ASTRA SCHULTS

First words of Estonian children: early communicative development

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ASTRA SCHULTS

First words of Estonian children: early communicative development

Institute of Psychology, University of Tartu, Estonia.

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CONTENTS

LIST OF ORIGINAL PUBLICATIONS

I   Schults, A.; Tulviste, T.; Konstabel, K. (2012). Early vocabulary and gestures in Estonian children. *Journal of Child Language, 39*, 664–686.

II   Schults, A.; Tulviste, T. (2016). Composition of Estonian infants' expressive lexicon according to the adaptation of CDI / Words and Gestures. *First Language,* (accepted).

III Schults, A.; Tulviste, T.; Haan, E. (2013). Early vocabulary in full term and preterm Estonian children. *Early Human Development, 89*, 721–726.

The author of the present dissertation contributed to these publications as follows:

   As the first author I formulated the research questions and wrote the manuscripts as the main author for each of the studies. For *Studies II and III*, I conducted the data analyses. For *Study I*, I conducted the majority of the data analyses. I have also contributed to the Estonian adaptations of MacArthur-Bates Communicative Development Inventories and to the data collection.

Principal aims of the studies

Study I had three main aims. First aim was to describe the proportional acquisition of semantic categories at the age of 0;8 to 1;4. Second aim was to study associations between gestures, receptive lexicon, and expressive lexicon. Third aim was to describe the effects of child's age, gender, birth order and maternal education on the size of expressive lexicon.

Study II aimed to provide information about possible impact that rich morphology and structural variability might have on expressive lexicon at the age of 0;8 to 1;4. Data for age and gender differences as well as for proportional distribution of semantic categories were described. In addition to that, the composition of the early expressive lexicon was presented.

Study III aimed to provide information about differences in early communicative development in full term and preterm born children at the age of 1;4 to 2;1. We assumed that full term born children have larger expressive lexicon and higher mean length of utterances compared to preterm born children. We also assumed that preterm born children compared to the full term children would have more social terms and common nouns, and fewer function words in their lexicon. Finally, regression analyses were done to show the effects of age, gender, prematurity, and proportional use of semantic categories on the size of expressive lexicon.

INTRODUCTION

Early communicative development

Communicative development consists of multiple verbal as well as nonverbal aspects. Research on communicative development enables us to describe the course and variability of it. Research on communicative development also gives us insight into processes that take part in modifying the course of communicative development. Different aspects of early communicative development have been shown to be associated with later development (Bartl-Pokorny et al., 2013; Can, Ginsburg-Block, Golinkoff, & Hirsh-Pasek, 2013; Goldin-Meadow et al, 2014; Hoff, 2013; Justice, Mashburn, & Petscher, 2013; Kuhn et al., 2014; Moll, Snowling, Göbel, & Hulme, 2015; Rudolph & Leonard, 2016; Unhjem, Eklund, & Nergard-Nilssen, 2014). Thus, it is important to be able to describe the course of development of different aspects in communicative development and the factors that influence it, as this gives us not only an opportunity to predict future development of a child but also to intervene and redirect the course of development if need be. The focus of this dissertation is that part of early communicative development that starts with receptive lexicon and the use of gestures followed by expressive lexicon. Word comprehension precedes word production and appears between the age of 0;8[1] and 0;10 (Fenson et al., 1994; Stolt, Haataja, Lapinleimu & Lehtonen, 2008). The number of words comprehended exceeds the number of words produced up to the age of three years (Fenson et al., 1994). Gesture use also starts before words are produced (Bates et al., 1975, 1979) and gesture production is correlated positively with word production (Acredolo & Goodwyn, 1988; Bates & Dick, 2002; Bates et al., 1989; Bretherton, et al., 1981; Goodwyn & Acredolo, 1993; Iverson, Capirci & Caselli, 1994). Before the first birthday children have been shown to produce only a few words regardless of the language they are acquiring (Bates et al., 1994; Fenson et al., 1994; Stolt et al., 2008). During the following months the lexicon will grow quite steadily until accelerated growth appears around the age of 1;3 (Goldfield & Reznick, 1990; Stolt *et al.*, 2008).

I will address each of these components and describe data for Estonian children's receptive lexicon, the use of gestures and development of expressive lexicon.

Factors associated with communicative development

Language development has fascinated researchers for decades. It has been shown that there is high variance in language development (e.g., Fenson *et al.*, 1994) and research has produced information that has enabled us to identify factors that influence language development (e.g., Bauer, Goldfield & Reznick, 2002; Bornstein, Hahn & Haynes, 2004b; Bornstein, Leach, & Haynes, 2004c;

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[1]   Age is presented in the form of years; months.

Eriksson *et al.*, 2012; Fenson *et al.*, 1994; Foster-Cohen, Edgin, Champion & Woodward, 2007; Galsworthy, Dionne, Dale & Plomin, 2000; Goldfield & Reznick, 1990; Hoff, 2006; Huttenlocher, Haight, Bryk, Seltzer & Lyons, 1991; Kern & Gayraud, 2007; Rowe & Goldin-Meadow, 2009a; Rowe, Raudenbush & Goldin-Meadow, 2012; Stokes & Klee, 2009; Stolt *et al.*, 2008). Research has also produced information about the impact of language development on other areas, such as academic achievement (e.g., Bartl-Pokony *et* al., 2013; Ghassabian *et* al., 2014; Justice *et al.*, 2013; Moll *et* al., 2015; Young *et al.*, 2002) and social competence (e.g., Commodari, 2013). Thus, it is important to be able to take into account the factors that have an influence on communicative development, to describe the normative course of language development of Estonian children, and to be able to decide if language development follows the normative pattern in a timely manner.

Gender differences. Most of the previous studies have found girls to have a slight advantage compared to boys in word comprehension (Fenson *et al.*, 1994), gesture production (Eriksson *et al.*, 2012; Fenson *et al.*, 1994), and word production (Bornstein *et al.*, 2004b; Eriksson *et al.*, 2012; Fenson *et al.*, 1994; Galsworthy *et al.*, 2000; Stolt *et al.*, 2008). In addition to finding that girls have more items in their lexicon compared to boys it has been shown that girls tend to acquire new words at a faster rate compared to boys (Bauer *et al.*, 2002). Whilst it should be noted that girls' slight advantage has been found starting from the age of 1;8 but not found at the age of 1;1 (Bornstein *et al.*, 2004b) the question about the age when the gender difference in lexicon size appears has remained open. The girls' advantage seems to have two possible explanations in current literature. Firstly, girls have been considered to mature more rapidly (Maccoby & Jacklin, 1974; Yu *et al.*, 2014). Secondly, the social environment might stimulate girls more than boys regarding language development (Caldera, Huston, & O'Brien, 1989; Leaper, Anderson, & Sanders, 1998).

Birth order. Some studies have found first born children to have a larger lexicon in general (Hoff, 2006) and proportionally more nouns in particular (Goldfield & Reznick, 1990). Larger lexicon size in first born children might be due to the possibility that compared to the later born children parents could have more episodes of joint attention with the firstborns. In addition parents could use more child directed speech with the first born. A larger number of joint attention episodes (Farrant & Zubrick, 2012) and amount of child directed speech (Huttenlocher *et al.*, 1991; Rowe *et al.*, 2012) have been found to lead to larger lexicon sizes. Later born children have been found to have an advantage in the development of conversational skills (Fenson *et al.*, 1994; Bornstein *et al.*, 2004c).

Socioeconomic status. Maternal level of education is often used as an indicator of parental socioeconomic status (SES). Some studies have found SES-related differences in children's receptive and expressive lexicon (Hoff, 2006) as well as in gesture production (Rowe & Goldin-Meadow, 2009a). These studies show that higher SES mothers talk more, to use a larger lexicon (Hoff, 2006), and to use more gestures while communicating with their children com-

pared to lower SES mothers (Rowe & Goldin-Meadow, 2009a). The studies also show that higher SES mothers expect more verbalization from the child compared to lower SES mothers (Hoff, 2006). However, other studies have found no significant SES-related differences in children's early lexicon or in gesture production (Fenson *et al.*, 1994).

Previous studies have found a positive correlation between child-directed speech and the size of a child's lexicon (Huttenlocher *et al.*, 1991; Rowe *et al.*, 2012). Regardless of being middle class, Estonian mothers have been found to direct less speech to their children compared to mothers from Germany, Sweden, and the USA (Junefelt & Tulviste, 1997; Tulviste, Mizera & De Geer, 2004). This might result in slower pace of lexicon development in Estonian children.

Preterm birth. Preterm born children have been shown to have fewer canonical syllables (well formed syllables with consonant vowel structure) around the age of 0;10[2] (Oller, Eilers, Steffens, Lynch & Urbano, 1994). Preterm children also have a smaller production lexicon (Foster-Cohen *et al.*, 2007; Kern & Gayraud, 2007) and proportionally more social terms in their production lexicon compared to the full term children (Kern & Gayraud, 2007). At the age 3;6 to 5;0 preterm born children produce fewer verbs and shorter sentences compared to the full term children (Le Normand & Cohen, 1999). Variance of two aspects can contribute to the language development differences. Firstly, preterm born children have shorter gestational age and lower birth weight combined with lower levels of physical development (including development of the central nervous system). Secondly, preterm born children are prone to have medical problems and the degree of severity of these problems varies within the preterm born group. In a study where medical problems were eliminated differences between language development of preterm and full term children were not found (Perez-Pereira, Fernandez, Gomez-Taibo & Resches, 2014).

Morphological richness. It has been known since the work of Nelson (1973) that there are proportionally more nouns than verbs in children's productive lexicon. According to the ideas that derive from the works of Slobin (1973) and Gentner (1982) the fact of morphological richness might make it more difficult for English speaking children to acquire verbs compared to nouns as verbs are inflected more often than nouns (Bornstein *et al.*, 2004). Estonian language has a rich morphology which might result in a slower pace of lexicon development. However, some of the previous research has found that morphological richness of particular type of words does not make it more difficult for children to acquire those words (Xantos *et al.*, 2011). In addition to this, findings from Finnish suggest that structure of language does not affect the rate of lexicon development (Stolt *et al.*, 2008).

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[2] When comparing preterm born and full term born children's development corrected age is used for preterm born children up to the age of 2;0.

Language development research methods

Lexicon development is one of the aspects in language development that has been measured by many authors in many different ways. Diaries (e.g., Rescorla, 1980), recordings (e.g., Whitehurst *et al.*, 1988), tests (e.g., Holm & Kunze, 1969), and checklists (e.g., Fenson *et al.*, 1994) have been used to gain knowledge about the first words that children start to produce, how children use their first words, how the environment affects language development, and if there is a pattern that language development follows regardless of individual differences.

Lexicon development data have been gathered from different informants using different methods. For example, young children who have just started to say their very first words, might speak only in certain situations and they might refrain from speaking to strangers or indeed from saying anything at all if they are explicitly asked to name an object or a picture. Thus, recording their speech or testing their lexicon might be a time consuming exercise and indeed the quality of obtained data may suffer. Diaries for young children's lexicon development are often kept by their parents or primary carers. As these are the people who have the most experience with the child in various situations they do have access to the whole lexicon the child is currently using. However, the diary studies also have disadvantages. Firstly, an extended period of time is needed to gather all the required information and it does require commitment from the individual to maintain a diary for such a lengthy period. Secondly, as the diaries are kept for single individuals it does make the information gathered highly individualised. Thus, it is time consuming to analyse the data and as there are small samples it can make it difficult to generalize the results.

Parental reports in the form of checklists have been seen as one of the possible solutions for the above mentioned difficulties. Checklists that use a recognition format make it easy for parents to decide what are the words currently produced by their child, so filling in a checklist does not require specialized training or exceptionally good memory abilities. As the person who is spending the most time with the child is asked to fill in a checklist the resulting data has the advantage of coming from the source that has the most experience with the child's lexicon. Checklists also have the advantage of being cost effective as it does not take so much time to complete (at least compared to diaries, recordings, and tests) and thus they enable large sets of data to be gathered. The MacArthur-Bates Communicative Development Inventory (henceforth CDI) is one of the parental checklists which has been frequently used in many countries and languages (http://mb-cdi.stanford.edu/adaptations.html). The reason for it's frequent use and it's many adaptations lies in the fact that in addition to cost effectiveness and ease of administration of CDIs have been shown to be very reliable (internal consistency, $r = .96$; test-retest, $r = .95$) and highly valid tool (concurrent validity range from .40 to .83; predictive validity range from .60 to .80; Fenson *et al.*, 1994).

The original work that formed the basis of the CDIs was conducted by Bates and colleagues (Bates, Camaioni, & Volterra, 1975; Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979; Snyder, Bates, & Bretherton, 1981). Firstly, free-form interviews were conducted with parents, then the interviews were modified so that parents were asked a standard set of open ended questions, and then the structured interview was replaced with an orally administered checklist format. The final version of CDIs is in self-administered checklist format (Fenson *et al.*, 1994).

The CDIs used to gather data for this dissertation have two versions. One is intended for the children within the age range of 0;8 to 1;4 and is called CDI: Words and Gestures. This version starts with questions about child's responsiveness to language, if the child can understand phrases in everyday context, and whether the child has started to imitate words and to label objects or events. The parents are asked to check the words their child understands or understands and produces. The original lexicon list contains 396 items and the words are organised into 19 semantic categories (e.g., vehicles, clothing, games and routines, verbs, question words etc.) The list of words is followed by a list of gestures. The original list of gestures contains 63 items that are organised into five categories and parents are asked to decide if their child uses those gestures. Finally, parents are asked to provide examples of symbolic play if their child has begun to engage in pretend play (Fenson *et al.*, 1993).

The other version of CDI is intended for the children aged 1;4 to 2;6 and is called CDI: Words and Sentences. The major part of it contains a 680-item checklist which is organised into 22 semantic categories and parents have to decide for each word if they have heard their child produce it. Then, the parents are asked about their child's use of decontextualized language and the morphological and syntactic development, including multiword utterances (Fenson *et al.*, 1993). The CDIs have been adapted to many languages and dialects (see http://mb-cdi.stanford.edu/adaptations.html).

CDIs do also have their limitations. Firstly, these do not include a comprehensive list of lexicon. Thus, the data gathered via CDI does not enable us to make conclusive decisions about the content or size of an individual child's lexicon. Secondly, whilst the list of words is not comprehensive it is still a lengthy one and thus it is difficult to use CDIs as screening tools in medical context. Thirdly, having parents checking the words they have heard their child produce does not give information about the frequency of word use. Also, parents with low education levels have been shown to be less exact in reporting the size of their children's lexicon. These parents have been found to either underestimate (Roberts, Burchinal, & Durham, 1999) or over-estimate (Feldman *et al.*, 2000) the use of words by their children. In addition to these limitations, the use of checklists does not enable us to gather information about the development of word pronunciation nor the situational factors that have an effect on the lexicon development. Thus, interpretation of the results has to take these limitations into consideration.

Categorizing words: From noun
dominance to semantic categories

Words can be divided to categories according to the word function and lexicon development pattern. Nelson (1973) was one of the first authors to look for development related differences in words categorized to *Nouns* and *Non-nouns* and to point out that Nouns dominate over Non-nouns in the early lexicon of English speaking children. More specifically, Nelson (1973) showed that when the English speaking children's lexicon contains 50 words it includes proportionally more Nouns compared to Non-nouns. Noun dominance persists as the lexicon grows up to 200 words (Caselli, Casadio, & Bates, 1999; Bates *et al*., 1994). Nouns form the largest proportion of the early lexicon in several languages (Bornstein *et al*., 2004a; Caselli *et al*., 1995; Fenson *et al*., 1994; Stolt *et al*., 2008; Wehberg *et al*., 2007) but not in every language (Tardif, 1996). Korean and Mandarin speaking children's early lexicon has been shown to include proportionally more verbs compared to nouns (Tardif, 1996). The existence or lack of noun bias has been explained by the differences in child-directed speech (Hart, 2004). Mothers' speech can contain proportionally more nouns as is the case in North America or proportionally more verbs as in Asia (Hoff, 2006). Parents' strategies can direct children to produce either more nouns or more verbs (Fernald & Morikawa, 1993, Tardif, 1996). Maternal use of directives is connected to child's verb production (Tomasello & Kruger, 1992). Estonian mothers have been found to use many directives in their child-directed speech (Junefelt & Tulviste, 1997; Tulviste, Mizera & De Geer, 2004). This might have an effect on the composition of Estonian children's lexicon. In addition, it is assumed that it is easier for the children to acquire the words that appear frequently in the salient position (see Bornstein *et al.,* 2004a). Subject-verb-object is the most usual order in declarative sentences in Estonian. In this type of sentence a common noun is often the last word and thus it is in a salient position. In directive sentences predicates and function words often appear in salient position. Thus, due to Estonian children being frequently exposed to directives they might have proportionally more predicates in their lexicon compared to children from cultures where fewer directives are used in child-directed speech.

Bates and her colleagues (1994) pointed out that words included in CDI can be divided into three different categories all of which have a different course of development. These categories include Common nouns, Predicates, and Closed-class items. The category of *Common nouns* is similar to Nelson's (1973) Noun category. Common nouns are words that are used to name objects like animals, food items, vehicles and toys (Bates *et al*., 1994; Bornstein *et al*., 2004a; Caselli *et al*., 1995, 1999; Fenson *et al*., 1994; Nelson, 1973; Stolt *et al*., 2008; Wehberg *et al*., 2007). Bates and colleagues (1994) showed that if we examine the absolute numbers of words, the category of Common nouns has the highest scores as expressive lexicon emerges and the scores will remain the highest regardless of the size of expressive vocabulary. However, if we examine the

proportions, then the category of Common nouns starts to dominate as the size of expressive lexicon reaches 51 words and the dominance will persist until the size of expressive lexicon reaches 501 words. Verbs and adjectives belong to the category of *Predicates* (Bates *et al*., 1994; Caselli *et al*., 1999; Tardif, 1996). In Predicates and especially Closed-class items categories there are fewer words that children are using compared to Common nouns. If we examine proportional use then it can be seen that Predicates start to gain in proportion as the child's expressive lexicon reaches 201 words and Predicates will be used proportionally as much as Common nouns as the child's expressive lexicon size reaches 501 words (Bates *et al*., 1994). The number of Predicates in a child's lexicon grows more slowly than the number of Common nouns in the languages where noun dominance has been demonstrated. *Closed-class items* include pronouns, question words, prepositions and locations, and quantifiers (Bates *et al*., 1994; Caselli *et al*., 1995). The category of Closed-class items is represented to a lesser extent in the early lexicon and the increase of the number of words from this category is the slowest compared to the other word categories. Proportional use of words in the category of Closed-class items remains at a low level regardless of expressive lexicon size (Bates *et al*., 1994).

Caselli and colleagues (1995) differentiated semantic categories further. They assigned *Sound effects and animal sounds* to its own category in addition to words for *People* and words and phrases for *Games and routines*. In later research the *Social terms* category has been used and this consists of words and phrases that are used during social routines and games, to name important or favourite people, and to produce sound effects and animal sounds (Caselli *et al*., 1999; Stolt *et al*., 2008). Thus, the *Common nouns* category in these studies consists only of nouns. The category of *Predicates* is divided into two semantic categories, *Action words* and *Descriptive words* (Caselli *et al*., 1995). Content of category of *Closed-class items* remains the same but is assigned a more descriptive name of *Function words*. The first words that children start to produce are Social terms (that is they start to use for example words and phrases that accompany routines), reference is acquired next (expressive lexicon will gain more Common nouns), and finally predication appears (as children start to express themselves with Action and Descriptive words) (Caselli *et al.,* 1995).

Categorizing gestures

Deictic gestures are used to point at objects (Bates *et al*., 1975; McNeill, 1992). Pointing gesture production is associated with object name comprehension (Harris, Barlow-Brown & Chasin, 1995). Deictic gestures precede word production as they emerge between the ages of 0;9 and 1;1 (Bates *et al*., 1975, 1979). The more primitive deictic gestures (e.g., requesting via reaching) are used only by very young children as the frequency of using those gestures starts to decline around the age of 0;11 (Blake & Dology, 1993). Other deictic gestures (e.g., pointing with extended index finger) are used throughout life.

Object gestures are used with appropriate objects to refer to their functions (e.g., holding phone against ear) (Bates, Thal, Whitesell, Fenson & Oakes, 1989). Object gestures emerge around the same time as children start to produce object names. Object gestures are positively correlated with naming for six months after the child has reached age 1;0 (Acredolo & Goodwyn, 1988; Bates & Dick, 2002; Bates *et al*., 1989; Bretherton, *et al*., 1981; Goodwyn & Acredolo, 1993; Iverson, Capirci & Caselli, 1994). Children who produce more different object gestures at the age of 1;2 have larger lexicon at the age of 4;6 (Rowe & Goldin-Meadow, 2009a, 2009b).

Gestural routines are culturally appropriate sequences of gestures that are executed during everyday events that include interaction (e.g., waving good bye to a leaving person) (Acredolo & Goodwyn, 1988; Bates *et al*., 1989; Iverson *et al*., 1994). Gestural routines can be accompanied with production of appropriate words or phrases (e.g., saying 'bye-bye' while waving good bye).

Aims of the dissertation

The first aim of this dissertation is to present the adaptation of ECDI: Words and Gestures. The second aim is to present descriptive normative data for gestures, receptive lexicon, and expressive lexicon development in Estonian children from the age of 0;8 to 1;4. We also present our findings about the factors related to the variability of early communicative development. In addition to this, three topics will be elaborated further. Firstly, how are different categories of words in receptive lexicon and different types of gestures connected to different categories of words in expressive lexicon? Secondly, is Estonian children's language development affected by the language itself? Thirdly, is the language development of children born preterm qualitatively different from the language development of children born full term?

METHOD

Participants and procedure

In all of the studies, children and their parents were recruited through paediatricians, play-group teachers, internet forums, and by those parents who had already completed the inventory. We included the data of children who were healthy and acquiring Estonian as their first and only language according to the subject information sheet filled in by parents. Most of the participants (more than 90%) were from middle or higher SES homes. In all of the studies, parents were asked to fill in the ECDIs according to their child's performance at that time.[3]

In *Study I* data were gathered for 592 children between the age of 0;8 and 1;4 (M = 1;0, SD = 2.56). There were data for 314 boys and 278 girls. The data for *Study I* were gathered using the ECDI: Words and Gestures. The data were scored into three categories. The categories of *Word comprehension* (or receptive lexicon) and *Word production* (or expressive lexicon) included the words from ECDI: Words and Gestures. The subcategories of Common nouns, Predicates, Social terms, and Function words were used in both of the above mentioned categories. Absolute as well as proportional numbers of words of all of the subcategories were calculated for both word comprehension and word production. Third category of *Gestural production* included the gestures from ECDI: Words and Gestures. Subcategories of deictic gestures, object gestures, and gestural routines were used in analyses in addition to the category of gestural production. Analyses of variance and Scheffé tests as *post hoc* were used to describe age and gender differences. Pearson correlations between word comprehension, word production, and gestural production were calculated. Poisson regression models were used to demonstrate the factors predicting the production of words belonging to different subcategories.

The data in *Study II* included the data from *Study I* with two modifications. First, additional data were collected. Second, the children who did not have any words in their expressive lexicon according to parental report have been excluded from this data set. Thus, the data for 903 children between the age of 0;8 and 1;4, (M = 1;4, SD = 2.38, 459 boys and 444 girls) were used in *Study II*. The data for *Study II* were gathered using the ECDI: Words and Gestures. In *Study II*, we divided the data into six groups according to the size of child's expressive lexicon (one word, two to five words, six to ten words, eleven to twenty five words, twenty six to fifty words, fifty one or more words). We also categorized the data into seven semantic categories (Sound effects and animal sounds; Common nouns; People; Games and routines; Action words; Descriptive words; Function words). We calculated the proportions of semantic categories using the total number of words in the expressive lexicon according to the parental report. We used multivariate analysis of variance (MANOVA) to

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[3] The work has been approved by Ethics Review Committee (ERC) on Human Research of the University of Tartu (no 170/T-12 28.04.2008).

describe the age and gender effects on expressive lexicon. The effect of vocabulary size (six groups) on vocabulary composition (seven semantic categories) was explored by analysis of variance (ANOVA). Percentages and rankings of word frequency were calculated for content analysis. T-tests were used for lexicon size and semantic categories proportion comparisons between genders.

Study III included data for healthy preterm children in addition to data for full term children. There were data for 40 preterm children (16 boys and 24 girls) included in *Study III*. Preterm children were those born before the 36th week of pregnancy (M = 30.6, SD = 2.3, range 24–35). The mean weight of preterm children at birth was 1618.1g (SD = 388.8, range 840–2500). Corrected age was used for the preterm children (M = 1;10, SD = 0;3, range 1;6–2;4). Preterm children were recruited by medical personnel. In *Study III*, we used data for two matched groups of full term children. The data for matching came from norming study of ECDI: Words and Sentences. The first full term group consisted of 120 children who were matched by age and gender. The second full term group consisted of 109 children who were matched by age, gender and size of expressive lexicon. The data for *Study* III were gathered using ECDI: Words and Sentences. Parents were asked to check the words that their children produced and to provide samples of the three longest utterances their children had produced. We categorized the words into four categories (Social terms, Common nouns, Predicates, and Function words). We used absolute as well as proportional numbers of words in categories in the analyses. In addition, parents were asked if the child had already started to use multiple word utterances. If parents stated that their child has started to do so, they were asked to write the three longest utterances they had heard their child produce. Mann Whitney U-tests were used for two group comparisons. Analyses of variance and Scheffé test as *post hoc* were used for multiple group comparisons. Poisson regression was used to model factors predicting the size of expressive lexicon.

Adaptation of Estonian CDI

Adapting CDIs into Estonian was a part of this dissertation. The first step for the Estonian adaptations of CDIs was to translate the original CDIs (Fenson *et al*., 1993) into Estonian. We kept the whole instrument as similar as possible to the originals regarding all of the parts to be included. The second step was to add to the checklist these words that would be among the first ones in Estonian children's lexicon but were not included in the original CDIs according to recordings of children's speech in everyday family interactions from previous research (e.g., Junefelt & Tulviste, 1997, Tulviste, 2003).

Pilot data were collected from 30 children belonging to the appropriate age group. Their parents were encouraged to add comments about the Estonian CDI as well as any words their children understood or produced but which were not included in the adaptation. According to analyses of these data the final adaptations of the checklists were created. We included all of the original words if any

of the parents had checked that these were understood or produced by their child. We added the words that were not included in the original if at least three of the parents had either checked those or added them to the list (e.g., potato). To keep the length of the list of words similar to the original we eliminated the words that were not checked by any of the parents and that were considered to be rarely used in Estonian (e.g., turkey).

Estonian CDIs have two versions parallel to the original CDIs. The first one is intended for children within the age range of 0;8 to 1;4 and is called CDI: Words and Gestures (henceforth ECDI: Words and Gestures). All of the parts included in the original are present in the adaptation. ECDI: Words and Gestures starts with asking if the child shows signs of understanding speech directed to the child. The lexicon list that follows contains 386 items (*vs* 396 in original) and the words are organised into the same 19 semantic categories as in the original. Parents are asked to decide on each word whether their child understands each word, or if the child understands and produces it. The list of gestures contains 60 items (*vs* 63 items in original) that are organised into the same five categories as in the original. Parents are asked to decide if their child uses those gestures. Parents are also asked to provide examples of symbolic play if their child has started to engage in it.

The other Estonian version of CDI is intended for children aged 1;4 to 2;6 and is called CDI: Words and Sentences (henceforth ECDI: Words and Sentences). The major part of it contains a 630-item (*vs* 680 in original) checklist that is organised into 21 semantic categories (*vs* 22 semantic categories in original; ECDI: Words and Sentences does not have a semantic category of Helping verbs due to properties of Estonian language) and parents have to decide for each word if they have heard their child produce it. The parents are also asked about their child's use of decontextualized language and the morphological and syntactic development, including multiword utterances.

Normative data. The normative database for ECDI: Words and Gestures included data for 1070 healthy Estonian speaking children (age range from 0;8 to 1;4, M = 1;0, SD = 2.50, 549 boys and 521 girls). Detailed age and gender distribution is presented in Table 1. Norms were described using percentile scores for each age group. As the size of gender effect to the expressive lexicon is small in this age range the norms are presented for children as a group.

Table 1. The number of children by age and gender in normative database

Gender	Child's age									Row
	0;8	0;9	0;10	0;11	1;0	1;1	1;2	1;3	1;4	**Totals**
Boys	54	58	56	61	77	66	58	73	46	549
Girls	57	55	51	54	62	62	71	61	48	521
All Groups	111	113	107	115	139	128	129	134	94	1070

RESULTS

Study I aimed to model the factors influencing production of words belonging to different semantic categories. First, we showed that the proportions of different semantic categories in Estonian children's receptive and expressive lexicon follow the same pattern that has been found in previous research in other languages (Bornstein *et al.*, 2004a; Caselli *et al.*, 1995; Fenson *et al.*, 1994; Stolt *et al.*, 2008; Wehberg *et al.*, 2007). Social terms predominate as the size of lexicon is from one word to twenty words and their proportion decreases as the size of lexicon grows larger. The proportion of Common nouns grows as the size of lexicon grows and it exceeds the proportion of Social terms when lexicon size is larger than fifty words. The proportion of Predicates grows slowly but remains at a low level. As the size of lexicon reaches more than one hundred words Social terms and Predicates take up similar proportions of lexicon. Function words remain constantly at a very low proportion. As expected when comparing older children's receptive and expressive lexicon to the younger children's lexicon, we found the number of Common nouns to be larger as well as the numbers of Predicates and Social terms, whereas the numbers of Function words remains at a low level. As we compared the numbers of gestures used by older and younger children, we found more object gestures to be used by older children while the use of deictic gestures and gestural routines did not differ as much. Secondly, we modelled the factors influencing word production in different semantic categories and found that older children have more words in each semantic category (except Function words) as expected. Also, the more gestures children used, the more they had words in each of the semantic categories. The number of words that child understood had a different effect on words production depending on the semantic category the words belonged to. If the child understood more Common nouns this had a positive effect on the production of Common nouns as well as on production of Predicates. But as the child understood more Predicates, it had a negative effect on the production of Common nouns and Social terms. In addition to this, if the mother had low level of education children tended to produce fewer common nouns and predicates. Gender and birth order effects were not as straight forward as the effects of other contributing factors.

Study II was aimed to compare the size and content of Estonian children's expressive lexicon to the findings from other languages in order to find out how cultural and language differences reflect in early lexicon. In *Study II* we repeated the main effect of age on the size of expressive lexicon we had already shown in *Study I*. At the age of 1;4 Estonian children's mean size of expressive lexicon was 43 words and median sixe of expressive lexicon was 29 words. In addition to that, we found that on average girls had a larger vocabulary than the boys at the age of 1;2 to 1;4. We also replicated the findings from *Study I* of semantic categories distribution in different vocabulary size groups. There is additional information in *Study II* regarding small lexicon sizes and more

differentiated semantic categories. The categories of Sound effects and animal sounds, Games and routines, and People prevailed as the size of expressive lexicon was smaller than 10 words. As Common nouns started to gain a larger proportion this occurred at the expense of social terms. The category of predicates was divided into semantic categories of Descriptive words and Action words. It was found that the Descriptive words start to gain in proportion as the size of expressive lexicon is larger than ten words whereas the proportion of Action words starts to rise as the expressive lexicon exceeds 51 words. As in *Study I* we also found in *Study II* that the Function words remain at a proportionally low level in each lexicon size group. We conducted content analyses of word frequency and found that in a group as a whole four of the words were used by more than in 50% of the children (*aitäh* thank you 78.1%, *nämm-nämm* yum yum 64.7%, *ema* mother 57.8%, *aidaa* bye bye 50.3%). There was only one word that more boys used compared to the girls (*põrr-põrr* vroom). The scores, distribution, and content of Estonian children's expressive lexicon were found to be similar to the findings from other languages (Caselli *et al.*, 1995; Stolt *et al.*, 2008).

Study III aimed to elaborate on possible differences in the communicative development of preterm and full term children regarding the size of expressive lexicon, proportional use of semantic categories, and mean length of utterance. We used two matched groups of full term children in order to make comparisons with preterm children's communicative development. The children belonging to the first full term group were matched regarding age and gender and they had larger expressive lexicon scores compared to the preterm group. We know from *Studies I* and *II* that as lexicon size is smaller it consists of proportionally more Social terms. We also showed in *Study III* that children in first full term group had fewer Social terms in their lexicon compared to the preterm children. In addition to that, children in first full term group had more Function words in their lexicon compared to the preterm group. The mean length of utterances was longer in the first full term group compared to the preterm group. The children belonging to the second full term group were matched not only for age and gender but also for expressive lexicon size. There were no differences in the lexicon composition or mean length of utterances between the second full term and preterm group.

Reliability and validity of adaptation of Estonian CDI

The internal consistencies for ECDI were calculated for both versions regarding each of the semantic categories included in either of the versions. For the ECDI: Words and Gestures internal consistency scores for both receptive and expressive lexicon were calculated. For the ECDI: Words and Sentences internal consistency scores were found based on expressive lexicon. The statistics for internal consistency can be found in Table 2. For most of the part ECDI shows good

semantic category internal consistency (standardized α > 0.80), the only exception to this are semantic categories that include words that children have very rarely in their expressive lexicon at the age of 0;8 to 1;4 (e.g., Quantifiers).

To evaluate test-retest reliability and validity of ECDI: Words and Gestures data for 10 children (5 boys and 5 girls) were gathered. First the mothers completed the ECDI: Words and Gestures as the children were at the age of 1;2. During the following week all mother and child pairs were videotaped at their homes in three situations – mealtime, puzzle solving, and picture book reading. The videos were transcribed. As the children turned 1;4 the mothers filled in the ECDI: Words and Gestures for the second time.

According to ECDI: Words and Gestures the mean size of receptive lexicon at the age of 1;2 was 103 words (range from 31 to 222, SD = 60.5) and at the age of 1;4 it was 184 words (range from 92 to 318, SD = 84.2). The mean size of expressive lexicon at the age of 1;2 was 11 words (range from 2 to 31, SD = 8.5) and at the age of 1;4 it was 29 words (range from 5 to 80, SD = 23.7).

Test-retest correlations were calculated for each of the semantic categories included in the ECDI: Words and Gestures. There were high correlations between test and retest scores in four semantic categories: Outside things and places to go (28 items; $r = .94$, $p < .001$), Sound effects and animal sounds (17 items; $r = .91$, $p < .001$), Small household items (34 items; $r = .91$, $p < .001$), and Vehicles (9 items; $r = .89$, $p < .001$). There were also significant correlations between the test and retest scores in four semantic categories: Animal names (34 items; $r = .73$, $p < .01$), People (17 items; $r = .69$, $p < .05$), Food and drink (29 items; $r = .62$, $p < .05$), and Games and routines (17 items; $r = .60$, $p < .05$). In the eleven of the semantic categories the correlations were either not significant or impossible to calculate due to the occasions when none of the children had said any of the words from these categories according to the parental report.

As to lexicon as a whole, receptive lexicon size at the age of 1;2 was significantly correlated to expressive lexicon size at the same age ($r = 0.75$, $p < .05$) as well as to receptive lexicon size ($r = 0.74$, $p < .05$) and expressive lexicon size ($r = 0.68$, $p < .05$) at the age of 1;4. Expressive lexicon size at the age of 1;2 was correlated to the expressive lexicon size at the age of 1;4 ($r = 0.93$, $p < .001$). The number of different words uttered by children during recordings was counted based on transcriptions. The mean number of words transcribed was three words (range from 0 to 8, SD = 2.3; one of the children did not use any words, two of them used one word, one used two words, five of them used four words, and one used eight words). Spearman correlations were calculated for the number of transcribed words and ECDI Infant Form scores. The number of transcribed words was correlated to the expressive lexicon size at the age of 1;4 ($rs = 0.66$, $p < .05$).

Table 2. Statistics for internal consistency of semantic categories in ECDI

Semantic category		N	M	(SD)	corr	α	Std α
Sound effects and ani-mal sounds	I R	17	7.54	(4.81)	.357	.903	.902
	I E		2.56	(2.80)	.230	.816	.835
	II E	15	9.13	(3.95)	.287	.854	.855
Animals names	I R	34	6.94	(7.82)	.377	.951	.953
	I E		1.54	(3.39)	.259	.908	.921
	II E	47	20.09	(13.71)	.402	.969	.969
Vehicles	I R	9	2.28	(2.34)	.398	.844	.853
	I E		0.41	(0.93)	.271	.673	.767
	II E	14	6.56	(4.33)	.405	.906	.903
Toys	I R	8	3.53	(2.49)	.370	.824	.823
	I E		0.36	(0.86)	.234	.653	.705
	II E	19	7.24	(5.57)	.390	.924	.923
Food and drink	I R	29	7.49	(7.41)	.357	.940	.943
	I E		0.86	(2.59)	.300	.910	.924
	II E	69	28.04	(20.66)	.413	.980	.979
Clothing	I R	18	5.54	(5.12)	.394	.920	.920
	I E		0.42	(1.55)	.328	.882	.896
	II E	30	11.72	(9.12)	.407	.952	.952
Body parts	I R	21	6.27	(5.70)	.372	.928	.923
	I E		0.50	(1.72)	.292	.886	.894
	II E	26	11.86	(8.35)	.478	.960	.960
Furniture and rooms	I R	22	6.49	(6.59)	.436	.944	.944
	I E		0.28	(1.34)	.272	.888	.888
	II E	34	11.05	(10.18)	.447	.965	.963
Small household items	I R	34	9.92	(9.47)	.407	.957	.958
	I E		0.95	(2.70)	.258	.905	.921
	II E	49	19.32	(15.63)	.461	.976	.976
Outside things and places to go	I R	28	4.74	(5.64)	.314	.924	.926
	I E		0.61	(1.77)	.215	.853	.865
Outside things	II E	32	11.93	(9.83)	.447	.962	.962
Places to go	II E	22	5.19	(5.06)	.335	.915	.916

Semantic category		N	M	(SD)	corr	α	Std α
People	I R	17	6.57	(3.23)	.193	.802	.796
	I E		1.53	(2.02)	.211	.776	.807
	II E	23	10.03	(5.43)	.295	.907	.903
Games and routines	I R	17	10.86	(4.62)	.328	.889	.891
	I E		2.70	(2.53)	.197	.794	.806
	II E	27	14.16	(6.66)	.295	.921	.917
Action words	I R	52	16.26	(13.85)	.369	.968	.968
	I E		1.87	(3.56)	.186	.891	.926
	II E	82	28.51	(27.01)	.517	.989	.988
Words about time	I R	8	0.65	(1.45)	.396	.827	.836
	I E		0.02	(0.21)	.165	.567	.566
	II E	15	3.06	(4.12)	.460	.925	.926
Descriptive words	I R	38	6.15	(7.59)	.321	.944	.947
	I E		0.47	(1.72)	.173	.871	.884
	II E	66	19.30	(18.11)	.396	.978	.977
Pronouns	I R	8	1.57	(2.26)	.467	.869	.874
	I E		0.13	(0.48)	.260	.546	.729
	II E	12	3.70	(3.47)	.416	.890	.893
Question words	I R	6	1.03	(1.31)	.318	.705	.731
	I E		0.05	(0.32)	.264	.665	.677
	II E	7	1.65	(2.23)	.448	.841	.842
Prepositions and locations	I R	13	3.15	(3.87)	.454	.914	.915
	I E		0.12	(0.65)	.261	.789	.815
	II E	24	7.74	(7.44)	.451	.949	.951
Quantifiers	I R	7	0.58	(1.12)	.279	.690	.726
	I E		0.05	(0.27)	.106	.456	.448
	II E	9	2.24	(2.28)	.346	.821	.823
Connecting words	II E	8	1.20	(1.91)	.454	.848	.867

Note: N – number of items in semantic category, corr – average inter-item correlations, α – Cronbach α, Std α – standardized α, I R – ECDI: Words and Gestures receptive lexicon, I E – ECDI: Words and Gestures expressive lexicon, II E – ECDI: Words and Sentences expressive lexicon

Norms for ECDI: Words and Gestures. We calculated the percentile scores for each age group regarding the number of gestures children used (see Table 3 and Figure 1), the size of receptive lexicon (see Table 4 and Figure 2), and the size of expressive lexicon (see Table 5 Figure 3) according to the parental report in ECDI: Words and Gestures. We ran Poisson regression analyses three times: first for background factors that have been shown to influence the size of expressive lexicon (including child's age, gender, birth order, and mother's education level), second for communicative development factors (including the size of receptive lexicon and number of gestures), and third for background and communicative development factors combined. All three of the Poisson regression models showed that each of the factors was significantly related to the size of expressive lexicon (see Table 6 for the comprehensive model).

Table 3. Percentile scores for Estonian children's gestures use

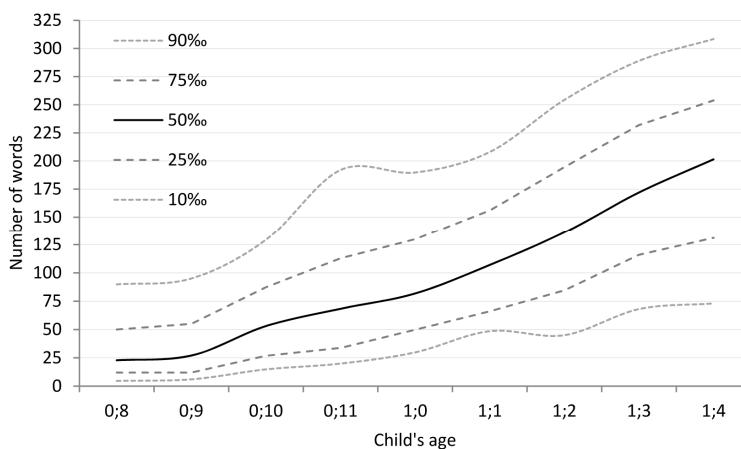| % Rank	Child's age								
	0;8	0;9	0;10	0;11	1;0	1;1	1;2	1;3	1;4
99	21	31	34	42	47	51	52	55	59
95	19	25	32	39	40	46	47	52	53
90	17	22	27	32	37	41	46	51	51
85	16	20	25	29	35	39	44	47	48
80	14	18	24	28	33	37	42	47	47
75	13	16	22	27	32	36	41	44	47
70	12	15	21	26	30	36	40	43	46
65	11	14	19	24	29	35	38	42	45
60	11	13	19	23	28	33	37	42	44
55	10	12	18	22	28	33	36	41	43
50	9	12	17	21	27	32	35	38	42
45	9	11	16	20	25	31	34	38	41
40	8	10	15	19	24	31	33	37	39
35	8	10	15	19	24	29	32	36	37
30	7	9	14	18	22	28	30	35	37
25	6	8	14	16	21	26	30	33	36
20	6	7	13	16	19	24	27	32	34
15	5	6	12	14	18	22	25	31	32
10	4	6	11	13	16	20	23	29	31
5	3	3	10	10	14	16	21	27	27
1	1	0	4	9	11	9	9	25	21
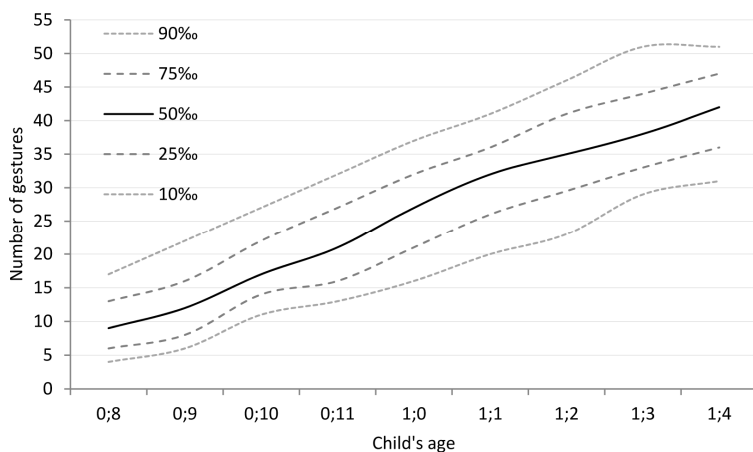
Figure 1. Number of gestures of Estonian children

**Table 4.** Percentile scores for Estonian children's receptive lexicon

% Rank	Child's age								
	0;8	0;9	0;10	0;11	1;0	1;1	1;2	1;3	1;4
99	127	198	221	279	274	283	376	340	384
95	98	134	150	231	244	247	282	318	348
90	90	95	129	192	190	208	254	289	308
85	70	79	114	152	164	192	230	269	277
80	54	58	96	128	147	176	199	247	267
75	50	55	87	113	130	156	195	232	254
70	47	48	66	93	122	144	180	214	240
65	37	40	64	80	108	128	168	201	234
60	32	33	59	76	100	118	156	193	225
55	28	28	56	71	89	113	145	186	213
50	23	27	53	68	82	107	136	172	202
45	21	23	45	58	74	99	124	165	186
40	20	21	38	52	66	93	110	149	172
35	16	16	32	47	63	83	101	141	164
30	14	14	29	39	54	73	92	130	147
25	12	12	27	34	50	66	85	116	131
20	8	11	19	27	43	58	68	106	115
15	7	9	17	23	36	51	57	91	87
10	5	6	15	20	30	49	45	68	73
5	2	2	9	10	22	34	29	47	63
1	0	1	5	4	10	14	19	22	48

Figure 2. Size of Estonian children's receptive lexicon

Table 5. Percentile scores for Estonian children's expressive lexicon

% Rank	Child's age								
	0;8	0;9	0;10	0;11	1;0	1;1	1;2	1;3	1;4
99	8	13	25	29	49	54	188	161	239
95	6	9	15	27	35	32	62	86	158
90	5	8	10	18	23	27	50	61	98
85	4	6	8	12	18	22	38	48	79
80	3	5	7	10	15	18	28	37	61
75	2	3	6	9	13	16	26	31	52
70	2	3	5	8	11	14	19	27	40
65	2	2	5	6	10	12	17	25	36
60	1	2	4	6	9	11	15	21	33
55	1	2	4	5	8	10	13	19	30
50	1	2	3	5	7	10	12	17	28
45	0	1	3	5	6	8	10	14	23
40	0	1	3	4	5	8	9	13	21
35	0	1	2	3	4	6	8	12	19
30	0	0	2	3	4	6	8	11	18
25	0	0	1	2	3	5	7	10	14
20	0	0	1	2	3	4	5	9	9
15	0	0	1	1	2	3	4	7	8
10	0	0	0	0	1	3	3	7	6
5	0	0	0	0	0	1	2	5	2
1	0	0	0	0	0	0	0	2	0
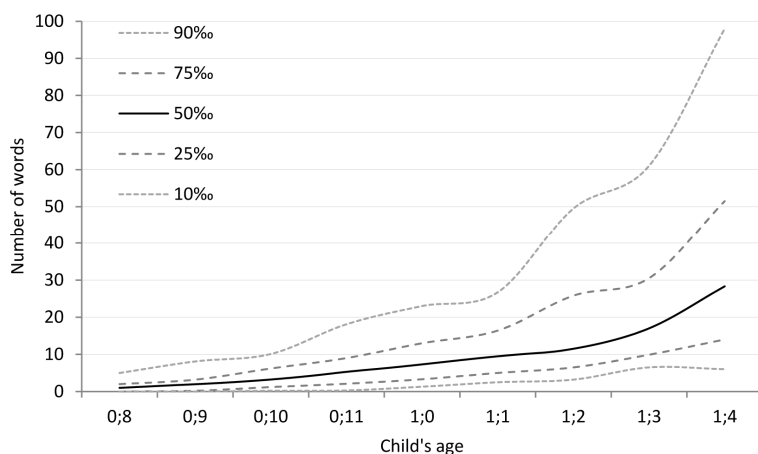
Figure 3. Size of Estonian children's expressive lexicon

Table 6. Poisson regression model for the size of expressive lexicon in Estonian children

Variable	Estimate	Standard Error	Wald Statistic	p
Intercept	-0.604	0.065	87.1	.0001
Receptive lexicon size	0.006	0.0001	2297.2	.0001
Child's age	0.141	0.006	565.2	.0001
Number of gestures	0.022	0.001	317.0	.0001
Boys *vs* girls	-0.087	0.008	108.5	.0001
Level of mother's education	-0.030	0.006	25.7	.0001
Order of birth	-0.006	0.002	10.0	.002

DISCUSSION

The first aim of this dissertation was to present the adaptation of ECDI: Words and Gestures. It has been shown in previous studies that parental reports in the form of checklists are reliable and valid tool to gather information about child's current receptive and expressive lexicon as well as about the gestures the child currently has in his or her repertoire (Fenson *et al*., 1994). While researching a young child's communicative development we have to be aware of the factors that might become obstacles. For example, young children might use particular words only in certain situations and it might be difficult to elicit these words in any other circumstances. Thus, it is especially important in the studies of young children that the information about the child comes from the person who has the most experience with the child. Most often parents are the persons spending the most time with the child and they see their children in various situations during longer periods of time. This gives them access to the whole of child's communicative development. We can gather this information from parents in different ways, recognition format checklists being one possibility (Fenson *et al*., 1994). A recognition format has other advantages in addition to being filled in by parents. It is cost effective to give to the parents a checklist of items. In this checklist they have to recognize the items that are current in their child's repertoire (Fenson *et al*., 1994). Cost effectiveness results first from the fact that compared to long term observation it takes only relatively little time to complete the checklists. Secondly, it has been shown that it is easy for the parents to decide about words and gestures that are current instead of relying on their memory for words and gestures that were used by their child a while ago (Fenson *et al*., 1994). In addition to the ease of deciding if the items are in their child's current repertoire the information provided by parents via recognition format has been shown to be highly reliable and valid (Can *et* al., 2013; Fenson *et al*., 1994).

Until now there were no checklists in Estonian therefore there was a need to either create one or adapt one of the existing tools. We chose to adapt the MacArthur-Bates Communicative Development Inventories as these had been proven to be valid and reliable in several languages (http://mb-cdi.stanford.edu/ adaptations.html). The adapted ECDIs have high internal consistencies of semantic categories both in receptive and expressive lexicon. Also, ECDI: Words and Gestures has been shown to be a valid tool. Therefore, we can conclude that ECDIs are reliable and a valid means to gather information about lexicon development. We have used ECDIs to gather and describe the normative data of Estonian children's communicative development as well as to answer questions about some aspects in communicative development.

The second aim of this dissertation was to present descriptive normative data for gestures, receptive lexicon, and expressive lexicon development in Estonian children from the age of 0;8 to 1;4. As the variability in early communicative development is high, it is essential to be able to gather large data sets to establish the communicative development norms that would enable us to decide if

child's communicative development is at an age appropriate level both quantitatively (e.g., sixe of expressive lexicon) and qualitatively (e.g., proportions of semantic categories in a child's lexicon). ECDI: Words and Gestures enables us to gather information about receptive as well as expressive lexicon in addition to the information of gestures use. ECDI: Words and Sentences enables us to gather data about expressive lexicon and grammar development including information about whether the child has started to combine single words into longer utterances and mean length of utterances. We have used both of these tools for research as these are intended for children from different ages. In this dissertation normative data is presented only for ECDI: Words and Gestures.

In early communicative development children start to understand the meaning of words and to use gestures before they say their first word. It has been shown in previous research that word comprehension appears around the age of 0;8 and 0;10 (Fenson *et al*., 1994; Stolt *et al*., 2008). The same applies to Estonian children. According to our results most of the children at the age of 0;8 already have some words in their receptive lexicon and by the age of 0;10 virtually all of the children have some words in their receptive lexicon. Thus, before children produce their first word they already understand many words and they already use gestures to communicate their own thoughts to other people. Both the number of words comprehended and number of gestures produced have been shown to be in positive correlation with word production (Acredolo & Goodwyn, 1988; Bates & Dick, 2002; Bates *et al*., 1989; Bretherton, *et al*., 1981; Fenson *et al*., 1994; Goodwyn & Acredolo, 1993; Iverson, Capirci & Caselli, 1994). In our data the same also applies, the bigger the size of receptive lexicon and the more communicative gestures the child has the more words are included in the child's expressive lexicon. In addition to this, we showed that size of receptive lexicon and number of produced gestures both contribute independently and positively into the size of expressive lexicon. Children have been shown to have a few words in their expressive lexicon around their first birthday (Bates *et al*., 1994; Fenson *et al*., 1994; Stolt *et al*., 2008). Estonian children have about three to thirteen words in their expressive lexicon at the age of 1;0 with only a few children who do not have any words yet in their expressive lexicon. It has been shown previously that there is high variance in the early language development (e.g., Fenson *et al*., 1994), and the same holds for Estonian children as well. However, it is important to pay attention to the fact that starting from the age of 1;0 only 10% of the children have one word or no words at all in their expressive lexicon. After saying their first words children's expressive lexicon has been shown to grow at a steady pace up to a point around the age of 1;3 when they start to produce increasingly more new words (Goldfield & Reznick, 1990; Stolt *et al.*, 2008). This can be observed in Estonian children, too.

In addition to this, gender and birth order have been shown to have an effect on children's communicative development. Girls and first born children are oftentimes found to have slight advantage in lexicon development (Bornstein *et al*., 2004b; Eriksson *et al*., 2012; Fenson *et al*., 1994; Galsworthy *et al*., 2000;

Goldfield & Reznick, 1990; Hoff, 2006; Stolt *et al*., 2008). Our regression model replicated this slight advantage both for girls and for first born children. Thus we can conclude that in Estonian children's early communicative development gender is one of the factors that has impact on communicative development, similar to that found in some of the earlier studies (Bornstein *et al*., 2004b; Eriksson *et al*., 2012; Fenson *et al*., 1994; Galsworthy *et al*., 2000; Stolt *et al*., 2008). However, it is worthwhile to note that gender differences before the age of 1;4 have rarely been found (Eriksson *et al*., 2012; Fenson *et al*., 1994), the earliest age that gender differences are found consistently starts around the age of 1;8 (Bornstein *et al*., 2004b). First born children have been found to have larger expressive lexicon reported by mothers in earlier studies (Bornstein, *et* al., 2004c; Hoff, 2006), and this also applies to Estonian children's expressive lexicon size. Being the only child (as it oftentimes is for firstborns at the age we looked at) comes with the opportunity to be the focus of their parents' attention. This could mean that the first born children experience more child directed speech which has been shown to have beneficial effects to lexicon development (Huttenlocher *et al*., 1991; Rowe *et al*., 2012). On the other hand, this could also mean that mothers are more aware of the words their first born children are using, thus the reports they fill in are more complete. Receptive lexicon and gestures use development precedes expressive lexicon development in Estonian children (see Fenson *et al*., 1994; Stolt *et al*., 2008 for findings in English and Finnish respectively). Estonian children start to understand words at around the age of 0;8 and produce words at around the age of 0;10 as are the children who are acquiring other languages and the growth curve of expressive lexicon of Estonian children is similar to that of children from other languages (Caselli *et al*., 1995; Stolt *et al*., 2008; see also S*tudy II*).

Next we turned to the question about connection of different categories of words in receptive lexicon and different types of gestures to different categories of words in expressive lexicon. Categorizing of words started with the works of Nelson (1973) who demonstrated that the Nouns are dominant in children's expressive lexicon after it has reached 50 words. Later, Bates and colleagues (1994) separated the categories of Predicates and Closed-class items within the category of Non-nouns. Predicates start to gain in proportion as the size of expressive lexicon exceeds 200 words and Closed-class items are used rarely throughout early communicative development. Caselli and colleagues (1995) continued to differentiate semantic categories. They separated Social terms from the category of Common nouns. They also differentiated Action words and Descriptive words within the category of Predicates. The developmental pattern regarding different categories of words has been demonstrated to start with Social terms, to continue with Common nouns, and the use of Predicates. In Studies I and II we demonstrated that the first word of Estonian children tends to belong either to the category of Sound effects and animal sounds or to the category of Games and routines. As the size of expressive lexicon grows up to ten words most of the words are Social terms, including words from the two categories mentioned previously as well as words from the category of People.

Next, Common nouns start to gain in proportion and become dominant when the size of expressive lexicon reaches the 50 words criterion. It is important to take note that this happens regardless of the finding that Estonian mothers' child directed speech has more directives in it compared to the child directed speech from other languages where noun dominance has been demonstrated (Junefelt & Tulviste, 1997; Tulviste, Mizera & De Geer, 2004). The proportion of Descriptive words starts to grow at a lower lexicon size compared to the growth of proportion of Action words. Predicates remain at a lower proportional level compared to Common nouns regardless of the lexicon size. Function words take up only a small proportion of lexicon regardless of its size.

As to factors influencing the expressive lexicon size in different semantic categories we found that the more Common nouns children understood the larger was their lexicon in the categories of Common nouns and Predicates. However, if children understood more Predicates, the size of lexicon in the categories of Common nouns and Social terms was smaller. Thus, it is important to pay attention not only to the size of child's receptive lexicon but also to its content. Gestures can be categorized into three subcategories: deictic gestures that gain meaning via pointing to an object or an event and appear before children start to talk, object gestures that reflect functions of objects and are positively correlated with the size of expressive lexicon, and gestural routines that are used in everyday social interactions. In *Study I* we showed that the number of object gestures used by the children is larger if we compare older children to younger ones. Thus, in Estonian children too, we can observe a positive correlation between the number of object gestures and the size of expressive lexicon. In addition to this, we found that object gestures use as well as the use of gestural routines contributed positively to expressive lexicon size in each of the semantic categories.

It was of interest to examine whether Estonian children's communicative development is affected by the properties of Estonian language. Estonian is a morphologically rich language. Morphological richness applies both to nouns and verbs in Estonian. Nelson (1973) showed that nouns dominate in the expressive lexicon as the size of lexicon approaches fifty words and it has been theorised that the morphological richness of verbs might be one of the possible reasons for noun dominance in English speaking children (Gentner, 1982; Slobin 1973). According to this theory, we might assume that lexicon development is slower in Estonian because of its rich morphology. Contrary to this however, there is research that has shown that morphological richness of verbs does not slow down the pace of acquiring verbs (Xantos et al., 2011). In addition to this we know from previous studies that the rate of lexicon development in Finnish children does not appear to be affected by the rich morphology of Finnish (Stolt et al., 2008). So, it is possible that the rich morphology of the Estonian language does not have an effect on the rate of lexicon development. The results from Study II support the later viewpoint. We found that Estonian children's expressive lexicon size at different ages from 0;8 to 1;4 is comparable to that of children acquiring Italian, English, and Finnish. As the

rate of the expressive lexicon growth is similar to that of children from other languages we can also infer that the smaller amount of child-directed speech does not have a negative effect on Estonian children's expressive lexicon size at the age of 0;8 to 1;4.

In addition to age, gender, and properties of child-directed speech it has been shown by many previous studies that preterm birth has an effect on communicative development. Often preterm born children have been found to start to say their first words at a later age and have smaller expressive lexicon sizes compared to the children born full term (Foster-Cohen *et al*., 2007; Kern & Gayraud, 2007). It is important to keep in mind that preterm birth can be accompanied by several medical problems with different severity levels and if healthy preterm children's lexicon development is compared to full term children's lexicon development no differences were found (Perez-Pereira, Fernandez, Gomez-Taibo & Resches, 2014). *Still, it is important to ascertain if the language development of children born preterm is qualitatively different from the language development of children born full term if differences in language development are found in preterm and full term children.* In *Study II* we found that if lexicon size is matched in addition to the age and gender then there are no differences in semantic categories proportions in the children's lexicon. In addition, the mean length of utterances was similar in both preterm and full term groups, if matching took the size of expressive lexicon into account. If matching was done based on age and gender, then the expected differences appeared, as the preterm born children then had smaller expressive lexicon containing proportionally more Social terms and fewer Function words. Preterm children also had a shorter mean length of utterances compared to full term children's mean length of utterances as matching was done based only on age and gender.

Limitations and future plans

Using the parental report as cross-sectional data gathering means has some limitations. Two of these seem to be the most relevant. Firstly, cross-sectional research does not enable us to follow individual growth curves of children's communicative development. Therefore in future we intend to conduct a longitudinal study to compare the results with those obtained by carrying out cross-sectional research. Secondly, ECDI: Words and Gestures is too long to be used as a quick screening tool in the medical context. Therefore, we will start to create a shortened form that would make it more usable for general practitioners and paediatricians.

Conclusions and practical implications

As we know from earlier research academic achievement (e.g., Young *et al.*, 2002) and social competence (e.g., Commodari, 2013) are dependent on communicative development. Thus, it is of great importance to have knowledge about onset and rate of communicative development as well as about the regular communicative development patterns. Published research about Estonian children's early communicative development has been scarce and norms for early communicative development based on a particular research method have been lacking. This dissertation aimed to give an overview of some of the aspects of Estonian children's early communicative development and presented norms of early gestural use, receptive lexicon size, and expressive lexicon size. This knowledge gives us the possibility of noticing differences from normative data and of starting to investigate the reasons for these differences. Also, if we have means to notice possible communicative development problems at an early age then we are able to begin to discover the causes and starting to develop interventions before secondary problems arise.

According to the data gathered with ECDI: Words and Gestures the development of Estonian children's early communicative development is highly similar to that of children acquiring other languages. Estonian children understand their first words around the age of 0;8 and say their first words (*aitäh* thank you, *nämm-nämm* yum yum, *ema* mother, *aidaa* bye bye) around the age of 0;10. Most of the children say more than seven words at the time of their first birthday and at the age of 1;4 the number of words in expressive lexicon has grown four times; thus more than a half of the children say at least 28 words at that age.

Gender differences in early expressive lexicon size do not appear before the age of 1;2 to 1;4. So girls seem to reach the acceleration of lexicon earlier but up to that age the number of words in girls' and boys' expressive lexicon is virtually the same.

Estonian children start to use first the words from Social terms category and noun dominance appears as the size of lexicon is around 50 words. Descriptive words are acquired sooner than the Action words but for the predication to happen, children have to have big enough lexicon to start to combine words into longer utterances. Function words are not used often by children who are just starting to talk. To have many Common nouns in a child's receptive lexicon appears to be helpful in acquiring a larger expressive lexicon in general. But as a child has more Predicates in their receptive lexicon their expressive lexicon tends to be smaller. In addition to this, to have many gestures and thus be able to practice communication facilitates expressive lexicon development.

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SUMMARY IN ESTONIAN

Eesti laste esimesed sõnad: suhtlemise varane areng

Selle väitekirja teemaks on suhtlemise varane areng alates sõnadest arusaamisest ja žestide kasutamisest kuni esimeste sõnade ütlemiseni ja sõnavara suurenemiseni. Suhtlemise varase arengu ja seda mõjutavate tegurite uurimine on oluline, sest edaspidine areng (sealhulgas näiteks täidesaatvate funktsioonide, lugemisoskuse, loetust arusaamise, arvutamisoskuse, õppeedukuse oma) sõltub varasest suhtlemise arengust. Riskitegurite väljaselgitamine võimaldab kavandada sekkumistegevusi varase suhtlemise arengu toetamiseks. Väitekirja üheks eesmärgiks on esitada andmed 0;8^4 kuni 1;4 vanuste eesti laste suhtlemise tavapärase arengu kohta. Nende andmete kogumiseks kasutasime meie endi poolt eesti keelde kohandatud MacArthuri ja Batesi suhtlemise arengu küsimustikku (edaspidi CDI): sõnad ja žestid. Esitame normandmed ja kirjeldame, millised tegurid mõjutavad varase ekspressiivse sõnavara suurust. Keskendume sellele, kuidas erinevatesse kategooriatesse kuuluvate sõnade mõistmine ja žestide kasutamine mõjutab ekspressiivse sõnavara koostist. Uurime, milline mõju on eesti keele morfoloogilisel rikkusel laste ekspressiivse sõnavara suurusele ja koostisele. Lisaks võrdleme enneaegselt ja ajaliselt sündinud laste suhtlemise arengut vanusevahemikus 1;6 kuni 2;1. Viimasena nimetatud andmete kogumiseks kasutasime suuremate laste uurimiseks mõeldud mõõtevahendit CDI: sõnad ja laused.

Esimese uurimusega näitasime, milline on semantiliste kategooriate proportsionaalne jaotus eesti laste varases retseptiivses ja ekspressiivses sõnavaras. Leidsime, et kui sõnavara on väiksem kui kakskümmend sõna, kuulub suurem osa kasutatavatest sõnadest sotsiaalsete väljendite hulka. Nimisõnad hakkavad sõnavaras domineerima alates sellest, kui sõnavara on suurem kui viiskümmend sõna. Teistesse kategooriatesse kuuluvaid sõnu kasutavad lapsed vähe. Žestide puhul muutub enim objektižestide kasutamine. Nimelt kasutavad vanemad lapsed rohkem objektižeste kui nooremad lapsed. Regressioonanalüüsi tulemusena selgus, et laste poolt kasutatava sõnavara suurus sõltub sellest, millistesse kategooriatesse kuuluvad nende poolt mõistetavad sõnad ja kasutatavad žestid. Mida suuremast hulgast nimisõnadest laps aru sai, seda rohkem oli tema sõnavaras nii nimisõnu kui ka predikaate; kui aga laps sai aru enamatest predikaatidest, oli tema sõnavaras vähem sotsiaalseid väljendeid ja nimisõnu.

Teises uurimuses võrdlesime eesti laste ekspressiivse sõnavara suurust ja koostist teisi keeli emakeelena omandavate laste sõnavaraga. Tulemusena leidsime, et vanuses 1;4 on eesti laste sõnavaras keskmiselt 43 sõna, kui lähtuda aritmeetilisest keskmisest või 29 sõna, kui lähtuda mediaanist. Need väärtused on sarnased sõnavara suurusele, mis on leitud teisi keeli omandavate laste puhul. Leidsime, et poiste ja tüdrukute sõnavara suurus on sarnane vanuses 0;8 kuni 1;1 ning alles vanuses 1;2 kuni 1;4 on tüdrukute sõnavara suurem poiste sõnavarast. Lisaks kordasime ja täpsustasime *esimeses uurimuses* kirjeldatud

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^{4} Vanus on esitatud kujul aastad;kuud.

tulemust eri kategooriatesse kuuluvate sõnade proportsionaalse jaotuse kohta sõnavaras. Sõnavara sisu analüüsist selgus, et vähemalt pooled valimisse kuulunud lapsed kasutasid nelja sõna, mis olid esitatud CDIs: sõnad ja žestid; nendeks olid *aitäh* (78,1% lastest)*, nämm-nämm* (64,7% lastest)*, ema* (57,8% lastest) ja *aidaa* (50,3% lastest).

Kolmandas uurimuses võrdlesime enneaegselt ja ajaliselt sündinud laste sõnavara suurust ja koostist ning keskmist lausungi pikkust. Kui moodustada ajaliselt sündinud laste võrdlusgrupp laste vanuse ja soo alusel, on võrdlusgrupi sõnavara enneaegselt sündinud laste omast suurem. Lisaks on sellisel juhul enneaegselt sündinud laste sõnavaras proportsionaalselt rohkem sotsiaalseid väljendeid ja vähem funktsioonisõnu kui ajaliselt sündinud lastel . Samuti on sellisel juhul enneaegselt sündinud laste keskmine lausungi pikkus lühem kui ajaliselt sündinud lastel. Kui aga moodustada ajaliselt sündinud laste võrdlusgrupp lisaks vanusele ja soole ka sõnavara suurusest lähtudes, ei ilmne erinevusi kahe grupi sõnavara koostises ega keskmises lausungi pikkuses.

Lisaks esitasime CDI: sõnad ja žestid reliaabluse ja valiidsuse näitajad ning testitulemuste normandmed žestide kasutamise, retseptiivse ja ekspressiivse sõnavara suuruse kohta vanuses 0;8 kuni 1;4.

Nende tulemuste juures tuleb arvestada mõne olulise piiranguga. Esiteks on tegemist läbilõikeandmetega, mis ei võimalda teha järeldusi individuaalse sõnavara muutuste kohta. Seega tuleks teha pikaajaline uuring, et võrrelda saadud andmeid läbilõikeandmetega. Teiseks on CDI: sõnad ja žestid sõnade nimekiri liiga pikk, et seda saaks kasutada kiire esmase hindamise vahendina näiteks arstide poolt. Sellest tulenevalt on oluline koostada CDI: sõnad ja žestid lühiversioon, mis seda võimaldaks.

Kokkuvõtteks, eesti laste varane suhtlemise areng sarnaneb teisi keeli emakeelena omandavate laste suhtlemise arengule. Eesti lapsed saavad esimestest sõnadest aru umbes kaheksa kuu vanuselt ning ütlevad oma esimese sõna umbes kümne kuu vanuselt. Esimese sünnipäeva paiku kasutavad eesti lapsed kõnes keskmiselt seitset sõna ning neli kuud hiljem 28 sõna. Poiste ja tüdrukute vahelised erinevused sõnavara suuruses hakkavad ilmnema vanusevahemikus 1;2 kuni 1;4, mil tüdrukute sõnavara on suurem poiste omast. Esimesed sõnad kuuluvad sotsiaalsete väljendite hulka, nimisõnad hakkavad domineerima siis, kui sõnavara on suurem kui 50 sõna. Omadusi tähistavad sõnad omandatakse varem kui tegevusi tähistavad sõnad. Funktsioonisõnade kasutamine suhtlemise arengu varases perioodis on harv. Rohkematest nimisõnadest arusaavate laste produktiivne sõnavara on suurem, samas kui suuremat hulka predikaate mõistvate laste ekspressiivne sõnavara on pigem väiksem. Lisaks sellele on suurem sõnavara neil lastel, kes kasutavad enese väljendamiseks rohkem žeste.

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Publications:
1. Schults, A., Tulviste, T. (2016). Composition of Estonian infants' expressive lexicon according to the adaptation of CDI / Words and Gestures. *First Language*, x−x [in press].
2. Schults, A.; Tulviste, T. (2015). The very first words of Estonian children: A comparison of two parental report types. *Advances in Pediatric Research*, 2(14), 10.12715/apr.2015.2.15.
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