Annette Nylund

Factors in the Child´s Growing Environment Influencing Early Vocabulary Development

Åbo Akademi University

Factors in the Child´s Growing Environment Influencing Early Vocabulary Development

Annette Nylund

Speech and Language Pathology
Faculty of Arts, Psychology and Theology
Åbo Akademi University
Åbo, Finland, 2023

Supervised by:

Docent Pirkko Rautakoski, PhD
Department of Speech and Language Pathology
Åbo Akademi University, Finland

Professor Ville Peltola, MD, PhD
Department of Pediatrics
Institute of Clinical Medicine
University of Turku
Department of Pediatrics and Adolescent Medicine
Turku University Hospital, Turku, Finland

Professor Viveka Lyberg Åhlander, PhD
Department of Speech and Language Pathology
Åbo Akademi University, Finland

Reviewed by:

Professor Christina Samuelsson, PhD
Department of Clinical Science, Intervention and Technology
Karolinska Institutet, Sweden

Docent/Associate Professor Lucyna Schalén, MD, PhD
prev Department of Logopedics, Phoniatrics and Audiology
Lund University, Lund, Sweden

Opponent:

Professor Christina Samuelsson, PhD
Department of Clinical Science, Intervention and Technology
Karolinska Institutet
Sweden

ISBN 978-952-12-4255-7 (printed)
ISBN 978-952-12-4256-4 (digital)
Painosalama, Turku, Finland 2023

Acknowledgements

These studies have been carried out at the Faculty of Arts, Psychology and Theology at Åbo Akademi University. The work has been supported by Kommunalrådet C.G. Sundells stiftelse.

My sincerest thanks to all the families that have volunteered to take part in the STEPS Study. Without you giving of your precious time to complete formulas, sending in samples, and sharing your life, there would be much less knowledge about the development of young children.

I am sincerely thankful to the reviewers of this thesis Professor Christina Samuelsson and Docent Lucyna Schalén for all valuable comments and kind suggestions to improve the thesis. I am also very grateful to Professor Christina Samuelsson for acting as my opponent at the public defence.

I wish to express my deepest gratitude to my supervisor Pirkko Rautakoski, PhD, who challenged me to come to Turku and to start my PhD studies at the Department of Speech and Language Pathology at Åbo Akademi University. I am so grateful for all your advice, wise thoughts, and for always giving of your time and having a good word of encouragement. I cannot imagine the endless number of hours you have spent reading and reviewing my texts.

I also owe my deepest gratitude to my other supervisor Ville Peltola, MD, PhD, for opening the interesting world of respiratory tract infections and guiding my first stumbling steps in writing articles. Your patience has been huge. I am also thankful to Professor Viveka Lyberg Åhlander who stepped in as a supervisor at the last yards of this journey. I am so grateful for all support and help you have given, always seeing possibilities.

I would like to express my sincere gratitude to Pirjo Korpilahti. You have shared of your excellent knowledge in child research and how to write concisely. Thank you for reminding me of the possibility to shorten up my looooong sentences. I am deeply grateful to all co-authors: Dr Pirkko Rautakoski, Dr Ville Peltola, Dr Pirjo Korpilahti, Dr Viveka Lyberg Åhlander, Dr Laura Toivonen (for all valuable comments, suggestions, and small greetings of encouragement once in a while), Dr Anne Kaljonen (for doing the statistics and guiding me into the world of analysis and statistical terminology, and always ready to help), and Dr Piia af Ursin (for giving of your valuable time to brainstorm and for sharing your insight into SEM analysis. I have enjoyed the collaboration!).

My sincerest thanks to Susanna Sid who was the first to introduce me to the STEPS Study in its initial phase. You also encouraged me to become a visiting lecturer at Åbo Akademi, which prepared the way for my doctoral studies. I would also express my profound gratitude to all my colleagues at the department of Speech and Language Pathology at Åbo Akademi University for giving me the time and the encouragement to focus on writing the thesis and sometimes substituting me in courses: Viveka Lyberg Åhlander, Pirkko Rautakoski, Anna Schmidt, Catharina Nordström, Leena Maria Heikkola, Stina Sundstedt, Johan Mårtensson, Sonja Tuxen Borlaug, Jannica Lindholm, Elvira

Kaiser, Sofia Holmqvist-Jämsén, Greta Wistbacka, Mirjam Forsbäck, Julia Manelius, Sonja Haga-Erickson, Leena Tuomiranta, and Kerttu Huttunen.

Sincerest thanks to all my former and current co-doctoral students. You have been good examples and we have shared different aspects of the life as a PhD student. Especially, I would like to mention Jenny Lindgren who took time to introduce me to the world of research during a meal of Indian food. I am also so grateful to Eva Ståhlberg-Forsén for all research discussions during lunch time or late in the evenings over a cup of coffee. And thank you Denice Ollas-Skogster for taking time to comment my text and to answer questions. My gratitude goes also to our big PhD seminar family at Turku University and Åbo Akademi University. Thank you for encouragements and for all hard questions which helped me to look deeper into different issues.

I am grateful to Associate Professor Kristina Hansson for taking the time to read and comment the thesis in progress at a 90% seminar in 2022. Your valuable advice has improved this thesis significantly. I have also had the privilege to consult Senior Researcher Eero Laakkonen and Lecturer Jouko Katajisto regarding statistics and analysis. Thank you for your valuable help. Without the help of a skilful and fast language editor this thesis would not have been done. Thank you Adelaide Lönnberg for the patience to correct the same misspellings, time after time, and for good advice.

This part would not be complete, without mentioning all the students at the department of Speech and Language Pathology at Åbo Akademi University. Thank you, for challenging me with questions and letting me share some of your journey to become future colleagues.

I am also sincerely thankful to my clinical mentor and role model (since the time of being a SLP student) Gitta Lönnqvist. The book you gave me when I entered this new phase, “Humlans hemlighet” (The secret of the bumblebee) was of great encouragement when I took my first shaky steps. Thank you Gunilla Öller for encouraging me to do research and to apply for the position as a university teacher in Åbo.

I would also like to thank my parents and my sister with family for always encouraging, praying, and cheering me. You are so dear to me. And most of all thanks to my dear Magnus for giving me the possibility to do this! You have always been there to support me, even in times with a very tired and absent-minded wife. Above all, thank you for loving and praying for me. Love you more than I can tell.

Finally, my greatest appreciation goes to the One who is my wisdom and my strength.

Karis, January 2023

Annette Nylund

Annette Nylund

Abstract

Studies of early language development show a wide variability between children, especially in vocabulary size. Despite several earlier studies, there are still many open questions about which factors influence the variation in early vocabulary. Trajectories of language development are already established during the first few years, which is why this age is optimal to study.

The main aim of the thesis was to study environmental and biological factors influencing vocabulary development between 13 and 24 months of age. We also investigated whether these factors relate differently to vocabulary development in boys and girls.

All four studies in the thesis are sub-studies to Steps to the Healthy Development and Well-being of Children (the STEPS Study), a longitudinal prospective birth cohort study. The participants were recruited from an eligible cohort of 9,811 families, of which 1,797 with 1,805 children chose to participate in the STEPS Study. Number of participating children in *Study I* was 646, *Study II* 420, *Study III* 685, and *Study IV* 719 children.

S*tudies I* and *II*, analysed the significance of recurrent respiratory tract infections (RTIs) on vocabulary size at 13 and 24 months of age and on vocabulary growth between 13 and 24 months of age in boys versus girls. *Study III* focused on the influence of paternal factors on vocabulary growth and *Study IV* analysed vocabulary growth in lexical categories in relation to child and family factors. The results of the studies show that recurrent RTIs are not a risk factor for vocabulary growth. The study results also show a significant difference between vocabulary growth in boys and girls. A difference between vocabulary growth in boys and girls was also observed in relation to risk and background factors. Vocabulary size at 13 months of age predicted vocabulary growth between 13 and 24 months of age in boys, but not in girls. Boys with fathers working less than full time had a larger vocabulary growth compared to boys with fathers fully employed. A maternal high level of occupation predicted larger vocabulary growth in boys compared to boys with mothers of lower occupational status. Girls with fathers having a high level of occupation had again, a larger vocabulary growth compared to girls with fathers of lower occupational status. The differences, between boys and girls, in how vocabulary growth is related to environmental and biological factors was also observed in the growth of lexical word classes. In boys, a family burden of late onset of speech related negatively to vocabulary growth in all lexical categories except for *sound effects*. Boys in day care at 24 months of age had a larger vocabulary growth in the lexical category of *sound effects*. Girls attending day care at 24 months of age were predictive of larger growth in the lexical categories *sound effects*, *nouns*, *people words*, and *games and routine words*. Firstborn girls had a larger growth in the lexical categories of *descriptive* and *functional words*.

The present thesis shows that variation between boys and girls can be found not only in vocabulary size but also in vocabulary growth already at 13–24 months of age. It emphasizes environmental and biological factors related to

early vocabulary growth and demonstrates that early vocabulary growth in boys and girls relates differently to these factors. The thesis highlights the need to analyse factors influencing language development separately in boys and girls. Doing so will give us a more comprehensive picture of differences between vocabulary growth in boys and girls and help ensure the best possible trajectory in language development.

Sammanfattning

Studier av den tidiga språkutvecklingen hos barn visar på en stor variation mellan barn, framför allt i ordförrådets storlek. Trots en mångfald av tidigare studier finns det ännu öppna frågor om vilka faktorer som inverkar på variationen i tidigt ordförråd. Utvecklingsförloppet för barnets språkutveckling läggs redan under de första åren, vilket gör denna ålder viktig att undersöka.

Avhandlingens målsättning var att utreda omgivningsfaktorers och biologiska faktorers inverkan på ordförrådets utveckling mellan 13 och 24 månaders ålder. Vi analyserade även om dessa faktorer inverkade olikt på pojkars och flickors ordförrådsutveckling.

Alla fyra studier I avhandlingen är delstudier I Nycklarna till en god tillväxt (to Steps to the Healthy Development and Well-being of Children, the STEPS Study), som är en longitudinell, prospektiv kohortstudie. Deltagarna rekryterades från en kvalificerad kohort på 9811 familjer, av vilka 1797 familjer med 1805 barn valde att ingå i STEPS studien. Antalet deltagare i studierna fördelade sig enligt följande, *Studie I* 646, *Studie II* 420, *Studie III* 685 och *Studie IV* 719 barn.

Studie I och *Studie II* analyserade betydelsen av återkommande luftvägsinfektioner på ordförrådets storlek vid 13 och 24 månaders ålder och på ordförrådstillväxten mellan 13 och 24 månaders ålder hos pojkar och flickor. *Studie III* fokuserade på betydelsen av pappan för ordförrådets tillväxt och *Studie IV* analyserade betydelsen av barn- och familjefaktorer på utvecklingen av lexikala kategorier i ordförrådet. Studieresultaten visar på att återkommande luftvägsinfektioner inte är en riskfaktor för tidig ordförrådsutveckling, varken hos pojkar eller flickor. Det framkom även en skillnad i hur pojkars och flickors ordförrådsutveckling relaterade till risk- och bakgrundsfaktorer. Ordförrådets storlek vid 13 månaders ålder predicerade hos pojkar ordförrådsutvecklingen mellan 13 och 24 månaders ålder. Så var inte fallet för flickor. Pojkar i familjer där pappan jobbade mindre än heltid hade en större ordförrådstillväxt jämfört med pojkar där pappan arbetade heltid. Mammor med högre tjänsteställning var associerat med större ordförrådsutveckling hos pojkar i jämförelse med pojkar där mamman hade en lägre tjänsteställning. Däremot hade flickor en större ordförrådstillväxt om deras pappa hade en högre tjänsteställning jämfört med flickor där pappan inte hade det. Skillnaden mellan pojkar och flickor i hur ordförrådets tillväxt relaterade till omgivnings- och biologiska faktorer kunde även märkas i tillväxten av lexikala kategorier. Pojkar där det i släkten fans en historia av sen talstart hade en lägre tillväxt i alla lexikala kategorier förutom kategorin *ljudeffekter*. Däremot hade pojkar som varit i dagvård vid 24 månaders ålder en större tillväxt enbart i den lexikala kategorien *ljudeffekter*, medan flickor som varit på daghem vid 24 månaders ålder var associerat med en större tillväxt i de lexikala kategorierna *ljudeffekter*, *substantiv*, *personord* och *lek- och*

rutinord. Förstfödda flickor hade en större tillväxt i de lexikala kategorierna *beskrivande ord* och *funktionsord*.

Avhandlingen visar att det finns en skillnad mellan pojkar och flickor inte enbart i ordförrådets storlek utan också i ordförrådets tillväxt mellan 13 och 24 månaders ålder. Resultaten understryker betydelsen av biologiska och omgivningsfaktorer för ordförrådets tillväxt och påvisar att ordförrådstillväxten hos flickor och pojkar relaterar på olika sätt till dessa faktorer. Avhandlingen markerar behovet av att analysera faktorer som inverkar på språkutvecklingen separat för pojkar och flickor. Detta ger en mer djupgående bild av skillnader i ordförrådsutvecklingen hos pojkar och flickor och möjliggör stödåtgärder för ett gott utvecklingsförlopp.

List of original publications

I. Nylund, A., Toivonen, L., Korpilahti, P., Kaljonen, A., Peltola, V., & Rautakoski, P. (2019). Recurrent respiratory tract infections or acute otitis media were not a risk factor for vocabulary development in children at 13 and 24 months of age. *Acta Peadiatrica, 108*(2), 288–294. https://doi.org/10.1111/apa.14546

II. Nylund, A., Toivonen, L., Korpilahti, P., Kaljonen, A., Lyberg Åhlander, V., Peltola, V., & Rautakoski, P. (2022) Influence of respiratory tract infections on vocabulary growth in relation to child´s sex: the STEPS Study. *International Journal of Environmental Research and Public Health, 19*(23). https://doi.org/10.3390/ijerph192315560

III. Nylund, A., Korpilahti, P., Kaljonen, A., & Rautakoski, P. (2022). Associations of Paternal Factors and Child´s Sex with Early Vocabulary Development – the STEPS study. *First Language, 0*(0). https://doi.org/10.1177/01427237221133623

IV. Nylund, A., af Ursin, P., Korpilahti, P., & Rautakoski, P. (2021). Vocabulary Growth in Lexical Categories Between Ages 13 and 24 Months as a Function of the Child's Sex, Child, and Family Factors. *Frontiers in Communication, 6.* https://doi.org/10.3389/fcomm.2021.709045

Table 1
Thesis at a Glance

Study	Study aim	Method	Results	Conclusion
I	Is there a relationship between recurrent respiratory tract infections (RTIs) or acute otitis media (AOM) during the first and/or second year of life and early vocabulary size (receptive and expressive) at age 13 months and expressive vocabulary size at 24 months?	*N* = 646 (338 boys, 308 girls at 13 months; 278 boys, 244 girls at 24 months) *Outcome*: receptive vocabulary size at 13 months of age, expressive vocabulary size at ages 13 and 24 months *Risk factors*: recurrent RTIs and AOM episodes at 0–12 & 13–23 months *Background factors*: gender, parental level of education & occupation, family income, parental chronic illness, day care attendance	Children with recurrent RTIs and AOM did not have smaller receptive or expressive vocabulary size at age 13 months, or smaller expressive vocabulary size at 24 months compared to less sick children. Girls had larger vocabulary size than boys. High parental socioeconomic status was associated with larger vocabulary size at age 24 months.	At least on a group level at two specific ages a burden of RTIs and AOM do not seem to have negative effects on vocabulary size. The study focused on vocabulary size at two different time points, but not necessarily for the same children. A study measuring vocabulary growth between the two time points could possibly give a more precise result, given that the children measured at 13 and 24 months of age would be the same.
II	Does expressive vocabulary growth between ages 13 and 24 months differs in boys vs girls with and without recurrent RTIs and AOM and in relation to background factors?	*N* = 462 (248 boys, 214 girls) *Outcome*: vocabulary growth between ages 13–24 months *Risk factors*: recurrent RTIs and AOM 0–12 & 13–23 months *Background factors*: day care attendance, parental level of education and occupation *Control variables:* vocabulary size at 13 months of age, siblings	Boys with recurrent RTIs at 13–23 months had larger vocabulary growth. Larger expressive vocabulary at 13 months also predicted larger vocabulary growth in boys. In comparing mean vocabulary size, paternal high education and parental high level of occupation were associated with a larger mean vocabulary growth in boys, but not in girls.	No restrictions of vocabulary growth because of RTIs were found. There were associations between risk and background factors and vocabulary growth only in boys, not in girls. There is a need to study more early language development as a function of the child´s sex and how this development is related in boys vs girls.

Table 1 *(continued)*

III	How do paternal factors (working full time, taking paternal/paternity leave, hours spent with the child, high education, and occupational status) relate to vocabulary growth during the second year of life in boys vs girls?	*N* = 385 (354 boys & 331 girls) *Outcome:* vocabulary growth between ages 13 and 24 months. *Paternal factors:* working full time, use of paternal/parental leave, hours spent with the child, high level of education and occupation *Control variables:* maternal high level of education and occupation, and vocabulary size at 13 months of age	Paternal full-time employment predicted less vocabulary growth in boys, but larger vocabulary size at 13 months, and maternal high level of occupation predicted larger vocabulary growth in them. Paternal high level of occupation predicted larger vocabulary growth in girls	Vocabulary growth in boys and girls reacts differently to environmental factors. Vocabulary growth in boys seem to be more dependent on their father working less, whereas vocabulary development in girls benefits from fathers working as professionals
IV	Are child and parental factors related to differences in early growth in lexical categories and are these factors equally related to lexical growth in boys vs girls?	*N* = 719 (369 boys & 350 girls) *Outcome*: vocabulary growth in lexical categories between ages 13 and 24 months *Child factors:* firstborn status, day care attendance *Family factors:* parents´ educational and occupational levels, family burden of late onset of speech	Day care attendance at 24 months of age predicted in boys a larger vocabulary growth only in the category *sound effects*, but in girls in the categories *sound effects*, *nouns, people*, and *games and routines*. Being firstborn predicted in girls a larger growth in the categories descriptive and function words. Family burden of late onset of speech predicted in boys less growth in all categories except sound effects.	Differences in how various factors influence early vocabulary growth differently in boys and girls can also be found at the level of lexical categories. It is still unclear what in these factors trigger the variation in vocabulary development in boys and girls.

Abbreviations: RTI = respiratory tract infection; AOM = acute otitis media.

Abbreviations

AOM	acute otitis media
CDI	MacArthur-Bates Communicative Development Inventory
CDI-I	MacArthur-Bates Communicative Development Inventory for infants
CDI-T	MacArthur-Bates Communicative Development Inventory for toddlers
RTI	respiratory tract infection
OM	otitis media
SEM	structural equational modelling
SES	socioeconomic status
SLP	speech and language pathologist
STEPS	Steps to the Healthy Development and Well-being of Children

Table of contents

1. Introduction

"*A word in its season – how good!*"[1]

The beauty of words said at the right time has fascinated people throughout the ages. As words are added to words, we find meaning, grammar, and a larger concept of language. Language, as a tool of communication, plays a critical role in everyday life both at macro and micro levels in our society. The child´s development into a skilful communicator is filled with a vast amount of small neural details, smaller and larger biological, and environmental influences both pre- and postnatal. All these factors cumulate in understanding and producing the first words or word-like sounds. The child´s first words uttered, even if only a combination of sounds resembling a word form and not yet developed into a conventional word, has for generations made parents proud and delighted.

Theories of how language develops have undergone different phases through the years, from assuming that words just appear to more interactive perspectives. Bruner (1983) states the significance of biological and environmental aspects for language development. The capacity to develop language has a biological foundation, but the development and use of this capacity is dependent on environmental factors (Bruner, 1983). According to this social interactional framework, the child is tuned to react to and interact with human communicative initiatives. In this interaction with persons in the near environment, the child´s behaviour changes but also the communication partner´s behaviour changes in response to the child´s (Bruner, 1983). Bronfenbrenner and Ceci (1994) developed this theory further, including a broader ecological context. The child´s development is not only shaped by the near family but is part of a broader interaction with the environment through i.e., family factors such as political systems, cultural and educational trends, parental educational level, and working conditions (Bronfenbrenner & Ceci, 1994; Rowe & Weisleder, 2020; Shelton, 2018). This gives a rationale for considering environmental as well as biological factors in the analysis of early language development.

Early vocabulary is a palpable measure of the child´s communication development for parents and the immediate environment. It is easy to measure vocabulary produced and understood when vocabulary size is still under 500 words. Especially expressive words are easy to detect. This makes words produced and understood a good measure in early language assessments and studies. Around 1 year of age is marked as the time when a child produces the first words, following a period of sound play and babbling (Kuhl, 2004). Towards the end of the second year, the child starts combining words into sentences and the grammar starts to be more involved in the utterances (Fenson et al., 2007). Around 2 years of age, the vocabulary size has usually

[1] Proverbs 15:23, Young´s Literal Translation 1898.

increased considerably and is therefore harder to measure. The time up to the second birthday is a period with giant steps in early language development and is therefore a favourable time to study variations in early vocabulary growth and factors associated with this growth. Furthermore, there is evidence that limitation in early language already at this stage can have far reaching consequences. Rescorla (2009) found consequences of limited vocabulary at 2 years of age in the vocabulary and verbal memory of youth at 17 years of age. Findings like this make it imperative to study more closely variations in early vocabulary development and factors that may affect it. Detecting factors associated with early vocabulary development will benefit early language assessment and early preventive language support.

This thesis examines variations in vocabulary development during the first 2 years of children´s life. The focus is on factors in the child´s growing environment which could possibly be associated with variability in early vocabulary development. These are health related factors (common respiratory tract infections [RTIs] and early acute otitis media [AOM]), environmental factors (e.g., parents´ education and occupational and working status), child factors (e.g., the child´s sex, firstborn, day care attendance), and biological (parents´ own history of late onset of speech).

2. Review of the Literature

2.1. Early Language Development

After birth and during the first year, the early language development of the infant is comprehensive. The infant starts to distinguish phonetic contrasts, moving to language-specific vowels, stress patterns, sound combinations, and consonants, and then begins to discriminate between native and non-native speech sounds (Bosch, 2011; Kuhl, 2004). These early precursors of development are of greatest significance for how language later develops. The ability to discriminate vowels at age 6 months has been demonstrated to be associated with the child´s receptive and expressive vocabulary at 13 and 24 months of age (Tsao et al., 2004). Early ability to segment speech for familiar words between the ages of 7.5 and 12 months is found to relate to expressive vocabulary at age 24 months (Newman et al., 2006). This implicates the importance of early perception skills for later language development. The stage of learning to perceive language sounds precedes understanding of what these sounds mean. Development of word comprehension has often been thought to initiate at around 8 months of age (Fenson et al., 1994; Reznick, 1990), but more recent evidence points to 6 months of age for common words (Bergelson & Swingley, 2012). At this early age, the number of words a child understands varies substantially (Fenson et al., 1994).

Vocalizations along with gestures are early means that a child uses to communicate expressively. The child stretches its arms to get picked up and shows or brings things to the adult. These gestures can usually be observed at 8 months of age (Fenson et al., 1994). Despite being expressive, gestures appear to relate more to receptive language than to word production (Fenson et al., 1994). Fenson et al. suggest that gestures act as a bridge between the receptive and the expressive language in early development, as together with vocalizations they are the main way of communicating desires at 8 months of age (Carpenter et al., 1983).

2.1.1. Expressive Vocabulary

Parallel to the development of perception, the child starts to produce non-speech and vowel sounds, which develop into babbling and use of more language-specific word forms and eventually into the first words at the end of the first year of life (Kuhl, 2004; McGillion et al., 2017). Early vocabulary forms often include sound effects, animal sounds, and routine words (Caselli et al., 1995; Kuhl, 2004; Wehberg et al., 2007).

The early expansion of vocabulary can be described in four broad phases of development: the stage of routines and word games, the noun stage, the predicate stage, and the grammar stage (Caselli et al., 1999). Routine and word games are words like “hi”, “peekaboo”, and “over”, and they emerge when the child´s vocabulary size is between 0 and 10 words. As the vocabulary grows,

the proportion of these first types of words decreases in relation to the total vocabulary (Stolt et al., 2008; Wehberg et al., 2007). The next phase, between 50 and 200 words, contains mostly nouns and is accompanied by predicates (verbs and descriptive words) from the stage of around 100 words. According to previous studies, common nouns seem to increase until their relative frequency is at least around 50% of the early vocabulary (Stolt et al., 2008; Wehberg et al., 2007). The last stage, from 300 to 500 words, is characterized by function words needed for the grammar of the language (Caselli et al., 1999). Some studies using vocabulary questionnaires like the MacArthur-Bates Communicative Inventory (CDI) have further studied vocabulary in more narrow classes like sound effects and animal sounds, routine words, people words, common nouns, action words, descriptive words, and function words (Fenson et al., 2007– cf. Caselli et al., 1995; Schults & Tulviste, 2016; Wehberg et al., 2007, 2008).

2.1.2. Significance of Early Vocabulary Size

As early language develops, it appears that the trajectory does not deviate much from the course started (Fenson et al., 2007; Hart & Risley, 1995; Perkins et al., 2013). Duff et al. (2015) studied 300 children aged 16–24 months with follow-up at 4 to 9 years. They concluded that early receptive and expressive vocabulary size explained 16% of later vocabulary size and 18% of later reading comprehension. However, they found the stability in vocabulary development to be too low to foresee later development at an individual level. In another study, children with a larger expressive vocabulary at 2 years of age performed better in receptive and expressive language tasks at 36 and 54 months of age and up to the fifth year in school, compared to children with a smaller vocabulary size (Lee, 2011). Henrichs et al. (2011) found that expressive vocabulary size at 18 months of age described 11.5% of the variance in vocabulary records when the child was examined at 2.5 years of age.

Not only do we find in some children a persisting trajectory of small vocabulary up through the years, but those with a small vocabulary size at 2 years of age are at greater risk of having receptive language problems at 6 years of age (Ghassabian et al., 2014). Small vocabulary size at 2 years of age has also been associated with reading disabilities (Torppa et al., 2010), shortcomings in language tasks still at 17 years of age (Rescorla, 2009), and an increased risk of continuous difficulties in word and language learning (MacRoy-Higgins & Montemarano, 2015; Hammer et al., 2017). It is therefore imperative to find these children early and discover factors that may be associated with small vocabulary size at this age, so as to offer early and timely support to families with children at risk of developing language problems.

2.1.3. Assessment of Early Vocabulary

Early expressive vocabulary can be used as a distinct measure of the child´s communication development, and therefore vocabulary size has been a

common focus in studies of early language (Fenson et al., 2007; Heilmann et al., 2005; Lee, 2011; Rescorla, 1989).

Early vocabulary development is studied using different methods of assessment, like word diaries, videotaping, and clinical assessment. When focusing on the first stages of language development, parental assessment is a common screening tool. The parents are asked to complete a form with suggestions of words understood and produced, communication attempts, use of gestures, etc. Parental assessment enables more data to be obtained over a specific time lapse. One of the most widely used parental instruments for measuring early language abilities, is the CDI (Fenson et al., 1994, 2007). The CDI has been adapted to nearly 100 languages or dialects including Africans, Bengali, Inuktitut, etc. (MacArthur-Bates CDI). The Finnish questionnaire has been translated and validated by Lyytinen (1999), and the Swedish questionnaire by Eriksson and Berglund (2000).

The CDI consists of an inventory for infants aged 8–18 months, called "Words and Gestures" (CDI-I), and one for toddlers aged 16–30 months, called "Words and Sentences" (CDI-T) (Fenson et al., 2007). The CDI-I comprises one part on early words—including the first signs of understanding, phrases the child understands, the first steps of talking, and a vocabulary checklist—and a second part on the use of communicative actions and gestures (Fenson et al., 2007). The vocabulary list consists of 396 words in English and 380 words in the Finnish version (Fenson et al., 2007; Lyytinen, 1999). The CDI-T inventory is also in two parts, the first containing a vocabulary list of 680 English words (595 Finnish) divided into 22 (20) categories the child uses. The second assesses the use of sentences and grammar (Fenson et al., 2007; Lyytinen, 1999). The vocabulary in the questionnaires is made up of words likely to be found in the first vocabulary of the child (Fenson et al., 1994: Fenson et al., 2007). To make the completion easier, the wordlists are organized into semantic categories like sound effects, nouns (animals, vehicles, toy, food, clothing etc.), routine words, action and descriptive words, and function words (pronouns, question words, prepositions, quantifiers). The organizing into categories is not based on the child´s word conception but on the speech category used in adult language (Caselli et al., 1995). The parents are asked to complete the vocabulary list by marking which words the child understands and which he or she produces (CDI-I), and which words and sentences he or she understands and produces (CDI-T).

The use of parental reports has many advantages over clinical assessments, in that they are done by persons familiar with the child and the environment. Close family members also have the possibility to observe the child around the clock and in different situations when communicating with other people. Reports completed by parents provide larger study samples than would be possible with a researcher assessing the children. On the downside, parents are not usually trained observers, their recall of the vocabulary used or understood by the child may be inaccurate, and parental bias may affect their assessment. It has been suggested that parents with a lower level of education may

overestimate or be less accurate in estimating early vocabulary size (Feldman et al., 2000; Reznick, 1990), but there is evidence to support that parents are knowledgeable enough to report on their child´s expressive language development between the ages of 1.6 and 2.5 (Feldman et al., 2005). In comparison with other evaluation measures of early language, the CDI is regarded as a reliable tool for assessment of early vocabulary (Dale, 1991; Frank et al., 2021; Korpilahti et al., 2016; Thal et al., 1999). The CDI inventory has also been considered stable between repeated assessments and without influencing the parents´ way of assessment (Reznick & Schwartz, 2001).

2.1.4. Variation in Early Vocabulary

There is a wide variation in early language development between children during the first few years, particularly in the size of expressive vocabulary. This seems to be the case regardless of cultural background and fluctuates exceptionally strongly much compared to other developmental milestones (as motoric) in a child´s life (Frank et al., 2021). Vocabulary size at 12 to 13 months of age varies between 0 and 296 words, and at 24 months of age between 0 and 668 words in different studies (Bates et al., 1994; Cadime et al., 2018; Fenson et al., 2007; Lyytinen, 1999; Stolt et al., 2008). Fenson et al. (2007) found a range of 0 to 107 words at age 13 months and a range of 7 to 668 words at age 24 months. Lyytinen (1999) measured vocabulary with the Finnish version of the CDI and found broad variability, from 0 to 60 words and 0 to 595 at ages 13 and 24 months, respectively.

It is suggested that vocabulary growth after reaching a certain number of words starts to accelerate rapidly, often called the word spurt, and slows down as the child starts to combine words (MacRoy-Higgins et al., 2016). The spurt has been suggested to start when the child has acquired around 50 words, but again this number varies in different studies between 20 and 213 words (Anisfeld et al., 1998; Kunnari, 2000; Stolt et al., 2008). Even though not all children go through this word explosion (Goldfield & Reznick, 1990), there seems to be a progression in the early development of expressive vocabulary that is more dependent on the size of the vocabulary than on the age of the child (Caselli et al., 1995; Schults & Tulviste, 2016; Stolt et al., 2008; Wehberg et al., 2007). Large variations in early language development have been found between boys and girls, mostly in favour of girls (Andersson et al., 2011; Schults & Tulviste, 2016). The sex difference seems to be stable also over different language backgrounds (Eriksson et al., 2012; Kuvač-Kraljević et al., 2021). We thus find a large variation in early vocabulary size between different studies and between boys and girls. Many background factors causing variation between children´s vocabulary development have already been found, but there are still many unstudied factors in children´s environment, which possibly have an influence on this variation. In addition, these factors can have different influence on vocabulary development in boys and girls, thus calling for more studies on the first stages of vocabulary development.

2.2. Child Factors in Early Language Development

Numerous determinants have been considered in studying language development. Some of these are more related to the child and the child´s environment (in this thesis classified as child factors), whereas others are more related to the parents and the family (classified as family factors). Various child factors have been associated with the early development of language, among others the child´s sex, birth order, and day care attendance. This gives us reason to consider these factors when focusing on early vocabulary development.

2.2.1. Child´s Sex

Perhaps the most studied biological factor in early language development is the child´s sex, i.e., the difference between language acquisition in boys and girls. The advantage of girls over boys in early language is established in most studies (e.g., Andersson et al., 2011; Feldman et al., 2000; Galsworthy et al., 2000; Henrichs et al., 2011; Huttenlocher et al., 1991; van Hulle et al., 2004). There are, however, a few studies where no differences have been found between the language in boys and girls, or differences have been found only at certain ages. Bornstein et al. (2004) found that the advantage of girls in general language performance occurred only between the second and the fifth year. On the other hand, Hadley et al. (2016) found that girls outperformed boys at 21 months of age in vocabulary size, but not at 24, 27 and 30 months of age. Then again, Stolt et al. (2008) found an advantage in girls´ vocabulary compared to that of boys´ only at the ages of 1.3 and 1.6, but not earlier or at 2 years of age. Other studies, on the other hand, have observed differences between the sexes already at an earlier age. In a large study of early receptive and expressive language in 2,156 children (ages 1 and 2 years), girls outperformed boys in receptive tasks, use of gestures, but particularly in expressive vocabulary (Feldman et al., 2000). The size of vocabulary in girls between the ages of 16 and 30 months is estimated to be around 65 words larger than in boys (Urm & Tulviste, 2016). Girls not only have a larger vocabulary size during the first 2 years (age 8 months to 2 years), but their vocabulary growth seems to undergo a quicker pace than that of boys (Bauer et al., 2002; Huttenlocher et al., 1991). The ages of participants in the above studies varied between 8 months and 6 years of age. Some studies had more than 1,000 participants, while others had less than 30. Differences in study results can thus be a consequence of methodological issues.

One common way to include the child´s sex in language studies is to examine some "part" of the language, like verbal performance, and compare the differences between boys and girls in that area (e.g., Andersson et al., 2011; Eriksson et al., 2012; Huttenlocher et al., 1991; Lovas, 2011; Marjanovic-Umek & Fekonja-Peklai, 2017; Schults & Tulviste, 2016; Simonsen et al., 2014). In other studies, the child´s sex is included as a control variable among other factors like parental education or birth order (e.g., Ebert et al., 2012; Gilkerson et al., 2017; Henrichs et al., 2011; Keegstra, 2007; Zumach et al., 2011). Only a

few studies have examined whether environmental factors and other biological factors than sex affect early language development differently in boys and girls. These studies have demonstrated differences in how early language relate to heredity and SES factors as a function of the child´s sex. Boys have been considered to demonstrate greater heritability in relation to verbal development than girls (Galsworthy et al., 2000; Van Hulle et al., 2004).

There are also differences between the effect of parental SES background on language development in boys vs girls (Barbu et al., 2015; Lankinen et al., 2018). Paternal high educational and high occupational level has been found to relate more strongly to language development in boys than in girls (Lankinen et al., 2018). Barbu et al. (2015) found that low SES background impacted language development more in boys than in girls. According to these studies, early language development responds differently to biological and environmental factors in boys and girls. These previous studies have only included some factors like education and occupation. To be able to distinguish if also other factors, usually associated with early language development, relate differently to vocabulary growth in boys and girls, there is a need to focus also on factors like birth order and day care attendance.

2.2.2. Birth Order

Previous studies have suggested differences in early language development in relation to whether the child is firstborn. Schjøberg et al. (2011) studied predictors of early language development at age 18 months in 42,107 children and found that later born children in the family had a lower language outcome than firstborns. In addition, a larger vocabulary size is observed in firstborn children between the ages of 16 and 30 months (Berglund et al., 2005; Hoff-Ginsberg, 1998; Urm & Tuliviste, 2016). Not only quantitative but also qualitative differences in early language have been found between firstborns and children born later. Firstborn children have been suggested to use more nouns and have a more developed grammar than those born later, while the latter have a more varied lexicon and are more talented in conversational skills (Goldfield & Reznick, 1990; Hoff-Ginsberg, 1998; Schults et al., 2012).

It has furthermore been suggested that firstborn children have another pace in acquiring vocabulary, with a vocabulary spurt, whereas later-born children´s acquisition is more gradual (Goldfield & Reznick, 1990; Kunnari, 2000). The reason that firstborn children have a larger vocabulary has been attributed to the amount and character of speech directed to the child. Hart and Risley (1995) found no differences in the amount of speech the firstborn child heard compared to later-born children, except that it was more directed towards the child. However, Gilkerson and Richards (2009) discovered in their study of the first 4 years of the child that both parents used more words with firstborn boys compared to boys born later. There was no difference in how many words firstborn or later born girls heard. There are also study results that counter these findings. A larger vocabulary size is found in children at 36 months of age with older siblings (Tulviste & Shults, 2020). In another study with children

from Croatia, Finland, and Estonia, firstborn children at 2 years of age did not have a larger vocabulary size compared to children with siblings (Kuvač-Kraljević et al., 2021). The differences between study results could arise from different methodological issues, but there could also be a possible concealed gender issue, as previous studies have not analysed firstborn status in relation to vocabulary development separately in boys and girls. Our approach in the present thesis is to focus on the associations between vocabulary growth and firstborn status in boys vs girls.

2.2.3. Day Care

Many children attend day care outside the home at some point, often at least during the last year before starting school. In Finland in 2019, 77% of children between the ages of 1 and 6 years attended day care outside the home, and 76% of them in a typical kindergarten (i.e., centre-based day care) (Säkkinen & Kuoppala, 2020). For younger children aged 1 and 2 years, the number of children attending day care were lower, 37% and 69%, respectively (Säkkinen & Kuoppala, 2020). For example, in Estonia, children with more highly educated parents attend day care more often than children of less educated parents (Urm & Tulviste, 2016).

There are conflicting results from studies on the importance of day care outside the home for early language development. In a meta-analysis of the impact of early childhood education, Fukkink et al. (2017) found no evidence of cognitive or socioemotional gain. On the other hand, in a systematic review, Burger (2010) found positive short-term effects of attending day care but fewer long-term effects on cognitive development. Keegstra et al. (2007) studied possible background factors in children with language problems. They found that children aged 2–5 years with language problems had not usually attended day care. The benefits of day care on early language have also been studied in relation to the age of entering day care. It is suggested that girls under 2 years of age and staying at home have a larger vocabulary than girls and boys in day care (Stolarova et al., 2016). It has also been suggested that small children in day care have more restricted language, while day care enhances language development in preschool children (Luijk et al., 2015). Investigations of language in relation to the time spent in day care have given varied results; less than 10 hours/week has been associated with risk of late onset of speech (Hammer et al., 2017), but Urm and Tulviste (2016) found that children (aged 16–30 months) with more than 40 hours/week in day care had a smaller vocabulary than children attending for fewer hours.

There are also health challenges associated with day care attendance during the first 2 years of life (Lambert et al. 2005). There is a high consensus among researchers that children attending day care at an early age are at greater risk of developing respiratory and ear infections, peaking at the time of starting day care (Alho et al., 1990; Benediktdottir, 1993; Brennan-Jones et al., 2015; Chonmaitree et al., 2016; Côte´ et al., 2010; De Hoog et al., 2014; Kørvel-Hanquist et al., 2018; Schuez-Havupalo et al., 2017; Simoes, 2003). As day care

is a common factor in the life of many children from an early age, it is significant to include day care attendance in the analysis of early language development.

2.2.4. Respiratory Tract Infections

Respiratory tract infections (RTIs) are common in young children, particularly under the age of 5 years (Byington et al., 2015; Chen et al., 2014; World Health Organization, 2008) and most prominent during the first 2 years (Monto & Sullivan, 1993). In young children aged under 2 years acute respiratory infection episodes have been found at a mean frequency of 6.2 per year (Toivonen et al., 2019). In another study, children aged under 3 years had seven times more respiratory infections than children aged 7 years or older (Heikkinen et al., 2004). A young infant or toddler with RTIs can be sick for a prolonged time. Children with recurrent RTIs have substantially more episodes with fever, rhinorrhoea and cough, treatment with antibiotics, and hospitalizations compared to children with fewer infections (Toivonen, Karppinen et al., 2016; Tregoing, 2010).

There are different factors increasing the probability of children getting RTIs. Boys are at greater risk of respiratory tract infections than girls (Anders et al., 2015; Benediktdottir, 1993; Chen et al., 2016; Chetty & Thomson, 2007; Simoes, 2003; Wang et al., 2016). Boys with respiratory infections are also more likely to be hospitalized than girls with RTIs (Chen et al., 2016). Other risk factors for RTIs are prenatal stress in the family, asthma, having siblings, and being in day care outside the home (Anders et al., 2015; Chen et al., 2016; Henriksen et al., 2015; Simoes, 2003; Toivonen, Karppinen et al., 2016). Acute respiratory infections have been associated with asthma, so that children who had suffered repeated acute respiratory infections or wheezing during the first 2 years of life had a higher risk of asthma at age 7 years (Toivonen et al., 2019).

Otitis media (OM) is a state of inflammation in the middle ear and can be classified as acute otitis media (AOM), with acute signs of infection in the middle ear, or as otitis media with effusion (OME), a chronic inflammation with fluid accumulation in the middle ear (Bluestone et al., 2002). AOM is a common co-occurring or succeeding condition of respiratory infections (Chonmaitree et al., 2008). Factors increasing the risk for OM are similar to those for RTIs: being male, having allergies, exposure to passive smoking, and early day care outside the home (Alho et al., 1990; Brennan-Jones et al., 2015; Côté et al., 2010; Damoiseaux et al., 2006; Fang et al., 2016; de Hoog et al., 2014; Kørvel-Hanquist et al., 2018). The prevalence of being diagnosed with AOM in children with RTI lies between 13% and 50% (Chonmaitree et al., 2016; Schuez-Havupalo et al., 2018; Toivonen, Karppinen et al., 2016).

Recurrent RTIs in a child also affect the rest of the family, compromising the quality of life. Besides the effects of having a sick child at home, there is also the risk of transmitting respiratory viruses among family members. Sick children can cause parents many days of absence from work, which is costly financially (Heikkinen et al., 2004; Peltola et al., 2008). Kujala et al. (2017) investigated the effect of recurrent AOM episodes, often a co-occurring

condition with RTIs, on the quality of life. They found a poorer quality of life in families with children with recurrent AOM resulting from health issues, pain, and social distancing, but also due to time demands and emotional burden on the parents (Kujala et al., 2017).

Even though recurrent RTIs are most common in children during the critical time of early language development, studies on associations between recurrent RTIs and early language development are scarce; there are more that focus on the role of AOM/OM. The results have been diverse and sometimes contradictory, due in part to divergent ways of conducting and reporting studies on ear infections and language output. In their review, Roberts et al. (2004) emphasized several methodological issues with studies on OME that have contributed to different results. There are differences in the documentation of hearing levels, study designs and analysis, choice of control variables, age of study population, and language factors measured (Roberts et al., 2004).

Possible language related problems which have been emphasized to be associated with AOM/OM and the potential hearing loss associated with it are issues with auditory attention, discrimination and identification of speech sounds, and limited consonant inventories (Asbjørnsen et al., 2005; Haapala et al., 2014; Haapala et al., 2015; Zumach et al., 2011). In some studies, associations with early expressive vocabulary size, early language skills, but also long-lasting language difficulties have been reported (Haapala et al., 2015; Shany et al., 2014; Zumach et al., 2010). However, the sample sizes in these studies were small. On the other hand, there are studies where no relationships have been found between early OME or middle-ear effusion and attention, language outcomes, or school achievement (Berman, 2001; Feldman et al., 1999; McCormick et al., 2006; Roberts et al., 2004). In studies by Paradise et al. (2005) and Paradise et al. (2001), effusion in the middle ear in young children did not affect early development up to 6 years of age in more general language skills. The inconsistent results of the effect of OM on vocabulary growth highlight the need for further research.

As the child´s language develops in interaction with the environment (Bronfenbrenner & Ceci, 1994; Bruner, 1983; Shelton, 2018), there is reason to expect that frequent sickness in a child´s life and the subsequent stress in the family, at a time when the foundation of language is laid, influence early vocabulary development. However, recurrent RTIs in relation to vocabulary growth have not been studied previously. This thesis endeavours to close the gap in our understanding of the association between recurrent RTIs and early vocabulary development.

2.3. Family Factors in Early Language Development

Family factors considered in this thesis are the socioeconomic status (SES) of the family, history of late onset of speech and paternal factors, such as time spent with the child.

2.3.1. Paternal and Maternal Factors and Language Development

The child does not develop language in a vacuum but is surrounded by other people. Both the language environment and experiences from interacting with people in it form the developing language (i.e., Gilkerson & Richards, 2009; Gilkerson et al., 2018; Madigan et al., 2019; Pan et al., 2005; Topping et al., 2013). The way parents talk, how much they talk, and the content of their speech influence early communicative interaction with their child. It is suggested that the way parents talk to their child during the first 6 months of life is related to the child´s language abilities one or even several years later (Gilkerson & Richards, 2009). These aspects in parent-child communication are to some extent affected by the parent´s own language background and literacy skills (Gilkerson & Richards, 2009; Huttenlocher et al., 2010; Paavola et al., 2006; Pan et al., 2005; Topping et al., 2011). Even though both the number of adult words the child hears and the quality of adult speech are important for early language development, the content of parental speech is more strongly related to the language skills of the child (Anderson et al., 2021).

Earlier studies have focused primarily on the communication between mother and child. The mother´s sensitivity to early signals from her small child is related to the infant´s activity and early intentional communication (Paavola et al., 2006). In recent years the significance of the father for early language development has also been emphasized. The content of the father´s communication with his child under 2 years of age is associated with the child´s expressive language at 3 years of age (Lovas, 2011; Majorano et al., 2013; Rowe et al., 2004). Differences between maternal and paternal communication have been found when comparing how mothers and fathers talk to their children. Fathers´ language varies more than that of the mothers; they ask for explanations, use more questions, and alter their speech less when talking to their child (Leech et al., 2013; Lovas, 2011; Rowe et al., 2004). Children with fathers who use a greater variability in their speech and ask their children to explain things have a larger vocabulary (Leech et al., 2013).

Not only have differences been found in the way parents talk to their children, but also in how much language their sons and daughters hear. There is evidence that boys hear less maternal talk and more paternal talk than girls (Gilkerson & Richards, 2009). Also, the child hears more language than just the talk addressed to them specifically. The question has been raised whether overheard language also influences the child´s early language development as child-directed speech does. Compared to child-directed speech, adult-directed or overheard speech demands more of the young child. It is more complex (Foushee et al., 2016), not adjusted to the child´s perspective of what is discussed (Shneidman et al., 2013), and requires the capability to direct the attention to adult language not addressed to the child (Golinkoff et al., 2019). Some neuroscientific evidence has been presented that some influences on the development of dorsal language tracts in the child may result from conversational turns with an adult, but not from overheard speech (Romeo et al., 2018). At the same time, also the number of words used by the parent is

critical for myelination development in brain areas related to language (Fibla et al., 2022).

More time to spend with the child gives the parents an opportunity to be more engaged in communicative activities. In a recent study with language data from 13 countries, children´s language development between the ages of 8 and 36 months was followed up for 6 months during lockdown due to COVID-19 (Kartushina et al., 2021). Children who would otherwise have been in day care outside the home were more at home than before. The results showed that children being at home instead of in day care had a greater expressive and receptive vocabulary growth than expected. Expressive vocabulary size also benefited from participating in and listening to stories and having less screentime (Kartushina et al., 2021).

As the mother is usually the parent staying at home with the child during the first year, when she is nursing the child, she has often been the focus in studies of early language development. The importance of the father´s time spent at home for early vocabulary development of the child has been suggested in an earlier study by Korpilahti et al. (2016). They showed that children who had fathers staying more at home (due to a part-time job or unemployment) had a larger vocabulary size at 3 years of age compared to children with fathers having less time at home. The total overall workload in the Finnish society has dropped in recent years, including that of mothers and fathers (Miettinen & Rotkirch, 2012), but it is, not the whole picture; it is an average. On an individual level more persons are doing either shorter or longer working days than before (Miettinen & Rotkirch, 2012). Particularly fathers are putting in longer days. In the report from Miettinen and Rotkirch, more than a fifth of fathers with young children had workdays exceeding 10 hours. On the other hand, Finnish fathers have been more involved in the household and in childcare since the turn of the millennium (Miettinen & Rotkirch, 2012).

Finland has been a pioneer in enabling more time for the fathers with their children. Finland and Norway were the first countries to introduce paternity leave in 1977 (Huttunen & Eerola, 2016). Today, Finnish fathers can take around 9 weeks of paternity leave with a highly paid allowance (Adler & Lenz, 2016; KELA, 2021), giving them many opportunities to interact with their young child. That said, fathers with fewer working hours are not necessarily more involved in communicating with their children, though a lighter workload does seem to involve them more in caretaking of the child (NICHD Early Child Care Research Network, 2000). With results of Kartushina et al. (2021) and Korpilahti et al. (2016), we could assume a positive relationship between more paternal time with the child and early language development, but such studies are scarce, despite the significance of this knowledge for support in early childhood.

2.3.2. Family History of Late Onset of Speech

A biological factor associated with delayed language development in the child is late language development in the parents or the immediate family. A family

history of late onset of speech or other language problems is a risk factor in the child´s early vocabulary development (Reilly et al., 2007; Zambrana et al., 2014; Zubrick et al., 2007). Zubrick et al. studied 1,766 children at age 24 months in an epidemiological prospective observational study of late language emergence and of family and child factors predicting late onset of speech in the child. They found that children with late language emergence often had a family history of late onset of speech (22.2% vs 12.1%). A family burden of late talking has also been related to persistent language problems. In a study with 10,587 Norwegian children (ages 3 and 5 years), the probability of the child having persistent language difficulties was threefold in families with a familial risk of late onset of speech (Zambrana et al., 2014). A family history of language problems has also been found to relate strongly to smaller vocabulary size at age of 24 months (Reilly et al., 2007). Consequently, the effects of a family burden of late talking can already be seen in the language development of small children. This makes it important to consider parental late onset of speech when analysing factors influencing early language development.

2.3.3. Influence of Socioeconomic Status on Early Communication

Socioeconomic status (SES) is an environmental factor most studied together with early language development. However, how the SES concept is used and what it includes varies between studies, which makes it difficult to compare the results. Most commonly, the term SES has comprised one or more of the following factors: family income, parental (mostly the mother´s) education and/or occupation.

SES factors and their impact on everyday life have been studied since the 1960s, when among others Bloom (1966) emphasized the significance of poor environment for cognitive development. This is confirmed by, among others, McLoyd (1998), who concluded that poor school and cognitive performance can be predicted by low SES and poor economy in the family. The implication of SES on early language development has been studied extensively (i.e., Armstrong et al., 2017; Barbu et al., 2013; Feldman et al., 2000; Hart & Risley, 1995; Hoff-Ginsberg, 1998; Huttenlocher et al., 1991; Tomblin et al., 1997). Compared to children from a higher SES background, children from families with less educated parents, lower occupational status, and lower family income perform more poorly in language and vocabulary tasks and are at risk of developing language learning difficulties (Barbu et al., 2015; Hammer et al., 2017; Hart & Risley, 1995; Hoff, 2003; Keegstra et al., 2007; Lankinen et al., 2018; Rudolph, 2017; Tomblin et al., 1997).

The way parents interact linguistically with their child has been associated with the SES of the mother and father (Cabrera et al., 2007; Gilkerson et al., 2017; Hart & Risley, 1995; Huttenlocher et al., 2010; Rowe, 2008). The emphasis in SES studies in relation to language development has often been on the mother´s or primary care giver´s level of education and/or occupation (Alt et al., 2016; Feldman et al., 2000; Gilkerson et al., 2017, 2018; Korecky-Kröll et al., 2019; Letts et al., 2013; Rowe, 2012; Weisleder & Fernald, 2013). Highly

educated mothers seem to be more involved in communicative interaction with their child and use more words and more word variations than less educated mothers (Gilkerson et al., 2017; Huttenlocher et al., 2010). High SES mothers have also been found to be more sensitive to the child´s choice of communication theme, to ask more questions, and to be less directive in their communication (Hoff-Ginsberg, 1998).

More recently, the father´s contribution to the early language development of his children has been studied more, and the focus has shifted more towards including the father´s level of education and occupation (i.e., Armstrong et al., 2017; Barbu et al., 2015; Ghassabian et al., 2014; Keegstra, 2007; Lankinen et al., 2018; Pancsofar et al., 2010). Similar attributes in the father´s speech, i.e., own vocabulary, high education, and occupation, have been found to relate to early language development (Lankinen et al., 2018; Pancsofar et al., 2010; Zhang et al., 2008). A father´s higher educational level has also been suggested to influence his communication with the child (Cabrera et al., 2007). In a study by Cakir (2016), high SES fathers used more questions when playing with their children than did those with low SES.

Studies have thus demonstrated the importance of parental background for language development of the child. However, ambiguity in the use of the SES concept, often as a combined factor of education and occupation and/or family income or combined SES measure for the whole family based on parental educational or occupational level, does not tell us the different effects of factors included. The argument of high interrelation between the various measures of SES as a reason to analyse them together has been criticized (Braveman et al., 2005; Duncan & Magnusson, 2012).

3. Aims of the Study

The aims of this thesis were to examine factors associated with early language development during the first 2 years of life, more precisely with early vocabulary development.

The specific objectives and hypothesis were:

1. To analyse possible relationships between recurrent RTIs or AOM during the first and second year of life and receptive and expressive vocabulary size at 13 months and expressive vocabulary size at 24 months of age. The hypothesis was that a high burden of RTIs or AOM during the first 2 years could be negatively associated with language development. (*Study I*)

2. To investigate early expressive vocabulary growth in children between 13 and 24 months of age in relation to recurrent RTIs. More specifically to investigate a) whether vocabulary growth between 13 and 24 months of age differs in children with recurrent RTIs or AOM episodes compared to children without recurrent RTIs or AOM episodes and b) vocabulary growth between 13 and 24 months of age in boys and girls in relation to background factors often associated with early language development. The hypothesis was that a possible consequence of recurrent RTIs and AOM episodes on vocabulary growth could be revealed if boys and girls were studied separately. We also hypothesized that possible effects of background variables would relate differently to vocabulary growth in boys and girls. (*Study II*)

3. To study how paternal factors (working full time or not, use of paternal/parental leave, hours spent with the child, father´s level of education and occupation) relate to early vocabulary growth at ages 13–24 months in boys and girls. The hypothesis was that children with fathers working less than full time, who had taken paternity/parental leave, and who spent more hours with their child during the first year would have larger vocabulary growth. We also hypothesized that a father´s advanced education and occupational status would be associated with larger vocabulary growth in the child. We further hypothesized that paternal factors would relate more closely to vocabulary growth in boys than in girls. Vocabulary size at 13 months of age and maternal high level of education and occupation were control factors. (*Study III*)

4. To examine (1) whether child factors (firstborn, day care attendance) and family factors (level of education and occupation, family burden of late onset of speech) predict early vocabulary growth differently in lexical categories; and (2) whether these child and family factors predict vocabulary growth differently among boys and girls. The hypothesis was that high parental education and occupational level, family history

without late onset of speech, firstborn status, and not attending day care at 13 and 24 months of age would predict larger vocabulary growth in the lexical categories. We also hypothesized that there would be different effects of child and family factors in the development of lexical categories in boys and girls. (*Study IV*)

4. Methods

4.1. Study Design

Studies, *I–IV* were all sub-studies to an ongoing longitudinal observational prospective birth cohort study, Steps to the Healthy Development and Well-being of Children (the STEPS Study) (cf. Lagström et al., 2013). The STEPS Study is a multidisciplinary project focusing on biological, environmental, psychosocial, social, and demographic factors influencing the child´s development, health, and wellbeing from birth to adulthood (Lagström et al., 2013). As Finland has two national languages, Finnish and Swedish (minority language), the STEPS Study has approached both the Finnish and the Swedish speaking populations.

Families were recruited during pregnancy at maternity health clinics or soon after birth at the Hospital District of Southwest Finland. The cohort children were born between January 2008 and April 2010. The recruitment of participants in *Studies I–IV* is illustrated in Figures 1 and 2. Data was collected through clinic visits, parental diaries, and parental questionnaires, and from the National Birth Registry.

In *Study I*, outcome variables were receptive and expressive vocabulary size at 13 and expressive vocabulary at 24 months of age. *Studies II–IV* were longitudinal, measuring vocabulary growth from age 13 to 24 months. The primary outcome in *Studies II* and *III* was the total vocabulary growth. In *Study IV* the outcome was the growth of different lexical categories between the ages of 13 and 24 months.

Children enrolled in *Studies I* and *II* were followed up intensely during the first 2 years for respiratory tract infections, with a daily diary completed by the parents and visits to the study clinic during acute respiratory infections. Parents in *Studies I–IV* completed questionnaires about background data during pregnancy or at birth. Parental and child questionnaires were also completed when the child was 13 and 24 months of age. Language data was collected at 13 and 24 months of age through parental questionnaires.

4.2. Ethical Aspects

The Ministry of Social Affairs and Health approved the STEPS Study on 18.4.2008 (STM/1575/2008) and 1.7.2009(STM1838/2009), and the Ethics committee of the Hospital District of Southwest Finland on 27.2.2007. The parents gave their written consent on behalf of themselves and their child to participate in the study and were notified of their right to withdraw at any time.

4.3. Participants in the Sub-Studies

Of the eligible cohort of Finnish- and Swedish-speaking mothers (N = 9811) in the Hospital District of Southwest Finland, 1,797 mothers chose to participate

in the STEPS Study. The number of participating children in these families was 1,805 (30 pairs of twins).

4.3.1. Studies I and II

A subgroup of 982 children from the whole STEPS Study cohort of 1,797 families were recruited, without selection, in an intensive follow-up for RTIs during the child´s first 2 years. Of these, the families of 59 children did not return the infection diary, leaving 923 children. In *Studies I–II* the participants consisted of children from the intensive RTI follow-up with the required language data (*N* = 646 and *N* = 462, respectively).

Inclusion criteria for *Study I* were families that had completed the Finnish version of the MacArthur Communication Inventory (CDI) for infants (CDI-I) at 13 months of age and/or for toddlers (CDI-T) at 24 months of age (Lyytinen 1999 – cf. Fenson 1994; 2007). In *Study I*, 646 children (52.3% boys, 3 twins) were included (Figure 1). Inclusion criteria for *Study II* were families with data on RTIs who had completed both the CDI-I and CDI-T at 13 and 24 months of age. The study sample of *Study II* was 462 children (boys 54%, 2 twins) (Figure 1). Exclusion criteria were preterm birth (before 37+0 gestational weeks), missing or ambiguous data on gestational length, diagnosis, or conditions connected with language problems (e.g., cleft palate), and families where the mother was not speaking Finnish.

4.3.2. Study III

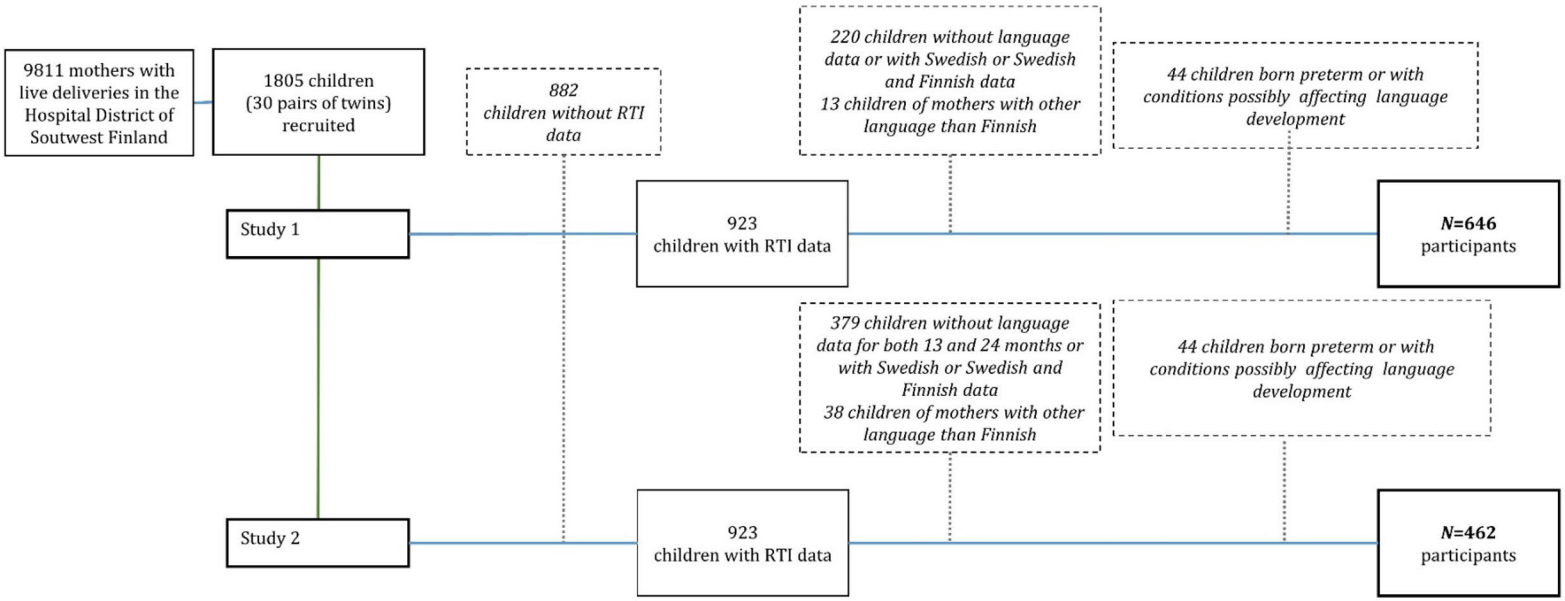
Inclusion criteria in *Study III* were Finnish-speaking mothers and fathers, from the whole STEPS Study Cohort (*N* = 1805), who had completed both the CDI-I and CDI-T. Exclusion criteria were families completing both Swedish and Finnish vocabulary questionnaires, preterm birth (before 37+0 gestational weeks), missing gestational data, diagnosis, or impairments connected with language problems. The total number of children in Study III was 685 (51.7% boys, 2 twins).

4.3.3. Study IV

In *Study IV* the participants were children with required language data available at 13 and 24 months from the whole STEPS Study cohort of 1805 children. Inclusion criteria for participants in *Study IV* were Finnish language data for both 13 and 24 months of age. If the family had completed both the Finnish and Swedish vocabulary questionnaires, they were not included. The reason was difficulty identifying the main language of the child. Exclusion criteria were preterm birth (before 37+0 gestational weeks), missing gestational data, diagnosis, or impairments connected with language difficulties, and children with mothers not speaking Finnish. The total number of children in *Study IV* was 719 (51.3% boys, 2 twins) (Figure 2).

Figure 1

Flowchart of Recruitment Procedure in Studies I & II

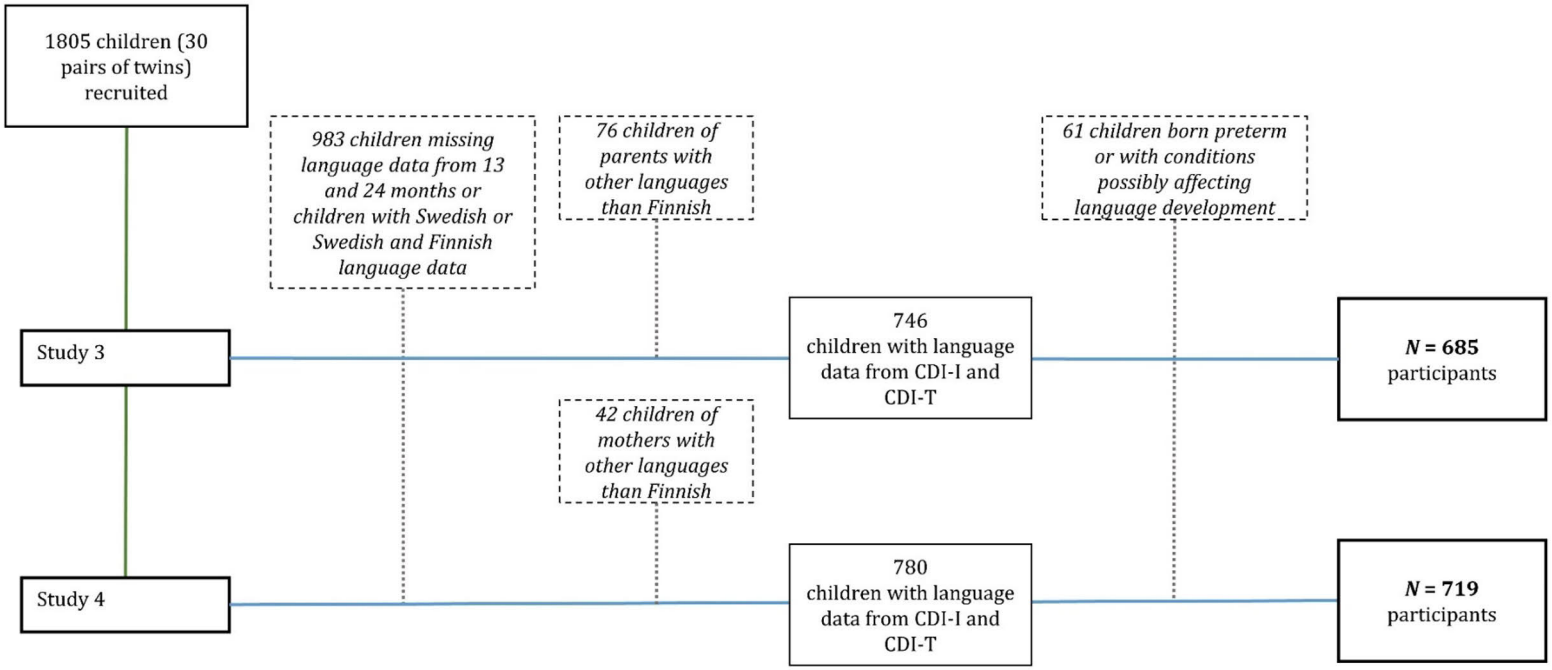


Note. Number of partcipants not included in dotted squares

Abbreviations. RTI = Respiratory tract infection

Figure 2

Flowchart of Recruitment Procedure in Studies III & IV



Note. Number of partcipants not included in dotted squares.

Abbreviations. CDI = MacArthur-Bates Communicative Development Inventory; CDI-I = CDI-Infant; CDI-T = CDI-Toddler

4.3.4. Included Families Compared to Not Included

Families who chose to participate in the STEPS Study (1,797) differed in some respects from the cohort families who did not take part (8,014). The participating mothers were mostly married (42.7% vs 36.6%), urban (42.7% vs 36.6%), had a higher occupational status (22.8% vs 19.0%) and were first-time mothers (54.3% vs 43.4%) (Lagström et al., 2013).

The study samples included in the present thesis were smaller (N = 646/ 462/ 685/ 719) than the STEPS Study cohort of 1,797 families because of dropouts and inclusion and exclusion criteria. Attrition analyses were therefore conducted in *Study II* and *Study III* between included and not included families. To analyse whether there were systematic differences between included and excluded participants, an independent two-tailed t-test was performed for numerical and a Chi-square test for categorical variables. The families included in sub-studies *II* and *III* (N = 462 and N = 685) differed in some respects from those not included. There was an anticipated difference in gestational length and Apgar points (5 min), as only full-term children were included in the studies. One difference was that more mothers in the included families had a higher education compared to those not included (66% vs 57%, 64% vs 57%, respectively), p = .001 and .002. Another difference was the that the included mothers were about 7–9 months older than those not included. In *Study II* there were also significantly more firstborn children among included than excluded children (61% vs 50%, p < .001), see Table 2.

Table 2

Descriptive Characteristics of Included and Excluded Participants in Studies II & III. The Chi-Square Test Was Conducted for Categorical Variables and Data Is Presented as Percentage

Characteristic	Study II Included (N = 462)	Study II Not included (N = 1343)	Study III Included (N = 685)	Study III Not included (N = 1120)
Children				
Child´s sex (boys) (%)	53.7	51.5	51.7	52.3
Firstborn (%)	61.0	50.3***	53.7	52.6
Day care outside home				
at 13 months (%)	25.3	21.6	21.0	22.7
at 24 months (%)	55.2	53.8	52.9	54.9
Parents				
High educational level (%)				
father	48.2	43.4	45.5	44.1
mother	66.0	57.3**	64.1	56.7**
High occupational level (%)				
father	56.9	56.6	56.0	57.1
mother	62.9	60.1	61.9	60.1
Family income, average or more (%)[a]	45.4	45.6	47.6	44.2
Late onset of speech (%)				
father	1.5	1.3	2.0	1.0
mother	1.3	1.0	1.0	1.1

Note. *<.05, ** <.01, ***<.001.

[a] 3,000 euros per month or more.

4.4. Data Variables

All variables used in the present thesis and described in the text are listed in Table 3.

Table 3
Data Variables and Measures in Studies I-IV

Study	Outcome variable	Predictors	Control variables
I	Receptive vocabulary size (13 months) Expressive vocabulary size (13 & 24 months)	Recurrent RTIs (days) and AOM (episodes) at 0–11, 12–24, and 0–24 months	Child´s sex, day care at 13 & 24 months (yes/no) paternal/maternal educational & occupational level (high/low), family net income (high/low), paternal/maternal chronic illness (yes/no)
II	Expressive vocabulary growth (13–24 months) (boys vs girls)	Recurrent RTIs (days) and AOM (episodes) at 0–12 and 13–23	Day care at 13 & 24 months, paternal/maternal high level of education & occupation (yes/no)
III	Expressive vocabulary growth (13–24 months) (boys vs girls)	Paternal full-time employment, parental/paternal leave, paternal high level of education & occupation (yes/no), hours spent with the child (hours)	Vocabulary size (13 months), maternal high level of education & occupation (yes/no)
IV	Expressive vocabulary growth in lexical categories (13–24 months) (boys vs girls)	Firstborn, day care at 13 & 24 months, family burden of late onset of speech (yes/no), paternal/maternal educational level (no occupational/college degree/lower university degree/university degree), paternal/maternal occupational level (low/medium/high)	

Abbreviations: RTI = respiratory tract infection; AOM = acute otitis media; CDI = MacArthur-Bates Communicative Development Inventory; CDI-I = CDI-Infant; CDI-T = CDI-Toddler; RTI = respiratory tract infection.

4.4.1. Language Data

The vocabulary data was assessed with the Finnish (Lyytinen, 1999) and Swedish (Eriksson & Berglund, 2000) versions of the CDI for infants (CDI-I) and toddlers (CDI-T) (Test information cf. Fenson et al., 1994, 2007). The CDI-I consists of two parts: Early words, with four subscales, and Early gestures, with five subscales. In *Studies I–IV* we used the subscale Vocabulary checklist from the section Early words. The Finnish vocabulary checklist consists of 19 categories with 380 words. Parents completed the vocabulary part of the CDI-I by marking either *understands* (1) or *understands and produces* (2). The CDI-T also consists of two parts: Words the child uses, with two subscales, and Sentence and grammar. In *Studies I–IV* we used the vocabulary checklist part which comprises 20 categories with altogether 595 words (ibid.). The vocabulary checklists consist of different lexical categories, which are described more in depth in Table 4. In the CDI-T, parents could mark only whether the child understands and produces the word (1). Words not marked in the CDI-I or CDI-T were considered not included in the child´s vocabulary (marked 0).

The parents completed the CDI-I when the child was 13 months of age and the CDI-T when the child was 24 months of age. The questionnaires were completed on paper or electronically. Questionnaires completed on paper were posted in stamped envelopes. New questionnaires were sent out if no answer was received within 2 weeks. The questionnaires were completed in Finnish or Swedish. In families where both languages were used, the family completed both a Finnish and a Swedish questionnaire. As there are some differences in the structure and instructions between the Finnish and Swedish versions, we decided only to include the Finnish CDI questionnaires. We also decided not to include families who had completed the CDI in both languages, as it was hard to know which was the child´s main language.

In *Study I* we analysed receptive and expressive vocabulary at 13 months and expressive vocabulary at 24 months of age. In *Studies II–IV* we analysed expressive vocabulary growth between 13 and 24 months of age. In *Study IV* we also analysed the growth in different lexical categories: sound effects, nouns, people, games and routine words, action words, descriptive words, as well as time words, pronouns, questions, prepositions, and number of words.

The outcome variables in *Study I* were defined as percent of number of words understood and of words produced at ages 13 and 24 months of age, calculated from the maximum numbers of words in the CDI-I and CDI-T. The outcome variable in *Studies II–III* was expressive vocabulary growth in number of words between 13 and 24 months of age. In *Study IV,* vocabulary growth between 13 and 24 months of age was analysed both in percent and size (number) for the different lexical categories at ages 13 and 24 months.

Table 4
Description of the Vocabulary Checklists of the CDI-I and CDI-T Used in the Study

Lexical categories	Content	Number of items in CDI-I	Number of items in CDI-T
Sound effects and animal sounds	E.g., sounds made by animals	13	13
Common nouns	Animals, vehicles, toys, food and drinks, clothes, body parts, furniture and rooms, kitchen items, nature, and places	207	293
People	Persons or names	16	24
Games and routines	E.g., bye-bye, wait	18	24
Action words	Verbs	60	106
Descriptive words	Adjectives	26	54
Function words	Time words, pronouns, question and quantity words, prepositions	40	83
TOTAL number of items		380	595

Abbreviations. CDI = MacArthur-Bates Communicative Development Inventory; CDI-I = CDI-Infant; CDI-T = CDI-Toddler.

4.4.2. Respiratory Tract Data (*Studies I* and *II*)

In *Studies I–II,* the main risk factor for language development studied was respiratory tract infections (RTI), accompanied by acute otitis media (AOM) as an often co-occurring condition. The study families completed a daily symptom diary from birth up to 23 months of age. In the symptom diary the parents noted the child´s respiratory and other symptoms, physician visits, diagnoses, treatments, and the child´s and parent´s absence from day care and work, respectively. The families were encouraged to visit the STEPS Study clinic when the child had symptoms of acute respiratory infection. All visits to the STEPS clinic or a clinic of the family´s choice outside the study were registered on structured forms and diagnoses of upper and lower respiratory tract, ear, and other infections were documented. Pneumatic otoscopy and tympanometry were used by the study physicians at the STEPS clinic to diagnose AOM.

Diagnosis of RTI was based on documented physician´s diagnosis or on existence of acute cough or rhinitis, with or without other symptoms, as documented by parents in the symptom diary. RTI episodes were considered separate episodes if there was at least 1 day without symptoms in between. The criteria for AOM diagnosis were symptoms of acute RTI, inflammation of the tympanic membrane, and signs of effusion in the middle ear. In case of continuing RTIs, AOM episodes were considered separate episodes if there were at least 14 days between the diagnoses of AOM (Toivonen, Schuez-Havupalo et al., 2016).

In *Studies I–II,* RTIs were considered recurrent at a cut-off point of the upper 10th percentile of the number of days with symptoms of RTI at different ages.

AOM was considered recurrent at the cut-off point of the upper 10th percentile of the number of AOM episodes. In using the 10th percentile cut-off, we followed the earlier practice of dividing data (Fenson et al., 2007; Korpilahti et al., 2016; Thal et al., 1997; Toivonen, Karppinen et al., 2016). Children belonging to the 10th percentile of recurrent RTIs during the first and second year of life had 91 and 119 sick days or more, respectively. Children with recurrent AOM during their second year had at least four episodes of AOM. Table 5 shows the minimum days or episodes of RTIs and AOM needed to be regarded as having recurrent infections.

The factors of recurrent RTI and AOM episodes for the different ages were computed into dichotomous variables: yes–no recurrent RTIs or AOM episodes according to the description above.

Table 5
Cut-Off Points for Recurrent RTIs and AOM at Different Ages in Children in Studies I–II

	Cut-off points for recurrent RTIs and AOM	
Recurrent infection in different ages	Study I	Study II
Recurrent RTIs 0–11 months	≥ 91 days	≥ 91 days
Recurrent RTIs 12–24 months	≥ 119 days	≥ 120 days
Recurrent RTIs 0–24 months	≥ 198 days	
Recurrent AOM 0–12 months	≥ 3 episodes	≥ 3 episodes
Recurrent AOM 13–23 months	≥ 4 episodes	≥ 4 episodes
Recurrent AOM 0–23 months	≥ 6 episodes	

Abbreviations. RTI = Respiratory tract infections; AOM = acute otitis media.

4.4.3. Health and Demographic Data of the Family

The parents completed questionnaires about their demographic and health data before or at the birth of the child, and when the child was 13 and 24 months of age. The parental questionnaires included, among other things, background data concerning family structure, parental education and occupation, family income, health problems and impairments in the family, languages used in the family and at day care, use of parental and maternity/paternity leave, time spent with child, and questions concerning upbringing. The child questionnaires contained questions concerning siblings, day care attendance, feeding and eating habits, presence of asthma or allergic diseases based on the International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire, presence of chronic diseases and conditions, health problems and impairments, languages used with the child, and sleeping characteristics. The child questionnaires were sent to the families starting from age 4 months. In the current study, child questionnaires sent at ages 13 and 24 months were considered. Register data from the National Birth Registry was

used to document birth-related data such as gestational length. The questionnaires were prepared by different research groups in the STEPS Study and brought for evaluation and ratification to the executive team before they were given to the families. The questionnaires included yes-no questions, multiple-choice questions, and fill-in questions.

Child variables used in the thesis were the child´s sex, being firstborn, and day care attendance at 13 and 24 months of age. All child variables were examined as dichotomous variables (yes–no). In *Studies II–IV,* boys and girls were analysed separately in relation to the other variables.

Parental variables used in the present studies were educational level, occupational status, father´s use of parental or paternity leave, father´s time spent with the child, family income, history of late onset of speech, and chronic illness. Educational and occupational levels were classified based on those used in Statistics Finland (classification of educational and occupational levels).

Parental education was defined in the parental questionnaire as a multiple-choice question with nine alternatives from no education/other education to doctoral degree. The variable was dichotomized in *Studies I–III* into high educational level, meaning bachelor, master or doctoral degree, and low educational level including college degree or no occupational education. The education variable was analysed separately for fathers and mothers. In *Study IV,* parental education was analysed at four levels: no occupational education, college degree, lower university degree, and higher university degree. In *Study IV*, all answers marked 'other education' were noted as a missing value, as the level of education could not be ascertained.

In the questionnaire, the level of occupation was in multiple-choice format with nine different classes including manager, specialist, professional, office worker, service worker, farmer, construction worker, process or transport worker, and other occupation (Statistics Finland; classification of educational and occupational levels). The variable was dichotomized in *Studies I–III* into high occupational status, meaning professional, specialist, and manager and the rest into low occupational level. The occupation variable was analysed separately for fathers and mothers. In *Study IV*, the occupation was analysed at three levels: low occupational status (including farmers, construction, process or transport workers, and other non-mentioned occupations), medium occupational status (including office and service workers), and high occupational status (including managers, specialists, and professionals).

Family income was analysed in *Study I*. It was given as net family income and dichotomized accordingly into average/high income or not. The average income was chosen as at least €3,000/month, as the average disposal money at the time of the first questionnaires was between €3,120 and €3,173 (PX-Web databases [Income] of Statistics Finland).

A history of late onset of speech was examined in *Study IV*. In the questionnaires, fathers and mothers could choose from a list of speech and language related conditions if they themselves or in the close family had had a late onset of speech as a child. We considered a possible history of late onset of

speech not only in the parents, but also in siblings and other close family (like cousin, uncle). The variable was a sum variable of data from all family members and was dichotomized into having or not having a history of late onset of speech in the family.

Chronic illness in the parents was included as a background factor in *Study I*. The parental questionnaire included 22 statements about various diseases in the family. Of these, 19 chronic states of illness were combined into a dichotomous variable—chronic condition or not—which was analysed both for fathers and for mothers. The reason to include chronic conditions as a variable was that it can be stressful to a family. Parental perceived stress has been associated with limitations in their child´s early language development (Henrichs et al., 2011; Schjøberg et al., 2011).

Father´s working full time together with paternal use of parental and paternity leave was included in *Study III*. In Finland, the father can stay at home for 54 days of paid leave after the birth of the child. He also has the option of staying longer at home if he chooses to split the paid parental leave of 158 days with the mother. We chose to combine the variable of paternity and parental leave as a dichotomous variable of using or not using paternity or parental leave.

Paternal time with the child was analysed in *Study III*. In the parental questionnaire, the fathers completed how many hours per day, during weekdays and weekends, they spent with their children at 13 months of age. The hours were computed to average hours and minutes per day by multiplying the time given for weekdays by the weight factor 5/7 and for free days by the weight factor 2/7.

4.5. Data Management and Statistical Analysis

Descriptive statistics used in the studies were mean and standard deviation (SD) in Studies I–IV, median and IQR (*Study I*), and median (*Study III*). Analytical statistics are presented separately for each study. A p value of $< .05$ was considered statistically significant. Bonferroni adjustments were conducted in *Study III*. Analyses were carried out using IBM SPSS Statistics (IBM Corp, Armonk, NY USA), versions 24.0–27.0, SAS for Windows Release 9.4, and Mplus 8.0 and 8.7 software with Maximum Likelihood estimator (Muthén & Muthén, 1998–2017).

The questions in the parental and child questionnaires were sometimes conducted in yes/no or marked/unmarked manner, which automatically led to dichotomized variables. In other cases, variables were dichotomized to get broader categories and thus accomplish more statistical power. Sometimes, without dichotomizing, the categories would have been too small for statistical analysis. In the recruitment part of the STEPS Study (Lagström et al., 2013), dichotomized variables were used. This enables comparing the results between different study disciplines in the project. However, in the Structural Equation

Model (SEM) analysis in *Study IV* of this thesis, parental education and occupation were changed to four and three level variables, respectively.

4.5.1. Study I

The receptive and expressive vocabulary sizes at age 13 months in children with recurrent RTIs and AOM episodes at age 0–11 months were compared to that in children without recurrent infections. The expressive vocabulary at 24 months of age in children with recurrent RTIs and AOM between 12 and 24 and between 0 and 24 months of age was compared to that in children with fewer infections. Also, background factors were analysed in relation to vocabulary size at 13 and 24 months of age.

Student´s independent two-tailed *t*-test was conducted to compare vocabulary size between children with and without recurrent RTIs or AOM episodes. A Chi-square test was conducted to analyse associations between risk and background factors. Adjusted effects of significant risk and background variables on vocabulary size were analysed using analysis of variance.

4.5.2. Study II

Vocabulary growth between the ages 13 and 24 months was the primary outcome of *Study II*. Vocabulary growth in children with recurrent RTIs and AOM episodes was compared to that in children without recurrent infections.

Results from a previous study (Nylund et al., 2019) had shown that girls´ vocabulary size significantly exceeded that of boys. First, a two-way analysis of variance was administered to all the background variables. A significant interaction term was found between "gender*maternal occupational status" ($p < .001$). This was our reason not only to include the child´s sex as an independent variable among others, but also to design the analysis separately for boys and girls. A two-tailed independent *t*-test was conducted to compare mean vocabulary growth in boys and girls in relation to recurrent RTIs and AOM episodes and background factors. The effect of risk and background factors on vocabulary growth were analysed with linear regression analysis with the addition of the control variables of vocabulary size at 13 months of age and presence of siblings.

4.5.3. Study III

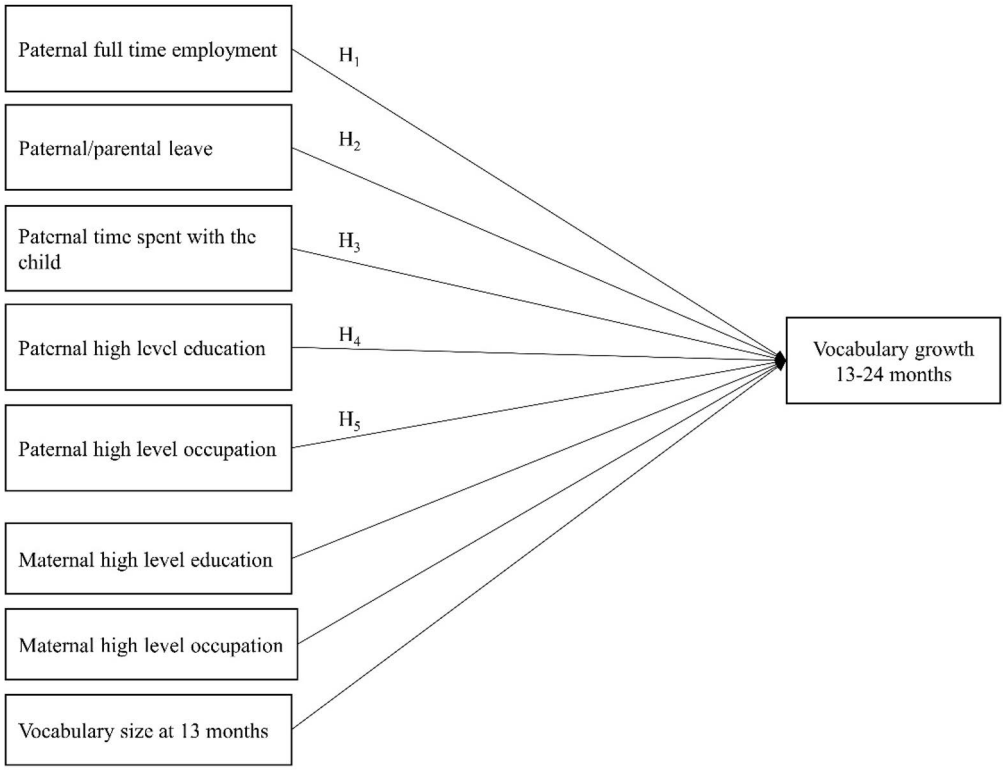
The main outcome was vocabulary growth between 13 and 24 months of age. Vocabulary growth was analysed separately for boys and girls in relation to paternal factors.

To exclude multicollinearity, collinearity analysis was conducted. A two-tailed independent *t*-test was conducted when comparing mean vocabulary growth in boys and girls in relation to paternal and control variables. Pearson´s correlation analysis was conducted when analysing relationships between vocabulary size at 13 & 24 months of age and vocabulary growth, and between paternal hours together with the child and vocabulary growth. Spearman´s

correlation was used when analysing correlations between categorical variables. Bonferroni adjustments were applied in independent t-tests in *Study III*. To analyse the predictive role of paternal factors on vocabulary growth in boys and girls, SEM analysis was performed with paternal factors and control variables. Fit indices applied in the SEM analysis in *Studies III–IV* were a root mean square error of approximation (RMSEA) under 0.08, Tucker-Lewis index (TLI) and comparative fit index (CFI) preferably over 0.95 (e.g. Hu & Bentler, 1999) but satisfactory if over 0.90 (e.g., Metsämuuronen, 2009). When analysing the effects of paternal factors on vocabulary growth, maternal high level of education, high occupational status, and vocabulary size at 13 months of age were controlled for. The conceptual model of hypothesized associations is shown in Figure 3.

Figure 3

Hypothesized Model of the Influence of Paternal and Control Factors on Vocabulary Growth between 13 and 24 Months of Age (Study III)



4.5.4. Study IV

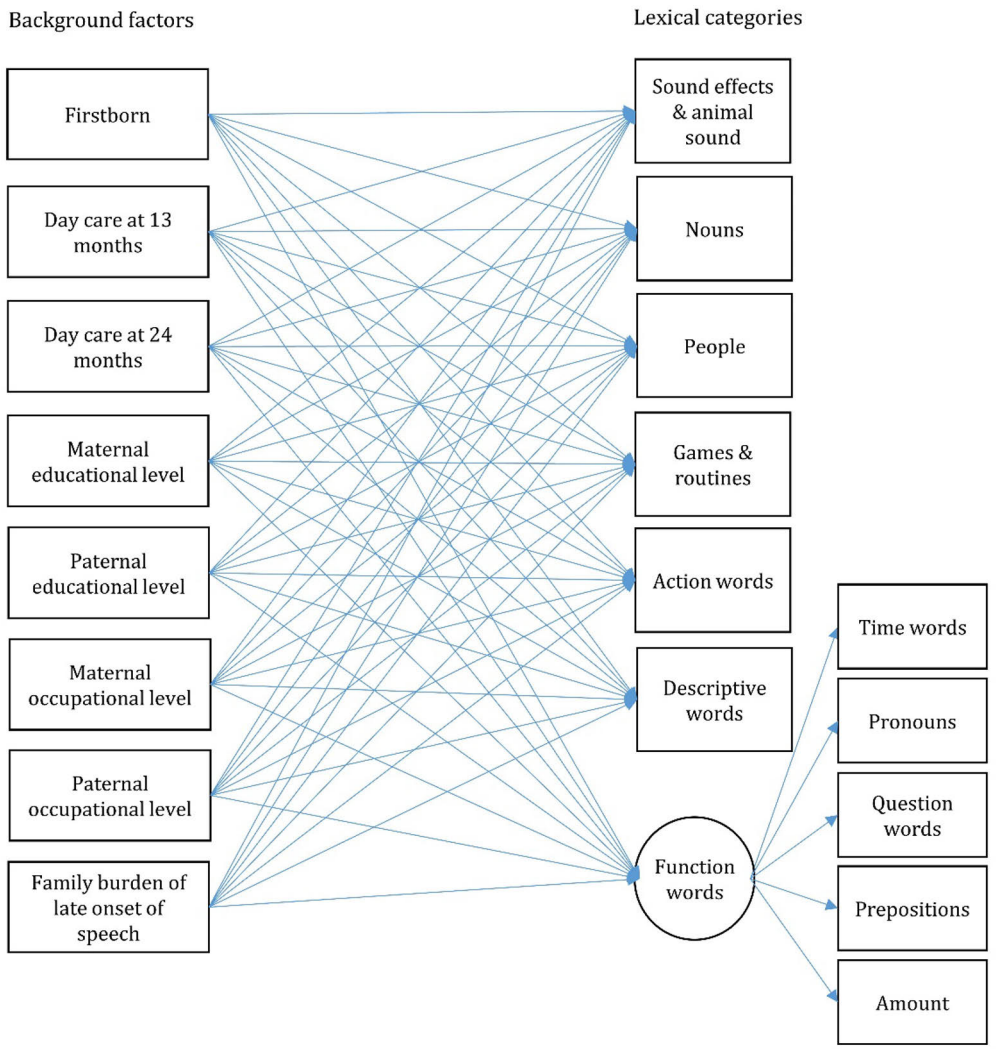
To examine possible demographic differences between boys and girls, background factors (Apgar score [5 min], firstborn status, day care attendance, parental age at birth, parental educational and occupational level, and a family

history of late onset of speech) were compared with an independent two-tailed t-test for numerical variables and a Chi-square test for categorical variables. There were no significant differences between background variables in boys and girls.

An independent two-tailed t-test was used to compare mean size in lexical categories between boys and girls. Pearson´s correlation analysis was conducted to examine the relationship between vocabulary growth in different lexical categories. SEM was conducted to test the hypothesized model (Figure 4) of differences in early lexical growth as a function of child and parental factors. The expectation-maximization algorithm was used to handle missing data. The analysis was conducted in two steps: First, confirmatory factor analysis (CFA) was used to examine the factor structure of the latent outcome variable. Second, SEM was used to analyse the regressions, including the CFA models and the observed variables. A Chi-square test was conducted to examine the fit of the models. Comparison of multigroup CFA (MGCFA) models across the child´s sex was done to examine possible effects on group differences by differential item functioning. A multigroup SEM (MGSEM) was conducted to test between group differences in the hypothesized model.

Figure 4

Hypothesized Model of Background Factors Influencing Differences in Vocabulary Growth in Lexical Categories Between the Ages of 13 and 24 Months, Measured With CDI-I and CDI-T (Study IV). The Model Was Applied Separately for Boys and Girls



Abbreviations. CDI = MacArthur-Bates Communicative Development Inventory; CDI-I = CDI-Infant; CDI-T = CDI-Toddler.

5. Results

This section presents the results of the thesis, starting with a general description of vocabulary size and growth in the study children, followed by the results of each study, beginning with *Study I*.

5.1. Early Vocabulary Development

Vocabulary size at 13 and 24 months of age was measured with the CDI-I (ceiling score 380 words) and CDI-T (ceiling score 595 words), respectively (Lyytinen, 1999). There was broad variation between the children in the words understood at age 13 months and those produced at 13 and 24 months of age (Table 6). Girls outperformed boys in receptive and expressive vocabulary at all ages (at 13 months, $p = .003–.006$; at 24 months, $p < .001$), and in expressive vocabulary growth between 13 and 24 months ($p = .005$). Vocabulary size at 13 months of age was a strong predictor of vocabulary growth between ages 13 and 24 months in boys ($p < .001$).

As the study children were not always the same in the four studies, there were also small differences in mean sizes of the vocabulary between the studies. One of the girls reached a ceiling of 595 words at 24 months of age, but none of the boys did. Some children had no vocabulary growth or even showed a decrease in vocabulary size ($n = 1$) between the ages of 13 and 24 months. The difference in vocabulary growth between 13 and 24 months of age can also be demonstrated on an individual level, as shown in Figure 5.

The lexical categories *sound effects*, *common nouns*, *people*, *games and routines*, *action words*, *descriptive words,* and *function words*, were analysed in boys and girls at ages 13 and 24 months and between 13 and 24 months of age. Significant differences between vocabulary size in boys vs girls, in favour of girls, were found in all categories at ages 13 and 24 months except for *action words*, *descriptive words*, and *function words* at 13 months of age (Table 7). In comparing vocabulary growth in the lexical categories between ages 13 and 24 months in boys and girls, there was a significant difference in all categories ($p < .001$) except sound effects. However, the development of lexical categories in boys and girls followed the same order and proportional size despite the discrepancy in size.

Table 6

Variation in Number of Words in Receptive and Expressive Vocabulary in Boys vs Girls at 13 and 24 Months of Age and in Expressive Vocabulary Growth Between 13 and 24 Months of Age in Studies I–IV

Studies	CDI-I 13 months Receptive vocabulary			CDI-I 13 months Expressive vocabulary			CDI-T 24 months Expressive vocabulary			Vocabulary growth 13–24 months		
	Variation	*Mean*(*Sd*)	*p*	Variation	*Mean*(*Sd*)	*p*	Variation	*Mean*(*Sd*)	*p*	Variation	*Mean*(*Sd*)	*p*
Study I (*N* = 646)												
All	2–339	111(70)		0–296	8(18)		4–595	297(166)				
Boys	2–339	104(67)		0–115	6(12)		4–593	256(165)				
Girls	2–334	120(73)	.005	0–296	10(23)	.006	7–595	343(156)	< .001			
Study II (*N* = 462)												
All				0–296	8(18)		4–595	295(167)		-17–594	287(163)	
Boys				0–115	6(11)		4–593	254(166)		-17–585	249(163)	
Girls				0–296	11(24)	.005	7–595	343(155)	< .001	5–594	332(150)	< .001
Study III (*N* = 685)												
All				0–297	10(18)		4–595	301(165)		-19–594	292(161)	
Boys				0–116	8(11)		4–593	264(168)		-19–582	256(165)	
Girls				0–297	12(23)	.003	4–595	342(152)	< .001	4–594	330(147)	< .001
Study IV (*N* = 719)												
All				0–297	10(18)		4–595	300(165)		-19–594	290(161)	
Boys				0–116	8(11)		4–593	262(168)		-19–582	254(165)	
Girls				0–297	12(23)	.003	4–595	340(153)	< .001	4–594	328(148)	< .001

Abbreviations. CDI = MacArthur-Bates Communicative Development Inventory; CDI-I = CDI-Infant; CDI-T = CDI-Toddler

Figure 5

Vocabulary Growth Between 13 and 24 Months of Age of Every Individual Study Child (Study III). Vocabulary Growth on the y-Axis and Individual Children on the x-Axis. Boys Are Marked in Green (n = 354) and Girls in Red (n = 331)

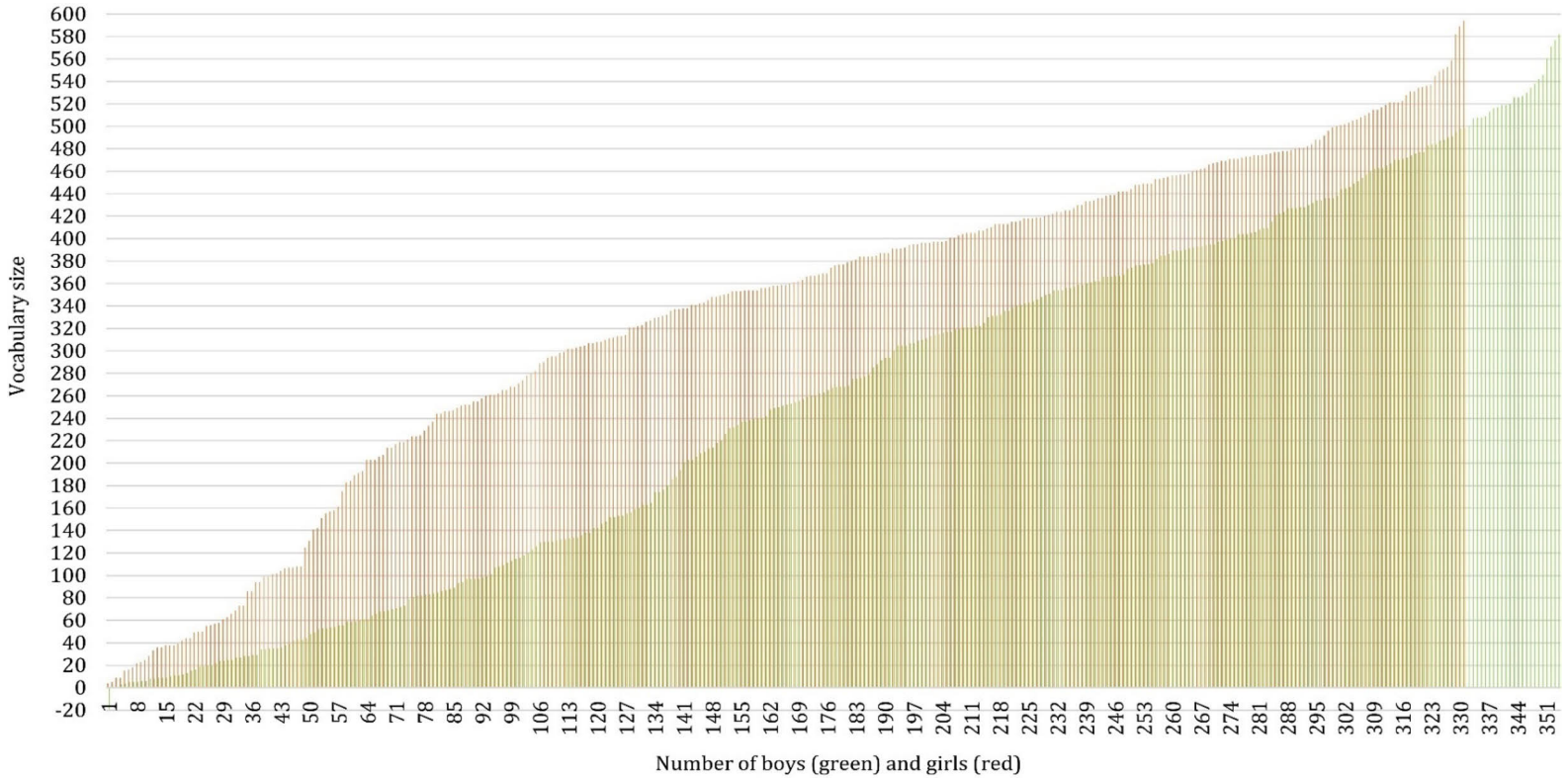


Table 7

Comparison of Vocabulary Size in Lexical Categories in Boys vs Girls at the Ages of 13 and 24 Months and of Vocabulary Growth in Lexical Categories Between 13 and 24 Months in Boys vs Girls (Study IV). Independent T-test

Variable	CDI-I number of words (13 months)			CDI-T number of words (24 months)			Vocabulary growth at ages 13–24 months, % words		
	Boys *Mean(SD)*	Girls *Mean(SD)*	*p*	Boys *Mean(SD)*	Girls *Mean(SD)*	*p*	Boys *Mean(SD)*	Girls *Mean(SD)*	*p*
Sound effects (13/13)	1.8(1.9)	2.5(2.4)	< .001	9.9(2.9)	10.5(2.7)	.005	0.62(0.22)	0.61(0.23)	.772
Common nouns (207/293)	3.2(6.5)	5.4(14.2)	.007	143.0(87.9)	184.5(78.5)	< .001	0.47(0.29)	0.60(0.26)	< .001
People (16/24)	1.2(1.5)	1.7(1.9)	.001	11.0(5.7)	13.0(4.9)	< .001	0.38(0.24)	0.44(0.21)	.001
Games and routines (18/22)	1.0(1.4)	1.3(1.9)	.007	13.1(6.6)	16.2(5.7)	< .001	0.54(0.29)	0.67(0.25)	< .001
Action words (60/106)	0.4(1.1)	0.5(3.0)	.429	46.0(37.2)	63.0(34.1)	< .001	0.43(0.35)	0.59(0.32)	< .001
Descriptive words (26/54)	0.1(0.4)	0.2(1.1)	.118	16.4(14.4)	22.1(14.8)	< .001	0.30(0.27)	0.40(0.27)	< .001
Time words (8/12)	0.0(0.0)	0.0(0.3)	.144	3.3(3.7)	4.4(3.9)	< .001	0.27(0.30)	0.37(0.32)	< .001
Pronouns (8/24)	0.0(0.2)	0.1(0.3)	.111	4.4(5.1)	6.0(5.2)	< .001	0.18(0.21)	0.24(0.21)	< .001
Questions (7/8)	0.1(0.3)	0.1(0.3)	.896	2.4(2.4)	3.2(2.4)	< .001	0.29(0.30)	0.40(0.30)	< .001
Prepositions (11/20)	0.0(0.3)	0.1(0.6)	.072	8.7(6.4)	11.1(5.9)	< .001	0.43(0.32)	0.54(0.29)	< .001
Amount (6/9)	0.0(0.1)	0.0(0.2)	.857	3.0(2.5)	4.0(2.6)	< .001	0.33(0.28)	0.44(0.28)	< .001
Particle (10), only CDI-T				1.4(2.0)	2.3(2.6)	< .001			

Abbreviations. CDI = MacArthur-Bates Communicative Development Inventory; CDI-I = CDI-Infant; CDI-T = CDI-Toddler

5.2. Relationship Between RTIs or AOM and Vocabulary Size at 13 and 24 Months (Study I)

The aim of the first study was to analyse possible relationships between recurrent RTIs or AOM during the first and second year of life, and receptive vocabulary size at age 13 months, and expressive vocabulary size at ages 13 and 24 months. Demographic factors that could possibly associate with vocabulary development at 13 and 24 months of age were also included.
During the first year 63 children had recurrent RTIs (at least 91 days with RTI symptoms) and during the second year 62 had recurrent RTIs (at least 119 days with RTI symptoms). Recurrent AOM episodes were detected in 48 children during the first (at least 3 episodes) and in 71 children during the second year (at least 4 episodes). Of the participating children, 20 had both recurrent RTIs and AOM episodes during the first 2 years with mean days of RTIs over 236 and mean number of AOM episodes almost nine compared to much lower numbers in children without recurrent RTIs and AOM (*mean* 82.1(48.7) and 1.3(1.5), respectively) (Table 8).

Children with recurrent RTIs during the first 2 years of life were more commonly boys (p = .043) and had siblings (p < .001), while children with recurrent AOM episodes during the first 2 years had more usually been in day care outside the home at 13 months of age (p = .001). No other differences in background factors were found between children with or without recurrent RTIs or AOM. Vocabulary size in children with recurrent RTIs and AOM episodes was compared to that in children without recurrent infections. The families reported more words for children with recurrent RTIs than for children without. However, the difference was not significant. The same was noticed in children with recurrent AOM episodes compared to children without. Recurrent RTIs and AOM episodes were not associated with a smaller vocabulary size at 13 or 24 months of age.

The significance of background factors was analysed in relation to vocabulary size at 13 and 24 months of age with an independent t-test. Adjusted effects of risk factors and significant background factors to receptive vocabulary size at age 13 months and productive vocabulary size at ages 13 and 24 months were analysed. Girls had a significantly larger receptive vocabulary size at 13 months (F(1,458) = 12.72, p < .001) and expressive vocabulary size both at 13 (F(1,481) = 8.00, p = .005) and 24 F(1,339) = 21.68, p < .001) months of age. Children in day care outside the home at age 13 months had a significantly smaller receptive vocabulary (F(1, 458) = 5.64, p = .018) than children staying at home. Children of fathers with a chronic illness had a larger receptive vocabulary than did children with healthy fathers (F(1,458) = 5.61, p = 0.022). Children of mothers with a high occupational status had a larger expressive vocabulary size at 24 months of age (F(1,339) = 5.10, p = .025).

Table 8
Number of Days With Symptoms of RTI and Number of AOM Episodes Different Ages Calculated from the Total Sample (N = 646, Study I)

Age	Recurrent RTIs		Recurrent AOM		Both recurrent RTIs and recurrent AOM episodes	
	Children	Sick days	Children	Episodes	Children	Sick days and episodes
	n(%)	*Mean*(*SD*)	*n* (%)	*Mean*(*SD*)	*n*	*Mean*(*SD*)
0–11 months	63(10.5)	122.2(30.5)	48(8.5)	3.8(1.4)	19	129.1(27.7)/ 3.8(1.0)
12–23 months	62(10.4)	157.7(43.6)	71(11.5)	6.8(4.9)	21	155.5(42.0)/ 6.2(2.5)
0–23 months	62(10.4)	250.1(56.5)	64(10.1)	8.6(4.8)	20	236.8(51.7)/ 8.7(5.2)

Abbreviations. AOM = acute otitis media; RTI = respiratory tract infection.
The total number of children varies in the different age groups based on the acquired report.

5.3. Expressive Vocabulary Growth in Relation to Recurrent RTIs, and Background Factors (Study II)

The objective for the second study was to investigate whether vocabulary growth between the ages of 13 and 24 months differs in boys vs girls with recurrent RTIs compared to children who are less sick. We were also interested to investigate possible differences in vocabulary growth in boys vs girls regarding background factors. When analysing vocabulary growth between 13 and 24 months of age in children with recurrent RTIs, the focus was on boys and girls separately. There were no significant differences in risk and background factors between boys and girls (Table 9). However, girls with recurrent RTIs during the first year were more likely to be cared for at home during the second year (77.8%) compared to girls with fewer RTIs (43.4%, p = .005). Girls with recurrent AOM episodes at 13–23 months of age were less likely to be cared for at home during their second year (83.3%) compared to girls with fewer AOM episodes (52.1%, p = .009).

Table 9

Descriptive Background Characteristics of Study Boys Compared to Study Girls. The Chi-square Test was Conducted for Categorical Variables and Data is Presented as Percentages, $p < .05$ (Study II)

Characteristic		Included in the study (N = 462)				
		Boys		Girls		
		n	(%)	*n*	(%)	*p*
Firstborn		153	(61.7)	129	(60.3)	.756
Recurrent RTIs						
	0–11 months	27	(11.4)	19	(9.2)	.445
	12–23 months	25	(10.6)	20	(9.7)	.746
Recurrent AOM						
	0–11 months	23	(10.0)	15	(7.5)	.371
	12–23 months	30	(12.4)	18	(8.5)	.177
Day care outside home						
	at 13 months	65	(26.2)	52	(24.3)	.638
	at 24 months	129	(56.3)	108	(54.0)	.628
Late onset of speech						
	Father	4	(1.6)	3	(1.4)	.853
	Mother	3	(1.2)	3	(1.4)	.856
High educational level*						
	Father	112	(45.9)	102	(51.0)	.285
	Mother	162	(66.4)	135	(65.5)	.848
High occupational level**						
	Father	106	(53.8)	103	(60.6)	.191
	Mother	135	(63.1)	113	(62.8)	.950
Family income, average or more***		101	(41.2)	105	(50.2)	.054

Note. *Bachelor´s, master´s, doctoral degree, **professionals, ***3,000 euros per month or more.

Vocabulary growth between ages 13 and 24 months varied greatly between the children and between boys and girls. Table 10 shows the variation in vocabulary growth between boys and girls and in relation to recurrent or no recurrent RTIs and AOM episodes.

Table 10
Vocabulary Growth (Number of Words) Between 13 and 24 Months of Age in Boys and Girls in Relation to RTIs and AOM Episodes (Study II)

Variable		Vocabulary growth Boys		Girls	
		Mean (SD) words	Variation	*Mean* (SD) words	Variation
Child´s sex		249(163)	-17–585	332(150)***	5–594
Recurrent RTIs 0–12	yes	264(166)	21–538	366(132)	94–594
	no	249(164)	-17–585	329(150)	7–589
Recurrent RTIs 13–23	yes	320(160) *	13–585	332(147)	94–594
	no	242(163)	-17–538	333(149)	7–589
Recurrent AOM 0–12	yes	289(126)	18–484	359(145)	57–594
	no	239(164)	-17–585	335(148)	5–589
Recurrent AOM 13–23	yes	269(168)	3–527	379(92)	212–499
	no	246(164)	-17–585	329(153)	7–594

Note. *< .05, ***< .001. One child had fewer words at 24 months of age compared to 13 months of age, which explains the minus number (-17) in the variation.
Abbreviations: RTI = respiratory tract infection; AOM = acute otitis media.

There was a difference in vocabulary growth in relation to recurrent RTIs. Boys with recurrent RTIs during the second year of life had a larger vocabulary growth compared to boys without recurrent RTIs during the same time. Boys with fathers with a high level of education had a larger mean vocabulary growth compared to boys with fathers with a lower level of education (father highly educated: M = 281 SD = 168, not highly educated: M = 225 SD = 154, $t(242) = 2.68$, $p = .008$). Boys with parents with a high level of occupation had a larger mean vocabulary growth compared to boys with mothers and fathers with a lower level of occupation (mother professional: M = 278 SD = 168, non-professional: M = 211 SD = 152, $t(212) = 2.93$, $p = .004$ and father professional: M = 262 SD = 167, non-professional: M = 210 SD = 151, $t(195) = 2.26$, $p = .025$). However, neither risk nor background factors were related to differences in mean vocabulary growth in girls.

Possible predictors of vocabulary growth between 13 and 24 months of age were analysed with linear regression for boys and girls separately. Risk and background factors were included in the regression together with vocabulary size at 13 months of age and having siblings as control variables. Only the linear regression model for boys was significant and explained 12% of the variance in vocabulary growth ($F(12, 138) = 2.70$; $p = .003$, $R^2 = 0.19$; $R^2_{Adjusted} = 0.12$) (Table 11). Recurrent RTIs during the second year and larger vocabulary size at 13 months of age predicted larger vocabulary growth in boys.

Table 11
Risk and Background Factors in Relation to Expressive Vocabulary Growth at Ages 13 to 24 Months in Linear Regression Analysis (N = 462, Study II)

Risk and background factors	Expressive vocabulary growth in boys				
	B	*SE B*	*β*	*p*	95% CI
Expressive vocabulary size at 13 months	3.41	1.05	0.26	.001	[1.34, 5.48]
Presence of siblings	-15.93	27.56	-0.05	.564	[-70.43, 38.56]
Recurrent RTIs, 0–12 months	-10.05	45.08	-0.02	.824	[-99.19, 79.09]
Recurrent RTIs, 13–23 months	109.88	43.79	0.21	.013	[23.29, 196.46]
Recurrent AOM, 0–12 months	10.34	43.38	0.02	.812	[-75.40, 96.07]
Recurrent AOM, 13–23 months	34.26	36.35	0.08	.348	[-37.61, 106,14]
High educational level, mother*	-18.84	32.64	-0.06	.565	[-83.38, 45.71]
High educational level, father*	18.25	36.58	0.06	.619	[-54.08, 90.59]
High occupational status, mother**	44.47	33.40	0.14	.185	[-21.58, 110.51]
High occupational status, father**	35.81	35.61	0.11	.316	[-34.60, 106.23]
Day care, 13 months	5.68	32.87	0.02	.863	[-59.32, 70.68]
Day care, 24 months	28.42	26.84	0.09	.292	[-24.66, 81.49]

Note. *Bachelor´s, master´s, or doctoral degree. **Professional.
Abbreviations: AOM = acute otitis media; RTI = respiratory tract infection.

5.4. Influence of Paternal Factors on Vocabulary Growth in Boys and Girls (Study III)

The focus of the third study was the part paternal factors play in expressive vocabulary growth between 13 and 24 months of age in boys and girls.

The study fathers had a mean age of 33 years at the birth of the child. Of these, 46% were highly educated, 85% were working full time, and 56% had a high occupational level. Many of the fathers (79%) had made use of paternal and/or parental leave. When the children were 13 months of age, the fathers spent a mean time of 4.5 hours/day with the boys and 4.3 hours/day with the girls. Fathers with a full-time job spent less time with their children than did fathers without full-time employment (r_s = -0.209, p < .001). A small number of fathers had themselves had a late onset of speech (2%). There were no significant differences between boys and girls in relation to paternal educational or occupational level, if the fathers were fully employed, had used paternal and/or parental leave, and how much time they spent with their sons and daughters.

A high level of paternal education was associated with a larger expressive vocabulary growth in boys compared to boys with less-educated fathers (*mean* = 286 words vs 232, p = .002). Boys and girls of fathers with a high level of

occupation had a larger vocabulary growth compared to children of fathers with lower occupational status (boys, mean = 275 words vs 214, p = .002 and girls, mean = 351 words vs 299, p = .004). Figure 6 gives a descriptive view of vocabulary growth in relation to paternal factors.

To explore how paternal factors predict vocabulary growth between 13 and 24 months of age in boys and girls, SEM analysis was conducted with paternal factors, the control variables being maternal high level of education, maternal high occupational status, and vocabulary size at 13 months of age. The SEM analysis was done separately for boys and girls. The father working full time predicted smaller vocabulary growth in boys, whereas a larger vocabulary size at 13 months of age and maternal high level of occupation predicted a larger vocabulary growth. In girls, paternal high level of occupation predicted larger vocabulary growth. Figure 7 lists the significant predictors in boys (n = 354) and girls (n = 331) ($\chi2(7) = 5.82$, $p = 0.5607$; RMSEA = 0.000; CFI = 1.000; TLI = 1.000; SRMR = 0.018 and $\chi2(7) = 7.56$, $p = 0.3732$; RMSEA = 0.016; CFI = 0.898; TLI = 0.883; SRMR = 0.024, respectively).

Figure 6

Comparison of Mean Vocabulary Growth in Boys and Girls Between 13 and 24 Months of Age in Relation to Paternal Factors (Study III, N = 685)

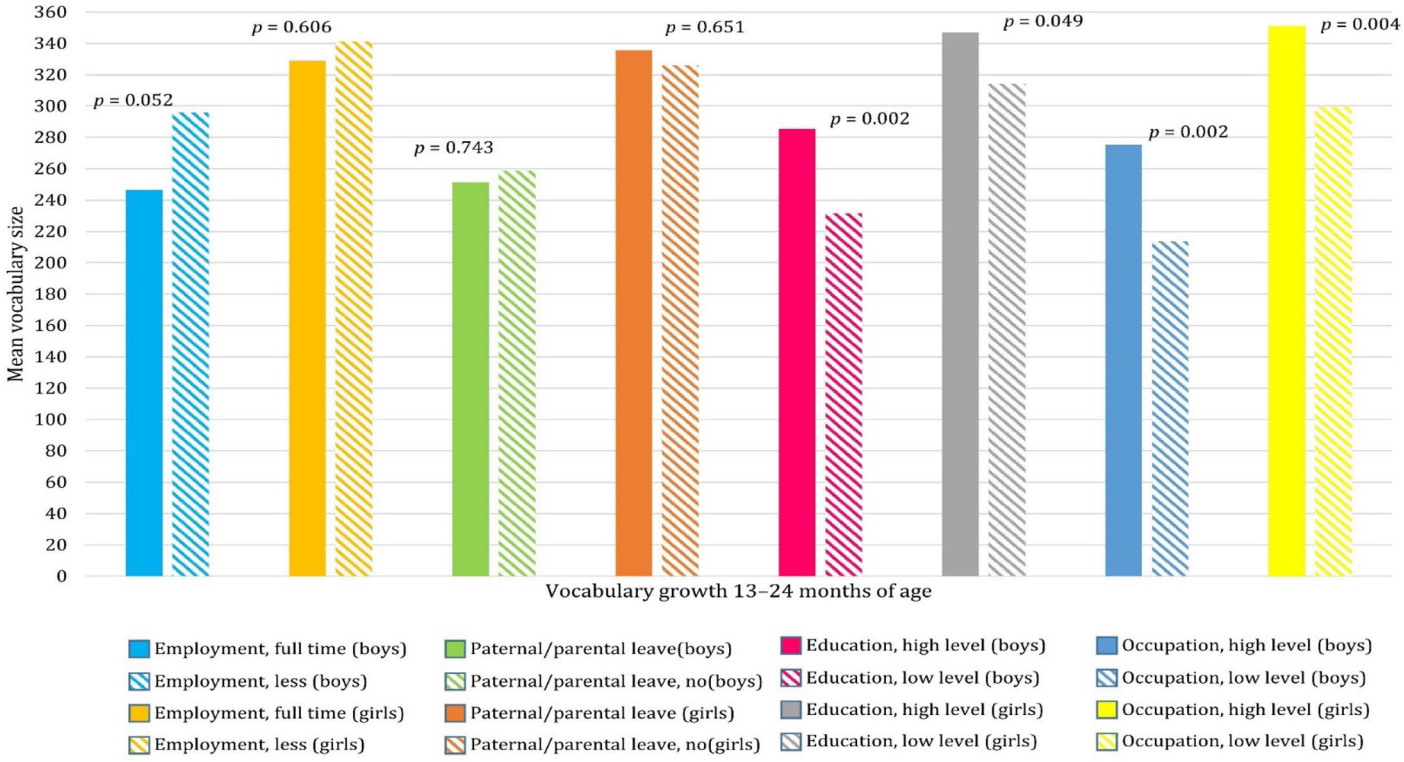
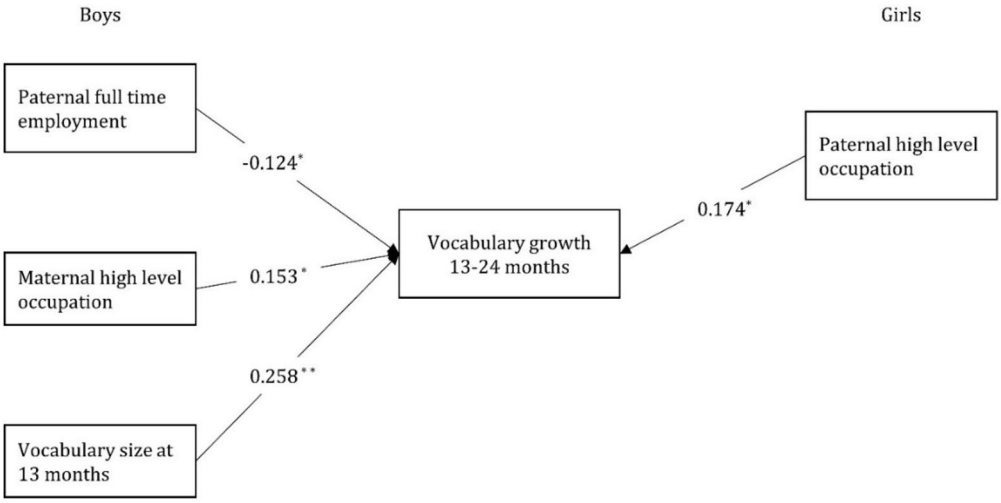


Figure 7

Predictive Factors of Vocabulary Growth Between Ages 13 and 24 Months in Boys (n = 354) and Girls (n = 331). SEM Analysis (Study III, N = 685)



5.5. Development of Lexical Categories at Ages 13 to 24 Months in Boys and Girls (Study IV)

The aim of the fourth study was to focus more closely on vocabulary growth in different lexical categories in relation to child (firstborn, attending day care at 13 and 24 months of age) and family factors (parent´s educational and occupational level and a family burden of late onset of speech) and examine if vocabulary growth in boys and girls are related in the same way to these factors.

There was a strong correlation between vocabulary growth in the different lexical categories both in boys and girls (r = 0.665–0.932 and r = 0.592–0.921, respectively, $p < .001$), except for sound effects (r = 0.237–0.447, $p < .001$ and r = 0.164–0.365, $p < .001$– .002, respectively)

To analyse how the different child and family factors predicted vocabulary growth in the different lexical categories, a multigroup SEM analysis was performed. The hypothesized associations between the child and family predictors and lexical growth were included in an initial structural model (Figure 4). The model proved to be a well-fitting multigroup model for the data ($\chi^2(128) = 285.13$, RMSEA = 0.071, CFI = 0.976, TLI = 0.947, SRMR = 0.018). However, there was a misfit of the data regarding equality of regression coefficients concerning the sexes. This indicated that vocabulary growth in boys and girls was affected differently by child and family factors.

There were differences in how child and family factors related to the vocabulary growth in the different lexical categories as a function of the child´s sex. Figure 8 shows significant predictions between child and family factors and lexical growth in boys and girls ($\chi2(60) = 122.29$, $p < 0.001$, RMSEA = 0.065, CFI = 0.9813, TLI = 0.958, SRMR = 0.016 and $\chi2(61) = 156.38$, $p < 0.001$, RMSEA = 0.082, CFI =

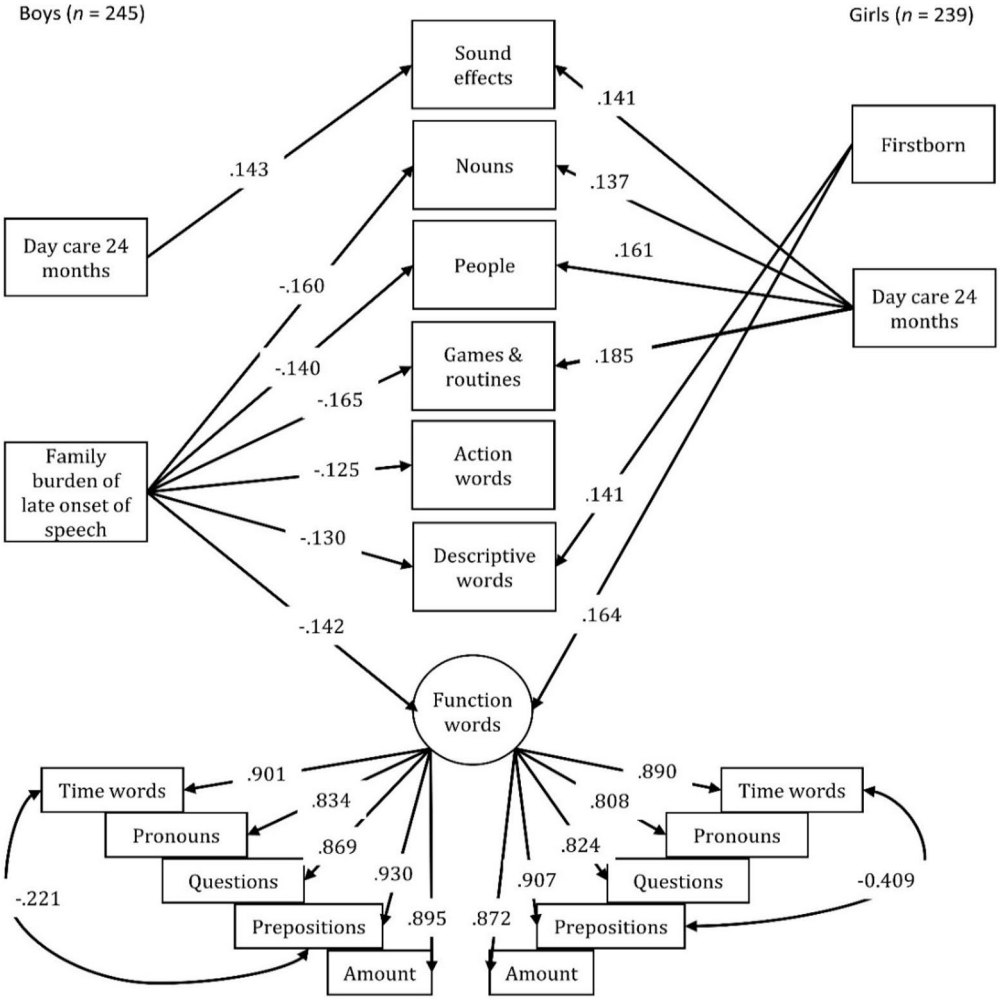
0.969, TLI = 0.925, SRMR = 0.018, respectively). The most prominent factor in vocabulary growth in boys was a family burden of late onset of speech, which predicted less vocabulary growth in all lexical categories except *sound effects*.

Boys attending day care at 24 months of age had larger growth of sound effects between the ages of 13 and 24 months. Girls attending day care at 24 months had a larger vocabulary growth in more categories than boys. These were *sound effects*, *nouns*, *people words*, and *games and routines*. Firstborn girls had a larger vocabulary growth in the lexical categories *descriptive words* and *function words*.

No associations were found between parental educational and occupational levels and vocabulary growth of lexical categories in boys or girls.

Figure 8

Structural Equation Model Showing Significant Predictions Between Child and Family Factors and Vocabulary Growth in Lexical Categories in Boys and Girls Between Ages 13 and 24 Months (Study IV)



6. Discussion

The aims of the thesis were (a) to analyse possible relationships between recurrent RTIs or AOM episodes during the first and second year of life and receptive and expressive vocabulary size at 13 months and expressive vocabulary size at 24 months of age, (b) to investigate whether expressive vocabulary growth between 13 and 24 months of age differs in boys and girls with recurrent RTIs compared to children without recurrent RTIs in relation to background factors often associated with language development, (c) to study how paternal factors relate to early vocabulary growth in boys and girls, and (d) to examine whether child and parental factors are related to differences in early growth of lexical categories (at 13–24 months of age) and whether this growth relates differently to child and parental factors in boys vs girls.

The findings of *Studies I–IV* are discussed below, starting with the associations of child factors with early vocabulary development, followed by the effects of parental/family factors on vocabulary size and growth. Then, the main results of the thesis, i.e., the differences in how vocabulary growth in boys and girls is associated with risk and background factors, are discussed.

This prospective cohort study examined what effects factors present in the child and in the near environment have on early vocabulary development. The theoretical view that a child develops in interaction with the surrounding micro and macro environment (Bronfenbrenner & Ceci, 1994; Shelton, 2018) emphasizes the importance of the child´s immediate environment. This can include demographic factors but also family characteristics and the medical history of family members, and the child itself, which needs to be considered when studying early language development. As mentioned earlier, vocabulary—especially expressive vocabulary—is a good measure of progress in early language development. Even though vocabulary develops throughout a person´s life, its growth during the first 2 years is huge by comparison. It opens the door to independent communication and gaining new information. The outcome of this early phase is crucial for later language and literacy development.

This thesis examined the effect of parental/family factors (education and occupational status, family income, paternal factors, burden of late onset of speech, and chronic illness) and child factors (child´s sex, birth order, presence of siblings, day care outside the home, RTIs) on early vocabulary size at 13 and 24 months of age and on vocabulary growth between 13 and 24 months of age. Except for *Study I*, the associations between these factors and vocabulary development were analysed separately for boys and girls.

6.1. Child Factors in Early Vocabulary Development

Child factors analysed in relation to early vocabulary development besides the child´s sex were recurrent RTIs and AOM episodes, being firstborn, and attending day care outside the home.

6.1.1. Variation in Vocabulary Size and Growth in Boys vs Girls

Receptive and expressive vocabulary were measured in the present study by using parental reports at 13 and 24 months of age (CDI-I and CDI-T). Receptive vocabulary size was only included in *Study I,* as the CDI-T does not include a separate part for receptive language. The predominant factor influencing vocabulary development was the child´s sex, which was one reason to analyse early language and factors influencing it separately in boys and girls. The present results underline a large variation in vocabulary size in receptive vocabulary at 13 months and in expressive vocabulary at ages 13 and 24 months both in boys and in girls, congruent with earlier findings on the first phases in vocabulary development (e.g., Bates et al., 1994; Fenson et al., 2007; Marchman & Bates, 1994; Tsao et al., 2004). Some children had no vocabulary growth or even showed a decrease in vocabulary size between the ages of 13 and 24 months. Also, vocabulary growth varied within and between the vocabulary in boys and girls. This large variation in vocabulary size around the end of the first year and beginning of the second has sometimes been accepted as the way things are, without deeper considerations of the possible reasons. The current findings show that the trajectory of expressive vocabulary growth may well be established at 13 months of age, at least for boys. Vocabulary size at 13 months of age was a strong predictor of vocabulary growth between the ages of 13 and 24 months, but only in boys. The larger vocabulary size the boys had at 13 months of age, the larger was their vocabulary growth up to 24 months of age. This finding adds to the body of knowledge from previous studies on the importance of early language skills for later development.

Girls outpaced boys in receptive vocabulary size at age 13 months. This contradicts several studies which found no differences between receptive language in boys and girls at this age (see e.g., Eriksson et al., 2012; Feldman et al., 2000; Schults et al., 2012; Stolt et al., 2008). To measure receptive vocabulary at this early age can be demanding for a parent, which could, together with the large variation in early language, explain some of the differences between studies. In the present thesis, receptive vocabulary size was only measured in the first study, the other studies focusing rather on expressive vocabulary growth. Girls´ expressive vocabulary growth exceeded that of boys in line with earlier studies (Bauer et al., 2002; Fenson et al., 2007; Korpilahti et al., 2016). The results of the thesis also show that the desirable vocabulary growth in girls was observed in all the lexical categories, except for *sound effects*, which is a transient category with onomatopoetic words. The absence of differences between boys and girls in the category *sound effects* could be a consequence of a more developed vocabulary in girls at this stage, meaning that some of the onomatopoetic words had already been established as conventional nouns and verbs. Accordingly, we can already find differences between boys and girls in favour of girls in the expressive lexical categories that are in use and significant in very early vocabulary development.

The differences in vocabulary size and growth as a function of the child´s sex become somewhat problematic, as we usually measure vocabulary size and

growth as a combined factor for boys and girls. This is common practice in test norms and in relation to background factors in studies. The results of the thesis suggest that by applying combined scores for boys and girls, we lose valuable information about different trajectories of early vocabulary development between the sexes. In the present thesis, the mean value of vocabulary size at 13 months of age in boys vs girls was 7.7. vs 11.9, respectively. The combined mean value of 9.8 would classify boys with lower mean values as not reaching the mean, while a mean value of 10 words in girls would be classified as above the mean. In using combined scores there is a possible risk of overdiagnosing boys but underdiagnosing girls with smaller vocabulary sizes. Rescorla (2011) suggests that when using combined scores for boys and girls in early language testing, boys would outnumber girls, but that if using sex-specific scores, the number of late talking boys and girls would be the same. However, girls would perform on a higher level than boys. The cut-off point for late-talking girls would be higher because of the faster trajectory of language development in girls overall. The use of separate language scores for boys and girls was also pointed out by Urm and Tulviste (2021) in a study of 908 Estonian children aged 1.8 to 3.1 years. The variation of vocabulary size as a function of the child´s sex, which for the most parts advantages girls, has often been linked to small effect sizes (Eriksson et al., 2012; Fenson et al., 2007), as was also the case in the present study with small to medium effect sizes.

6.1.2. Respiratory Tract Infections and Vocabulary

The present thesis examined vocabulary size and growth during the first 2 years in children with recurrent RTIs and AOM episodes, meaning the 10th percentile of children who were most sick compared to children with less RTIs and AOM episodes. The burden of recurrent RTIs and AOM did not limit vocabulary growth; on the contrary, a larger vocabulary growth was reported in sicker children, which was unexpected. The results of parental reports of more words in children with recurrent infections compared to children who were less sick were not significant when analysing vocabulary size as a combined measure for boys and girls (*Study I*). However, when boys and girls were analysed separately (*Study II)*, boys with recurrent RTIs during the second year of life had significantly larger vocabulary size between 13 and 24 months of age than boys who were less sick. There was no difference in vocabulary development between girls with or without recurrent infections.

These findings add new information concerning the possible risk factors for language development, as there are no earlier studies concerning RTIs and language development. Although it is established that recurrent infections can be a burden influencing both the child and the whole family (Toivonen, Karppinen et al., 2016), and studies have demonstrated negative effects of maternal stress on early language (Pierce et al., 2020), the hypothesis that children with recurrent RTIs would have less vocabulary was not met. On the contrary, the results suggest the presence of protective factors not measured in this thesis. These could be the availability of good health care, but also other

resources in the family or near environment that help the family cope with stress from the burden of a sick child or family.

The reason for boys with recurrent RTIs having a larger vocabulary growth during their second year could possibly lie in the attention a sick child receives from its parents. Communication with a sick child is apparently directed more specifically to the child, which has been associated with larger vocabulary size, compared to communication in a group (Hart & Risley, 1995; Rowe, 2008; Weisleder & Fernald, 2013). In a recent study by Kartushina et al. (2021), vocabularies in children aged 8–36 months from 12 language backgrounds were measured during the COVID-19 pandemic. Contrary to expectations, children gained more vocabulary during lockdown at home compared to normative data from pre-lockdown. This could also point to the importance of child-directed speech at this early age. A parent at home with a child may also be more acquainted with the child´s language level, which makes it easier to assess the vocabulary used by the child. Another possible explanation could be the human contact and infection spread. Nearness to and contact with adults are important for positive language development. A talkative parent communicating with their child at a close distance can transmit infections to the child at the same time as enhancing language.

The finding of no negative effects of recurrent AOM on vocabulary development both contradicts (i.e., Asbjørnsen et al., 2005; Feldman et al., 1999; Haapala et al., 2015) and affirms (i.e., Berman, 2001; Feldman et al., 1999; Roberts et al., 2004; Zumach et al., 2011) several other studies conducted in relation to AOM or OM episodes and early language development. The divergent findings of negative effects on language development or absence of effects can be a result of methodological issues. In studies where relationships between AOM or OM and limited vocabulary development or auditive discrimination have been found, OM and OM-related hearing loss have been studied together, or the study children have been selected from among children referred to a hospital, with or without inserted tympanostomy tubes (Haapala et al., 2014; Haapala et al., 2015; Roberts et al., 2004). When OM and hearing loss have been studied independently, no relation between OM and limited auditory perception or language development has been found (Zumach et al., 2010; Zumach et al., 2011). The present study was a cohort study, meaning that participants were not chosen as per symptoms of hearing loss, medical records, or enrolment to hospital due to OM or AOM. This can to some extent explain the differences in the results.

Day care attendance has in some studies been considered a risk factor for both RTIs and AOM (Benediktdottir, 1993; Chonmaitree et al., 2016; Simoes, 2003). The results did not show that children in day care had more recurrent RTIs than children cared for at home. However, in another more detailed study with more age points of the same STEPS cohort, children clearly had more RTIs for about 6 months after attending day care (Schuez-Havupalo et al., 2017). Girls in day care during the second year had, on the other hand, more recurrent AOM episodes than girls who stayed at home. This did not correlate with

differences in vocabulary growth. Corresponding results were not found in boys. The present thesis suggests no negative associations of recurrent AOM with vocabulary growth or size during the first 2 years. It was not within the scope of the thesis to analyse possible negative effects on auditory discrimination which may influence later vocabulary.

However, the results need to be interpreted with care, as the study was conducted in a European country. Finland has excellent health care, and the families in the STEPS Study could gain prompt access to a physician for symptoms of RTI. The risk of negative consequences of RTIs and AOM due to limited diagnostic and treatment availability is higher in developing countries (Monasta et al., 2012).

6.1.3. Other Child Factors and Vocabulary

Firstborn girls had a larger vocabulary growth in descriptive and function words compared to those born later. No associations between vocabulary growth in lexical categories and being firstborn were found in boys. In previous studies, being firstborn has been associated with using more people words or nouns (out of the broad lexical groups *nouns*, *predicates,* and *social terms*) (Schults et al., 2012; Wehberg et al., 2008). As these earlier studies have not studied vocabulary growth and firstborn status as a function of the child's sex, the differences in the results can be a result of this. The lexical categories of people words and nouns typically develop earlier in life than do descriptive and function words. The children in the studies of Schults et al. and Wehberg et al. were somewhat younger (0.8 to 1.4 years and 0.8 to 2.6 years, respectively). The younger age and the fact that these studies analysed boys and girls together may mean that only early developing lexical categories were found. The thesis shows that the vocabulary of girls develops faster than that of boys. With increased vocabulary size, more lexical categories like descriptive and function words needed for grammar are becoming part of the expressive vocabulary (Hoff-Ginsberg, 1998). It is possible that the girls in the present study were already at this level in their language development. When the status of being firstborn—without siblings—was analysed for boys and girls together, no significant difference in total vocabulary growth was found between firstborns and those born later. It seems that analysing vocabulary growth separately for boys and girls may give more precise results.

The results regarding the effect of day care attendance on early vocabulary development were inconclusive, as is the case with earlier studies on the effect of early day care. Only about one-fifth of the study children were in day care at 13 months of age compared to about half at 24 months of age. The current findings show that children attending day care at 13 months of age had a smaller receptive and expressive vocabulary size compared to children not in day care. As previous studies have shown, language development in younger children seems to benefit from the child staying at home compared to attending day care (Keegstra et al., 2007; Luijk et al., 2015; Stolarova et al., 2016).

However, the analysis of vocabulary growth in different lexical categories between the ages of 13 and 24 months shows differences between boys and girls and among categories that benefited from day care attendance at 24 months of age. The finding that only the category *sound effects* was positively related to boys attending day care at 24 months of age may result from of the developmental status of the boys. The category *sound effects* includes onomatopoetic, sound-resembling words and is one of the first to develop in expressive language. The children in the study were still quite young, and it appears that the contribution of other children, perhaps in play situations, and possibly adults, enhanced the use of these kinds of words. According to the emergentist coalition model for word learning (Hollich et al., 2000), the child is more dependent on attentional than social cues in the earlier phases of vocabulary development. Younger children are also more sensitive to breakdowns in these cues. The result that vocabulary growth in boys did not benefit from this day care milieu in the same way as in girls may suggest that boys, being later in vocabulary development, do not benefit from spoken language in group situations with mores social cues, but are still more dependent at this age on child-directed speech, which they can get at home (Rowe, 2008; Weisleder & Fernald, 2013).

Girls attending day care at 24 months of age had larger growth in several categories (*sound effects*, *nouns*, *people words*, and *games and routine words*). The lexical categories that were more developed in girls attending day care also represent early developing words. Except for the category *people names*, all the other categories were the largest growing categories during the second year. It indicates that caretakers at day care emphasize early lexical categories in day-to-day tasks and that girls can take advantage of that. This could be a result of more developed strategies in girls for learning new words. Girls at this age may be able to take advantage of social and linguistic cues (Hollich et al., 2000), which predominate more in a day care context. Cadime et al. (2018) found no associations between day care attendance and any lexical categories. Differences between the advantage of day care for vocabulary development in lexical categories in boys and girls could possibly have emerged, had they analysed vocabulary growth in boys and girls separately. Some differences may have been concealed in the use of combined scores.

6.2. Parental and Family Factors in Early Vocabulary Development

In the thesis, various parental factors in relation to early vocabulary development were investigated. Parental factors analysed in this thesis were level of education, occupational status, family income, paternal full-time employment, use of paternity or parental leave, hours spent with the child, late onset of speech, and chronic illness. Some of the parental factors were analysed as main or background factors in all the studies; others were analysed only in some of them.

No parental factor was associated with receptive vocabulary size at 13 months of age except for the positive effect of paternal chronic condition, which was somewhat unexpected. If the father had a chronic condition, it related positively to early receptive vocabulary size. It is possible that these fathers stayed more at home and gave more parental time to their children. It has been shown that fathers staying more at home are more involved in the life of their children (NICHD Early Child Care Research Network, 2000). Also, Korpilahti et al. (2016) found that children with larger vocabulary skills had fathers who were more at home during the first years of the child´s life. Studies show that Finnish mothers experienced less stress the shorter their partner´s working week was (Miettinen and Rotkirch, 2012). Fathers staying at home and sharing the daily chore burden may help create a less intense home environment, with more family time and therefore a richer verbal home environment. Even if overheard speech has not been associated with early language development as strongly as child-directed speech (Golinkoff et al., 2019), a richer verbal environment may also increase child-directed speech and thus strengthen the early stages in language acquisition. Chronic condition was not analysed in relation to vocabulary growth as a function of the child´s sex. This might have clarified whether the effect was found in vocabulary growth in both boys and girls.

In this thesis, the choice was to focus on maternal and paternal education and occupation and on the family economy as separate factors, in line with Braveman et al. (2005) and Duncan and Magnusson (2012). This procedure gives more precise information about possible differences in how maternal and paternal SES factors are related to early language development. As the results of the thesis show, there are differences between which parental SES factor influences vocabulary development. This would not have been found had the analyses been done with a combined variable of different SES elements. The current findings propose that educational and occupational level, as well as family income, should be analysed separately in association with early language development and separately for the mother and father. This will give clearer perspectives on how the maternal and paternal educational and occupational levels affect vocabulary growth.

The results emphasize the role of paternal education and occupation in relation to early expressive vocabulary development, in line with earlier studies where the father´s high level of education or occupation have been related to more progressive language development in the child (Lankinen et al., 2018; Pancsofar et al., 2010; Zhang et al., 2008). The results encourage future studies to consider both maternal and paternal SES factors, as they seem to contribute differently to early language development.

In line with previous studies where maternal high occupational status was found to be associated with positive language development (e.g., Hart & Risley, 1995; Hoff-Ginsberg, 1998; Hammer et al., 2017), the findings of this thesis show that a mother´s work as a professional is associated with a larger vocabulary size at age 24 months and with greater vocabulary growth during

the second year. However, this association was only found in boys. The father´s occupational status, on the other hand, was associated with vocabulary growth in both boys and girls. Altogether, the results show that the level of the paternal education and occupation and of maternal occupation is related to vocabulary development in the Finnish family context. One reason could be that parents working as professionals generally handle a richer and more variable vocabulary, which they bring home with them, and which is reflected in the way they communicate with their children—including a greater number of words and a wider range of vocabulary detailing the same concepts. Using a richer vocabulary may lead to grammatically more complex sentences, extending the language environment of the young child. These are factors that have been found to enhance early language development (Hart & Risley, 1995; Hoff, 2003). The finding that parents with high occupational and educational status are more supportive when communicating with their child and more readily affirm the child´s communication initiatives (Armstrong et al., 2017; Cabrera et al., 2007) could result not only from their professional life being brought home but also from a better understanding of the factors influencing language development. Parents with a high occupational status may also have better financial resources to support their child with toys, books, and experiences.

However, the educational level of Finnish mothers was not associated with any vocabulary growth in boys or girls, contrary to studies showing that the mother´s education is strongly related to positive language development (Cadime, 2018; Feldman et al., 2000; Gilkerson et al., 2017; Letts et al., 2013; Schjøberg et al., 2011). Also, in another study conducted in Finland, no associations were found between mother´s education and early vocabulary size at 2 years of age in typically developing children (Stolt et al., 2007). This lack of association between well-educated Finnish mothers and vocabulary growth could possibly be attributed to the Finnish educational system. The Finnish Ministry of Education is responsible for organizing education from pre-primary to upper secondary education and other non-vocational studies (Ministry of Education and Culture). In 2019, almost half of the women (47.4%) in Finland had completed their upper secondary education, meaning they had received 12 years of education (Statistics Finland´s PX-Web databases (education). In the present thesis, 80.2% of the mothers had completed their upper secondary education. There is reason to believe that Finnish mothers with at least 12 years of education have already adapted supporting communication strategies with their children, similarly to mothers considered highly educated in our study. Finnish mothers also get extensive support from maternity and child health clinics. During pregnancy, the mother meets with a nurse or a doctor 11 to 15 times (Ministry of Social Affairs and Health, 2022). Home visits are provided after the birth of the child, and several follow-ups for both mother and child are arranged at maternity and child health centres (Ministry of Social Affairs and Health, 2022). It seems that in countries like Finland with a well-planned and functioning maternity support and educational system, maternal education is not as decisive as in other countries. Our results suggest a stronger

focus on paternal education and both parents´ occupational status more than the educational level of the mother.

There were no associations between the time the fathers spent with their children or the use of paternal/parental leave and early vocabulary growth. One possible reason that time together with the child did not relate to vocabulary growth in this thesis could be that Finnish fathers talk less to their child than mothers do, a phenomenon that has also been established in international studies (Gilkerson & Richards, 2009; Johnson et al., 2014). It is suggested that mothers talk three times more to their children than do fathers and that mothers talk more to their daughters than to their sons (Topping et al., 2013). However, there are also opposite views not supporting a preference of mother-daughter dialogue over mother-son talk (Huttenlocher et al., 1991). It may be that the father´s use of language is more limited towards children in the early stages of vocabulary development. In a study by Miettinen and Rotkirch (2012), Finnish fathers of children aged 0 to 6 years talked for 7 minutes/day with their child while primarily doing something else, and only 2 minutes/day in direct conversation. The corresponding values for the mothers were 32 minutes/day and 5 minutes/day, respectively (Miettinen & Rotkirch, 2012). In the present thesis, father´s time spent with the child was asked but not specifically what was done during that time. According to Miettinen and Rotkirch (2012), fathers spend time with the child engaged not as much in talking as in play activities, as also proposed by Yeung et al. (2001). This could also be the content of the time—on average 4.4 hours per day— the fathers in the thesis reported spending with their child. On the other hand, boys with fathers working less than full time had a larger vocabulary growth compared to boys with fathers working full time. In the first study, receptive vocabulary size was larger in children with fathers suffering from a chronic condition and possibly staying more at home. This may suggest that fathers who are more regularly at home and for a longer time influence the home environment differently than is possible during shorter paternal/parental leave, and that early vocabulary growth in boys is more sensitive to any latent factors related to the presence of the father than a specific time spent with him.

The father´s presence at home together with paternal high level of education or occupation seem to prepare a fruitful environment for early vocabulary development in a more general way than just measured in hours spent with the child. The possible effects on early language development of the father´s involvement in the family and his relationship with the mother need to be addressed further in future studies.

Another factor influencing early vocabulary growth was a family burden of late onset of speech. Boys with family members who themselves had experienced a late onset of speech had a smaller vocabulary growth compared to children without this family load. There is evidence that late onset of speech in a close family member is a risk for limited language and later onset of speech in the child, which indicates a genetic liability (Reilly et al., 2007; Zambrana et al., 2014; Zubrick et al., 2007). In this thesis, only vocabulary growth in boys

was affected by this family burden. The effect of a paternal burden of late onset of speech can be viewed as a biological factor, a genetic predisposition, but also as a possible environmental factor. There is a possibility that a father who himself started to speak late is even more restricted in verbal communication with his son than fathers without this family risk. The result is that boys hear little talk from their father but also get less talk from their mother, ending in restricted vocabulary growth (Gilkerson & Richards, 2009).

No parental factor was associated with expressive vocabulary at 13 months of age. The expressive vocabulary at this early age is still very small in many children and the variation is large, which may restrict the analysis outcome. The problem of noisiness of expressive vocabulary size at this early age in analysis and interpretation has also been considered by Frank et al. (2021). It may also be that the effect of parental factors on expressive vocabulary is not recognizable at this early age.

6.3. Methodological Considerations and Future Directions

The present thesis examines a short time frame in the child´s life, between the ages of 13 and 24 months. The risk and background factors considered and analysed in the thesis are central and common factors in a child´s life. However, these factors represent only some of the elements involved in the early years, affecting the child´s well-being and possibly early language. This is also demonstrated by low effect sizes in most of the results. The strength of the present study is the large samples varying from 462 to 719 children in *Studies I–IV*.

The families of the eligible cohort that chose to participate in the study were mostly living in an urban area, the mothers were mostly married, and the study child was most often their first child (Lagström et al., 2013). The sub-sample included in this thesis comprised also highly educated mothers (over 60%) compared to the mothers not included. Participants who choose to take part in a study seem to have more interest in the development of the child and are often well educated, which can skew the results. The STEPS Study cohort was conducted in the Hospital District of Southwest Finland, which has several universities and colleges. Many people living in the area work in these places, which may have affected the results.

Studies I and *II* used data on the child´s symptoms of RTIs and on diagnoses of RTIs and AOM. The daily symptom diary gave meticulous information during the first 2 years. Additionally, the family had the possibility to visit the study clinic for examination by a study physician. Data was also collected on all RTIs and OM diagnoses established elsewhere. This ensures meticulous information about both RTIs and AOM episodes in the study children. Recurrent RTIs with or without OM in relation to early vocabulary development has not been investigated before, and these studies have thus brought a new perspective to vocabulary development in children with recurrent infectious diseases. In the thesis, recurrent RTIs and AOM episodes were examined as separate

conditions, even if AOM often co-occurs with or follows respiratory infections (Chonmaitree et al., 2008). The results may have varied somewhat had RTIs and AOM episodes been analysed together. However, children with both recurrent RTIs and AOM would have been too few ($n \leq 20$ children) to get reliable results about vocabulary growth. The children´s hearing was not measured in the STEPS Study, which could have provided information about temporary hearing loss during OM. Hearing problems were, however, asked about at 24 months of age. OM episodes were treated according to prevalent treatment principles. At the time of data collection this meant mainly antibiotic treatments.

Over 50% of the participating children in the thesis were firstborn. This may have affected the occurrence of RTIs in S*tudies I* and *II*. As RTIs are more common in children with siblings (Anders et al., 2015; Chonmaitree et al., 2016; Simoes, 2003; Toivonen, Karppinen, et al., 2016), this may have resulted in a smaller number of children with RTIs in the study compared to the prevalence at population level. Another limitation is that several years have passed since the follow-up, which may include changes in how infections are treated now. At least, as mentioned by Parviainen et al. (2019), the use of antibiotics in young children has decreased over the last few decades.

Study III investigated the role of the father in early vocabulary growth. Only a few studies have focused on a variety of paternal factors in relation to early vocabulary growth in boys and girls. Important information in the present study was that the fathers reported the number of hours spent with the child during weekdays and at weekends. A limit of the study was the absence of detailed questions about how many hours the father worked/did not work. There was only an option between working full time or not. There was also a considerable amount of missing data in the paternal questions (from 2.0–18.9%), which could have distorted the results. In this thesis, fathers not working full time, paternal high level of education, and paternal occupational status were positively associated with vocabulary growth. However, the hours the father spent with the child were not associated with larger vocabulary growth. Compared to many other countries, fathers in Finland have ample opportunity to engage with their children (Adler & Lenz, 2016). In future studies it would be beneficial not only to measure the paternal time spent with the child but also consider the content of that time. As language input from fathers is more comprehensive in children with more developed language, future studies could benefit from including somewhat older children as well.

In *Studies II–IV*, vocabulary growth was investigated separately in boys and girls in relation to child and family factors. As previous studies like this have been scarce, our results shed more light on factors influencing early vocabulary. However, there is a need for more meticulous studies to explore to what extent such differences can be detected, and at what ages. This should include neurodevelopmental studies. There have been recent studies focusing on the variation in neurodevelopment in relation to environmental factors, but they have focused mostly on SES and changes in brain structure (Brito & Noble,

2014; Hackman et al., 2010; Johnson et al., 2016). Some studies have examined the relationship between language experience and variation in brain structure (e.g., Romeo, 2019; Romeo et al., 2018), but studies focusing on variations in brain structure associated with environmental factors and as a function of the child´s sex are still scarce. King et al. (2020) are among the few studying environmental factors in relation to the child´s sex, finding that SES background relates differently to neurodevelopment in boys and girls.

All four studies included parental self-reports: Symptom diaries, background questionnaires for the parents and the study child, and reports of vocabulary development using the CDI-I and CDI-T questionnaires (Fenson et al., 2007; Lyytinen, 1999) together with register data on newborn children. Self-reported information can be exposed to subjectivity and personal interpretations of the information. On the other hand, without parental reports, cohort studies would be difficult to realize. The upside of parental reports, according to Dale (1991), includes familiarity with the observation setting, efficiency of the method, and assessment of the child in context. Parental reports have been used frequently in early language studies. Concerning vocabulary, earlier experiences show that parents have been found to be quite accurate in describing the expressive language of their children from 18 months onwards (Feldman et al., 2005). The CDIs for infants and toddlers have been considered a valid instrument for assessing young children´s vocabulary (Korpilahti et al., 2016; Feldman et al., 2005; Thal et al., 1999). One limitation of using wordlists like the CDI is the ceiling effect. Once the vocabulary size has grown larger, the variety of words used by the child can be hard to assess with an instrument like the CDI, which has a limited set of words (Frank et al., 2021). Therefore, the age of up to 2 years is a good time to measure vocabulary growth. In this thesis only one girl reached the vocabulary size score ceiling in the questionnaire at 24 months of age, but none of the boys did.

In the context of the present thesis, the focus was only on vocabulary growth between 13 and 24 months of age. Pre-vocabulary communication such as gestures was not considered. Gestures both precede and occur at the same time as the first words begin to emerge, and the number of early gestures predicts receptive and expressive vocabulary size (Cadime et al., 2017; Kuvač-Kraljević et al., 2014). To investigate whether there are differences already in gesture development between boys and girls in relation to environmental factors, it would be helpful to track down factors influencing the variation in early language. It would also be significant to follow up language development in the study children after the onset of more specific grammar and syntax in their speech. This could show whether there are similar differences between boys and girls in the sensitivity of language development to environmental factors compared to those observed in the present thesis up to the age of 2 years.

In the present thesis, information on the time of enrolment in day care was missing. This made it impossible to determine how long the child had been in day care during the first 2 years. In future studies, to adequately analyse the

effects of day care, the length and type of day care attendance should be considered.

The present thesis emphasizes the significance of environmental factors influencing early vocabulary growth as suggested by Bronfenbrenner and Ceci (1994) and Shelton (2018), but differently in boys and girls. The study highlights the possibility that vocabulary growth in boys and girls reacts differently to, among other things, environmental factors. While this is still a little studied area, the results advocate for further studies on various language functions with focus on differences between boys and girls. Further studies should also include focus on neurodevelopment and variations in brain structure. The broad variation in early language development is a result of various factors, some of them mentioned in this study. To get a more comprehensive picture of these early stages and the factors involved, we need to find ways to support especially boys and girls with limitations in their language development in the early years, to prevent a negative trajectory of language development. The purpose of this thesis was to focus on factors affecting typical vocabulary development, not late talkers. However, in future research it would be beneficial to study vocabulary growth for this group of children in association with child and parental factors as a function of the child´s sex.

6.4. Clinical Implications

The results of this doctoral thesis provide some novel information that brings new perspectives to clinical practice. The finding that vocabulary size at 13 months of age predicts vocabulary growth in boys underlines the importance of early language assessment and guidance to parents and personal of maternity clinic personnel. The general practice now is often to "wait and see", at least until the child is over 2 years of age. It should be especially important to follow up more closely boys with a family burden of late onset of speech at an early age, as the results show a risk for limited vocabulary growth in boys with this background. The trajectory for further vocabulary development seems to be set already at 13 months of age for boys. Maternal concerns over the child´s language development has been shown to be a reliable marker of language delay (Korpilahti et al., 2016), but in Finland it is rarely the case that a parent can take a 13-month-old child to a speech and language pathologist (SLP) based solely on their own concerns. However, it is already the practice at the Finnish maternity clinics and child health centres to follow up early child development and interaction. Extended collaboration between these centres and SLPs could enable early assessment and support for families and children at risk of limited vocabulary growth.

The most important implication of the results is related to the differences in vocabulary growth in boys vs girls and in relation to environmental and biological factors. First, one should be aware that comparing vocabulary scores of boys vs girls with combined mean scores may lead to the wrong conclusions

about the child´s developmental level. Second, if there are existing separate mean scores for vocabulary size of boys and girls, it is preferable to use them in addition to conventional scores. Third, the information that vocabulary growth in boys and girls relates differently to factors in the environment adds to the knowledge of how to counsel families with different backgrounds. In clinical evidence-based practice, SES factors have been acknowledged for some time. The current findings underline that a combined family SES measure may not give specific information related to early vocabulary growth. In Finnish society, parental occupational status as well as paternal educational level are related to vocabulary growth, while maternal education does not predict vocabulary growth. In counselling parents, it may be helpful to identify the different SES factors. Particularly parents with a low educational and occupational status may need support regarding how to attend to the child´s early communication, how to engage with the child in book reading, how to use toys or home utensils during play with the child, and how to use community resources like libraries.

The results also emphasize the role of the father in early vocabulary growth. Frequent contact between the family and maternity and child health clinics during pregnancy and after birth would be an opportunity to emphasize the importance of the father already in the early phase of the child´s life.

The results of the thesis suggest that not all young boys gain that much from day care as regards vocabulary growth. However, many young boys attend day care early, which is why day care personnel need strategies to support vocabulary growth in this group of children. The job description of SLPs has been evolving in recent years to include more counselling relating to the client´s near environment. This could include specific sharing with day care centres on how to support vocabulary growth in young children, especially boys.

7. Summary and Conclusions

The main findings of the thesis were:

- Recurrent RTIs and AOM did not associate negatively with receptive vocabulary size or with expressive vocabulary size or growth,
- Girls outperformed boys in vocabulary size and growth and in the growth of all lexical categories, except *sound effects*.
- Analyses of vocabulary development in boys and girls as a combined measure showed the importance of maternal high occupational status. When examining vocabulary growth in boys and girls separately, this was only predictive of vocabulary growth in boys, not in girls, while fathers working as professionals predicted larger vocabulary growth in girls.
- Fathers working full time were predictive of less vocabulary growth in boys, but not in girls. Children with fathers suffering from a chronic illness had a larger receptive vocabulary at 13 months.
- Day care attendance was related to smaller vocabulary size in both understanding and producing words at 13 months of age in boys and girls as a group, while attending day care at 24 months of age predicted larger vocabulary growth in some lexical categories in girls, but only in one category in boys.
- Firstborn girls had a larger vocabulary growth in lexical categories connected more to grammar, while there was no difference in vocabulary growth in firstborn or later-born boys.
- A family burden of late onset of speech negatively affected vocabulary growth in boys in all lexical categories except one.

According to the results, environmental and biological factors affect early language development differently in boys and girls. Some of the factors affected vocabulary growth in both boys and girls, e.g., day care attendance at 24 months of age. The effect of other factors, such as recurrent RTIs, fathers working full time, family burden of late onset of speech, and being firstborn, were only related to vocabulary growth in either boys or girls. At this early age we found more factors influencing vocabulary size and growth in boys than in girls.

Within the scope of this thesis, we propose that future studies should focus on language and its development separately in boys and girls when related to environmental and biological factors. This is especially important in a clinical environment, where combined scores for boys and girls can lead to neglect of girls at risk of being late talkers. Furthermore, the results of the thesis emphasize the different impacts maternal and paternal factors have on vocabulary growth, which should also be considered in clinical settings.

References

Adler, M. A., & Lenz, K. (2016). Conclusion. In M. A. Adler, & K. Lenz (Eds.), *Fatherhood in the early years: An international comparison of policy and practise* (pp. 231–252). Policy Press.

Alho, O-P., Koivu, M., Sorri, M., & Rantakallio, P. (1990). Risk factors for recurrent acute otitis media and respiratory infection in infancy. *International Journal of Pediatric Otorhinolaryngology, 19* (2), 151–61.

Alt, M., Arizmendi, G. D., & DiLallo, J. N. (2016). The role of socioeconomic status in the narrative story retells of school-aged English language learners. *Language, Speech, and Hearing Services in Schools, 47*, 313–323. https://doi.org/10.1044/2016_LSHSS-15-0036

Anders, K. L., Nguyen, H. L., Nguyen, N. M., Van Thuy, N. T., Hong Van, N. T., Hieu, N. T., Tham, N. T H., Thanh, P T., Lien, L. B., Chau, N. V. V., Hang, V. T. T., van Doorn, H. R., & Simmons, C. P. (2015). Epidemiology and virology of acute respiratory infections during the first year of life: A birth cohort study in Vietnam. *Pediatric Infectious Disease Journal, 34*(4), 361–70.

Anderson, N. J., Graham, S. A., Prime, H., Jenkins, J. M., & Madigan, S. (2021). Linking quality and quantity of parental linguistic input to child language skills: A meta-analysis. *Child Development, 92*(2), 484–501. https://doi.org/10.1111/cdev.13508

Andersson, I., Gauding, J., Graca, A., Holm, K., Öhlin, L., Marklund, U., & Ericsson, A. (2011). Productive vocabulary size development in children aged 18-24 months – Gender differences. *TMH-QPSR, 51*(1), 109–112.

Anisfeld, M., Rosenberg, E. S., Hoberman, M. J., & Gasparini, D. (1998). Lexical acceleration coincides with the onset of combinatorial speech. *First Language, 18*, 165–184.

Armstrong, R., Scott, J. G., Whitehiuse, A. J. O., Copland, D. A., Mcmahon, K. L., & Arnott, W. (2017). Late talkers and later language outcomes: Predicting the different language trajectories. *International Journal of Speech-Language Pathology, 19*, 237–250. https://doi.org/10.1080/17549507.2017.1296191

Asbjørnsen, A. E., Obrzut, J. E., Boliek, C. A., Myking, E., Holmefjord, A., Reisæter, S., Klausen, O., & Møller, P. (2005). Impaired auditory attention skills following Middle-ear infections. *Child Neuropsychology, 11*, 121–133.

Barbu, S., Nardy, A., Chevrot, J-P., Guellai, B., Glas, L., Juhel, J., & Lemasson, A. (2015). Sex differences in language across early childhood: Family socioeconomic status does not impact boys and girls equally. *Frontiers in Psychology, 6*(1874). https://doi.org/10.3389/fpsyg.2015.01874

Barbu, S., Nardy, A., Chevrot, J-P., & Juhel, J. (2013). Language evaluation and use during early childhood. Adhesion to social norms or integration of environmental regularities. *Linguistics, 51*(2), 381–412.

Bates, E., Marchman, V., Thal, D., Fenson, L., Dale, P., Reznick, J.S., Reilly, J., & Hartung, J. (1994). Developmental and stylistic variation in the composition of early vocabulary. *Journal of Child Language, 21*, 85–123.

Bauer, D. J., Goldfield, B. A., & Reznick, J. S. (2002) Alternative approaches to analyzing individual differences in the rate of early vocabulary development. *Applied Psycholinguist*, 23(3),13–335. https://doi.org/10.1017.S0142716402003016

Benediktdottir, B. (1993). Upper airway infections in preschool children-frequency and risk factors. *Scandinavian Journal of Prim Health Care, 11* (3), 197–201.

Bergelson, E. & Swingley, D. (2012). At 6–9 months, human infants know the meanings of many common nouns. *PNAS, 109*(9), 3253–3258. www.pnas.org/cgi/doi/10.1073/pnas.1113380109

Bergelson, E., Casillas, M., Soderstrom, M., Seidl, A., & Warlaumont, A. S. (2018). What do north American babies hear? A large-scale cross-corpus analysis. *Developmental Science, 22*. https://doi.org/10.1111/desc.12724

Berglund, E. & Eriksson, M. (2000). Reliability and content validity of a new instrument for assessment of communicative skills and language abilities in young Swedish children. *Logopedics, Phoniatrics, Vocology, 25*, 176–185.

Berglund, E., Erikson, M., & Westerlund, M. (2005). Communicative skills in relation to gender, birth order, childcare and socioeconomic status in 18-month-old children. *Scandinavian Journal of Psychology, 46*, 485–491.

Berman, S. (2001). Management of Otitis Media and functional outcomes related to language, behavior, and attention: Is it time to change our approach? *Pediatrics, 107*(5).

Bloom, B.S. (1966). *Stability and change in human characteristics*. (3rd ed). John Wiley & Sons, Inc.

Bluestone, C. D., Gates, G., A., Klein, J. O., Lim, D. J., Mogi, G., Ogra, P. L., Paparella, M. M., Paradise, J. L., & Tos, M. (2002). 1. Definitions, terminology, and classification of otitis media. *Annals of Otology, Rhinology & Laryngology, 111*. https://doi.org/10.1177/000348940211 10S304

Bornstein, M. H., Hahn, C-S., & Haynes, O. M. (2004). Specific and general language performance across early childhood: Stability and gender considerations. *First Language, 24*(3), 267–304. https://doi.org/10.1177/014272370404 5681

Bosch, L. (2011). Precursors to language in preterm infants: Speech perception abilities in the first year of life. *Progress in Brain Research, 189*. https://doi.org/10.1016/B978-0-444-53884-0.00028-2

Braveman, P. A., Cubbin, C., Egerter, S., Chideya, S., Marchi. K. S., Metzler, M., & Posner, S. (2005). Socioeconomic status in health research. One size does not fit all. *JAMA, 294*(22).

Brennan-Jones, C. G., Whitehouse, A. J. O., Park, J. Hegarty, M., Jacques, A., Eikelboom, R.H., Swanepoel, D. W., White, J. D., & Jamieson, S. E. (2015). Prevalence and risk factors for parent-reported recurrent otitis media during early childhood in the Western Australian Pregnancy Cohort (Raine) Study. *Journal of Paediatrics and Child Health, 51,* 403–409.

Brito, N. H. & Noble, K. G. (2014). Socioeconomic status and structural brain development. *Frontiers in Neuroscience, 8*(276). https://doi.org/ 10.3389/fnins.2014.00276

Bronfenbrenner, U. & Ceci, S. J. (1994). Nature-nurture reconceptualized in developmental perspective: A bioecological model. *Psychological Review, 101*(4), 568–586.

Bruner, J. (1983). *Child´s talk. Learning to use language.* Oxford University Press. (23–42).

Burger, K. (2010). How does early childhood care and education affect cognitive development? An international review of the effects of early interventions for children from different social backgrounds. *Early Childhood Research Quarterly, 25*, 140–165. https://doi.org/10.1016/j.ecresq.2009.1 1.001

Byington, C. L., Ampofo, K., Stockmann, C., Adler, F. R., Herbener, A., Miller, T., Sheng, X., Blaschke, A. J., Crisp, R., & Pavia, A. T. (2015). Community surveillance of respiratory viruses among families in the utah better identification of germs-Longitudinal Viral Epidemiology (BIG-LoVE) Study. *Respiratory Viruses Among Families, 61*. https://doi.org/10.1093/cid/civ486

Cabrera, N. J., Shannon, J. D., & Tamis LeMonda, C. (2007). Fathers' influence on their children's cognitive and emotional development: From toddlers to pre-k. *Applied Developmental Science, 11*(4), 208–213.

Cadime, I., Silva, C., Ribeiro, I., & Viana, F. L. (2018). Early lexical development: Do day care attendance and maternal education matter. *First Language, 38*(5), 503–519. https://doi.org/10.1177/014272371877 8916

Cadime, I., Silva, C., Santos, S., Ribeiro, I., & Viana F. L. (2017). The interrelatedness between infants´ communicative gestures and lexicon size: A longitudinal study. *Infant Behavior and Development, 48*, 88–97.

http://dx.doi.org/10.1016/j.infbeh.2017.05.005

Cakir, H. (2016). Open ended questions: A comparison of mothers' and fathers' language use during play time. *Creative Education, 7*, 574–585.

Carpenter, R. L., Mastergeorge, A. M., & Coggins, T. E. (1983). The acquisition of communicative intentions in infants eight to fifteen months of age. *Language and Speech, 26*(2).

Caselli, M. C., Bates, E., Casadio, P., Fenson, J., Sanderl, L., & Weir, J. A. (1995). Cross-linguistic study of early lexical development. *Cognitive Development, 10*, 159–199.

Caselli, C., Casadio, P., & Bates, E. (1999). A comparison of the transition from first words to grammar in English and Italian. *Journal of Child Language, 26*, 69–111.

Chen, Y., Liu, J., & Larson, E. (2016). Temporal trends and factors associated with hospital admission with a respiratory infection in children. *Journal of Asthma, 53*(1), 15–18. https://doi.org/10.3109/02770903.2015.1081940

Chen, Y., Williams, E., & Kirk, M. (2014). Risk factors for acute respiratory infection in the Australian community. *PLOS ONE, 9*(7).

Chetty, K., & Thomson, A. H. (2007). Management of community-acquired pneumonia in children. P*ediatric Drugs, 9*(6), 401–411.

Chonmaitree, T., Revai, K., Grady, J. J., Clos, A., Patel, J.A., Nair S, Fan, J., & Henrickson, K. J. (2008). Viral upper respiratory tract infection and otitis media complication in young children. *Clinical Infectious Diseases, 46*(6), 815–23. https://doi.org/10.1086/528685

Chonmaitree, T., Trujillo, R., Jennings, K., Alvarez-Fernandez, P., Patel, J.A., Loeffelholz, M.J., Nokso-Koivisto, J., Matalon, R., Pyles, R. B., Miller, A. L., & McCormick, D. P. (2016). Acute otitis media and other complications of viral respiratory infection. *Pediatrics. 137*(4). https://doi.org/10.1542/peds.2015-3555

Côté, S., Petitclerc, A., Raynault M-F., Xy, Q., Falissard, B., Bovin, M., & Tremblay, E. (2010). Short- and long-term risk of infections as a function of group child care attendance. *Arch Pediatr Adolesc Med, 164*(12), 1132–1137.

Dale, P. S. (1991). The validity of a parent report measure of vocabulary and syntax at 24 months. *Journal of Speech and Hearing Research, 34*, 565–571.

Daly, K. A., Hoffman, H. J., Kvaerner, K. J., Kvestad, E., Casselbrant, M. L., Homoe, P., & Rovers, M. M. (2010). Epidemiology, natural history, and risk factors: Panel report from the Ninth International Research Conference on Otitis Media. *International Journal of Pediatric Otorhinolaryngology, 74*, 231–240.

Damoiseaux, R. A. M. J., Rovers, M. M., Van Balen, F. A. M., Hoes, A. W., & de Melker, R. A. (2006). Long-term prognosis of acute otitis media in infancy: Determinants of recurrent acute otitis media and persistent middle ear effusion. *Family Practice, 23*, 40–45.

de Hoog, M. L. A., Venekamp, R. P., van der Ent, C. K., Damoiseaux, E. A. M. J., Bogaert, D., Uiterwaal, C. S. P. M., Smit, H. A., & Bruijning-Verhagen, P. (2014). Impact of early daycare on healthcare resource use related to upper respiratory tract infections during childhood: Prospective WHISTLER cohort study. *BMC Medicine, 12*(107).

Duff, F.J., Reen, G., Plunkett, K., & Nation, K. (2015). Do infant vocabulary skills predict school-age language and literacy outcomes? *Journal of Child Psychology and Psychiatry, 56*(8), 848–856. https://doi.org/10.1111/jcpp.12378

Duncan, G. J., & Magnusson, K. (2012). Socioeconomic status and cognitive functioning: Moving from correlation to causation. *WIREs Cognitive Science, 3*, 377–386.

Ebert, S., Lockl, K., Weinert, S., Anders, Y., Kluczniok, K., & Rossbach, H-G. (2012). Internal and external influences on vocabulary development in preschool children*. School Effectiveness and School Improvement: An International Journal of Research, Policy and Practice; 24*(2), 138–154.

Eriksson, M., Marschik, P. B., Tulviste, T., Almgren, M., Pereira, M. P., Wehberg, S.,

Marjanovič-Umek, L., Gayraud, F., Kovacevic, M., & Gallego, C. (2012). Differences between girls and boys in emerging language skills: Evidence from 10 language communities. *British Journal of Developmental Psychology, 30*, 326–343. https://doi.org/10.1111/j.2044-835X.2011.02042.x

Fang, T-Y., Rafai, E., Wang, P-C., Bai, C-H., Jiang, P-L., Huang, S-N., Chen, Y-J., Chao, Y-T., Wang, C-H., & Chang, C-H. (2016). Pediatric otitis media in Fiji: Survey findings 2015. *International Journal of Pediatric Otorhinolaryngology, 85*, 50–55.

Feldman, H. M., Dale, P. S., Campbell, T. F., Colborn, D. K., Kurs-Lasky, M., Rockette, H. E., & Paradise, J. L. (2005). Concurrent and predictive validity of parent reports of child language at ages 2 and 3 years. *Child Development, 76*(4), 856–868.

Feldman, H. M., Dollaghan, C. A., Campbell, T. F., Colborn, K., Kurs-Lasky, M., Janosky, J. E., & Paradise, J. L. (1999). Parent-reported language and communication skills at one and two years of age in relation to otitis media in the first two years of life. *Pediatrics, 104(*4).

Feldman, H. M., Dollaghan, C. A., Campbell, T. F., Kurs-Larsky, M., Janosky, J. E., & Paradise, J. L. (2000). Measurement properties of the MacArthur Communicative Development inventories at ages one and two years. *Child Development, 71*(2), 310–322.

Fenson, L., Dale, P. S., Reznick, J. S., Bates, E., Thal, D. J., & Pethick, S. J. (1994). Variability in early communicative development. *Monographs of the Society for Research in Child Development, 59* (5, Serial No. 242), 1−173.

Fenson, L., Marchman, V., Thal, D., Dale, P., Reznick, J., & Bates, E. (2007). *MacArthur-Bates communicative development inventories (2nd ed.).* Paul H Brookes Publishing Co.

Fernald, A., Marchman, V. A., & Weisleder, A. (2013). SES differences in language processing skill and vocabulary are evident at 18 months. *Developmental Science, 16*(2), 234–248. https://doi.org/10.1111/desc.12019

Fibla, L., Forbes, S. H., McCarthy, J., Mee, K., Magnotta, V., Deoni, S., Cameron, D., & Spencer, J. P. (2022). Language exposure and brain myelination in early development. *bioRxiv preprint*. https://doi.org/10.1101/2022.05.31.493945

Foushee, R., Griffiths, T. L., & Srinivasan, M. (2016). *Lexical complexity of child-directed and overheard speech: Implications for learning.* Proceedings of the 38th Annual Meeting of the Cognitive Science Society.

Frank, M. C., Braginsky, M., Yurovsky, D., & Marchman, V. A. (2021). *Variability and consistency in early language learning, The Worldbank Project*. The MIT Press.

Fukkink, R., Jilink, L., & Oostdam, R. (2017). A meta-analysis of the impact of early childhood interventions on the development of children in the Netherlands: An inconvenient truth? *European Early Childhood Education Research Journal,* 1752−1807. https://doi.org/10.1080/1350293X.2017.1356579

Galsworthy, M. J., Dionne, G., Dale, P. S., & Plomin, R. (2000). Sex differences in early verbal and non-verbal cognitive development. *Developmental Science, 3*(2), 206–215. https://doi.org/10.1111/1467-7687.00114

Ghassabian, A., Rescorla, L., Henrichs, J., Jaddoe, V. W., Verhulst, F. C., & Tiemeier, H. (2014). Early lexical development and risk of verbal and nonverbal cognitive delay at school age. *Acta Paediatrica, 103*, 70–80. https://doi.org/10.1111/apa.12449

Gilkerson, J., & Richards, J. A. (2009). *The power of talk. Impact of adult talk, conversational turns and TV during the critical 0–4 years of child development.* Boulder, CO: LENA Foundation.

Gilkerson, J., Richards, J. A., Warren, S. F., Montgomery J. K., Greenwood, C. R., Oller, D. K., Hansen, J. H. L., & Paul, T. D. (2017). Mapping the early language environment using all-day recordings and automated analysis. *American journal of Speech-Language Pathology, 26*, 248–265.

Gilkerson, J., Richards, J. A., Warren, S. F., Oller, K., Russo, R., & Vohr, B. (2018). Language experience in the second year

of life and language outcomes in late childhood. *Pediatrics, 142*(4).

Goldfield, B. A., & Reznick, J. S. (1990). Early lexical acquisition: Rate, content, and the vocabulary spurt. *Journal of Child Language, 17*, 171–183.

Golinkoff, R. M., Hoff, E., Rowe, M. L., Tamis-LeMonda, C. S., & Hirsh-Pasek, K. (2019). Language matters: Denying the existence of the 30-million-word gap has serious consequences. *Child Development*, 90(3), 985–992. https://doi.org/10.1111/cdev.13125

Haapala, S., Nimitalo-Haapola, E., Raappana, A., Kujala, T., Kujala, T., & Jansson-Verkasalo, E. (2015). Restricted consonant inventories of 2-year-old Finnish children with a history of recurrent acute otitis media. *First Language 35*(3), 219–236. https://doi.org/10.1177/0142723715589695

Haapala, S., Niemitalo-Haapola, E., Raappana, A., Kujala, T., Suominen K., Kujala, T., & Jansson-Verkkasalo, E. (2014). Effects of recurrent acute otitis media on cortical speech-sound processing in 2-year old children. *Ear & Hearing, 35*(3), e75–e83.

Hackman, D. A., Farah, M. J., & Meaney, M. J. (2010). Socioeconomic status and the brain: Mechanistic insights from human and animal research. *Nature Reviews Neuroscience, 11*.

Hadley, P. A., Rispoli, M., & Hsu, N. (2016). Toddlers´ verb lexicon diversity and grammatical outcomes. *Language, Speech, and Hearing Services in Schools, 47*, 44–58.

Hammer, C. S., Morgan, P., Farkas, G., Hillemeuer, M., Bitetti, D., & Maczuga, S. (2017). Late talkers: A population-based study of risk factors and school readiness consequences. *Journal of Speech, Language, and Hearing Research, 60*, 607–626. https://doi.org/10.1044/2016_JSLHR-L-15-0417

Hart, B., & Risley, T.R. (1995). *Meaningful differences in the everyday experience of young American children.* Paul H. Brookes Publishing Company.

Heikkinen, T., Silvennoinen, H., Peltola, V., Ziegler, T., Vainionpää, R., Vuorinen, T., Kainulainen, L., Puhakka, T., Jartti, T., Toikka, P., Lehtinen, P., Routi, T., & Juvén, T. (2004). Burden of influenza in children in the community. *The Journal of Infectious Diseases, 190*, 1369–1373.

Heilmann, J., Weismer, S. E., Evans, J., & Hollar, C. (2005). Utility of the MacArthur–Bates Communicative Development Inventory in identifying language abilities of late-talking and typically developing toddlers. *American Journal of Speech-Language Pathology, 14*, 40–51.

Henrichs, J., Rescorla, L., Schenk, J. J., Schmidt, H. G., Jaddoe, V. W. V., Hofman, A., Raat, H., Verhulst, F. C., & Tiemeierc, H. (2011). Examining continuity of early expressive vocabulary development: The Generation R Study. *Journal of Speech, Language, Hearing Research, 854* (54), 854–869.

Henriksen, R. E., & Thuen, F. (2015). Marital quality and stress in pregnancy predict the risk of infectious disease in the offspring: The Norwegian Mother and Child Cohort Study. *PLOS One, 10, 0137304.*

Hoff, E. (2003). The specificity of environmental influence: Socioeconomic status affects early vocabulary development via maternal speech. *Child Development, 74*(5), 1368–1378.

Hoff-Ginsberg, R. (1998). The relation of birth order and socioeconomic status to children's language experience and language development. *Applied Psycholinguistics, 19*, 603–629.

Hollich, G. J., Hirsh-Pasek, K., & Golinkoff, R. M. (2000). Breaking the language barrier: An emergentist coalition model for the origins of word learning. Monograps of the Society for Research in Child Development, 65 (3).

Hu, L-t., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*(1), 1–55. https://doi.org/10.1080/10705519909540118

Huttenlocher, J., Haight, W., Bryk, A., Seltzer, M., & Lyons, T. (1991). Early vocabulary growth: Relation to language input and

gender. *Developmental Psychology, 27*(2), 236–248.

Huttenlocher, J., Waterfall, H., Vasilyeva, M., Vevea, J., & Hedges, L. V. (2010). Sources of variability in children´s language growth. *Cognitive Psychology, 61*(4), 343–365. https://doi.org/10.1016/j.cogpsych.2010.08.002

Huttunen, J., & Eerola, P. (2016). *Finland*. In M. A. Adler, & K. Lenz (Eds.), *Fatherhood in the early years: An international comparison of policy and practise* (pp. 29–60). Policy Press.

Johnson, K., Caskey, M., Rand, K., Tucker, R., & Vohr, B. (2014). Gender differences in adult-infant communication in the first months of life. *Pediatrics, 134*(6). https://doi.org/10.1542/peds.2013-4289

Johnson, S. B., Riis, J. L., & Noble, K. G. (2016). State of the art review: Poverty and the developing brain. *Pediatrics, 137*(4). https://doi.org/10.1542/peds.2015-3075

Kartushina, N., Mani, N., Aktan-Erciyes, A., Alaslani, K., Aldrich, N. J., Almohammadi, A., Alroqi, H., Anderson, L., Andonova, E., Aussems, S., Babineau, M., Barokova, M. D., Bergmann, C., Cashon, C., Custode, S., der Calvalho, A., Dimitrova, N., Dynak, A., Farah, R., Fennell, C., ... Mayor, J. (2021). COVID-19 first lockdown as a unique window into language acquisition: What you do (with your child) matters. *PsyArXiv*. https://doi.org/10.31234/osf.io/5ejwu

Keegstra, A., Knijff, W., Post, W., & Goorhuis-Brouwer, S. (2007). Children with language problems in a speech and hearing clinic: Background variables and extent of language problems. *International Journal of Pediatric Otorhinolaryngology, 71*, 815–821. https://doi.org/10.1016/j.ijporl.2007.02.001

KELA (The Social Insurance Institution of Finland). (2021). "Maternity, paternity and parental allowances". Available at: https://www.kela.fi/web/en/parental-allowances

King, L. S., Dennis, E. L. Humphreys, K. L., Thompson, P. M., & Gotlib, I. H. (2020). Cross-sectional and longitudinal associations of family income-to-needs ratio with cortical and subcortical brain volume in adolescent boys and girls. *Developmental Cognitive Neuroscience, 44*. https://doi.org/10.1016/j.dcn.2020.100796

Korecky-Kröll. K., Dobek, N., Blaschitz, V., Sommer-Lolei, S., Boniecki, M., Uzunkaya-Sharma, K., & Dressler, W. U. (2019). Vocabulary as a central link between phonological working memory and narrative competence: Evidence from monolingual and bilingual four-year-olds from different socioeconomic backgrounds. *Language and Speech, 62*(3), 546–569. https://doi.org/10.1177/0023830918796691

Korpilahti, P., Kaljonen, A., & Jansson-Verkasalo, E. (2016). Identification of biological and environmental risk factors for language delay: The Let's Talk STEPS study. *Infant Behavior and Development, 42*, 27–35.

Kuhl P.K. (2004). Early language acquisition: Cracking the speech code. *Nature Review Neuroscience, 5* (11), 831–43.

Kujala, T., Alho, O-P., Kristo, A., Uhari, M., Renko, M., Pokka, T., & Koiviunen, P. (2017). Recurrent acute otitis media detracts from health-related quality of life. *The Journal of Laryngology Otology, 131*, 128–37.

Kunnari, S. (2000). *Characteristics of early lexical and phonological development in children acquiring Finnish*. [Dissertation]. Oulu University.

Kuvač-Kraljević, J., Blaži, A., Schults, A., Tulviste, T., & Stolt, S. (2021). Influence of internal and external factors on early language skills: A cross-linguistic study. *Infant Behavior and Development*, 63. https://doi.org/10.1016/j.infbeh.2021.101552

Kuvač-Kraljević, J., Cepanec, M., & Šimleša, S. (2014). Gestural development and its relation to a child´s early vocabulary. *Infant Behavior & Development, 37*, 192–202. http://dx.doi.org/10.1016/j.infbeh.2014.01.004

Kørvel-Hanquist, A., Koch, A., Lous, J., Olsen, S. F., & Homöe, P. (2018). Risk of childhood otitis media with focus on potentially modifiable factors: A Danish follow-up cohort study. International *Journal of Pediatric Otorhinolaryngology, 106*, 1–9. https://doi.org/10.1016/j.ijporl.2017.12.027

Lagström, H., Rautava, P., Kaljonen, A., Räihä, H., Pihlaja, P., Korpilahti, P., Peltola, V., Rautakoski, P., Österbacka, E., Simell, O., & Niemi, P. (2013). Cohort profile: Steps to the healthy development and well-being of children (the STEPS study). *International Journal Epidemiology, 42*(5), 1273−1284. d https://doi.org/10.1093/ije/dys150

Lambert, S. B., O´Grady, K. F., Gabriel, S. H., & Nolan, T. M. (2005). Challenges in infant immunity: Implications for responses to infection and vaccines. *Journal of Paediatric Child Health, 41*, 125−129.

Lankinen, V., Lähteenmäki, M., Kaljonen, A., & Korpilahti, P. (2018). Father–child activities and paternal attitudes in early child language development: The STEPS study. *Early Child development and care*. https://doi.org/10.1080/03004430.2018.1557160

Lee, J. (2011). Size matters: Early vocabulary as a predictor of language and literacy Competence. *Applied Psycholinguist, 32*, 69–92. https://doi.org/10.1017/S0142716410000299

Leech, K. A., Salo, V. C., Rowe, M. L., & Cabrera, N. J. (2013). Father input and child vocabulary development: The importance of wh-questions and clarification requests. *Seminars in Speech and Language, 34*(4), 249–259. https://doi.org/10.1055/s-0033-1353445

Letts, C., Edwards, S., Sinka, I., Schaefer, B., & Gibbons, W. (2013). Socio-economic status and language acquisition: Children's performance on the new Reynell Developmental Language Scales. *International Journal of Language & Communication Disorders, 48*(2), 131–143. https://doi.org/10.1111/1460-6984.12004

Lovas, G. S. (2011). Gender and patterns of language development in mother-toddler and father-toddler dyads. *First Language, 31*(1), 83–108.

Luijk, M. P. C. M., Linting, M., Henrichs, J., Herba, C.M., Verhage, M.L., Schenk, J.J., Arends, L. R., Raat, H., Jaddoe, V. W. V., Hofman, A., Verhulst, F. C., Tiemeire, H., & van IJzendoorn, M. H. (2015). Hours in non-parental child care are related to language development in a longitudinal cohort study. *Child: care, health, and development, 41*(6), 1188–1198. https://doi.org/10.1111/cch.12238

Lyytinen, P. (1999). *Varhaisen kommunikaation ja kielen kehityksen arviointimenetelmä (The Finnish version of the MacArthur Communicative Development Inventory, CDI).* Niilo Mäki Instituutti.

MacArthur-Bates CDI. [Cited 2021, June]; Retrieved from https://mb-cdi.stanford.edu/index.html

MacRoy-Higgins, M., & Montemarano, E. A. (2016). Attention and word learning in toddlers who are late talkers. *Journal of Child Language, 43*, 1020–1037.

Madigan, S., Orime, H., Graham, S. A., Rodrigues, M., Andersn, N., Khoury, J., & Jenkins, J. M. (2019). Parenting behavior and child language: A meta-analysis. *Pediatrics, 144*(4). https://doi.org/10.1542/peds.2018-3556

Majorano, M., Rainieri, C., & Corsano, P. (2013). Parents´ child-directed communication and child language development: A longitudinal study with Italian toddlers. *Journal of Child Language, 40*, 836–859. https://doi.org/10.1017/S0305000912000323

Marchman, V. A., & Bates, E. (1994). Continuity in lexical and morphological development: A test of the critical mass hypothesis. *Journal of Child Language, 21*, 339–366.

Marjanovic-Umek, L., & Fekonja-Peklaj, U. (2017). Gender differences in children's language: A meta-analysis of Slovenian studies. *Center for Educational Policy Studies Journal, 7*(2), 97–111.

McCormick, D. P., Johnson, D. L., & Baldwin, C. D. (2006). Early middle ear effusion and school achievement at age seven years. *Ambulatory Pediatrics, 6.* 280–287.

McGillion, M., Herbert, J. S., Pine, J., Vihman, M., dePaolis, R., Keren-Portnoy, T., & Matthews, D. (2017). What paves the way to conventional language? The predictive value of babble, pointing, and socioeconomic status. *Child Development, 88*(1), 156–166. https://doi.org/10.1111/cdev.12671

McLoyd, V. C. (1998). Socioeconomic disadvantage and child development. *American Psychologist, 53*(2), 185–204.

Metsämuuronen, J. (2009). *Tutkimuksen tekemisen perusteet ihmistieteissä* 4 [The basis for conducting research in human sciences 4]. Gummerus Kirjapaino Oy.

Miettinen, A., & Rotkirch, A. (2012). *Yhteistä aikaa etsimässä: Lapsiperheiden ajankäyttö 2000-luvulla* [Time use of Finnish families with children], Helsinki: Population research Institute.

Ministry of Education and Culture (n.d.). Early childhood education and care. https://minedu.fi/en/early-childhood-education-and-care

Ministry of Social Affairs and Health. (2022). Maternity and child health clinics. https://stm.fi/en/maternity-and-child-health-clinics

Monasta, L., Ronfani, L., Marchetti, F., Montico, M., Brumatti, L. V., Bavcar, A., Grasso, D., Barbiero, C., & Tamburlini, G. (2012). Burden of disease caused by otitis media; Systematic review and global estimates. *PLoS ONE,* 7.

Monto, A. S., & Sullivan, K. M. (1993). Acute respiratory illness in the community. Frequency of illness and the agents involved. *Epidemiology And Infection, 110*, 145–160.

Newman, R, Bernstein Ratner, N., Jusczyk, A.M., Jusczyk, P.W., & Dow, K.A. (2006). Infants´ early ability to segment the conversational speech signal predicts later language development: A retrospective analysis. *Developmental Psychology, 42*(4), 643–655. https://doi.org/10.1037/0012-1649.42.4.643

NICHD Early Child Care Research Network. (2000). Factors associated with father´s caregiving activities and sensitivity with young children. *Journal of Family Psychology, 14*(2), 200–219. https://doi.org/10.1037//D893-3200.14.2.200

Nylund, A., Toivonen, L., Korpilahti, P., Kaljonen, A., Peltola, V., & Rautakoski, P. (2019). Recurrent respiratory tract infections or acute otitis media were not a risk factor for vocabulary development in children at 13 and 24 months of age. *Acta Paediatrica, 108*, 288–294. https://doi.org/10.1111/apa.14546

Paavola, L., Kemppainen, K., Kumpulainen, K., Moilanen, I., & Ebeling, H. (2006). Maternal sensitivity, infant co-operation and early linguistic development: Some predictive relations. *European Journal of Developmental Psychology, 3*(1), 13–30. https://doi.org/10.1080/17405620500317789

Pan, B. A., Rowe, M. L., Singer, J. D., & Snow, C. E. (2005). Maternal correlates of growth in toddler vocabulary production in low-income families. *Child development, 76*(4), 763–782.

Pancsofar N., & Vernon-Feagans L. (2010). Fathers' early contributions to children's language development in families from low-income rural communities. *Early Childhood Research Quarterly, 25*(4), 450–463.

Paradise, J. L., Campbell, T. F., Dollaghan, C. A., Feldman, H. M., Bernard, B. S., Colborn, K., Rockette, H. E., Janosky, J. E., Pitcairn, D. L., Kurs-Lasky, M., Sabo, D. L., & Smith C. G. (2005). Developmental outcomes after early or delayed Insertion of Tympanostomy Tubes. *The New England Journal of Medicine, 353*, 576–586.

Paradise, J. L., Feldman, H. M., Campbell, T. F., Dollaghan, C. A., Colborn, K., Bernard, B. S., Rockette, H. E., Janosky, J. E., Pitcairn, D. L., Sabo, D. L., Kurs-Lasky, M., & Smith C. G. (2001). Effects of early or delayed insertion of tympanostomy tubes for persistent otitis media on developmental outcomes at the age of three years. *The New England Journal of Medicine, 344*(16).

Parviainen, S., Saastamoinen, L., Lauhio, A., & Sepponen, K. (2019). Outpatient antibacterial use and costs in children

and adolescents: A nationwide register-based study in Finland, 2008–16. *Journal of Antimicrobial Chemotherapy, 74*, 2426–2433. https://doi.org/10.1093/jac/dkz208

Peltola, V., Waris, M., Österback, R., Susi, P., Ruuskanen, O., & Hyypiä, T. (2008). Rhinovirus transmission within families with children: Incidence of symptomatic and asymptomatic infections. J*ournal of Infectious Diseases, 197*, 382–9. https://doi.org/10.1086/525542

Perkins, S. C., Finegood, E. D., & Swain, J. E. (2013). Poverty and language development: Roles of parenting and stress. *Innovations in Clinical Neuroscience, 10*(4).

Pierce, L. J., Reilly, E., & Nelson III, C. A. (2020). Associations between maternal stress, early language behaviors, and infant electroencephalography during the first year of life. *Journal of Child Language,* 1–28. https://doi.org/10.1017/S0305000920000501

Reilly, S., Wake, M., Bavin, E. L., Prior, M., Williams, J., Bretherton, L., Eadie, P., Barrett, Y., & Ukoumunne, O. C. (2007). predicting language at 2 years of age: A prospective community study. *Pediatrics, 120*. https://doi.org/10.1542/peds.2007-0045

Rescorla, L. (1989). The Language Development Survey: A screening tool for delayed language in toddlers. *Journal of Speech and Hearing Disorders, 54*, 587–599.

Rescorla, L., (2009). Age 17 language and reading outcomes in late-talking toddlers: Support for a dimensional perspective on language delay. *Journal of Speech, Language, and Hearing Research, 52*, 16–30.

Rescorla, L. (2011). Late Talkers: Do good predictors of outcome exist? *Developmental Disabilities Research Reviews, 17*, 141–150. https://doi.org/10.1002/ddrr.1108

Rescorla, L. A. (2013). *Longitudinal outcomes: A fifteen-year follow up of late-talking toddlers.* In L. A. Rescorla & P. S. Dale (Eds.), *Late takers: From research to practice*. Brookes.

Reznick, J. S. (1990). Visual preference as a test of infant word comprehension. *Applied Psycholonguistics, 11*, 145–166.

Reznick, J. S. & Schwartz, B. B. (2001). When is an assessment an intervention? parent perception of infant intentionality and language. *Journal of American Academy of Child and Adolescent Psychiatry, 40*(1).

Roberts, J. E., Rosenfeld, R. M., & Zeisel, S. A. (2004). Otitis media and speech and language: A meta-analysis of prospective studies. *Pediatrics, 113*, 238–48.

Romeo, R. R. (2019). Socioeconomic and Experimental Influences on the Neurobiology of Language Development. *Perspectives of the ASHA Special Interest Groups, 4*, 1229–1238.

Romeo, R. R., Seagaran, J., Leonard, J. A., Robinson, S. T., West, M. R., Mackey, A. P., Yendiki, A., Rowe, M. L., & Gabrieli, J. D. E. (2018). Language Exposure Relates to Structural Neural Connectivity in Childhood. *The Journal of Neuroscience, 38*(36), 7870–7877. https://doi.org/10.1523/JNEUROSCI.0484-18.2018

Rowe, M. (2012). A longitudinal investigation of the role of quantity and quality of child –directed speech in vocabulary development. *Child Development, 83*(5), 1762–1774. https://doi.org/10.1111/j.1467-8624.2012.01805.x

Rowe, M. L. (2008). Child-directed speech: Relation to socioeconomic status, knowledge of child development and child vocabulary skill. *Journal of Child Language, 35*, 185–205. https://doi.org/10.1017/S0305000907008343

Rowe, M. L., Coker, D., & Pan, B. A. (2004). A comparison of father´s and mother´s talk to toddlers in low-income families. *Social Development, 13*(2). https://doi.org/10.1111/j.1467-9507.2004.000267.x

Rowe, M. L. & Weisleder, A. (2020). Language development in context. Annual *Review of Developmental Psychology, 2*, 201-223. https://doi.org/10.1146/annurev-devpsych-042220-121816

Rudolph, J. M. (2017). Case history risk factors for specific language impairment:

A systematic review and meta-analysis. *American journal of Speech-Language Pathology, 26*, 991–1010. https://doi.org/10.23641/asha.5150122

Schjøberg, S., Eadie, P., Zachrisson, H. D., Øyen, A-S., & prior, m. (2011). predicting language development at age 18 months: Data from Norwegian Mother and Child Cohort Study. *Journal of Developmental & Behavioral Pediatrics, 32*, 375–383.

Schuez-Havupalo, L., Lahti, E., Junttila, N., Toivonen, L., Aromaa, M., Rautava, P., Peltola, V., & Räihä, H. (2018). Parents' depression and loneliness during pregnancy and respiratory infections in the offspring: A prospective birth cohort study. *PLOS ONE, 13*(9). https://doi.org/10.1371/journal.pone.0203650

Schuez-Havupalo, L., Toivonen, L., Karppinen, S., Kaljonen, A., & Peltola, V. (2017). Daycare attendance and respiratory tract infections: A prospective birth cohort study. *BMJ Open, 7*. https://doi.org/10.1136/bmjopen-2016-014635

Schults, A., & Tulviste, T. (2016). Composition of Estonian infants' expressive lexicon according to the adaptation of CDI/Words and Gestures. *First Language, 36*(5), 485–504. https://doi.org/10.1177/0142723716648864

Schults, A., Tulviste, T., & Konstabel, K. (2012). Early vocabulary and gestures in Estonian children. *Journal of Child Language, 39*, 664–686. https://doi.org/10.1017/S0305000911000225

Shany, B., Subbarao, T .A., & Thushara, M. K. (2014). A study of performance of children with history of ear infection on linguistic profile test. *Language in India, 14*(1), 61–82.

Shelton, L. (2018). *The Bronfenbrenner primer. A Guide to Develecology*. Rouledge.

Shneidman, L. A., Arroyo, M. E., Levine, S. C., & Goldin-Meadow, S. (2013). What counts as effective input for word learning? *Journal of Child Language, 40*, 672–686. https://doi.org/10.1017/S0305000912000141

Simoes, E. A. F. (2003). Environmental and demographic risk factors for respiratory syncytial virus lower respiratory tract disease. *Journal of Pediatrics. 143*, 118–126.

Simonsen, H. G., Kristoffersen, K. E., Bleses, D., Wehberg, S., & Jø rgensen, R. N. (2014). The Norwegian Communicative Development Inventories: Reliability, main developmental trends and gender differences. *First Language, 34*(1), 3–23. https://doi.org/10.1177/0142723713510997

Statistics Finland´s PX-Web databases (classification of educational and occupational levels). [cited 2021 October]; Retrieved from https://www.stat.fi/en/luokitukset/koulutusaste/koulutusaste_1_20160101/ and https://www.stat.fi/en/luokitukset/ammatti/

Statistics Finland´s PX-Web databases (education). [cited 2021 May]; Retrieved from https://pxnet2.stat.fi:443/PXWeb/api/v1/en/StatFin/kou/vkour/statfin_vkour_pxt_12bq.px

Statistics Finland´s PX-Web databases (Income). [cited 2020 Jan 20]; Retrieved from http://tilastokeskus.fi/til/tjt/index_en.html

Stolarova, M., Brielmann, A. A., Wolf, C., Burke, T., & Baayen, H. (2016). Early vocabulary in relation to gender, bilingualism, type, and duration of childcare. *Advances in Cognitive Psychology, 12*(3), 130–144. https://doi.org/10.5709/acp-0192-6

Stolt, S., Haataja, L., Lapinleimu, H., & Lehtonen, L. (2008). Early lexical development of Finnish children A longitudinal study. *First Language, 28*(3), 259–279. https://doi.org/10.1177/0142723708091051

Stolt, S., Klippi, A., Launonen, K., Munck, P., Lehtonen, L., Lapinleimu, H., & Haatja, L. (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,* 34:2, 283–310.

https://doi.org/10.1017/S0305000906007902

Säkkinen, S., & Kuoppala, T. (2020). *Varhaiskasvatus 2019*. THL, Tilastoraportti 33/2020. https://www.julkari.fi/handle/10024/140541

Thal, D. J., Bates, E., Goodman, J., & Jahn-Samilo, J. (1997). Continuity of language abilities: An exploratory study of late- and early-talking toddlers. *Developmental Neuropsychology, 13*(3), 239–273. https://doi.org/10.1080/87565649709540681

Thal, D., O´Hanlon, L., Clemmons, M., & Fralin, L. (1999). Validity of a parent report measure of vocabulary and syntax for preschool children with language impairment. *Journal of Speech, Language, and Hearing Research. 42*, 482–496.

Toivonen, L., Forsström, V., Waris, M., & Peltola, V. (2019). Acute respiratory infections in early childhood and risk of asthma at age 7 years. *Journal of Allergy and Clinical Immunology, 143*, 407–410.e6

Toivonen, L., Karppinen, S., Schuez-Havupalo, L., Teros-Jaakkola, T., Vuononvirta, J., Mertsola, J., He, Q., Waris, M., & Peltola, V. (2016). Burden of recurrent respiratory tract infections in children: A prospective cohort study. *Pediatric Infectious Disease Journal, 35*, 362–369. https://doi.org/10.1097/INF.0000000000001304

Toivonen, L., Schuez-Havupalo, L., Karppinen, S., Teros-Jaakkola, T., Rulli, M., Mertsola, J., & Peltola, V. (2016). Rhinovirus infections in the first 2 years of life. *Pediatrics, 138*(3), 1–9.

Tomblin, J. B., Smith, E., & Zhang, X. (1997). Epidemiology of specific language impairment: Prenatal and perinatal risk factors. *Journal of Communication Disorders, 30*, 325–344.

Topping, K., Dekhinet, R., & Zeedyk, S. (2011). Hindrances for parents in enhancing child language. *Educational Psychology Review, 23*, 413–455. https://doi.org/10.1007/s10648-011-9169-4

Topping, K., Dekhinet, R., Zeedyk, S. (2013). Parent–infant interaction and childrens language development. *Educational Psychology-Uk. 33*(4), 391–426. https://doi.org/10.1080/01443410.2012.744159

Torppa, M., Lyytinen, P., Erskine, J, Eklund, K., & Lyytinen, H. (2010). *Journal of Learning Disabilities, 43*(4), 308–321. https://doi.org/10.1177/0022219410369096

Tregoning, J. S., & Schwarze, J. (2010). Respiratory viral infections in infants: Causes, clinical symptoms, virology, and immunology. *Clinical Microbiology Reviews, 23*(1), 74–98.

Tsao, F-M., Liu, H-M., & Kuhl, P. K., (2004). Speech perception in infancy predicts language development in the second year of life: A longitudinal study. *Child development, 75*(4), 1067–1084.

Tulviste, T. & Schults, A. (2020). Parental reports of communicative development at the age of 36 months: The Estonian CDI-III. *First Language, 40*(1), 64–83. https://doi.org/10.1177/0142723719887313

Urm, A., & Tulviste, T. (2016). Sources of individual variation in Estonian toddlers´ expressive vocabulary. *First Language, 36*(6), 580–600. https://doi.org/10.1177/0142723716673951

Urm, A., & Tulviste, T. (2021). Toddlers´ early communicative skills as assessed by the short form version of the Estonian MacArthur-Bates Communicative Development Inventory II. *Journal of Speech, Language, and Hearing Research, 64*, 1303–1315. https://doi.org/10.1044/2020_JSLHR-20-00201

Van Hulle, C. A., Goldsmith, H. H., & Lemery, K. S. (2004). Genetic, environmental, and gender effects on individual differences in toddler expressive language. *Journal of Speech, Language, and Hearing research, 47*, 904–912.

Wang, H., Zheng, Y., Deng, J., Wang, W., Liu P, Yang, F., & Jiang, H. (2016). Prevalence of respiratory viruses among children hospitalized from respiratory infections in Shenzhen, China. *Virology Journal, 13*(39). https://doi.org/10.1186/s12985-016-0493-7.

Weisleder, A., & Fernald, A. (2013). Talking to children matters: Early language experience strengthens processing and builds vocabulary. *Psychological Science 24*(11), 2143–2152. https://doi.org/10.1177/0956797613488145

Wehberg, S., Vach, W., Bleses, D., Thomsen, P., Madsen, T.O., & Basbøll, H. (2007). Danish children's first words: Analysing longitudinal data based on monthly CDI parental reports. *First Language, 27*(4), 361–383. https://doi.org/10.1177/0142723707081723

Wehberg, S., Vach, W., Bleses, D., Thomsen, P., Madsen, T. O., & Basbøll, H. (2008). Girls talk about dolls and boys about cars? Analyses of group and individual variation in Danish children's first words. *First Language, 28*(1), 71–85. https://doi.org/10.1177/0142723707081729

World Health Organization. The global burden of disease: 2004 update. (2008). [cited 2020 Aug 17]; World Health Organization. https://apps.who.int/iris/handle/10665/43942

Yeung, W. J., Sandberg, J. F., Davis-Kean, P. E., & Hofferth, S. L. (2001). Children´s time with fathers in intact families. *Journal of Marriage and Family, 63*, 136–154.

Zambrana, I. M., Pons, F., Eadie. P., & Ystrom, E. (2014). Trajectories of language delay from age 3 to 5: Persistence, recovery and late onset. *International Journal of Language and Communication Disorders, 49*(3), 304–316. https://doi.org/10.1111/1460-6984.12073

Zhang, Y., Jin, X., Shen, X., Zhang, J., & Hoff, E. (2008). Correlates of early language development in Chinese children. *International Journal of Behavioral Develeopment, 32*(2), 145–151. https://doi.org/10.1177/0165025407087213

Zubrick, R. S., Taylor, C. L., Rice, M. L., & Slegers, D. W. (2007). Late language emergence at 24 months: An epidemiological study of prevalence, predictors, and covariates. *Journal of Speech, Language, and Hearing Research, 50*, 1563–1592.

Zumach, A., Chenault, M. N., Anteunis, L. J. C., & Gerrits, E. (2011). Speech perception after early- life otitis media with fluctuating hearing loss. *Audiology and Neurotology, 16*, 304–14. https://doi.org/10.1159/000322501.

Zumach, A., Gerrits, E., Chenault, M., & Anteunis, L. (2010). Long-term effects of early-life otitis media on language development. *Journal of Speech Language and Hearing Research, 53*, 34–43. https://doi.org/10.1044/1092-4388(2009/08-0250)

ISBN 978-952-12-4255-7