IV). The mean percentages, standard deviations and the minimum – maximum percentages of each subgroup and the group comparisons are presented.

| | FT | | VLBW | | Group comparison |
|---|---|---|---|---|---|
| | Mean (SD) | Min.-Max. | Mean (SD) | Min.-Max. | *p*-value |
| *< 50 words* | | | *< 50 words* | | |
| *n =11* | | | *n = 6* | | |
| Social terms | 53 (19) | 37 - 100 | 61 (17) | 50 - 94 | 0.216 |
| Nouns | 32 (14) | 0 - 49 | 25 (15) | 0 - 39 | 0.387 |
| Predicates | 7 (6) | 0 - 20 | 9 (4) | 5 - 14 | 0.450 |
| Function words | 5 (7) | 0 - 22 | 0 (0) | 0 - 0 | 0.149 |
| *51- 174 words* | | | *51 - 174 words* | | |
| *n =16* | | | *n =14* | | |
| Social terms | 21 (4) | 15 - 28 | 23 (9) | 14 - 45 | 0.822 |
| Nouns | 56 (6) | 47 - 70 | 56 (11) | 33 - 67 | 0.914 |
| Predicates | 12 (4) | 5 - 20 | 12 (7) | 0 - 25 | 0.833 |
| Function words | 5 (2) | 1 -9 | 5 (2) | 2 - 9 | 0.703 |
| *175 - 300 words* | | | *175 - 300 words* | | |
| *n = 16* | | | *n =17* | | |
| Social terms | 13 (2) | 10 - 18 | 13 (1) | 10 -15 | 0.983 |
| Nouns | 52 (5) | 45 - 62 | 55 (5) | 45 - 64 | 0.129 |
| Predicates | 22 (3) | 15 - 26 | 20 (4) | 14 - 28 | 0.109 |
| Function words | 6 (2) | 4 - 10 | 6 (2) | 3 -11 | 0.363 |
| *310 - 424 words* | | | *310 - 424 words* | | |
| *n =25* | | | *n = 8* | | |
| Social terms | 11 (1) | 9 - 13 | 11 (2) | 9 - 14 | 0.634 |
| Nouns | 50 (4) | 42 - 58 | 50 (4) | 46 - 59 | 0.553 |
| Predicates | 25 (4) | 19 - 32 | 23 (4) | 16 - 28 | 0.223 |
| Function words | 7 (2) | 4 - 11 | 8 (2) | 4 - 10 | 0.468 |
| *>425 words* | | | *>425 words* | | |
| *n =16* | | | *n =16* | | |
| Social terms | 10 (1) | 9 - 13 | 10 (0) | 10 - 11 | 0.956 |
| Nouns | 45 (2) | 41 - 48 | 47 (2) | 44 - 50 | 0.001 |
| Predicates | 28 (2) | 25 - 32 | 27 (2) | 24 - 30 | 0.100 |
| Function words | 10 (1) | 8 - 12 | 8 (1) | 5 - 11 | 0.004 |
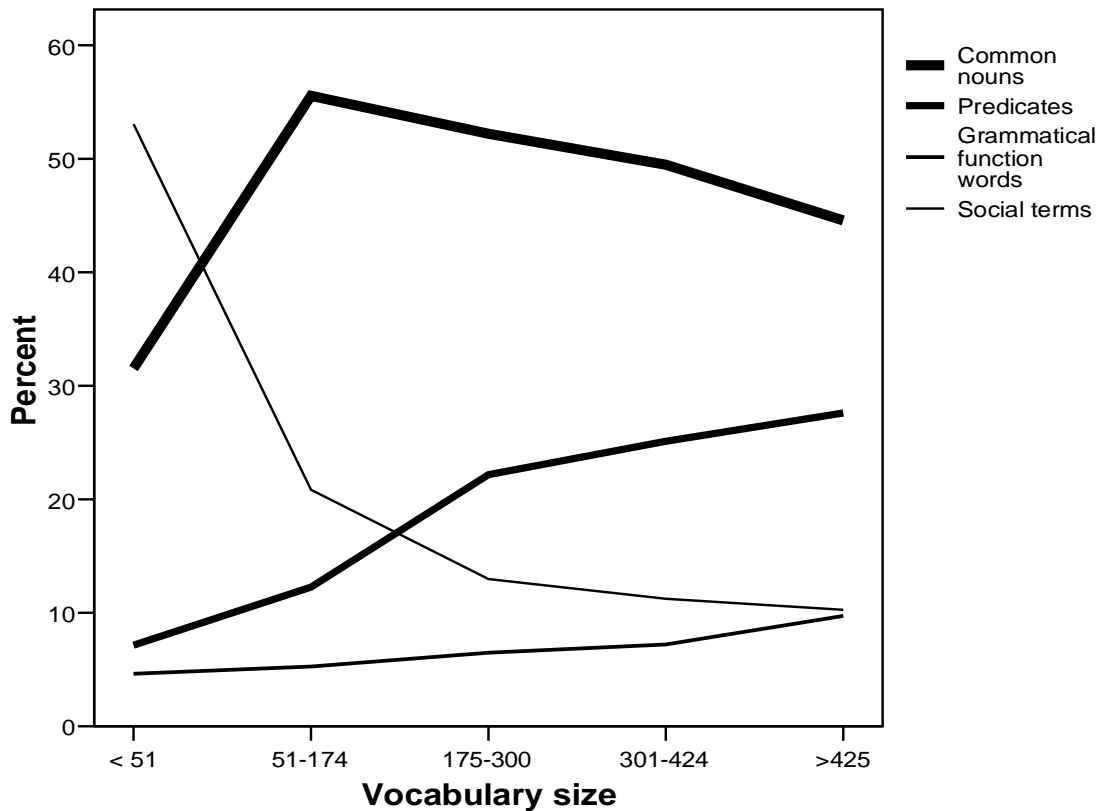
Figure 3. The composition of the expressive lexicon as a function of the vocabulary size in the cross-sectional sample of full-term children at 2;0.

*Lexical data gathered using the FinCDI vs. analysed from spontaneous speech.* Nearly all simultaneous associations were significant between the number of the different word types analysed from the spontaneous speech and those measured using the FinCDI (Table 12), proposing that if a child had lexical knowledge he / she used it in spontaneous speech.

Table 12. Spearman's correlation co-efficient values between the lexical and grammatical data gathered using FinCDI and analysed from spontaneous speech at 1;6 and 2;0 (N = 35; full-term children).

| | *Speech 1;6* Word types | Noun types | Verb types | Closed-class word types |
|---|---|---|---|---|
| *FinCDI 1;6* | | | | |
| Lexicon size | 0.80 $p < 0.0001$ | | | |
| Nouns | | 0.74 $p < 0.0001$ | | |
| Verbs | | | 0.55 $p = 0.0006$ | |
| Closed-class words | | | | 0.66 $p < 0.0001$ |
| | *Speech 2;0* Word types | Noun types | Verb types | Closed class word types |
| *FinCDI 2;0* | | | | |
| Lexicon size | 0.52 $p < 0.0015$ | | | |
| Nouns | | 0.16 *n.s.* | | |
| Verbs | | | 0.64 $p < 0.0001$ | |
| Closed-class words | | | | 0.68 $p < 0.0001$ |

| | *Speech 1;6* Case form types | Verb infl. types | *Speech 2;0* Case form types | Verb infl. types |
|---|---|---|---|---|
| *FinCDI 1;6* | | | | |
| Case form types | 0.54 $p = 0.0009$ | | | |
| Verb infl. types | | 0.51 $p = 0.0017$ | | |
| *FinCDI 2;0* | | | | |
| Case form types | | | 0.64 $p < 0.0001$ | |
| Verb infl. types | | | | 0.55 $p < 0.0006$ |

5.2 Emergence of grammar and its associations to lexicon growth in the full-term children

5.2.1 Emergence of grammar

*The FinCDI grammatical data.* At 1;6, the 35 full-term children were reported to have only a few inflectional types (Table 13). The most often reported case form type was the partitive (*vettä,* water; Table 14). The use of illative (*kotiin,* home), genitive (*äitin,* mother's, *pappan,* grandpa's) and the plural forms *(talot,* houses*, kukkii,* flowers) were also reported. Of the verbal inflectional types, the use of the 2S imperative (*anna,* give), the 3S indicative (*lukee,* reads), the negative construction (*ei saa,* is not allowed to) and the passive (*mennään,* go) were reported. The mean value of the M3L was short. Half of the children combined words.

At 2;0, the mean number of the reported inflectional types had grown considerably (Table 13). The most often reported case form types in both samples (N = 35, N = 146; Table 14) were the partitive (e.g. *maitoa,* milk), the illative (e.g. *kauppaan,* to a shop), and the genitive (e.g. *isin,* daddy's). The use of the plural form (e.g. *pojat,* boys) was also reported often. Moreover, the order of appearance of the local cases was parallel in both samples and can be outlined broadly as follows: the use of the illative was reported the most often, and the use of the elative and the ablative was the least in both samples. The order varied for the adessive, inessive and allative. Of the verbal inflectional types, the mothers of both samples reported that the most often used inflectional types were the 2S imperative (*anna,* give), the 3S indicative (*istuu,* sits), the negative construction (*ei saa,* is not allowed to), the 3S indicative preterite (*meni* went) and the passive (*tehdään,* do). The M3L value had grown considerably during the latter part of the second year. All children in the longitudinal sample, and the majority of the children (87 %) in the cross-sectional sample, combined words at 2;0.

*Spontaneous speech grammatical data.* At 1;6, 66 % of the children (n = 23) only used the unmarked nominative in their spontaneous speech. If other cases were used, they were usually the partitive and illative (Tables 13 and 14). The illative was used in a noun (e.g. *sänkyyn,* to bed) at this age by only one child. All other illative forms were used in pro-words (e.g. *tohon,* there). Very rarely did children use local cases other than the illative at 1;6. If other local cases were used, they were used in the pro-words (e.g. *tossa,* in there), not in the nouns. Four children (11 %) expressed locality by using what is called the *–nne* forms (e.g. *tonne,* there). Moreover, two children (6 %) used the nominative-accusative in their speech (e.g. *anna auto,* give a car). The genitive-accusative was not used in the videotaped interactions at 1;6. Nearly half of the 35 children (n = 16, 46 %) used neither verbs nor verbal inflections in their

spontaneous speech at 1;6. Those using verb inflections used mainly the 3S indicative present and the 2S imperative forms.

Table 13. The emergence of grammar in the longitudinal (LT) sample of the 35 full-term children at 1;6 and 2;0, and in the cross-sectional (CS) sample of the 146 full-term children at 2;0. The mean values, standard deviations (SD) and minimum – maximum values (Min. – Max.) are presented.

| | LT at 1;6 | | LT at 2;0 | | CS at 2;0 | |
|---|---|---|---|---|---|---|
| Measures | Mean (SD) | Min.-Max. | Mean (SD) | Min.-Max. | Mean (SD) | Min.- Max. |
| *Morphology / FinCDI* | | | | | | |
| Inflectional types/ total | 3 (2) | 0 - 8 | 12 (4) | 3 – 16 | 9 (5) | 0 – 16 |
| Case form types | 1 (1) | 0 - 5 | 7 (3) | 1 – 9 | 5 (3) | 0 - 9 |
| Verb inflectional types | 2 (1) | 0 - 5 | 5 (1) | 2 - 7 | 4 (2) | 0 - 7 |
| *Morphology / Speech* | | | | | | |
| Inflectional types/ total | 2 (2) | 0 - 7 | 11 (4) | 2 - 19 | | |
| Case form types | 2 (2) | 0 - 5 | 7 (3) | 1 - 11 | | |
| Verb inflectional types | 1 (1) | 0 - 3 | 5 (2) | 1 - 10 | | |
| *M3L* | 2.2 (0.9) | 1.0 - 5.0 | 6.7 (2.3) | 2.3 -10.3 | 6.0 (3.4) | |
| *Combines words / % of the children* | 18 (51 %) | | 35 (100 %) | | 127 (87 %) | |

FinCDI = the Finnish version of the Communicative Development Inventory, M3L = mean value of the three longest utterances counted in morphemes.

At 2;0, the most used case form types, in addition to those already used at 1;6, were the inessive, adessive, accusative and allative (Tables 13 and 14). The elative and ablative were used the least. The order of the local cases in the pro-words was: the inessive (n = 23, 66 %, e.g. *tossa,* there), the adessive (n = 21, 60 %, e.g*., täällä,* in here), the illative (n = 18, 51 %, e.g. *tähän,* here), the elative (n = 10, 29 %, e.g. *tosta,* from there), the ablative (n = 10, 29 %, e.g. *tuolta,* from there), and the allative (n = 6, 17 %, e.g. *tolle,* to that). The –*nne* forms were also used often (n = 23, 66 %, e.g. *tonne* there). In the nominal words, the order of appearance

Table 14. The order of appearance of the morphological inflectional types in the longitudinal sample of 35 children at 1;6 and at 2;0, and in the cross-sectional sample of 146 children at 2;0.

| Case form types / speech | 1;6 N = 35 % | 2;0 N = 35 % | Case form types / FinCDI | 1;6 N = 35 % | 2;0 N = 35 % | 2;0 N = 146 % |
|---|---|---|---|---|---|---|
| Nominative | 85.7 | 100 | Partitive | 57.1 | 97.1 | 82.9 |
| Partitive | 28.6 | 88.6 | Illative | 20.0 | 88.6 | 76.7 |
| Illative | 11.4 | 74.3 | Genitive | 17.1 | 97.1 | 74.0 |
| Adessive | 5.7 | 65.7 | Plural form | 17.1 | 85.7 | 61.0 |
| Accusative | 5.7 | 57.1 | Adessive | 8.6 | 77.1 | 50.0 |
| Allative | 5.7 | 48.6 | Inessive | 2.9 | 65.7 | 52.1 |
| Inessive | 2.9 | 71.4 | Allative | - | 62.9 | 50.7 |
| Genitive | 2.9 | 45.7 | Elative | 2.9 | 57.1 | 40.4 |
| Ablative | 2.9 | 28.6 | Ablative | 2.9 | 42.9 | 32.2 |
| Elative | - | 34.3 | | | | |
| Plural form | - | 45.7 | | | | |

| Verb inflectional types / speech | 1;6 | 2;0 | Verb inflectional types / FinCDI | 1;6 | 2;0 | 2;0 |
|---|---|---|---|---|---|---|
| 3S ind. | 42.9 | 94.3 | 2S imp. | 88.6 | 97.1 | 93.2 |
| 2S imp. | 20.0 | 74.3 | 3S ind. | 37.1 | 97.1 | 84.3 |
| 3S ind. pret. | 5.7 | 68.6 | Negative construction | 22.9 | 94.3 | 73.6 |
| 3S ind. neg. | 5.7 | 65.7 | Passive | 20.0 | 77.1 | 56.2 |
| Passive | 2.9 | 45.7 | 3S ind. pret. | 5.7 | 80.0 | 62.3 |
| 1S ind. | - | 34.3 | 1S ind. | 2.9 | 31.4 | 34.9 |
| 1S ind. neg. | - | 28.6 | 3S perfect | - | 40.0 | 26.0 |
| 3$^{rd}$ inf. illative | - | 17.1 | | | | |
| 1$^{st}$ infinitive | - | 14.3 | | | | |
| Passive pret. | - | 5.7 | | | | |
| 3S perfect neg. | | 5.7 | | | | |
| 3S conditional | - | 5.7 | | | | |
| Passive perfect | - | 2.9 | | | | |
| Passive neg. | - | 2.9 | | | | |
| 3S perfect | - | 2.9 | | | | |
| 3S pret. neg. | - | 2.9 | | | | |
| 1S conditional | - | 2.9 | | | | |
| 2S imp. neg. | - | 2.9 | | | | |
| 2P imp. | - | 2.9 | | | | |
| Passive 2$^{nd}$ participle | - | 2.9 | | | | |
| Passive 1$^{st}$ participle | - | 2.9 | | | | |

FinCDI = The Finnish version of the MacArthur Communicative Development Inventory, 1 SG = first person singular (likewise 2$^{nd}$ and 3$^{rd}$), 1 PL = first person plural (likewise 2$^{nd}$ and 3$^{rd}$), neg. = negation, pret. = preterite, imp. = imperative, ind. = indicative.

of the local cases was: the illative (n = 21, 60 %; e.g. *piiloon,* into a hiding place), the allative (n = 17, 49 %; *vauvalle,* to baby), the adessive (n = 11, 31 %; e.g*., pyörällä,* on a bike), the inessive (n = 9, 26 %; *nenässä,* in a nose), the elative (n = 5, 14 %; e.g. *kaupasta,* from a shop), and the ablative (n = 2, 6 %; e.g. *tädiltä,* from aunt). The genitive was used in spontaneous speech by 16 children (46 %) at 2;0. Further, both of the accusative forms were in use at 2;0 (the nominative-accusative, n = 15, 43 %, e.g. *anna muki,* give a mug; the genitive- accusative, n = 9, 26 %: e.g. *äiti ottaa pois tämän,* mother takes this away). The plural forms were used by 16 children (46 %) at 2;0. Most often the plural form appeared in the partitive at 2;0 (n = 12, 34 %, e.g. *tommosia,* those kinds of), and in the nominative (n = 10, 29 %, e.g. *muumimammat,* Moomin mummies). One child used the plural form in the inessive (e.g. *hevosissa,* in the horses), and one in adessive (*e.g. näillä,* they). No child used marginal cases in their spontaneous speech at either of the age points.

Of the verb inflectional types, the 1S indicative (n = 12, 34 %, e.g. *laitan,* I put) and the 1S indicative negative forms (n = 10, 29 %, e.g. *en anna,* I don't give) were in use, in addition to those forms used already at 1;6. The passive was used by 16 children (46 %) at 2;0, and most of the uses involved the 1st person plural form (e.g. *mennään,* let's go). However, there were also forms indicating the passiveness more in its true sense (e.g. *mul on pöytäliina laitettu,* the table cloth has been laid). Furthermore, the 3rd infinitive illative (n = 6, 17 %, e.g. *nukkumaan,* to sleep) and 1st infinitive (n = 5, 14 %, e.g. *ei saa kaataa,* is not allowed to pour) were also used by some at 2;0.

*A comparison of the number of the case form and verb inflectional types.* The children used significantly more nominal than verb inflectional types in their spontaneous speech at 1;6, t(34) = 4.78, $p < .0001$, and at 2;0, t(34) = 4.55, $p < .0001$.

*Grammatical data gathered using the FinCDI versus the data analysed from spontaneous speech.* At both age points, there was a high variation between individual children in their grammatical development (Table 13). All the simultaneous associations were significant between the number of the inflectional types reported in the FinCDI and those analysed from the children´s spontaneous speech (Table 12).

5.2.2 Associations between the expressive lexicon and the grammar

*The overall association between the lexicon and the grammar.* The correlation coefficient values between the lexical and grammatical measures were strong for both groups of the full-term children (Table 15). The emergence of the word combinations was associated with the lexicon size. For the longitudinal sample at 1;6, the mean value of the lexicon size was 100 (SD 63, min. 28, max. 261) for children combining words, and 35 (SD 45, min. 4, max. 185) for those who did not, W = 194, *p* = .001. At 2;0, all the 35 children combined words. For the cross-sectional sample, the mean value of the lexicon size for those children combining words (n = 127; 87 %) was 311 (SD 147, min. 33, max. 581), and for those who did not (n = 19; 13 %) 46 words (SD 34, min. 5, max. 116), W = 294, *p* < .001. A clear, regular growth of grammar in relation to the vocabulary growth was detected in both samples when described in relation to the lexicon size in detail (Tables 16, 17 and 18).

Table 15. The correlation co-efficient values between the lexical and grammatical measures in the longitudinal sample (N = 35, Spearman's correlation co-efficient values) at 1;6 and at 2;0, and in the cross-sectional sample (N = 146, Pearson's correlation co-efficient values) at 2;0.

*Longitudinal sample at 1;6:*

|  | Inflectional types / FinCDI | M3L / FinCDI | Inflectional types / speech |
|---|---|---|---|
| Lexicon size / FinCDI | 0.83 *** | 0.72 *** | 0.74 *** |
| Word types in speech | 0.66 *** | 0.62*** | 0.86 *** |

*Longitudinal sample at 2;0:*

|  | Inflectional types / FinCDI | M3L / FinCDI | Inflectional types / speech |
|---|---|---|---|
| Lexicon size / FinCDI | 0.73 *** | 0.59 *** | 0.64 *** |
| Word types in speech | 0.41* | 0.71*** | 0.79 *** |

*Cross-sectional sample at 2:0*

|  | Inflectional types / FinCDI | M3L / FinCDI |
|---|---|---|
| Lexicon size / FinCDI | 0.89 *** | 0.80 *** |

*p* < .05, **p* < .001, ***p< .0001. FinCDI = the Finnish version of the Communicative Development Inventory, M3L - the mean length of the three longest utterances counted in morphemes.

Table 16. The composition of expressive lexicon, the number of the words in the different semantic lexical categories used in spontaneous speech, and the emergence of grammar as a function of the lexicon size in the sample of 35 full-term children at 1;6. The mean values and standard deviations (SD) are presented.

| Measures | Lexicon size subgroups | | | |
|---|---|---|---|---|
| | 1-50<br>n = 17 | 51-100<br>n = 10 | 101-200<br>n = 6 | 201-300<br>n = 2 |
| *Lexicon /*<br>*FinCDI* | Mean (SD) | Mean (SD) | Mean (SD) | Mean (SD) |
| Lexicon size | 21 (12) | 72 (17) | 143 (25) | 234 (39) |
| Nouns | 6 (6) | 40 (15) | 81 (20) | 150 (20) |
| Verbs | 2 (1) | 4 (2) | 16 (12) | 15 (7) |
| Closed class words | 1 (1) | 3 (3) | 7 (3) | 11 (4) |
| Nominals | 7 (7) | 42 (14) | 87 (21) | 164 (25) |
| *Lexicon /*<br>*Speech* | | | | |
| All word types | 5 (4) | 13 (5) | 24 (12) | 14 (4) |
| Noun types | 1 (2) | 5 (3) | 9 (4) | 7 (1) |
| Verb types | 0 (1) | 1 (1) | 3 (3) | 2 (1) |
| Closed class word types | 1 (1) | 2 (3) | 5 (4) | 2 (3) |
| Nominal types | 1 (2) | 6 (3) | 10 (5) | 7 (1) |
| *Morphology /*<br>*FinCDI* | | | | |
| Inflectional types / total | 2 (2) | 3 (1) | 5 (2) | 8 (1) |
| Case form types | 1 (1) | 1 (1) | 2 (1) | 5 (0) |
| Verb inflectional types | 1 (1) | 2 (1) | 3 (1) | 3 (1) |
| *Morphology /*<br>*Speech* | | | | |
| Inflectional types / total | 1 (1) | 3 (1) | 5 (2) | 4 (3) |
| Case form types | 1 (1) | 2 (1) | 3 (2) | 3 (2) |
| Verb inflectional types | 0 (0) | 1 (1) | 2 (1) | 2 (1) |
| *M3L* | 1.7(0.7) | 2.4 (0.6) | 3.2 (1.1) | 2.7 (0) |
| *Combines words /*<br>*% of the children* | 4<br>(24 %) | 7<br>(70 %) | 5<br>(83 %) | 2<br>(100 %) |

FinCDI = the Finnish version of the MacArthur Communicative Development Inventory, M3L = mean length of the three longest utterances counted in morphemes, n = number of the children.

Table 17. The composition of the expressive lexicon, the number of the words in the different semantic lexical categories used in spontaneous speech, and the emergence of grammar as a function of the lexicon size in the sample of 35 full-term children at 2;0. The mean values and standard deviations (SD) are presented.

| Measures | Lexicon size subgroups | | | | |
|---|---|---|---|---|---|
| | 51-100<br>n = 2 | 101-200<br>n = 4 | 201-300<br>n = 7 | 301-400<br>n = 12 | > 400<br>n = 10 |
| *Lexicon /*<br>*FinCDI* | Mean (SD) | Mean (SD) | Mean (SD) | Mean (SD) | Mean (SD) |
| Lexicon size | 68 (11) | 174 (47) | 240 (23) | 364 (22) | 447 (39) |
| Nouns | 29 (4) | 101 (29) | 132 (11) | 182 (17) | 210 (17) |
| Verbs | 4 (3) | 18 (10) | 34 (13) | 66 (8) | 87 (10) |
| Closed class word types | 4 (3) | 9 (3) | 16 (5) | 27 (7) | 36 (7) |
| Nominals | 32 (3) | 109 (30) | 147 (13) | 210 (16) | 250 (23) |
| *Lexicon /*<br>*Speech* | | | | | |
| All word types | 17 (11) | 31 (14) | 43 (11) | 59 (9) | 56 (16) |
| Noun types | 4 (4) | 15 (9) | 15 (2) | 17 (5) | 15 (5) |
| Verb types | 1 (0) | 3 (2) | 7 (3) | 13 (3) | 14 (5) |
| Closed class word types | 2 (0) | 6 (2) | 11 (6) | 19 (6) | 18 (7) |
| Nominal types | 5 (4) | 18 (10) | 20 (4) | 25 (4) | 23 (8) |
| *Morphology /*<br>*FinCDI* | | | | | |
| Inflectional types / total | 5 (2) | 9 (1) | 10 (5) | 13 (2) | 15 (2) |
| Case form types | 2 (1) | 5 (2) | 5 (3) | 8 (1) | 8 (2) |
| Verb inflectional types | 3 (1) | 4 (1) | 5 (2) | 5 (1) | 6 (1) |
| *Morphology /*<br>*Speech* | | | | | |
| Inflectional types / total | 2 (0) | 6 (3) | 10 (3) | 13 (3) | 14 (3) |
| Case form types | 1 (0) | 4 (2) | 6 (2) | 7 (2) | 8 (2) |
| Verb infl. types | 1 (0) | 2 (2) | 4 (2) | 6 (2) | 6 (2) |
| *M3L* | 2.5 (0.2) | 4.5 (0.7) | 5.7 (2.6) | 7.7 (1.5) | 8.1 (1.4) |
| *Combines words /* | 2 | 4 | 7 | 12 | 10 |
| *% of the children* | (100 %) | (100 %) | (100 %) | (100 %) | (100 %) |

FinCDI = the Finnish version of the MacArthur Communicative Development Inventory, M3L = mean length of the three longest utterances counted in morphemes, n = number.

Table 18. The composition of the expressive lexicon and the emergence of grammar as a function of the lexicon size in the sample of 146 full-term children at 2;0. The mean values and standard deviations (SD) are presented.

| Measures | Lexicon size subgroups | | | | | |
|---|---|---|---|---|---|---|
| | < 51<br>n = 21 | 51-100<br>n = 11 | 101-200<br>n = 18 | 201-300<br>n = 22 | 301-400<br>n = 33 | > 400<br>n = 41 |
| *Lexicon / FinCDI* | Mean<br>(SD) | Mean<br>(SD) | Mean<br>(SD) | Mean<br>(SD) | Mean<br>(SD) | Mean<br>(SD) |
| Lexicon size | 32 (13) | 76 (14) | 148 (30) | 242 (29) | 354 (34) | 467 (52) |
| Nouns | 12 (8) | 41 (10) | 79 (20) | 128 (18) | 179 (20) | 213 (21) |
| Verbs | 1 (1) | 5 (4) | 17 (10) | 38 (11) | 65 (11) | 91 (9) |
| Closed class words | 1 (2) | 5 (2) | 9 (5) | 15 (5) | 24 (7) | 43 (13) |
| Nominals | 13 (8) | 45 (11) | 87 (21) | 144 (19) | 204 (22) | 259 (31) |
| *Morphology / FinCDI* | | | | | | |
| Inflectional types / total | 2 (1) | 3 (1) | 7 (4) | 9 (3) | 12 (3) | 15 (2) |
| Case form types | 1 (1) | 2 (1) | 3 (2) | 5 (2) | 7 (2) | 8 (1) |
| Verb inflectional types | 1 (1) | 2 (1) | 4 (1) | 4 (1) | 5 (1) | 6 (1) |
| *M3L* | 2 (1) | 3 (1) | 4 (2) | 6 (2) | 7 (2) | 9 (3) |
| *Combines words /* | | | | | | |
| *% of the children* | 38 % | 64 % | 89 % | 100 % | 100 % | 100 %) |

FinCDI = the Finnish version of the MacArthur Communicative Development Inventory, M3L = mean length of the three longest utterances counted in morphemes, n = number.

*The emergence of the case form types in relation to the growth of the nominal lexicon.* The number of the case form types grew in relation to the growth of the nominal lexicon size (Figure 4). For the 35 full-term children in the longitudinal sample, the values (combined values) were at 1;6: 1-50 nominal words in the FinCDI, the mean value of the case form types of the lexicon-size subgroup was 1.1 (SD 0.8), 51-100 nominal words, mean 2.0 (SD 1.0), 101-200 nominal words, mean 3.0 (SD 1.5). At 2;0 the values were: 1-50 nominal words in the FinCDI, the mean value of case form types 1.5 (SD 0.7); 51-100 nominal words, mean 2.0 (SD 0); 101-200 nominal words, mean 6.0 (SD 2.0); 201-300 nominal words, mean 7.8 (SD1.3). Respectively, the values (based on the FinCDI data) for the cross-sectional data at 2;0 were: 1-50 nominal words in FinCDI, mean 1.0 (SD 1.1); 51-100 nominal words, mean 3.0 (SD 1.9); 101-200 nominal words, mean 5.1 (SD 2.0);and > 200 nominal words, mean 8.0 (SD 1.7).

Figure 4. The number of the case form types as a function of the nominal lexicon size in a longitudinal sample (LT, N = 35) at 1;6 and at 2;0, and in the cross-sectional sample (CS, N = 146) at 2;0. The values were gathered using the Finnish version of the Communicative Development Inventory (FinCDI) and were analysed from the spontaneous speech.

The percentage of the children having acquired only the basic case form types (the nominative and partitive, Laalo, 2002) was calculated for each nominal lexicon-size subgroup. The percentage decreased parallel with the growth of the nominal lexicon size. The percentages (analysed based on the information gathered using the FinCDI and analysed from spontaneous speech) were at 1;6: 1-50 nominal words in the FinCDI, 70 % of the children had and used only the basic forms; 51-100 nominal words, 33 %; 101-200 nominal words, 0 %; and at 2;0: 1-50 nominal words in FinCDI, 50 % of the children had and used only the basic forms; 51-100 nominal words, 0 %; 101-200 nominal words, 0 %; 200 nominal words, 0 %. A parallel phenomenon was detected in the cross-sectional sample. The percentage of the children reported to use the partitive only (the nominative form is not reported in the FinCDI) in the nominal lexicons of the different sizes were: 1-50 nominal words, 67 %; 51-100 nominal words, 0 %; 101-200 nominal words, 0 %; and > 200 nominal words, 0 % of the children.

In the longitudinal sample at 1;6, the nominal lexicon size in the FinCDI predicted the use of basic case forms only, with an odds ratio estimate of 0.96, $p = .005$ (95 %

confidence interval 0.93 - 0.99). Thus, when the number of the nominal words in the lexicon increased by one unit, the odds that a child would have and use the basic case forms only, decreased by a factor of 0.96. At 2;0, only one child had and used only the basic case form types in a longitudinal sample. A parallel phenomenon was detected in the cross-sectional sample at 2;0. The nominal lexicon size in the FinCDI predicted significantly the use of the basic case form types only, the odds ratio estimate 0.93, $p < .001$, (95 % confidence interval 0.89 – 0.97). When the number of nominal words in the lexicon increased by one unit, the odds that a child would have the basic case form only decreased by a factor of 0.93.

*The emergence of the verb inflectional types in relation to the growth of the verb lexicon.* The number of verb inflectional types grew in relation to the growth of the verb lexicon size (Figure 5). In the longitudinal sample, the mean value of the verb inflectional types (the combined value) in the verb lexicons of different sizes were at 1;6: 1-9 verbs in the lexicon in the FinCDI, the mean value of the verb inflectional types was 1.0 (SD 0.6), 10-25 verbs, mean 2.3 (SD 0.6), 26-50 verbs, mean 4.0 (SD 0). Respectively, at 2;0, the mean value of verb inflectional types were: 1-9 verbs in lexicon in FinCDI, the mean value of verb inflectional types was 2.0 (SD 0.5); 10-25 verbs, mean 3.5 (SD 1.7); 26-50 verbs, mean 4.6 (SD 1.5); 51-75 verbs, mean 5.7 (SD 1.1); >75 verbs, mean 5.9 (SD 1.2). For the cross-sectional sample, the values of the verb inflectional types in each verb lexicon size subgroup were: 1-9 verbs, mean 1.8 (SD 1.1); 10-25 verbs, mean 3.1 (SD 1.1); 26-50 verbs, mean 4.3 (SD 1.2); 51-75 verbs, mean 5.1 (SD 1.0); > 75 verbs, mean 6.3 (SD 0.8).

The transition from the use of only the basic verb inflectional types (2S imperative, 3S indicative; Laalo, 2003) to the use of the other verb inflectional types was analysed by counting the percentage of those children reported to have in the FinCDI and using only the basic verb inflectional types in their spontaneous speech, in each verb lexicon subgroup. The percentage of these children decreased parallel with the growth of the verb lexicon size. The values in the longitudinal sample at 1;6 were: 1-9 verbs in the lexicon 71 % of the children used only the basic forms; 10-25 verbs 20 % and 26-50 verbs 0 % used only the basic forms. At 2:0 the values were: 1-9 verbs in the lexicon, 0 % of the children used only basic forms; 10-25 verbs, 25 %; 26-50 verbs, 0 %; 51-75 verbs, 0 %; and >76 verbs, 0 %. For the cross-sectional sample at 2;0, the percentages were: 1-9 verbs, 58 % of the children used only basic verb inflections; 10-25 verbs, 33 %; 26-50 verbs, 4 %; 51-75 verbs, 0 %; and > 75 verbs, 0 %.
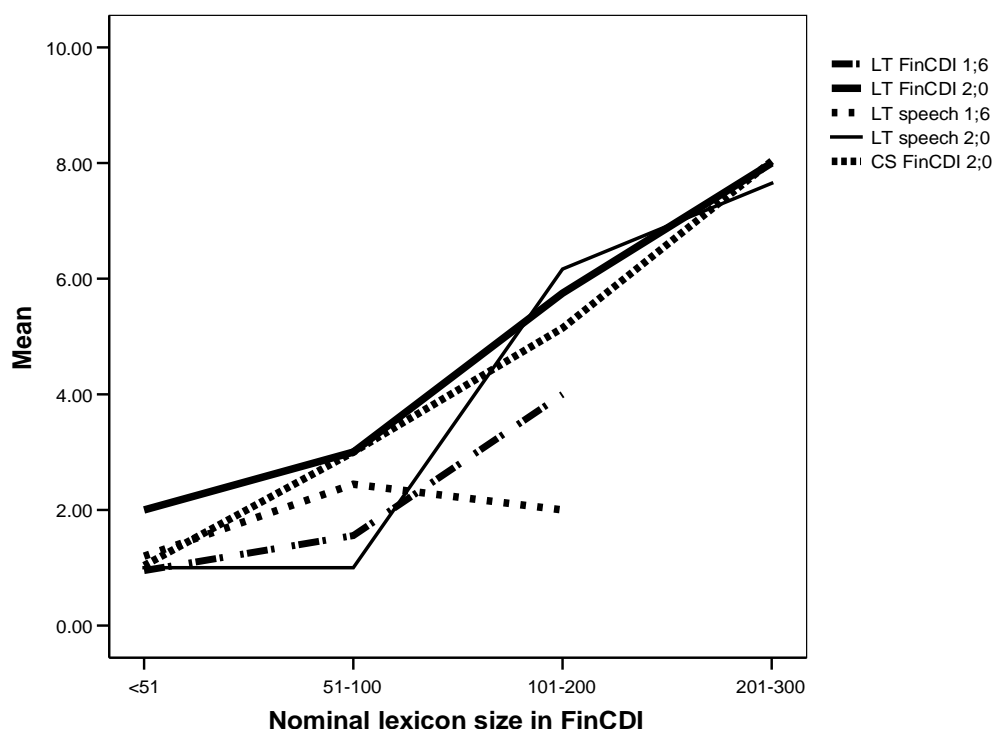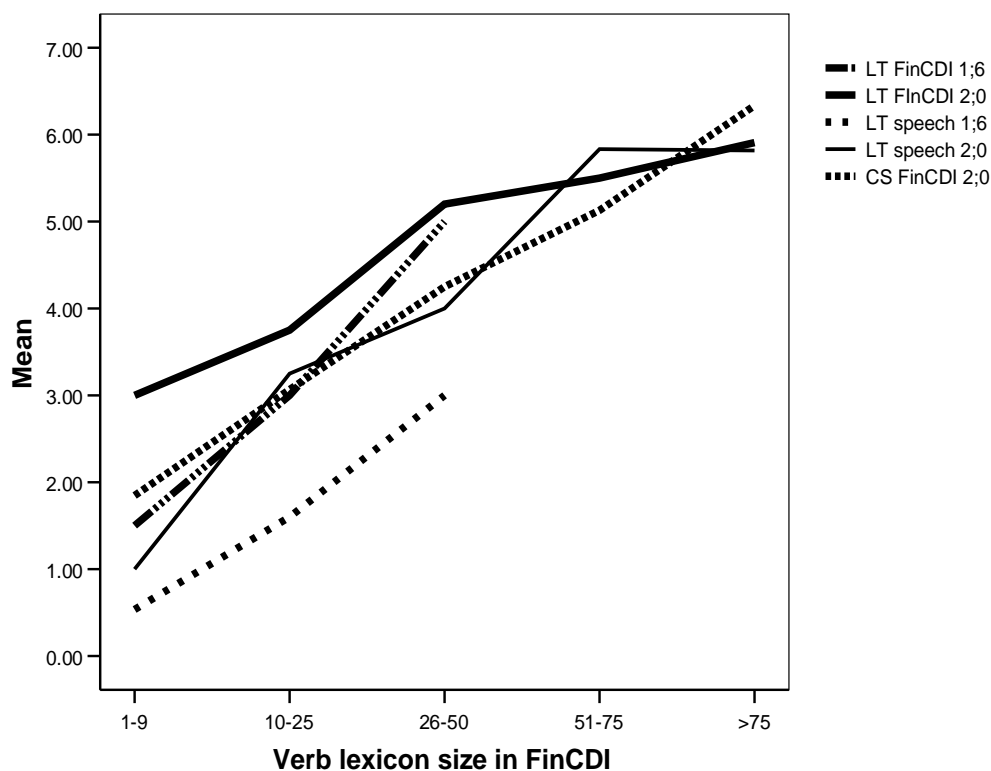
Figure 5. The number of the verb inflectional types as a function of the verb lexicon size in a longitudinal sample (LT, N = 35) at 1;6 and at 2;0, and in the cross-sectional sample (CS, N = 146) at 2;0. The values were gathered using the Finnish version of the Communicative Development Inventory (FinCDI) and were analysed from the spontaneous speech.

In the longitudinal sample at 1;6, the number of the verbs in the lexicon in the FinCDI predicted the use of only the basic verb inflections, with an odds ratio estimate of 0.77, $p = .03$ (95 % confidence interval 0.63-0.97). Thus, when the number of verbs in the lexicon increased by one unit, the odds that a child would have and use the basic verb inflections only, decreased by a factor of 0.77. At 2;0, only one child had and used the basic verb inflections only. The same phenomenon was found in a cross-sectional sample, the odds ratio estimate of 0.88, $p < 0.001$ (95 % confidence interval 0.82 – 0.94).When the number of verbs in the lexicon increased by one unit, the odds that a child would have been reported to have the basic verb types only decreased by a factor of 0.89.

5.3 Language development of the VLBW children

5.3.1 Quantitative growth of the receptive and expressive lexicons

*Receptive lexicon.* The receptive lexicon sizes of all the VLBW children (N = 32; Table 6; Study III) were significantly smaller than those of the full-term children (N = 35) at each measured age point ($\chi^2(1)$ = 7.91, *p* = 0.005). The receptive vocabularies of the full-term children were estimated to be 1.8 times larger than those of all the VLBW children (the confidence interval for the estimate was 1.3 - 2.6). The interaction between the groups and age on the vocabulary growth was not significant ($\chi^2(2)$ = 4.16, *p* = 0.13). The effect of time on the receptive lexicon growth in all VLBW children was significant ($\chi^2(2)$ = 45.91, *p* < 0.0001).

The receptive vocabularies of those VLBW children who had no major neurological disability (n = 27) were significantly smaller than those of the full-term children (N = 35) at each measured age point ($\chi^2(1)$ = 6.22, *p* = 0.01). The receptive lexicon sizes of the full-term children were estimated to be 1.7 times larger (the confidence interval for estimate 1.2–2.4). The interaction between the groups and time was not significant ($\chi^2(2)$ = 3.95, *p* = 0.14). The effect of time on the receptive lexicon growth in the NoDis VLBW children was significant ($\chi^2(2)$ = 39.92, *p* < 0.0001; Figure 6).

*Expressive lexicon.* When the expressive lexicon growth of all the VLBW children (N = 32; Table 6, Study III) was compared to that of the full-term children (N = 35), the interaction between the groups and time on the vocabulary growth was significant ($\chi^2(4)$ = 9.77, *p* = 0.045). Thus, the effect of the group differed at the different age points, and the values were analysed separately at each age point. The expressive lexicon size of the VLBW children was significantly smaller than that of the full-term children at 24 months ($\chi^2(1)$ = 9.74, *p* = 0.002). The expressive lexicon size of the full-term children was estimated to be 1.6 times larger than that of the VLBW children (a confidence interval for an estimate 1.2 – 2.2) at that age. A significant difference in the expressive lexicon size was detected at no other age point between the groups. The effect of time on expressive lexicon growth was significant ($\chi^2(4)$ = 32.87, *p* = < 0.0001) for the group of all VLBW children.

The expressive lexicon sizes of the NoDis VLBW children (n = 27; Figure 7) did not differ from those of the full-term children ($\chi(1)$ = 0.11, *p* = 0.74). The interaction between the group and time in the expressive lexicon growth was not statistically significant ($\chi^2(4)$ = 8.72, *p* = 0.07). The effect of time on the expressive growth was significant ($\chi^2(4)$ = 30.29, *p* < 0.0001) for NoDis VLBW children.
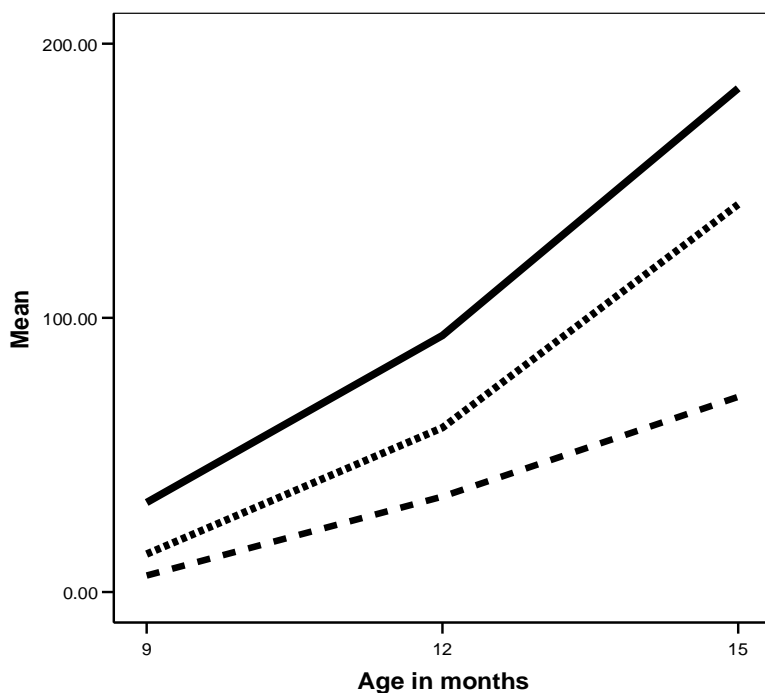
Figure 6. The growth of the receptive lexicon in very-low-birth-weight children with (n = 5, dash line) and without (n = 27, dotted line) a diagnosed neurological disability and in the full-term controls (N = 35, solid line) between the ages of 9 and 15 months.
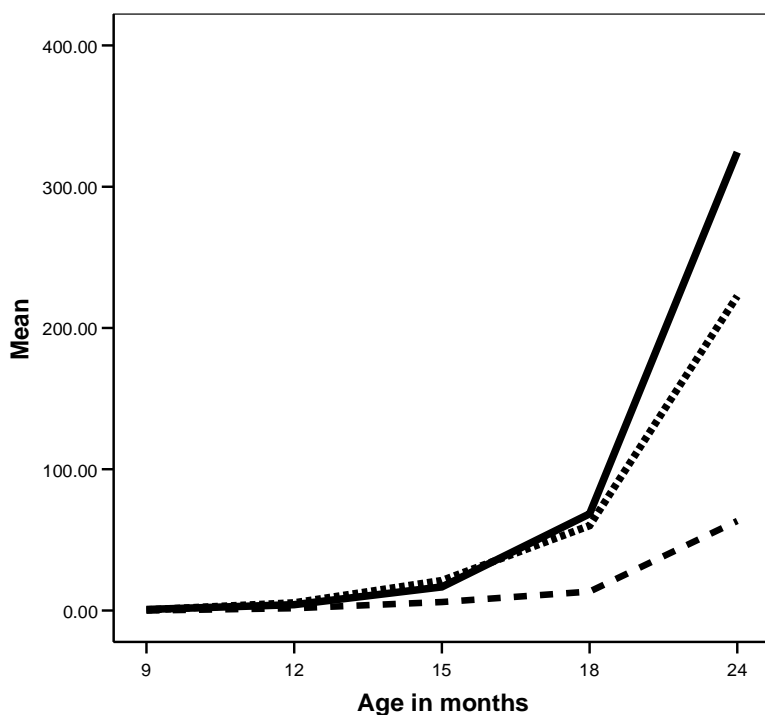


Figure 7. The growth of the expressive lexicon size in very-low-birth-weight children with (n = 5, dash line) and without (n = 27, dotted line) a diagnosed neurological disability and in the full-term controls (N = 35, solid line) between the ages of 9 and 24 months.

The difference in the expressive lexicon size between the cross-sectional samples of the 66 VLBW and the 87 full-term children (see the descriptive statistics in Table 6, page 49) at 2;0 was not significant ($Z = -0.68$, $p = .496$; Study IV). The percentage of the children with very small lexicons at 2;0 ($< 50$ words) did not differ in the group of the 66 VLBW children when compared to the group of the 87 full-term children (VLBW: n = 10, 15 %, full-term: n = 12, 14 %; $\chi^2 = 0.06$, df = 1, $p = 0.81$).

5.3.2 Compositional development of the receptive and expressive lexicons

*Receptive lexicon.* The acquisition order of the semantic lexical categories was generally the same for all the VLBW children (N = 32), for the NoDis VLBW children (n = 27) and for the full-term children (N = 35; Table 19; Study III). However, significant differences emerged in the number of words the VLBW children had acquired in each semantic lexical category in their vocabularies when compared to the lexicons of the full-term children. When the values of all the VLBW were considered, the prematurely born children had significantly less nearly all types of words in their lexicon at each three age points. Furthermore, the NoDis VLBW children had less grammatical function words in their lexicons at each measured age point when compared to full-term children, in addition to the smaller number of social terms at 0;9, verbs at 1;0 and adjectives at 1;3.

When the percentages of the words in the different semantic categories were compared between the VLBW and the full-term children with the receptive lexicons of similar sizes (the two longitudinal samples), most percentages were comparable (Table 20; Figure 8). However, the proportions of the grammatical function words were lower in the VLBW than in the full-term children in the two lexicon-size subgroups, and the difference in the percentage of the grammatical function between the groups nearly reached the statistical significance level in a third vocabulary-size subgroup.

Table 19. The composition of the receptive lexicon of all very-low-birth-weight (VLBW; N = 32), VLBW children with no major neurological disability (NoDis; N = 27) and full-term (FT) children at 0;9, 1;0 and 1;3. The mean values and standard deviations (SD) and the group comparisons are presented.

| | FT<br>M (SD) | All<br>VLBW<br>M (SD) | Group<br>comparison<br>$p$-value | NoDis<br>VLBW<br>M (SD) | Group<br>comparison<br>$p$-value |
|---|---|---|---|---|---|
| *At 0;9* | | | | | |
| Social terms | 10 (7) | 6 (5) | 0.01 | 6 (5) | 0.03 |
| Common nouns | 14 (19) | 5 (8) | 0.04 | 6 (8) | 0.09 |
| Verbs | 5 (10) | 1 (2) | 0.02 | 1 (3) | 0.06 |
| Adjectives | 2 (4) | 0 (1) | 0.11 | 1 (1) | 0.22 |
| Function words | 2 (3) | 0 (1) | 0.00 | 1 (1) | 0.01 |
| *At 1;0* | | | | | |
| Social terms | 19 (9) | 14 (7) | 0.02 | 15 (7) | 0.07 |
| Common nouns | 45 (35) | 29 (24) | 0.04 | 31 (25) | 0.11 |
| Verbs | 16 (13) | 7 (9) | 0.00 | 8 (9) | 0.01 |
| Adjectives | 5 (6) | 2 (2) | 0.02 | 2 (2) | 0.07 |
| Function words | 6 (5) | 2 (3) | 0.00 | 3 (4) | 0.00 |
| *At 1;3* | | | | | |
| Social terms | 28 (8) | 23 (9) | 0.03 | 24 (8) | 0.10 |
| Common nouns | 93 (39) | 69 (45) | 0.03 | 75 (44) | 0.11 |
| Verbs | 32 (15) | 22 (16) | 0.02 | 23 (16) | 0.06 |
| Adjectives | 10 (6) | 6 (5) | 0.00 | 6 (5) | 0.01 |
| Function words | 12 (7) | 7 (6) | 0.00 | 7 (6) | 0.01 |

Table 20. The composition of the receptive lexicon as a function of the lexicon size in the longitudinal samples of the full-term (FT) and very-low-birth-weight (VLBW) children (Study III). The mean percentages, standard deviations and minimum – maximum percentages of each subgroup and the group comparisons are presented.

| | FT | VLBW | Group comparison |
|---|---|---|---|
| | M (SD) | M (SD) | *p*-value |
| *1 - 9 words*, n = 12 | | *1 - 9 words*, n = 19 | |
| Social terms | 72 (31) | 63 (35) | 0.51 |
| Common nouns | 11 (16) | 29 (35) | 0.15 |
| Verbs | 5 (10) | 5 (9) | 0.98 |
| Adjectives | 0 | 1 (4) | 0.47 |
| Function words | 5 (5) | 0 | 0.01 |
| *10 - 49 words*, n = 24 | | *10 - 49 words*, n = 25 | |
| Social terms | 43 (14) | 49 (21) | 0.47 |
| Common nouns | 39 (13) | 39 (17) | 0.82 |
| Verbs | 9 (8) | 7 (8) | 0.60 |
| Adjectives | 2 (3) | 2 (4) | 0.58 |
| Function words | 5 (5) | 3 (3) | 0.03 |
| *50 - 99 words*, n = 17 | | *50 - 99 words*, n = 21 | |
| Social terms | 23 (6) | 25 (6) | 0.24 |
| Common nouns | 47 (8) | 51 (12) | 0.13 |
| Verbs | 16 (6) | 13 (7) | 0.07 |
| Adjectives | 4 (2) | 4 (3) | 0.46 |
| Function words | 6 (3) | 5 (4) | 0.11 |
| *100 - 249 words*, n = 29 | | *100 - 249 words*, n = 18 | |
| Social terms | 17 (3) | 17 (4) | 0.79 |
| Common nouns | 52 (6) | 55 (7) | 0.17 |
| Verbs | 17 (4) | 17 (4) | 0.84 |
| Adjectives | 5 (3) | 4 (2) | 0.12 |
| Function words | 6 (2) | 4 (2) | 0.05 |
| *> 250 words*, n = 8 | | *> 250 words*, n = 3 | |
| Social terms | 13 (1) | 14 (1) | 0.62 |
| Common nouns | 48 (4) | 52 (2) | 0.16 |
| Verbs | 18 (1) | 18 (1) | 0.69 |
| Adjectives | 7 (1) | 6 (0) | 0.16 |
| Function words | 7 (2) | 6 (1) | 0.49 |
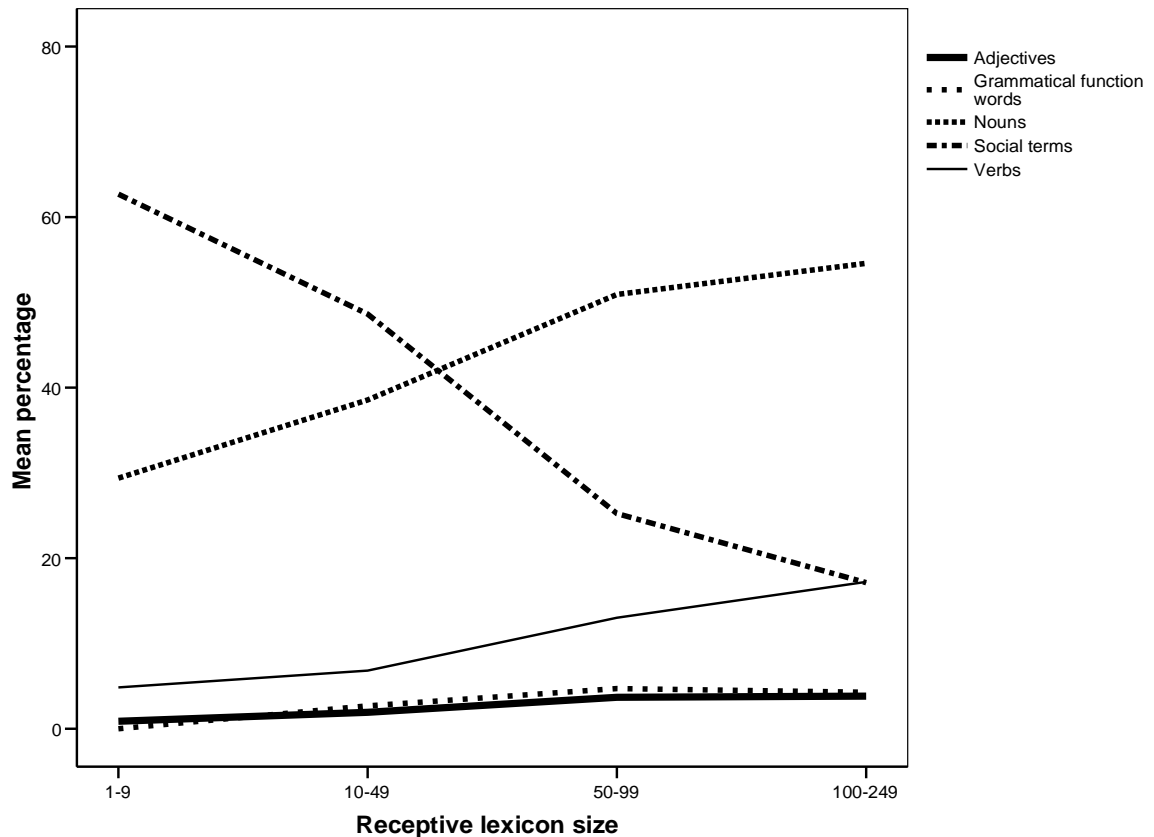
Figure 8. The composition of the receptive lexicon as a function of vocabulary size in the longitudinal sample of the 32 very-low-birth-weight children.

*Expressive lexicon.* The development of the semantic lexical categories generally occurred in a parallel manner in all the VLBW children (N = 32), and in the NoDis VLBW children (n = 27), as in the full-term children (N = 35; Table 21, Study III). However, at 2;0, there were significant differences in the numbers of the words in all lexical categories between the groups of all the VLBW and full-term children. The NoDis VLBW children had less social terms, nouns, verbs and adjectives in their lexicons than the full-term controls at that age.

The compositions of the children´s expressive lexicons of similar sizes in the VLBW and the full-term children in the two longitudinal samples (Table 22; Figure 9) displayed some differences: in small lexicon sizes (1-9 words in the lexicon), the VLBW children had a significantly higher percentage of nouns than the full-term children. No other significant differences were detected between the groups.

Table 21. The composition of the expressive lexicon of all the very-low-birth-weight (VLBW; N = 32), VLBW children with no major neurological disability (NoDis; N = 27) and the full-term (FT) children at 0;9, 1;0, 1;3, 1;6 and at 2;0. The mean values and standard deviations (SD) and the group comparisons are presented.

| | FT M (SD) | ALL VLBW M (SD) | Group comparison *p*-value | NoDis VLBW M (SD) | Group comparison *p*-value |
|---|---|---|---|---|---|
| *At 0;9* | | | | | |
| Social terms | 1 (2) | 0 (1) | 0.27 | 0 (1) | 0.40 |
| Common nouns | 0 (0) | 0 (0) | 0.74 | 0 (0) | 0.89 |
| Verbs | 0 (0) | - | 0.36 | - | 0.40 |
| Adjectives | - | - | | - | |
| Function words | - | - | | - | |
| *At 1;0* | | | | | |
| Social terms | 3 (3) | 3 (3) | 0.49 | 3 (3) | 0.79 |
| Common nouns | 1 (3) | 2 (4) | 0.21 | 2 (4) | 0.11 |
| Verbs | 0 (0) | 0 (0) | 0.89 | 0 (0) | 0.92 |
| Adjectives | - | - | | - | |
| Function words | 0 (0) | 0 (0) | 0.63 | 0 (0) | 0.73 |
| *At 1;3* | | | | | |
| Social terms | 8 (6) | 7 (7) | 0.11 | 7 (7) | 0.33 |
| Common nouns | 7 (10) | 9 (17) | 0.41 | 11 (18) | 0.68 |
| Verbs | 1 (1) | 1 (2) | 0.68 | 1 (2) | 0.73 |
| Adjectives | 0 (1) | 0 (1) | 0.78 | 0 (1) | 0.96 |
| Function words | 0 (1) | 1 (1) | 0.44 | 1 (1) | 0.40 |
| *At 1;6* | | | | | |
| Social terms | 17 (7) | 13 (11) | 0.04 | 14 (11) | 0.17 |
| Common nouns | 37 (41) | 28 (46) | 0.10 | 32 (49) | 0.26 |
| Verbs | 6 (8) | 5 (11) | 0.02 | 6 (11) | 0.08 |
| Adjectives | 2 (4) | 2 (3) | 0.21 | 2 (4) | 0.41 |
| Function words | 3 (4) | 3 (5) | 0.25 | 3 (5) | 0.49 |
| *At 2;0* | | | | | |
| Social terms | 38 (8) | 27 (14) | 0.00 | 29 (14) | 0.02 |
| Common nouns | 162 (53) | 97 (82) | 0.00 | 109 (83) | 0.02 |
| Verbs | 57 (29) | 33 (34) | 0.00 | 38 (34) | 0.02 |
| Adjectives | 21 (12) | 12 (12) | 0.00 | 14 (12) | 0.02 |
| Function words | 24 (12) | 15 (15) | 0.01 | 17 (15) | 0.06 |

Table 22. The composition of the expressive lexicon as a function of the lexicon size in the longitudinal samples of full-term and very-low-birth-weight children (Study III). The mean percentages, standard deviations and minimum – maximum percentages of each subgroup and the group comparisons are presented.

| | FT<br>M (SD) | VLBW<br>M (SD) | Group comparison<br>$p$-value |
|---|---|---|---|
| | *1 - 9 words*, n = 27 | *1 - 9 words*, n = 27 | |
| Social terms | 83 (29) | 66 (36) | 0.07 |
| Common nouns | 14 (28) | 31 (36) | 0.04 |
| Verbs | 1 (2) | 2 (10) | 1.00 |
| Adjectives | 0 | 0 | 1.00 |
| Function words | 0 | 0 | 1.00 |
| | *10 - 49 words*, n = 27 | *10 - 49 words*, n = 26 | |
| Social terms | 54 (16) | 50 (17) | 0.48 |
| Common nouns | 34 (15) | 38 (17) | 0.60 |
| Verbs | 6 (5) | 5 (4) | 0.36 |
| Adjectives | 1 (1) | 2 (3) | 0.16 |
| Function words | 1 (3) | 3 (4) | 0.15 |
| | *50 - 99 words*, n = 14 | *50 - 99 words*, n = 10 | |
| Social terms | 29 (6) | 28 (6) | 0.71 |
| Common nouns | 53 (10) | 56 (8) | 0.44 |
| Verbs | 5 (2) | 5 (3) | 0.71 |
| Adjectives | 3 (3) | 2 (2) | 0.36 |
| Function words | 4 (3) | 2 (3) | 0.27 |
| | *100 - 249 words*, n = 15 | *100 - 249 words*, n = 9 | |
| Social terms | 16 (4) | 18 (6) | 0.45 |
| Common nouns | 58 (5) | 56 (8) | 0.23 |
| Verbs | 10 (5) | 10 (4) | 0.84 |
| Adjectives | 4 (1) | 4 (2) | 0.72 |
| Function words | 5 (2) | 7 (3) | 0.58 |
| | *> 250 words*, n = 24 | *> 250 words,* n = 14 | |
| Social terms | 11 (1) | 12 (2) | 0.10 |
| Common nouns | 50 (4) | 50 (5) | 0.82 |
| Verbs | 18 (3) | 17 (3) | 0.28 |
| Adjectives | 7 (1) | 6 (2) | 0.13 |
| Function words | 8 (2) | 8 (2) | 0.95 |
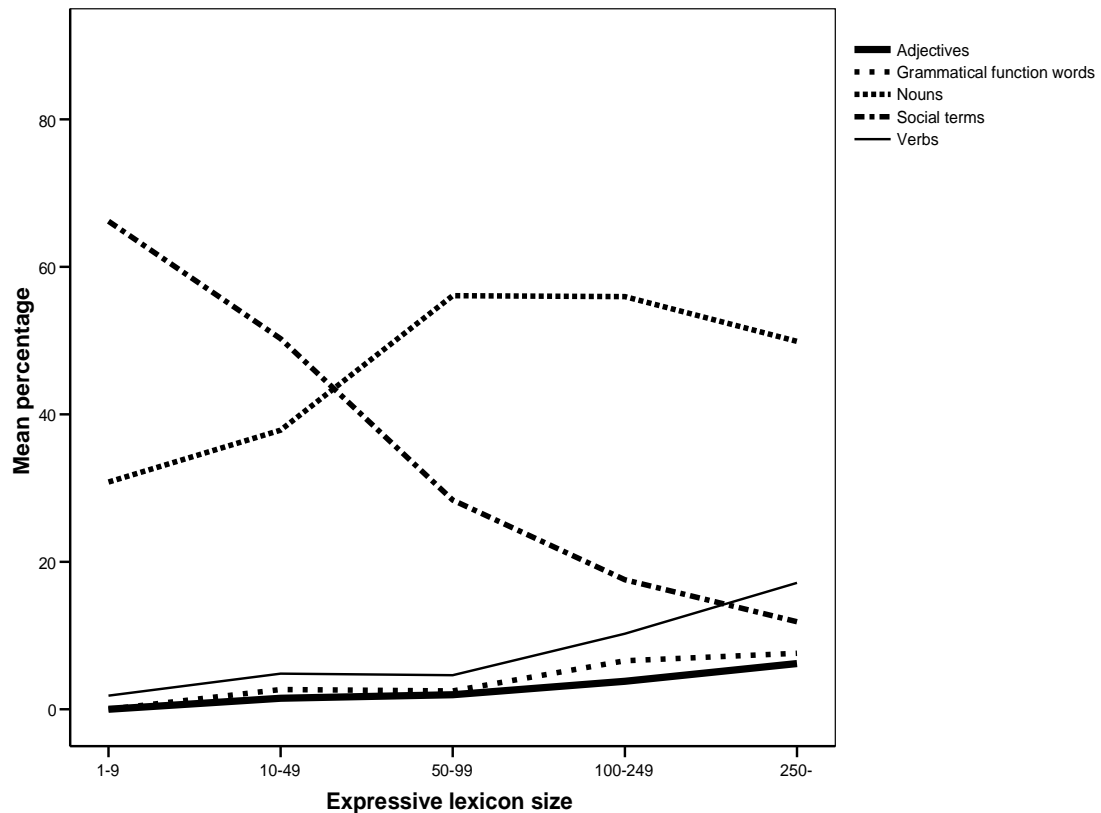
Figure 9. The composition of the expressive lexicon as a function of vocabulary size in the longitudinal sample of the 32 very-low-birth-weight children.

For the cross-sectional cohort of the cognitively normally developing (MDI > 85; n = 61) VLBW children (Study IV), comparable developmental trajectories for the semantic lexical categories were detected for the VLBW children as for the full-term children when analysed in relation to the children´s vocabulary size (Table 11 p. 56, Figure 10). However, when the percentages of the lexical semantic categories, calculated from the total number of the words in the lexicon, were compared between the VLBW and the full-term children with parallel lexicon sizes, the percentage of nouns was higher ($t(30) = 3.56$, $p = 0.001$) and the percentage of grammatical function words lower ($t(30) = -3.15$, $p = 0.004$) in the large lexicons ( > 425 words) of the VLBW children.
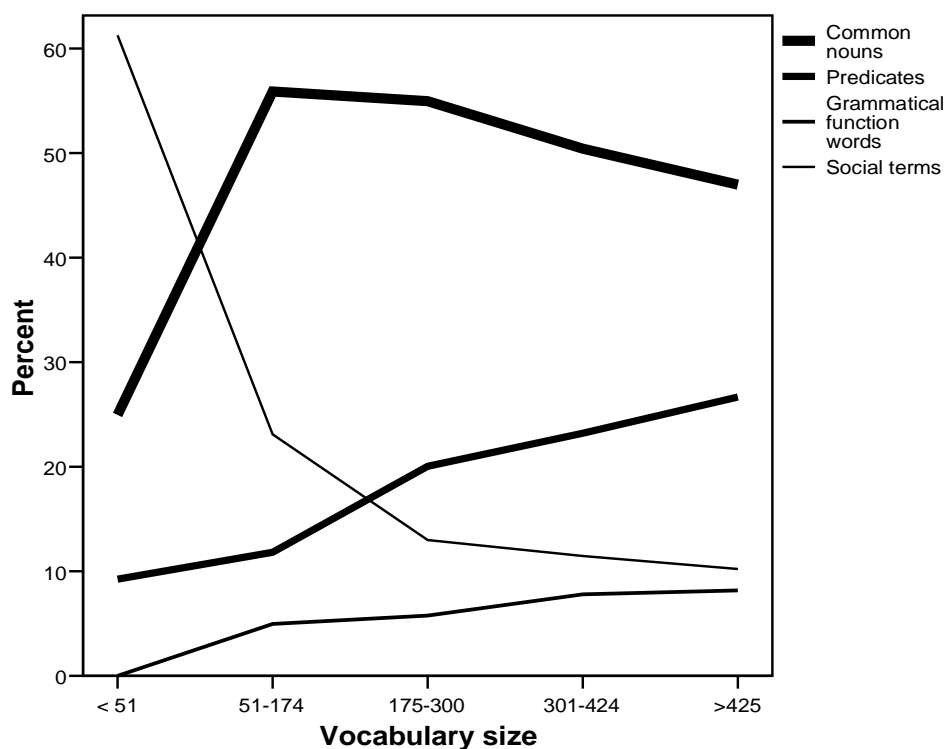
Figure 10. The composition of the expressive lexicon as a function of vocabulary size in the cross-sectional sample of the very-low-birth-weight children at 2;0.

5.3.3 Language skills at 2;0 and predictive value of the lexical growth

The 32 VLBW children performed significantly weaker than the 35 full-term controls in the RDLS III at 2;0 (full-term children: mean standard score of the group 109, SD 13; all VLBW children: mean 93, SD 18; NoDis VLBW children: mean 95, SD 18; a comparison to the full-term children: all the VLBW children $t(65) = -4.4$, $p <. 0.0001$, NoDis VLBW children $t(60) = -3.52$, $p = 0.0008$).

The receptive lexicon sizes of the VLBW children at 12 and 15 months of age were significantly associated with their performance in the RDLS III at 2;0 (Table 23). The expressive lexicon sizes already predicted the performance in the RDLS III at 1;0, but the correlations were stronger at 1;6. The findings were parallel for all the VLBW and for the NoDis VLBW children.

Table 23. The Spearman's correlation co-efficient values (r) between the receptive and expressive lexicon sizes and the language skills at 2;0 in all very-low-birth-weight (VLBW, N = 32 and in the VLBW children with no neurological disability (NoDis, n = 27).

|  | ALL VLBW<br>RDLS III<br>Total Score | NoDisVLBW<br>RDLS III<br>Total Score |
|---|---|---|
| Receptive lexicon |  |  |
| 0;9 | 0.30 | 0.24 |
| 1;0 | 0.67 *** | 0.68 *** |
| 1;3 | 0.73 *** | 0.71 *** |
| Expressive lexicon |  |  |
| 0;9 | 0.10 | 0.06 |
| 1;0 | 0.41 * | 0.45 * |
| 1;3 | 0.44 * | 0.49 ** |
| 1;6 | 0.64 *** | 0.63 *** |
| 2;0 | 0.81 *** | 0.78 *** |

$p < 0.05$ *, $p < 0.01$** , $p < 0.001$***, RDLS III = Reynell Developmental Language Scales III

## 5.4. Correlations between the information gathered using different methods

The simultaneous correlations between the results derived using different methods were clear and significant at 2;0 (Table 24).

Table 24. The correlation co-efficient values for the data gathered using different methods (N = 35 and N = 32 Spearman's correlation co-efficient values; N = 66 and N = 146, Pearson's correlation co-efficient values)

| FinCDI | FT, N = 35<br>RDLS III | FT, N = 146<br>MDI | VLBW, N = 32<br>RDLS III | VLBW, N = 66<br>MDI |
|---|---|---|---|---|
| Lexicon sixe | 0.78 ** | 0.73 *** | 0.81*** | 0.73** |
| Inflectional types | 0.54 *** | 0.78 ** |  |  |
| M3L | 0.65 *** | 0.79 *** |  |  |

FT = full-term children, VLBW = very-low-birth-weight children, N = the number of the children, FinCDI = the Finnish version of the Communicative Development Inventory, RDLS III = Reynell Developmental Language Scales, MDI = mental developmental index in Bayley II, M3L = the mean length of the three longest utterances counted in morphemes.

5.5 Influence of the background variables on the lexicon growth in the full-term and VLBW children

*Gender.* For the receptive lexicon of the longitudinal sample of the 35 full-term children (Study I), the effect of gender alone was not significant, although the girls´ values tended to be slightly higher, $\chi(1) = 1.7$, $p = 0.19$. The interaction between gender and age on the vocabulary growth was not significant, $\chi(2) = 0.7$, $p = 0.72$. The influence of age was significant, $\chi(2) = 29.8$, $p <.0001$ (95 % confidence intervals for the estimated mean values: at 0;9 for girls, 22.4 – 75.9 and for boys, 16.5 – 43.3; at 1;0 for girls, 80.7 – 156.2 and for boys, 60.2 – 118.5; at 1;3 for girls, 184.4 – 265.5 and for boys, 135.9 – 197.7).

For the expressive lexicon of the longitudinal sample of the 35 full-term children (Study I), the effect of the interaction between age and gender on the lexicon growth was significant, $\chi(4) = 10.8$, $p = 0.03$, indicating that the effect of gender was different at the different age points. Further analysis showed that the girls had significantly larger lexicon sizes than the boys at 1;3, $\chi(1) = 10.8$, $p = 0.001$, and at 1;6, $\chi(1) = 4.20$, $p = 0.04$. At other age points studied, the girls had larger expressive lexicon sizes, but the difference between the sexes was not significant (95 % confidence intervals for the estimated mean values: at 0;9 for girls, 0.4 – 4.7 and for boys, 0.1 – 0.8; at 1;0 for girls, 2.7 – 11.7 and for boys, 2.0 – 5.5; at 1;3 for girls, 17.7 – 40.7 and for boys, 7.4 – 15.3; at 1;6 for girls, 71.0 – 139.5 and for boys, 33.8 – 87.0; at 2;0 for girls, 323.6 – 418.0 and for boys, 264.2 – 383.8).

For the cross-sectional sample of the full-term children (N = 87, Study IV) at 2;0, the expressive lexicon sizes of the girls were significantly larger than those of the boys (girls: mean 324 words, SD 152, median 343; boys: mean 200 words, SD 150, median 160; $Z = -3.466$, $p = 0.001$). However, for the cross-sectional sample of the VLBW children, no significant gender difference in the lexicon size was detected (VLBW girls: 248 mean, SD 170, median 215; VLBW boys: mean 247, SD 180, median 243; $Z = -.203$, $p = 0.84$).

*The length of the mother's basic education.* The length of the basic education of the mother was not associated with the lexicon size in the cross-sectional sample of the 87 full-term children at 2;0 (Study IV; 9-12 years: mean lexicon size 258 words, SD 160, median 279; over 12 years: mean 261, SD 162, median 276; $Z = -0.04$, $p = 0.97$). However, in the group of 66 VLBW children, there was a significant association between the length of the mother's basic education and the children's lexicon size at 2;0 (Study IV). The vocabulary size of those VLBW children having a mother with between 9-12 years of basic education was significantly lower than in those having a mother with over 12 years of basic education (9-12 years: mean

165 words, SD 153, median 129, over 12 years: mean 292, SD 170, median 279; $Z = -2.97$, $p = 0.003$).

*Birth weight and SGA.* There was no significant association between the birth weight and lexicon size in a cross-sectional sample of the 87 full-term children at 2;0 ($r = -0.09$, $p = 0.39$). However, in the cohort of the 66 VLBW children, there was a significant, positive association between the birth weight and the lexicon size at 2;0 ($r = 0.25$, $p = 0.04$).

No significant association between the growth retardation (SGA) and lexicon size at 2;0 was detected in the group of the 66 VLBW children ($Z = -0.49$, $p = 0.62$). There were no SGA children in the group of the full-term children.

5.6 Summary of the results

The findings related to the lexical acquisition of the full-term Finnish children showed that the receptive lexicon was acquired earlier, at a faster rate and with higher individual variation than their expressive lexicon. The expressive lexicon was acquired slowly at first, but the growth rate accelerated. A clear change in the growth rate of the expressive lexical acquisition happened in the majority, but not all, of the full-term children followed longitudinally. The change in the growth rate was also detected in the receptive lexicon for many, although it was not as prominent as in the expressive lexicon. Moreover, the findings showed that the highly parallel developmental trajectories for the lexical semantic categories were detected in both lexicons when analysed in relation to the growth of the lexicon size. However, verbs were acquired more readily in the receptive than in the expressive lexicons. For the expressive lexicon, the developmental trajectories for the semantic lexical categories were comparable whether the data was gathered longitudinally between the ages of 0;9 and 2;0, or was derived from the cross-sectional sample at 2;0. The compositional development detected in the lexicons of the Finnish children was highly parallel to that reported for children acquiring other languages (e.g. Bates et al., 1994; Caselli, Casadio & Bates, 1999).

The detailed description of the emergence of grammar in relation to the expressive lexical growth in the two independent samples of the full-term children, suggested that these two language domains were acquired in close association with each other at the end of the second year. Furthermore, the detailed analysis of the two inflectional systems of Finnish (nominal / verbal inflections) in relation to the growth of the respective lexicon (nominal / verb lexicon growth), indicated a close association between the acquisition of the inflectional

system and the respective lexical growth. Qualitative differences were also detected in the developmental trajectories of the nominal and the verbal inflectional types when analysed in relation to the growth of the respective lexicon. The nominal inflectional types were used in spontaneous speech significantly more than the verbal inflectional types at both studied age points.

The VLBW children acquired their receptive lexicons at a significantly slower rate than the full-term children. No such clear difference between the groups of VLBW and full-term children was detected in the expressive lexical development. The VLBW children acquired the semantic lexical categories at a slower rate than the full-term children, but generally qualitatively the two groups performed in a parallel manner when the compositional development was analysed in relation to the lexicon size. The comparisons between the two groups with the lexicons of similar sizes showed, however, that the VLBW children had significantly less grammatical function words in their receptive and expressive lexicons. The VLBW children, irrespective of their neurological status, also had significantly weaker language skills at 2;0 than the full-term children. The early receptive lexical growth at the beginning of the second year strongly predicted the language performance at 2;0. The predictive value of the expressive lexicon grew stronger only in the second part of the second year.

The effect of background variables (gender, length of the mother's basic education, birth weight) on lexical growth differed in the VLBW and the full-term children. Gender had a clear effect on the lexicon size in the full-term children, but not in the VLBW children. Maternal education was not associated with the lexicon growth in the full-term children, whereas it was in the VLBW children. Further, birth weight had no effect on the lexicon growth in the full-term children, but in the group of the VLBW children, the association between birth weight and the expressive lexicon size at 2;0 was significant.

6.0 Discussion

6.1 Early lexical development of the full-term children

6.1.1 Quantitative growth and a change in the growth rate

The receptive lexicons were acquired earlier, faster and with higher individual variation than the expressive lexicons. These findings are parallel with earlier results (Caselli et al., 1995; Fenson et al., 1994; Lyytinen, 1999). The earlier growth of the receptive lexicon emphasises the fact that the linguistic development has already begun when the first words are produced (Ingram, 1999). This is an important matter to keep in mind in clinical work where the focus is often on the expressive lexical development when the skills of the very young children are evaluated. The relationship between the receptive and expressive lexicons is not, however, straightforward. Bates et al. (1995) reported that there was a wide variation in the expressive lexicon size among those with large receptive lexicons. Thus, a large comprehended vocabulary does not guarantee that a child proceeds in a comparable manner in his/her expressive vocabulary acquisition. One reason for this may be that comprehension and production skills map onto different aspects of non-linguistic development. For example, Lyytinen, Poikkeus and Laakso (1997) reported that the percentage of symbolic play at 1;6 was more strongly associated with language comprehension than with production (see also Bates et al., 1995). It is possible that language comprehension and production are mediated by different neural systems (Bates et al., 1995). There is a need for further studies in order to fully understand how the early receptive and expressive vocabularies interact with each other.

The sizes of the receptive and expressive lexicon of the full-term children were comparable to those detected earlier for Finnish children (Lyytinen, 1999; see also Kunnari, 2000; Jansson-Verkasalo, 2003; Paavola, 2006). These parallel results from independent studies verify the general developmental paths for the quantitative lexical growth during the second year of Finnish children. Furthermore, the expressive lexicon sizes of the 35 children in the longitudinal sample at 2;0 were slightly larger than those in the cross-sectional sample. This may be because all the children in the longitudinal sample were first-borns, contrary to the randomised cross-sectional sample. Fenson et al. (1994) reported that the birth order had a significant effect on the development of early receptive and expressive lexicons in a sample of children acquiring English. The children born later were at a slight disadvantage in this development than the first-borns. The other explanation for the slightly higher mean value of

the expressive lexicon size at 2;0 in the longitudinal sample when compared to the cross-sectional sample, might be that the language development of the children in the longitudinal sample was followed intensively during the first two years. This intensive data collection procedure might have worked as a minor intervention.

The present study provided a detailed analysis of the quantitative growth of the receptive and expressive lexicons in individual children during their second year. Few earlier studies have provided information on the change in the growth rate of Finnish children´s early vocabulary, and the sample sizes in these studies have been small (Kunnari, 2000; Nieminen, 1991). For a majority of the 35 children followed longitudinally, the growth rate of the expressive lexicon changed from slow to more rapid. Most children acquired new words so rapidly during the data collection period when the acquisition rate changed, that the definition used for a spurt in the earlier studies could be used with a widened time frame. For many, this strong growth continued for a longer period. This strong growth was also detected in the receptive lexicon, although this was not as clear as in the expressive lexicon. However, some of the children in the present study showed plateaus in their vocabulary acquisition, in both lexicons. This finding is also parallel with earlier findings. For example, Nieminen (1991) reported that both active and plateau periods were detected in the lexical growth of the 10 children followed in that study.

Those full-term children whose expressive vocabulary acquisition was slower than in the others (i.e. the definition of 60 words per three months, or 120 per six months could not be used) had smaller lexicon sizes at 2;0. Still, they also showed growth in their expressive lexicons. It is possible that they went through a short acceleration phase in the acquisition of the expressive vocabulary, were in the middle of the accelerating period at 2;0, or went through it later (Goldfield & Reznick, 1990, 1996; Mervis & Bertrand, 1995). The expressive lexicon size at the end of the second year has been shown to have predictive value for later language skills. Weismer (2001) reported that roughly half of those having small expressive lexicons at 2;0 or at the beginning of the third year, catch up their peers by 3 years, while others continue to have delays in different domains of language development. Rescorla (2005) examined the language and reading skills at 13 years of age for the 28 children who were identified at 24 to 31 months of age as late talkers, and reported that the vocabulary size at an early age measured by the structured parental rating method, the Language Development Survey, predicted significantly the vocabulary, grammar, verbal memory, and reading comprehension skills at 13 years of age. Thus, although it is not clear why the majority of the children demonstrate a change in their expressive lexical acquisition growth rate during their second year of life, and

what is an exact cause for this, it may be that this change in the growth rate, or the absence of it, may have more important long-term effects than perhaps previously thought.

6.1.2 Compositional development of the receptive and expressive lexicons

One of the novel findings of the present work was that the parallel developmental shift from reference to predication and grammar in relation to the growth of lexicon size was detected in the vocabularies of Finnish children as has been reported in children acquiring other languages, for example, in English (Bates et al., 1994), Italian (Caselli et al., 1995; Caselli, Casadio & Bates, 1999), Hebrew (Maital et al., 2000) and Spanish (Jackson-Maldonado et al., 1993; compare also Bornstein et al., 2004a). It is interesting that children acquiring different target languages have highly comparable growth trajectories for the lexical semantic categories. These findings suggest that the early acquisition of the semantic lexical categories is not so strongly tied to the structure of the target language, but there are other matters that influence this development. One explanation for these parallel results might be that words belonging to the different lexical semantic categories have different characters, but roughly similar in different languages. Nouns are the words having a naming function. The grammatical function words mark the meanings between the content words inside the linguistic structures, whereas the verbs and adjectives are used to indicate an action, state or relationships involving one or more arguments (Bates et al., 1994; Gentner & Boroditsky, 2001). To be able to use verbs and adjectives, a child must have some kind of argument structure in mind. Thus, the acquisition of the predication (i.e. verbs, adjectives) may not be possible before children have acquired a sufficient number of content words (Caselli et al., 1995). Bates et al. (1994; see also Caselli et al., 1995; Caselli, Casadio & Bates, 1999) suggest that this developmental shift in early lexical acquisition is based on cognitive development, for example, the development of perception and memory skills (Bates et al., 1994; Caselli et al., 1995). Support for this view comes form parallel findings of the studies on children acquiring different target languages.

Even though the Finnish children had highly parallel developmental trajectories for social terms, nouns, verbs and grammatical function words, as reported in the literature, minor differences also emerged. The growth trajectory of the grammatical function words in the expressive lexicons gradually increased in Finnish children. In contrast, for children acquiring English, the growth trajectory of the grammatical function words in the expressive lexicons has been found to begin to increase only after the vocabulary size has exceeded approximately 400 words (Caselli,Casadio & Bates, 1999). This difference in the findings is interesting since

Finnish uses morphological endings to convey many meanings, whereas English uses grammatical function words for this purpose. There are also more items for grammatical function in the English version of the CDI (102 items, 15 % of the checklist words; Caselli et al., 1999) than in the FinCDI. One might think that those who hear more grammatical function words around them would also begin to use those words ´earlier` (i.e. when the lexicon sizes are smaller). However, according to these two findings, this seems not to be the case. Further, it has been also shown that Italian children acquire grammatical function words slowly, parallel to the growth of the lexicon size (Caselli, Casadio & Bates, 1999). Caselli et al. (1999) interpreted this difference between the English and Italian children to reflect structural differences (i.e. an increased morphological load in Italian when compared to English) between the target languages. If the gradually increasing growth trajectory of the grammatical function words detected in the expressive lexicons of the Finnish children is interpreted in the context of the findings of Caselli et al. (1999), then the rich morphology of Finnish may have affected the acquisition of the closed-class words in the expressive lexicons of these two samples of Finnish children. It may be that because of the intensive morphology of Finnish, children begin to pay attention to the small grammatical words inside the language structures earlier (i.e. already in small lexicon sizes) when compared to those acquiring a language with less intensive morphology.

The same kind of developmental shift from reference to predication to grammar was detected in the vocabularies of the independent samples: in the longitudinal sample followed from 0;9 to 2;0, and in the cross-sectional sample gathered at 2;0. This result suggests that the compositional development of the lexicon is more related to the vocabulary size than to the child´s age. Fenson et al. (1994) found that age is a poor predictor of the lexical and grammatical growth between the ages 16 and 30 months (see also Bates & Goodman, 1997). Thordardottir et al. (2002) also reported a high variation in the lexical and grammatical development between individual children in the samples of the children acquiring Icelandic and English at 2;0. That age is a poor predictor of lexical development at the end of the second year, and at the beginning of the third year, should be carefully take into consideration when the language skills of the young children are analysed for scientific purposes. This can be achieved by collecting sufficiently large sample sizes to catch the variation. The use of a definition criteria, the use of a formal language test with appropriate normative data, for example, has also been suggested (Thordardottir et al., 2002).

A parallel developmental shift in the vocabulary composition was found in the receptive and expressive lexicons, a finding compatible with earlier results. Caselli et al. (1995)

found parallel growth trajectories for the semantic lexical categories (nouns, verbs, adjectives, grammatical function words) in the receptive and expressive lexicons of the English and Italian children. Benedict (1979) reported that the growth order of the lexical categories was comparable in the early receptive and expressive vocabularies (i.e. the first 50 words in both lexicons) in those children acquiring English. This overall symmetry is interesting especially if taking into consideration that the two lexicons are acquired at different times and rates. However, both Caselli et al. (1995) and Benedict (1979) reported that the verbs were acquired more actively in the receptive than in the expressive lexicons, a finding that was also detected in the present work. Goldfield (2000) hypothesised that one explanation for the faster acquisition of verbs in the receptive than in the expressive lexicons may be found in pragmatics. In the early interactions analysed by Goldfield (2000), mothers more often prompted children to produce an action than produce a verb. Mothers also elicited their children's noun production, but only rarely asked them to produce verbs. Thus, verb comprehension may be favoured over production in the early mother-child –interactions.

6.2 Emergence of grammar and its associations to lexicon growth in full-term children

6.2.1 Emergence of grammar

The current results showed that the active grammatical growth in the expressive language in the majority of the children occurred only during the second part of the second year. At 1;6, only a few children had acquired grammatical function words, only half of the children combined words, the M3L values were short, and the number of the morphological inflectional types were small. A considerable number of the children used only basic inflectional types at that age. On the other hand, at 2;0, the number of grammatical function words in the children's vocabularies was clearly higher. All the children in the longitudinal sample combined words. The mean M3L value was clearly higher than six months earlier, as was the mean number of all morphological inflectional types, both reported and those analysed from spontaneous speech. A few children used only basic inflectional types at 2;0. Descriptions of the different aspects of the grammatical development of Finnish children at an early age have also been given in earlier studies (e.g. Laalo, 2002 and 2003; Lyytinen, 1999; Nieminen, 1991; Toivainen, 1980 and 1997). However, the present study provides a detail description of

this phenomenon in relation to the expressive lexicon growth in a large sample of Finnish children, which has not been addressed in earlier studies.

The order of appearance of the nominal inflectional types in the spontaneous speech of the 35 full-term Finnish children was roughly comparable to that reported by Toivainen (1980) and Laalo (2002). The first case form types that were used were the unmarked nominative and partitive forms. The most often used local cases at 2;0 were the illative in nominals, the inessive and the adessive in adverbs, and the *-nne* forms. The last cases to appear were the elative and the ablative in nominal words. All other local cases except the illative were used in adverbs first and in the nominal words only later. All these findings are parallel with those reported by Toivainen (1980) and Laalo (2002). However, some differences did emerge between the earlier findings and the present ones. For example, the order of appearance of the following cases was different: the illative in adverbs, the allative in nominals, the adessive in nominals, the elative in adverbs, and the ablative in adverbs. These differences may be due to the different sample sizes in the studies.

The order of appearance of the verb inflectional types in the present work was highly parallel with that presented by Toivainen (1980) and Laalo (2003; compare also Nieminen 1991). Among the most used suffixes, after the first basic forms, were the 3S preterite form, the 3S negative construction, the 1S indicative present, passive, and the 3rd indicative illative, the same as reported by Toivainen (1980). Yet, contrary to the findings of Toivainen (1980), in the present work, the passive was used in spontaneous speech slightly more often than the 1st person singular form at 2;0.

The comparable acquisition orders of the inflectional types detected in the earlier studies (Laalo, 2002 and 2003; Nieminen, 1991; Toivainen, 1980 and 1997) and in the present one, verify the acquisition order of the inflectional types acquired by the full-term Finnish children at the end of the second year. It is important for those working in clinical practice to have exact knowledge of the emergence of early morphology. One explanation as to why children acquire the lightly marked inflections first might be that they are easier to perceive and produce. Another possible explanation is that the pragmatic reasons may account for why children use the 2S imperative form (*avaa,* open; *anna,* give*)* early, as has been proposed by Laalo (2003). It has also been suggested (Laalo, 2003) that the specific verbs (*avaa,* open! *ann,a* give!) are continuums from the early reduplicative babbling strings (i.e. *avaaavaaavaa* or *annaannaanna*), which may well be the case. Moreover, it is interesting to note that the elative (*talosta,* out of the house) and the ablative (*talolta,* from the house) were acquired last in the present samples, as they were in Toivainen´s (1980) data (see also Laalo, 2002). Could it

be that the meanings of ´going out of` (i.e. the elative) or ´from` something (i.e. the ablative) are more difficult to perceive than ´being in somewhere` (i.e. the inessive), ´be at somewhere / on something` (e.g. the adessive), ´going into something` (i..e. the illative) or to go somewhere (e.g. the allative)? If so, the acquisition of these forms could be connected to cognitive growth.

The present study demonstrated that significantly more case forms than verb inflectional types were used in the spontaneous speech of the 35 full-term children at 1;6 and at 2;0, which is a phenomenon not tested in the earlier studies of Finnish children. If the inflectional suffixes are acquired in close association with the lexicon in which they are mainly used, as the findings of the present work propose, then the different acquisition rates of the nouns and verbs might provide an explanation for a more active acquisition of the nominal inflectional types. Nouns were acquired earlier and at a faster rate in early lexical acquisition than the verbs. Nouns are the largest group of nominal words. It may be that children begin to acquire the nominal inflectional types earlier than the verb inflections because they have acquired more nouns, and also more information of how to use these words than verbs in their lexicons earlier. It is also possible that the larger grammatical load (Gentner & Boroditsky, 2001) influences the acquisition of the verbs, as well as the verb inflectional types.

The mean values of the inflectional types and the M3L in the present samples of the full-term children at 1;6 and 2;0 were parallel to those reported by Lyytinen (1999). These comparable values derived from the different samples of Finnish children, verify the development of the early grammatical growth of the Finnish children measured by the FinCDI at the end of the second year.

6.2.2 Associations between the expressive lexicon and grammar

The findings clearly proposed that the emergence of grammar was associated with the growth of the expressive lexicon size. When the grammatical growth was described in detail in relation to the expressive lexicon size, the regular grammatical growth (i.e. the growth of grammatical function words, the growth of morphological inflectional types and the M3L, emergence of word combinations) in relation to the expressive vocabulary growth was detected at both studied age points and in both samples of the full-term children. A close association between the expressive lexicon and grammar became even more evident in the cross-sectional sample due to the high variation in the expressive lexicon size between individual children at 2;0. Parallel findings were detected from the data gathered using the FinCDI and analysed from

spontaneous speech. The result that the expressive lexical and grammatical development are tightly woven together at the end of the second year is parallel with the recent published results focusing on the association between these language domains in children acquiring English (e.g. Anisfeld et al., 1998; Bates et al., 1995), Italian (Caselli et al., 1999), Hebrew (Maital et al., 2000), Icelandic (Thordardottir et al., 2002), and German (Szagun et al., 2006) as their first language. Thus, the results of the present work extend the earlier findings, to include children who acquire a highly inflected language. This close association has not been described in detail in Finnish children before.

On the theoretical level, the findings of the close association between the expressive lexical growth and the emergence of the expressive grammar suggests that grammar is not acquired as a separate module independent of vocabulary acquisition at the end of the second year, but these two language domains develop in a close association with each other (Bates & Goodman, 1997, 1999). Thus, the findings of the present work support the lexicalist approach to the processes by which grammar is acquired (Bates & Goodman, 1997, 1999). However, although the present work provides a detailed description of the association between the expressive lexicon and grammar at the end of the second year in Finnish children, the mechanisms of how the lexicon and grammar interact with each other were not analysed. It is possible that children use different strategies in their language acquisition. For example, children may use semantic bootstrapping, that is, the conceptual information of the different types of words (i.e. nouns refer to peoples, things and places, verbs to actions or state) are used to infer the meanings of new words (Clark, 2003). Or, children may use syntactic bootstrapping, that is, the syntactic information (i.e. sentence level semantics, morphological cues, word order) to interpret the meanings of a new lexical items (Bates & Goodman, 1999; Clark, 2003). Or, it is also possible that different mechanisms are in use at the same time, as has been detected in English children between the ages of 2;0 and 3;0 (Dionne et al., 2003). From the clinical point of view, the findings of the close association between the expressive lexicon and grammar provide predictability in early language development, and thus, offer tools for those working in a clinical practice to better understand early language acquisition.

Differences were found in the acquisition of the two inflectional systems of Finnish when analysed in relation to the lexicon in which the inflections are mainly used. Children started to acquire the nominal inflectional types more actively only after a number of the nominal words had been acquired, but the active acquisition of the verb inflectional types began when the verb lexical acquisition started. Moreover, a larger nominal lexicon size was needed in order for the case forms, other than the basic forms, to emerge, in comparison to the

emergence of the verb inflectional types analysed in relation to the verb lexicon size. These differences in the acquisition of the two inflectional systems support the proposal set by Bates and Goodman (1997) that the different grammatical structures display different degrees or types of lexical dependence. The acquisition of the case form types supports the ´critical mass` hypothesis proposing that children needed to acquire a number of nominal words first before the growth of the case-form types could begin. This finding is in line with those of the non-linear association between the lexicon and grammatical growth (e.g. Bates and Goodman, 1997). However, the steady growth of the verb inflectional morphology contradicts the findings in English (Marchman & Bates, 1994) and Icelandic children (Thordardottir et al., 2002). These differences may be explained by the differences in the verb inflectional morphology of Finnish as compared to English or Icelandic.

The differences found in the acquisition of the case form and verb inflectional types are interesting if interpreted in light of the development of the composition of lexicon. As detected in the present work, by analysing the compositional development of Finnish children in relation to the lexical growth, the vocabulary composition reorganises during early lexical acquisition in highly parallel manner as reported for children acquiring other target languages (e.g. Bates et al., 1994; Caselli, Casadio & Bates, 1999). There is a strong increase in the acquisition of the nouns in small lexicons (< 50 words), the proportion of nouns is very high (roughly 55 % of the total vocabulary) when children have approximately 50 – 200 words in their vocabulary, and this proportion begins to decrease as the lexicon sizes grow. The acquisition of verbs is slow and the growth trajectory for the proportional share of verbs is steady, linear in shape. In the present work, a clear increase in the acquisition of the nominal inflectional types happened when the proportional share of nouns was very high in the lexicons. The verb inflectional types were acquired in a more linear manner. It may be that as the proportional share of nouns is very high in the lexicon, children start to pay attention to the suffixes added to these words, and then acquire the nominal inflections parallel to the growth of the nominal lexicon. As there is no such rapid increase in the proportional share of the verbs, there is no rapid increase in the acquisition of the verb inflectional types, either.

6.3 Early language development in the VLBW children

6.3.1 Quantitative growth of the receptive and expressive lexicons

The present study provided detailed information of the early lexicon growth of the VLBW children in a reasonably large, representative sample followed longitudinally for 15 months. In the earlier studies providing longitudinal information of the early (< 2;0) vocabulary acquisition in the VLBW children, the sample sizes have been small and/or there has been no control group (Menyuk et al., 1991; Menyuk, Liebergott & Schultz, 1995; Raschew et al., 2005; Riitesuo, 2000).

Prematurely born children acquired their early receptive lexicons at a significantly slower rate than the full-term children. One explanation for this might be the difficulty in the auditory processing skills reported in the VLBW children. Jansson-Verkasalo (2003) found that VLBW children had difficulty in the auditory processing measured using the auditory event related potentials: the mismatch negativity (MMN) amplitudes were smaller in the VLBW children than in the controls. Moreover, parallel with the diminished MMN amplitudes, a weaker object-naming ability at 4;0 was detected. Mikkola et al. (2007) also reported differences in the auditory event-related potentials between the preterm children and their controls at 5 years of age. There was also a significant association between the MMN values and the results of language tests (the verbal IQ, Nepsy language subtests). Thus, the VLBW children in the present study might have had weaker auditory processing skills than the full-term controls, which could explain the weaker early receptive lexical acquisition. Further, the findings of the present work related to receptive lexical acquisition of the VLBW children differ from the results of Menyuk et al. (1991 and 1995). Menyuk et al. (1991, 1995) followed longitudinally the lexical acquisition of a group of prematurely born children, including 12 VLBW children and full-term controls. The only difference between the groups of the VLBW and the full-term children was that the former group acquired their first 10 comprehended words significantly later than the full-term children. Otherwise the VLBW children made good progress in their receptive lexicon acquisition (Menyuk et al., 1991 and 1995). There might be several reasons that account for this difference between the findings of Menyuk et al. and the present work. In the present work, the group of the VLBW children included all the VLBW children born in the Turku University hospital, who met the intake criteria of the study, and whose families were willing to participate in the study. The Menyuk et al. sample was not a full cohort, but some of the children were recruited by post, and some were recruited through

the hospital. Furthermore, the sample of the VLBW children was small (N = 12) in the study by Menyuk et al. In addition, the full-term children in the study seemed to proceed slowly in their acquisition of expressive lexicon as compared to the values reported in the literature (e.g. Bates et al., 1995; Lyytinen, 1999). All these differences between the present study and that of Menyuk et al., may have contributed so that the findings of these two studies differ.

The findings related to the quantitative growth of the expressive lexicon of the VLBW children were minor when compared to the findings on the receptive vocabulary development. In the longitudinal sample of 32 VLBW children, the difference in the expressive lexical growth was detected only if all the VLBW children were included in the analysis. In the cross-sectional sample of 66 VLBW children at 2;0, no significant difference in the expressive lexicon size was found when compared to the full-term children. This finding that the expressive lexicon size of the VLBW children does not significantly differ from that of the full-term children is consistent with the results of Jansson-Verkasalo (2003) and Sansavini et al. (2006) at 24 and 28 months, respectively. It may be that the difficulties that the VLBW children encounter in their linguistic development are not clearly visible in the early expressive lexical acquisition, but in other language domains, for example, in the receptive language or in the acquisition of grammatical structures.

6.3.2 Compositional development of the receptive and expressive lexicons

The findings of the present work showed that although the compositional development of the receptive and expressive lexicons was slower in the VLBW children than in those who were full-term, this development happened generally qualitatively in a parallel manner when analysed in relation to the lexicon size: the shift from reference to predication and to grammar in relation to the growth of the lexicon size was detected in both lexicons of the VLBW children. However, differences in the compositional development were also found. In both studies providing information of the lexical acquisition of the VLBW children, the percentage of the grammatical function words was lower for the VLBW than for full-term children. This difference was observed in the receptive lexicon at the beginning of vocabulary acquisition and in the expressive lexicons at 2;0. These findings propose that the acquisition of grammar, in particular, may be difficult for the VLBW children. This view receives support from the other finding of the present work, that is, from the finding that the VLBW children performed significantly weaker than the full-term children on a formal language test which focuses on the comprehension and production of language structures. The compositional

development of the early lexicon in relation to growth of the lexicon size in the VLBW children has not been analysed earlier, and thus, these findings are new. However, in comparison, Koster et al. (2005) found when analysing the expressive lexical composition in the children at risk for dyslexia and controls, that the former group had fewer closed-class words and verbs in their lexicons at 1;7 when the vocabulary size was controlled. The results of the present work also suggest that the acquisition of the grammatical markers may be difficult for children at risk for language problems.

6.3.3 Language skills at 2;0 and the predictive value of early lexical growth

The language skills of the VLBW children were significantly weaker than those of the full-term children at 2;0. This result is in line with earlier findings (e.g. Jansson-Verkasalo, 2003). In addition, the results of the present work proposed that the linguistic problems in the VLBW children also appear independently of the neurological difficulties (compare Landry, Smith & Swank, 2002; Wolke et al., 2008). In the present work, the weaker language performance of the VLBW children was not likely to be due to the background variables since the parental education did not differ between the groups. Nevertheless, there was a group difference in the cognitive development measured using the MDI. These lower general cognitive skills might provide one explanation for their difference in the language skills. However, the MDI value is a composite score including only a few sections that measure language skills, and even fewer that measure the receptive language. As a results, the normal MDI value does not exclude a language delay (Siegel et al., 1995). The findings of the present work supports this, since there were 6 VLBW children with an MDI standard score of < 85 (< - 1 SD), but 13 with the receptive standard score on the RDLS III of < 85 (< - 1 SD) in the longitudinal sample of the VLBW children. The problems encountered in the linguistic development may be particularly difficult to perceive if they appear in the receptive language. Thus, the results propose that the language development of the VLBW children should be carefully followed using appropriate methods to assess both the receptive and expressive lexicon and grammar to detect those requiring support.

The receptive lexicon size at the beginning of the second year was associated significantly with the performance on the RDLS III at 2;0 in the VLBW children. Earlier studies have also shown, although not in the VLBW children, that the early receptive lexicon has a predictive value for later linguistic growth. For example, Lyytinen (1999) reported a significant association between the early receptive lexicon size (at 1;0 and 1;2) and the

receptive score on the RDLS at 1;6, and Paavola et al. (2006) that the receptive lexicon size at 1;0 was associated significantly with the receptive score on the RDLS at 2;6. Since the VLBW children acquired their receptive lexicons at a significantly slower rate, and this acquisition was associated with later linguistic performance, the findings of the present work propose that the early receptive lexical growth is an early predictor of later language problems for the VLBW children.

6.4 Influence of the background variables on the lexicon growth

The effect of the background variables on the expressive lexical acquisition differed for the full-term and VLBW children. Gender had a clear effect on the lexicon size of the full-term children, but not of the VLBW children. Maternal education was not associated with the lexicon growth in the full-term children, whereas it was in VLBW children. Birth weight had no effect on the lexicon growth in full-term children, but the association between birth weight and the expressive lexicon size at 2;0 was significant for the VLBW children. These differences suggest that the biological and / or contextual factors may have more influence on the language development in the VLBW than in those who are full-term.

The finding that full-term girls are more ahead in their lexical development than the full-term boys is parallel with earlier results. For example, Bornstein, Hahn and Haynes (2004) reported that in the second through fifth years of age, girls consistently outperformed boys in language measures (see also Fenson et al., 1994). However, the findings related to the gender difference in the prematurely born children are inconsistent. Jennische and Sedin (2003) reported in their study of the language skills of 230 children requiring neonatal intensive care (NIC; born between 1986 and 1989), and 71 full-term controls at 6;5 that the language development of the extremely or very preterm NIC boys was less influenced than in NIC girls. This was detected in the matched pair comparisons (i.e. NIC girls versus control girls, NIC boys versus control boys): although the spontaneous speech and linguistic skills of the NIC girls were better than the NIC boys, the NIC girls did not reach the level of the control girls, whereas the NIC boys performed nearly as well as the control boys. On the other hand, Sansavini et al. (2006) reported that prematurely born males had a significantly smaller lexicon size than those of females at 2;6. There could be different explanations for the finding of the present work that there was no clear gender difference in the expressive lexicon size in the VLBW children. One explanation may be the different mortality percentages for the extremely-

very-low-birth-weight girls and boys at an early age. A higher percentage of the ELBW girls remain alive than the ELBW boys (Behrman, Kliegman & Jenson, 2000). Thus, the sample of the ELBW girls may be more heterogeneous if compared to the ELBW boys. Moreover, Jennische and Sedin (2003) reported that the number of different neonatal factors (e.g. gestational age, need for oxygen therapy, pathological findings on cerebral ultrasound) were associated with the language performance at 6;5, but differently in boys and girls. For example, gestational age was not associated with later language performance in the NIC girls (born between 23 and 31 weeks of gestation), whereas in NIC boys (between 23 and 31 weeks of gestation), an increased gestational age was associated with a lower risk of deviation in the articulation in spontaneous speech. The explanation for the finding of no gender difference in the early lexical acquisition of the VLBW children may be complex. There may be both biological and contextual matters influencing the lexical, and language, development of the VLBW children. More research is needed to fully understand this finding.

The length of the mother's basic education was not associated with the lexicon size in the full-term children, but it was in the VLBW children's group. Maternal education has been reported quite consistently to have a positive effect on language (e.g. Menyuk et al., 1995) and the cognitive outcome (e.g. Brooks-Gunn, Klebanov, Liaw & Spiker, 1993) of the prematurely born children, but this effect is not always found in the full-term children (e.g. Pan et al., 2004). Landry et al. (1997) reported that mothers who were sensitive to the children's focus of interest and did not highly control or restrict their behaviour had children who had greater increases and faster rates of cognitive-language and social development. The relations were stronger in the group of the high-risk VLBW children (i.e. one or more severe medical complications including the BPD, periventricular leukomalacia or severe IVH) than in the group of low-risk VLBW (i.e. one or more less severe medical complications, for example, transient respiratory distress, or oxygen required less than 28 days) or in the full-term children. It may be that the more educated mothers are more sensitive to the needs of their high-risk children, and thus more capable of supporting the development of the language skills in the most adequate ways.

The association between birth weight and / or gestational age and later language skills has been reported in the VLBW children earlier. For example, Foster-Cohen, Edgin, Cahmpion & Woodward (2007) reported that in the regional cohort of 90 VLBW children, there was a clear linear relationship between the gestational age at birth and later language outcomes: decreasing gestational age was associated with poorer language skills at 2;0 (see also Kern, 2007a; Sansavini et al., 2006). The result of the significant association between the birth

weight and later lexicon size can partially be explained by the fact that the risk of the different neurological disabilities increases with a decreasing birth weight (e.g. Mikkola et al., 2007).

## 6.5 Methodology and clinical implications

### 6.5.1 Methodology

Different types of methods were used in the present work to obtain as representative information as possible from the children's language. The methods gave parallel information, a finding comparable with published results (e.g. Fenson et al., 1994; Lyytinen, 1999; Thal et al., 1999, 2000). The result that the structured parental rating method provides representative information from children's early language is important for those working in a clinical setting: very young children do not always co-operate in the clinical context with an unfamiliar adult and thus, the language samples derived in the clinical situations may not always be representative (Fenson et al., 1994). The structured parental rating method offers an opportunity to get information from the children's language in contexts other than the formal clinical ones only. However, it is important to notice that these different methods give parallel, not identical information. The structured parental rating method provides knowledge of what a child knows, whereas spontaneous speech analysis tells about the speech a child chooses to use in a specific situation (lexical knowledge versus lexical use; e.g. Caselli, Casadio & Bates, 1999). Moreover, one shortcoming of the structured parental rating method is that parents may under- or overestimate their child's language. This effect can be reduced by providing the criteria of what constitutes a word for the parents. Requesting that the parents write down a word their child is saying may also reduce the overestimation.

Although different versions of the CDI provide norms for both lexicons (e.g. Fenson et al., 1994; Lyytinen, 1999), the study of the receptive vocabulary acquisition has been much less intense than the study of the expressive lexicon (see however Benedict, 1979; Caselli et al., 1995; Ring & Fenson, 2000). One reason for this might be that it may be more difficult for a parent to decide as to which words her / his child understands in comparison to the words a child produces. The results of the present work support the use of a structured parental rating method in the study of the receptive lexicon. Firstly, the receptive vocabulary growth of the full-term children in the longitudinal sample proceeded in a highly parallel manner as reported for the normative sample of the FinCDI (Lyytinen, 1999). Secondly, there was a significant difference between the longitudinal samples of the full-term and the VLBW children in their

receptive vocabulary growth, and thirdly, the receptive lexicon size at the beginning of the second year was significantly associated with the later language performance. Ring and Fenson (2000) compared the information collected from parents to that derived using the formal test. They first showed pictures to the parents and asked them whether their child would recognise a word for these pictures. The child´s word comprehension for these particular words was subsequently tested. The results indicated a significant, positive correspondence between the parent report and the judgement of the child´s comprehension. It was also observed by Lyytinen (1999) that in the full-term children, the receptive lexicon size at 1;2 was significantly associated with the receptive score on the RDLS at 18 and 30 months of age (see also Paavola, 2006) To conclude, the findings suggest that the study of the receptive vocabulary acquisition provides meaningful information in the clinical context. One has to note, however, that if the CDI is used to collect the data of the receptive vocabulary acquisition, this can be achieved though using the Infant form only, as the Toddler form of the CDI does not cover the receptive language. Other methods are needed to gather information from children's receptive language after the age of 16 months.

In the present work the information from the children´s early morpho-syntactical development was derived using different measures (the M3L, the number of morphological inflectional types reported and analysed from spontaneous speech, whether a child combined words, Reynell III). Nieminen (2007) analysed the morpho-syntactical development of 40 Finnish children at 2;6 using the MLU and the index of productive syntax. These two measures provided highly parallel, but qualitative slightly different information. In the present work, the use of the index of productive syntax might have provided even wider information on the children´s early morpho-syntactical development than the measures used.

The samples in the present study were representative. Both samples of the VLBW children included all the children completing the intake criteria of the study born in the Turku University Central Hospital whose families were willing to participate in the study. Due to the fact that the VLBW children´s group is heterogeneous, it is important that the sample is representative. Further, in the longitudinal study of the lexical development of the VLBW children, the groups of the VLBW and the full-term children were also comparable regarding parental education, whether a child was a first-born, a singleton / multiple birth and in terms of their linguistic backgrounds. All these matters affect to the children´s linguistic development (e.g. Fenson et al., 1994). Due to the fact that the background factors were taken into consideration during the data collection, the results provided highly comparable information about the early language development of the VLBW and full-term children. However, it may

also be that because the two samples were selected, and many matters which have been shown to have a slightly negative effect (e.g. heterogeneous language background, multiple birth) on the early language development were not present, the information derived from these samples may appear to be ´too positive`. This should be taken into account when applying the present information to a clinical context. Furthermore, in all four samples, all the mothers had completed at least nine years of basic education. Although these are typical Finnish samples, this matter should be taken into consideration if the findings are interpreted in the countries with a greater variation in the basic education of mothers.

The present work provided both qualitative and quantitative information on children's language. The reasonable large sample sizes made it possible to detect the high variation in the children´s language acquisition, which cannot be determined in small sample sizes. Moreover, without a reasonable large sample size, it would not have been possible to detect the qualitative shift from reference to predication and to grammar in the children´s early lexical acquisition, or to test the differences in the lexical acquisition between the VLBW and the full-term children. In short, the quantitative information provided qualitative data.

6.5.2 Directions for future studies and clinical implications

In the present study, the child language acquisition was analysed up to the age of 2;0. In the future, it is important to study the predictive value of early language for even later linguistic performance. Although there are studies providing information on the predictive value of the early lexicon of full-term children (e.g. Rescorla, 2005), or in children with a familial risk for dyslexia (e.g. Lyytinen & Lyytinen, 2004), the predictive value of early language to the later (i.e. after 2;0) linguistic performance of the VLBW children is unclear. In addition, it is important to analyse other features of the early communicative development of the VLBW children in detail to find out whether there are other significant predictors of the later linguistic performance than the receptive lexical acquisition detected in the present work.

The findings of the present work revealed that the linguistic development of the VLBW is not optimal. Although the weak language performance of this group at 2;0 has been reported earlier (e.g. Jansson-Verkasalo, 2003), it is important to note that there is a constant need to obtain information of the linguistic development of the VLBW children due to the continuous progress in the neonatal clinical treatments. The findings also suggest that information on the early lexical acquisition provides useful data in the clinical context if the goal is to detect early those with problems in linguistic development. Moreover, some of the

children with weak language skills at 2;0, had a normal MDI value. In other words, it was not possible to recognise language problems using the MDI value only. Thus, the results propose that the language development (the receptive and expressive lexicon and grammar) of the VLBW should be followed in detail using appropriate methods to recognise those who need support for their linguistic development. If the follow-up methods are not detailed enough, the linguistic problems may not be detected.

6.6 Conclusions

The present work provided a detailed description of the early linguistic growth of Finnish children from the acquisition of the early receptive lexicon to the emergence of grammar. The findings showed a shift from reference to predication and grammar, which happened in relation with the lexicon growth, in the receptive and expressive vocabularies of the Finnish children, both in the full-term and VLBW children. The findings also provided detailed information on the close associations between the expressive lexical and grammatical growth at the end of the second year. The present findings extend the earlier reported results of the compositional development of the early lexicon (e.g. Bates et al., 1994; Caselli, Casadio & Bates, 1999), and the close association between the lexicon and grammar at the end of the second year (e.g. Bates & Goodman, 1997; Caselli, Casadio & Bates, 1999; Conboy & Thal, 2006; Thal et al., 1996) in children acquiring a highly inflected language, Finnish. The findings underline the role of the early lexicon in language acquisition. They suggest that grammar is not acquired as a separate module, but in close association with a child´s expressive vocabulary growth at the end of his or her second year. The results provide tools to better understand the early language acquisition of the Finnish children in a clinical context. For the VLBW children, the findings provide detailed information of their early language acquisition and underline the need for a follow-up in their early language development using appropriate, detailed methods to recognise those encountering problems in linguistic development.

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# Appendix A

Table A1. Description of the case forms in Finnish (Dasinger, 1997; Karlsson, 2006; Toivainen, 1997).

| Case | Suffix | Main function | Example |
|---|---|---|---|
| *Grammatical cases* | | | |
| Nominative | - (sg), -t (pl) | subject | silmä *eye* |
| Partitive | -a /-ä, -ta /-tä | object / subject / predicative | silmä-ä *eye* |
| Accusative | -n (sg), -t (pl) | object | silmä-n *eye* |
| Genitive | -n | possession | silmä-n *eye´s* |
| *Inner local cases* | | | |
| Inessive | - ssa /-ssä | ´in` | silmä-ssä *in the eye* |
| Elative | - sta /-stä | ´out of` | silmä-stä *from the eye* |
| Illative | - hVn, -Vn, -seen | ´into` | silmä-än *into the eye* |
| *Outer local cases* | | | |
| Adessive | - lla / -llä | ´at/on` | silmä-llä *on the eye* |
| Ablative | - lta / -ltä | ´from` | silmä-ltä *from the eye* |
| Allative | - lle | ´to` | silmä-lle *to the eye* |
| *Other cases* | | | |
| Essive | -na / -nä | ´as` | silmä-nä *as an eye* |
| Translative | -ksi | ´to/becoming` | silmä-ksi *to an eye* |
| Abessive | - tta / -ttä | ´without` | silmä-ttä *without an eye* |
| Comitative | -ne | ´with` | silmi-ne-en *with his eyes* |
| Instructive | -n | manner, means, instruction | silmi-n *with his eyes* |

Table A 2. Description of the verb inflections in Finnish (Dasinger, 1997; Karlsson, 2006; Laalo, 2003; Toivainen, 1997).

*Person-number*

1st person singular minä puhu-n *I speak*
2nd person singular sinä puhu-t *you speak*
3rd person singular hän puhu-u *he / she speaks*
1st person plural me puhu-mme *we speak*
2nd person plural te puhu-tte *you speak*
3rd person plural he puhu-vat *they speak*

In addition to the person-number markings, verbal morphology for finite verbs can express tense (present, preterite, perfect, and past perfect), voice (active and passive), and mood (indicative, imperative, conditional, potential). The unmarked forms are non-past, active, and indicative. Other meanings are expressed using a distinct form. Verbs in the passive mode are not inflected for person and number. Negation is expressed using a negative auxiliary conjugated for person and number. The marking of perfect aspects is built up using the verb ´to be` (olla) in conjugation with participle forms of verbs (Dasinger, 1997; Toivainen, 1997).

# Appendix B

Dear parents,

The following contains instructions on how to complete the *Communicative Development Inventory (MCDI method).*

The method focuses on evaluating the development of expressive ("understands and says") lexicon, morphological inflections and early word combinations.

When you evaluate the development of the expressive lexicon (the words a child "understands and says"), mark all those words your child says independently (i.e. without a model), and uses repeatedly when referring to the same thing. If your child uses a different form from that written in the method (a child form, e.g. doggie – dog), mark it anyway. Write down the word on the CDI form as your child says it as strictly as possible. If you cannot find the word your child uses in the word lists, you can write it down in the blank space provided page 10.

When you evaluate the development of inflections (*Inflections and sentences*, p. 11), write down examples of those forms your child uses. Write in the *Word combinations* –part (page 13) the three longest utterances you have heard your child saying recently. Rhymes known by heart or the words of songs are not accepted.

Return the completed CDI Inventory in the envelope enclosed within two weeks,

_____ at the latest.

If you have any questions, please call:

Suvi Stolt tel. xxx xxxxxxxx
Phil., Lic., Speech and Language Pathologist

Thank you for completing the inventory!

## List of original publications

**I**    Stolt, S., Haataja, L., Lapinleimu, H. and Lehtonen L. (2008). Early lexical development of Finnish children – a longitudinal study. *First language*. 28:3, 259-279.

**II**    Stolt, S., Haataja, L., Lapinleimu, H.. and L. Lehtonen, L. (in press) Associations between lexicon and grammar at the end of the second year in Finnish children. *Journal of Child Language.*

**III**    Stolt, S., Haataja, L., Lapinleimu, H., and Lehtonen, L. (2009). The early lexical acquisition and its predictive value to language skills at two years in very-low-birth-weight children. *Journal of Communication Disorders,* 42, 107-123.

**IV**    Stolt, S., Klippi, A., Launonen, K., Munck, P., Lehtonen, L., Lapinleimu, H., Haataja, L. and  the Pipari studygroup (2007). Size and composition of the lexicon in prematurely born-very-low-birth-weight and full-term Finnish children at two years of age. *Journal of Child Language*, 34, 283-310.