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Department of Special Education



Children's Vocabulary Development

The role of parental input, vocabulary composition
and early communicative skills

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Abstract

The aim of this thesis is to examine the early vocabulary development of a sample of Swedish children in relation to parental input and early communicative skills. Three studies are situated in an overall description of early language development in children. The data analyzed in the thesis was collected within a larger project at Stockholm University (SPRINT- “Effects of enhanced parental input on young children’s vocabulary development and subsequent literacy development” [VR 2008-5094]).

Data analysis was based on parental report via SECDI, the Swedish version of the MacArthur-Bates Communicative Development Inventories, and audio recordings. One study examined parental verbal interaction characteristics in three groups of children with varying vocabulary size at 18 months. The stability of vocabulary development at 18 and 24 months was investigated in a larger study, with focus on children’s vocabulary composition and grammatical abilities. The third study examined interrelations among early gestures, receptive and productive vocabulary, and grammar measured with M3L, i.e. three longest utterances, from 12 to 30 months.

Overall results of the thesis highlight the importance of early language development. Variability in different characteristics in parental input is associated with variability in child vocabulary size. Children with large early vocabularies exhibit the most stability in vocabulary composition and the earliest grammatical development. Children’s vocabulary composition may reflect individual stylistic variation. Use of early gestures is associated differentially with receptive and productive vocabulary.

Results of the thesis have implications for parents, child- and healthcare personnel, as well as researchers and educational practitioners. The results underscore the importance of high quality in adult-child interaction, with rich input fine-tuned to children’s developmental levels and age, together with high awareness of early language development.

Keywords: child language, vocabulary development, parent-child interaction, parental input, vocabulary composition, CDI, SECDI, CLAN, grammar, lexical-grammar relationships, communicative gestures, Sweden

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*If we knew what we were doing, it would not be called research, would it? -
Albert Einstein*

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Abbreviations

ANOVA	Analysis of variance
CDI	Communicative Development Inventories
CHAT	Codes for the Human Analysis of Transcripts
CHILDES	Child Language Data Exchange System
CLAN	Computerized Language Analysis
LENA	Language Environment Analysis
PLI	Pragmatic language impairment
SECDI	Swedish Early Communicative Development Inventories
SES	Socioeconomic status
SLI	Specific language impairment
SLP	Speech-language pathologist

1 Introduction

A father (Fat) and his 18-month-old son (Chi) are engaged in a mealtime conversation:

Chi: *gago.*
Fat: *vad säger du?* <What are you saying?>
Chi: *gågå.*
Fat: *gågå?*
Chi: *gågå.*
Fat: *[skratt] vad är det då?* <[laughing]What's that?>
Chi: *dä, dödä.*
Fat: *de(t) här?* <This?>
Chi: *nej, de(t) där.* <No, that.>
Fat: *de(t) här?* <This?>
Chi: *nej de(t)-* <No th->
Fat: *nappen, nej?* <The pacifier, no?>
Chi: *det där!* <That!>
Fat: *är det yoghurt menar du?* <Do you mean yoghurt?>
Fat: *är det det du säger?* <Is that what you're saying?>
Fat: *yoghurt?*
Chi: *de(t) där!* <That!>
Fat: *ja, det är ju locket till yoghurten.* <Yes, that's the lid to the yoghurt.>
Chi: *nä.* <No.>
Fat: *yoghurt.*
Chi: *gaga.*
Fat: *är det yoghurt du säger?* <Are you saying yoghurt?>
Fat: *yoghurt?*
Chi: *mm.*
Fat: *yoghurt, ja.* <Yoghurt, yes.>
Chi: *gågur.*
Fat: *[skratt] gågur! Vad duktig du var!* <[laughing]How clever you are!>
Chi: *gågur.*
Fat: *ja, vilken söt mun du får!* <Yes, that makes your mouth look so cute!>
Chi: *kuko.*
Fat: *kuko.*
Chi: *koko.*
Fat: *koko.*
Chi: *koko.*
Fat: *vill du ha en puss då?* <Do you want a kiss?> [father kisses child]
Chi: *dada go.*
Fat: *är det gott med yoghurt?* <Is the yoghurt good?>
Chi: *mm.*
Fat: *mm, godare än maten.* <Mm, better than food.>

The above excerpt gives evidence of a strong communicative will on the part of both child and parent. Neither gives up until understanding is achieved. The father encourages and imitates his son's attempts at producing the word 'yoghurt' and praises the child's efforts. The dialog illustrates the interactive style of this father-son pair and represents one particular family's version of what Hart and Risley call "the social dance that is talking between parents and children" (1999, p.1).

Important questions for the present thesis include how children's early vocabulary development is related to other early communicative skills, and what factors may account for the great variability in children's language development. Further key issues are the role played by the input provided by a child's first caregivers, namely parents, and the importance for children of having an early command of words and grammar. These are essential questions to ask in a globalized society which puts a premium on the language abilities of individuals. The questions are relevant for mainstream educators as well as special needs educators. In addition, the answers influence the way support and guidance is given to families with infants and toddlers. This thesis discusses these and other related issues in a Swedish context.

The thesis addresses first language acquisition in Swedish children, with a main focus on families where Swedish is the first language. The thesis is based on investigation of the early vocabulary development of a sample of Swedish children from middle-class families. With this analysis, an attempt has been made to discuss vocabulary knowledge and timing of acquisition, the importance of input provided by parents, early vocabulary composition, as well as interrelationships among early communicative skills. Results from three studies are included in the thesis, with these results each comprising a separate chapter.

Why is it important to study vocabulary? A simple answer is that words form the basis for children's language production and reception. Measuring vocabulary also reveals much about the great variability across individual children regarding rates of development and stylistic or compositional differences. Vocabulary development is of importance for later language skills and academic achievement (e.g. Lee, 2011; Walker, Greenwood, Hart, & Carta, 1994). For example, language comprehension lays the foundation for later reading comprehension, as well as language development in general, and this has consequences for long-term literacy development (e.g. Dickinson, Golinkoff, & Hirsh-Pasek, 2010; Scarborough, 2001; Snow, Burns, & Griffin, 1998; Torppa, Lyytinen, Erskine, Eklund, & Lyytinen, 2010).

Variability is also typical of children with various impairments, which is important in its own right. In addition, studying language development in atypical populations also serves to advance our understanding of language growth in general. Vocabulary is a language domain which is strongly influenced by environmental input. The role of parental input in children's vocabulary development has been investigated to a great extent, especially in

the English-speaking world. The present thesis adds to the body of international literature by providing information on middle-class Swedish children's vocabulary knowledge and input provided by their parents.

To better understand children's early language development must be considered an issue of importance for the public health of a country, with its vast effects on children's future school success and general well-being. This crucial issue has obvious implications for the field of Special Education, which aims to prevent language difficulties, as well as to remediate them.

The data analyzed in this thesis was collected within a research project called SPRINT¹ at Stockholm University, a joint venture between the departments of Special Education and Linguistics, where the interaction between parents and children are in focus. The project emphasizes in particular the importance of vocabulary growth in language development. Formal results of the SPRINT project will be reported elsewhere.

1.1 The role of experience for language development

In recent years, children's first experiences, prenatally as well as in the post-natal period, have been understood to have a significant impact on their brain and behavioral development (Dawson, Ashman, & Carver, 2000; National Scientific Council on the Developing Child, 2010). This in turn has consequences for children's social, cognitive and linguistic development. Evidence from the fields of neuroscience, biology, population health and the behavioral and social sciences has demonstrated the interaction of genetics and environment during the early years (Mustard, 2006). In the late 1990s, the evidence from neuroscience in particular prompted a revival of emphasis on critical periods for early development, specifically the first three years of life (e.g. Shore, 1997). Other voices have argued against the misuse of neuroscience research to make unwarranted claims (Bruer, 1999; Rutter, 2002). The "myth of the first three years", also the title of Bruer's (1999) book, has been especially strong in the United States, where findings regarding synapse formation in the brain, critical periods and enriched environments have been used to influence parents and early childhood policy. Bailey (2002), who claims that it is "neither warranted nor necessary" to invoke critical periods to justify early childhood services, suggests an emphasis on the "timing of critical experiences necessary for healthy development of all children" (p. 281). Knowledge of the dynamic interplay between genetics and environment is especially important regarding children with delayed or impaired language development (see Section 3.2.6). Despite the fact that vocabulary growth is a lifelong process and is especially stimulated through reading

¹ SPRINT project (*Språkinterventions projektet*: "Effects of enhanced parental input on young children's vocabulary development and subsequent literacy development")

(Cunningham & Stanovich, 2001), the impact of early word learning must by no means be underestimated. It is well-established that early language development lays one of the foundations for later literacy achievement, leading to positive long-term outcomes (see Section 3.3). Therefore, ensuring that children grow up in an environment that is conducive to the development of language, as well as general knowledge, is not only beneficial to individuals, but also from a societal perspective. Thus it is important for policy makers to adopt an approach that is proactive and preventive in nature, includes early identification of developmental disabilities, and utilizes one of the most-fitting “primary engines of development”, namely parents (Bronfenbrenner & Morris, 1998, p. 996).

1.2 Aims of the thesis

The overarching aim of this thesis is to investigate the early vocabulary development of a sample of Swedish children, and examine this in relation to parental input and other early communicative skills. Three studies of Swedish children are situated in a general description of early language development in children. The results obtained are discussed from a number of different perspectives. The aims of the studies are as follows:

- Study I examines the way in which a group of Swedish middle-class mothers and fathers talk to their 18-month-old² children. The study aims to investigate parents’ verbal interaction characteristics, including the amount of input directed to children, and relate this to the size of children’s vocabularies.
- Study II examines the role of vocabulary composition and grammatical abilities in the vocabulary development of a larger sample of Swedish children. These variables are investigated in groups of children with different vocabulary size at the ages of 1;6 and 2;0.
- Study III examines how early communicative skills, including gestural use and vocabulary comprehension, are related to children’s vocabulary production and early syntactic development, measured here by the mean length of three longest utterances. Interrelationships between all these skills in a larger sample of children are investigated over a time period of one and a half years, from child age 1;0 to 2;6.

The studies are situated within the field of child language development research and have applications for research and programs aiming to prevent future language difficulties, as well as parents and preschool personnel. Hereafter, the word ‘thesis’ will be used to refer to the entire dissertation, while ‘study’, with or without modifiers, refers to an individual study.

² Within the field of child language research, child age of 18 months is denoted as 1;6 (one year and six months).

1.3 Outline of the thesis

Chapters 2 and 3 of this thesis provide background information for a full understanding of the studies. Chapter 2 traces historical approaches to early language development, as well as theoretical approaches to language acquisition. Chapter 3 presents an overview of child language development and begins by outlining interrelated developmental aspects involved in first language learning. The chapter continues with sections on social interaction, developmental outcomes related to early language learning, as well as on modern language intervention. Chapter 4 covers methods of data collection and analysis, in child language research in general, as well as specifically in this thesis. The next three chapters encompass results of the studies which form the basis of the thesis. A general discussion follows the chapter on early communicative skills.

Table 1.1 outlines the three studies, giving a description and research focus, as well as the number of participants involved and the materials and methods used. All three studies use some form of the Swedish Early Communicative Development Inventories (SECDI; Berglund & Eriksson, 2000a; Eriksson & Berglund, 1999), which are Swedish adaptations of the MacArthur-Bates Communicative Development Inventories (CDI; Fenson et al., 1993, 1994, 2007), parent questionnaires to measure children's vocabulary skills.

Table 1.1: Overview of the studies

Study	Description	Focus	Participants	Materials and Methods
I	A comparison of parental input characteristics in relation to children's vocabulary size and composition at 1;6	Amount and diversity of input Parental use of interactive feedback behaviors and questions	15 children and parents, in three groups according to vocabulary size at 1;6	SECDI: Words & Sentences Analysis of audio recordings Non-parametric group comparisons
II	Investigates the role of vocabulary composition and grammatical abilities in four groups of learners	Predictors of vocabulary size at 2;0 Vocabulary composition and stylistic variation	262 children at 1;6, 200 children at 2;0, 183 with data at both measurements	SECDI: Words & Sentences, measurements at 1;6 and 2;0 Correlation and regression analysis
III	Investigates interrelationships between early communicative skills over time	Gestural use Receptive and productive vocabulary Mean length of three longest utterances (M3L)	348 children in total	SECDI: Words & Gestures at 1;0 SECDI: Words & Sentences at 1;6, 2;0 and 2;6 Correlation analysis

2 Historical background

History and theory are tightly interwoven in the area of language development. Therefore, this chapter will attempt to present ideas and theories relevant to this thesis from an historical perspective. The viewpoints presented in this chapter have had implications for methods of study (Chapter 4). The first aim of this chapter is to trace the history of interest in early language development in general. A second aim is to discuss some of the main theoretical approaches to studying child language. A third aim is to present two theoretical models, the first presenting an ecological approach to early language acquisition, and the second situating language learning within the larger framework of human development.

2.1 Historical approaches to language development

As far back in time as ancient Egypt, there has been interest in the roles of nature and nurture in child development (Bornstein, 2002). Philosophers from Plato onwards have advanced different theories regarding infancy, human nature and the role of language.

2.1.1 Heredity and experience

The discussion regarding the role of experience for language development is part of the larger historical debate on human nature and the effects of heredity and experience. This debate began centuries ago, with opposing viewpoints reaching an extreme in the 17th century. The empiricist view, following Locke's (1689/2001) idea of infants' minds being a *tabula rasa*, or blank slate, can be contrasted with the view, exemplified for example by Descartes (1641/1996), that infants, as created in the image of God, were born with certain ideas that helped them understand the world. Descartes was the first of the modern rationalists, proposing the innate rational mind, rather than sensory experience, as the source of human knowledge. Although Descartes cannot be said to be a proponent of heredity per se, rationalists often held nativist views. With his scientifically oriented empiriocriticism, the philosopher Kant (1781/1998) attempted to reconcile the opposing traditions of empiricism and rationalism. Later, Galton (e.g. 1876) represented the nativist view emphasizing the importance of heredity, while Watson (1925) repre-

sented the empiricist view and advocated the primary role of the environment, aptly exemplified by the following statement:

Give me a dozen healthy infants, well-formed, and my own specified world to bring them up in, and I'll guarantee to take any one at random and train him to become any type of specialist I might select—doctor, lawyer, artist, merchant-chief and yes, even beggar-man and thief, regardless of his talents, penchants, tendencies, abilities, vocations, and race of his ancestors. (p. 82)

Despite the extreme views held by seeming opponents such as Galton and Watson, they both acknowledged the existence of interactions between heredity and experience (Sameroff, 2009). In modern times, either/or models have been replaced with the understanding of a mutual influence exerted by nature and nurture (see Section 1.1).

2.1.2 Early work on language/baby biographies

Some of the earliest observations on the subject of language include Salimbene (1250) and Joubert (1578)³, and the work of 18th century philosophers and psychologists can be seen as forerunners to more recent empirical study of child language acquisition. Questions addressed over 200 years ago concerned the origin of language (Herder, 1772/1901; Pockels, 1785⁴) as well as pedagogical ideas such as Rousseau's influential *Émile* (1762), a philosophy of education in novel form. Rousseau discussed the physical and emotional development of the child, as well as the role of the interactions of the child with the world. A method used to study child language was early diary descriptions of infant language learning written by philosopher or scientist parents, so-called "baby biographies". Such biographies include the diaries by Darwin (1877), Hall (1891), Preyer (1882), Taine (1877) and Tiedemann (1787)⁵. These diaries are often comprehensive works, detailing every child utterance and stage of development. Darwin's (1877) "Biographical Sketch of an Infant" comprises observations on his infant son's development, including gestures, imitation and understanding of language. Somewhat later, Dewey (1894) reported on his children's early child vocabulary composition in response to a comprehensive article on early language development (Tracy, 1893)⁶. Tracy (1893) also articulates the dual influences of heredity and experience on child language acquisition.

³ Both historical references from <http://childes.psy.cmu.edu/bibs/>

⁴ Historical reference (<http://childes.psy.cmu.edu/bibs/>)

⁵ For an exhaustive bibliography of research on child language acquisition with over 29,000 entries, see <http://childes.psy.cmu.edu/bibs/>

⁶ Both articles contain information on the composition of children's vocabulary (see Section 3.1.4.4 and Study II).

Among notable 20th century diaries focused mainly on language are those by the Sterns (1907)⁷, who document the psychological development of their three children, starting from birth to ages 12, 10 and 7. The Sterns were among the first to study children's acquisition of words and sentences, and noticed large individual variation in the size of their children's vocabularies. For example, their daughter Hilde had a productive vocabulary of 275 words at 2;0, while her younger brother produced 50 words at the same age. The first real Swedish diaries, focusing mainly on lexical development and inspired by the Sterns, are those by Bolin and Bolin (1916, 1920). Part 1 comprises detailed analysis of their daughter's vocabulary development during the first two years, while part 2 concentrates on psychological and linguistic observations through age 6. The tradition of baby biographies has continued to recent times (e.g. Brazelton, 1969/2010 (composite types of real babies); Leopold, 1939–1949; Stern, 1990; Tomasello, 1992). For more on diaries as a research method, see Section 4.3.1.

The publication of Wilhelm Wundt's *Die Sprache* (Language) in 1900 can be considered a synthesis of 19th century thinking in the field of psycholinguistics. The prolific Wundt, who is considered the father of experimental psychology, touched on almost every aspect of language, including babbling, gestures, sign language, speech disorders, speech sounds, morphology and syntax, as well as the origin of language.

William Stern, the co-author of the diaries documenting his children's language development discussed above, also wrote a monograph (1905) on the language development of Helen Keller, who was blind and deaf from 19 months of age. In this work he compares the stages of Helen's language acquisition, through Anne Sullivan's "conversational" finger-tapping method, to those of his oldest daughter Hilde's. With few exceptions, stages of development in Hilde and Helen Keller were identical, leading Stern to credit the influence of genetic laws. However impressive he may have thought Keller's development was, Stern considered the intellectual development of deaf-mutes, as long as they were limited to sign language, to "remain stunted" (Levelt, 2012, p. 312).

2.1.2.1 Speech and language disorders

The 19th century marks the appearance of the first scientific descriptions of speech disorders, as well as the first attempts to diagnose and treat such disorders (Samuelsson & Nettelbladt, 2008). In the late 1800s, a number of German-speaking specialists⁸ described language disorders and developed therapy programs (Weiner, 1986). The first speech clinics in Europe were also opened at this time. The actual field of logopedics, which concerns the

⁷ The Sterns were the first to use the year; month notation now standard in child language research.

⁸ Calling themselves *die Sprachärzte* (the language doctors)

study and correction of speech defects, had its start in the early 20th century. Emil Fröschels (1884–1972), considered the founder of logopedics as well as the coiner of the term, promoted research and therapy in child and adult speech pathology. Fröschel's early research drew parallels between the acquisition of speech in children and the loss of speech in aphasics. Roman Jakobson (1941), who was one of the most influential linguists of the 20th century, also compared phonological problems in patients with aphasia to phonological simplifications in child language. His monograph, *Kindersprache, Aphasie und allgemeine Lautgesetze*⁹ (1941), had a great impact on later work in child phonological development. In Sweden, the pediatrician Alf Tamm opened a speech clinic for Stockholm schools in the 1910s and wrote prolifically on the development and treatment of speech disorders.

2.1.3 20th century data collection and theorists

The proliferation of diary studies was one part of the trend towards data collection in the first half of the 20th century. Another was the growth in large-scale psychometric studies by educationalists and psychologists. The first tabulation of vocabulary statistics was conducted by Doran (1907). This work included a review of existing work at the time, as well as results of Doran's (1907) own vocabulary tests. At the Child Welfare Institutes in the USA, a number of studies in the 1920s through the 1940s aimed to provide norms for speech and language development, with McCarthy (1930) documenting language development in young children.

2.1.3.1 Behaviorism and Chomsky

The earlier dichotomy between empiricism (knowledge comes through sensory experience) and nativism (knowledge is inborn or innate) mentioned in Section 2.1.1 continued in the 20th century with behaviorists and learning theorists, such as Dollard and Miller (1950) and Skinner (1957), emphasizing the importance of early experience. Skinner (1957) suggested that children learn language through selective reinforcement by their parents or caregivers. Skinner's contributions to the study of behavior form the basis of modern therapies such as cognitive behavior therapy (CBT) and applied behavior analysis (ABA). The latter is a common form of treatment for children with autism or other neuropsychiatric disorders. Traces of Skinner's original ideas on the role of social feedback remain important, but in a less mechanistic way.

Noam Chomsky, although schooled in the behaviorist tradition, strongly rejected the behaviorist (or empiricist) view of language as represented by Skinner (1957), and argued that learning through reinforcement would only result in a collection of rote-learned phrases (1959). The fact that both adults

⁹ *Child language, aphasia and phonological universals*

and children are able to produce novel utterances led Chomsky to argue that humans possess a set of innate rules which enable them to generate new utterances. Thus, infants are born with knowledge, not only capabilities. This is reflected in Chomsky's idea of an innate Language Acquisition Device (LAD) which enables children to acquire and produce language. Chomsky later developed the biologically innate Universal Grammar model, used to explain the regularities which characterize child language, despite the abstract nature of adult language (1957, 1965). The term "poverty of the stimulus" (1980) suggests the idea that the input children are exposed to is so inadequate that it would be impossible to achieve adult language competence only based on input. Chomsky's work acted as a catalyst within the field of child language, essentially marking the beginning of the "cognitive revolution". Other linguists such as Lenneberg (1967) and Pinker (1994) have supported and extended Chomsky's theories.

2.1.3.2 Piaget

Piaget (1896–1980) was originally trained as a biologist, and came to his ideas on stages in intellectual development in children by first working on intelligence testing. For Piaget, who wrote only one book on language (1923), language is just one of the outcomes of the development of knowledge (epistemological development). This is in contrast to Chomsky, who considered language to be qualitatively different than other cognitive abilities. Piaget only focused on the representational function of language, and not whether language could be used as a tool for communication, social action or the development of knowledge. However, Piaget's early observations of young children paved the way for a new, non-diary approach to the study of child speech development. Furthermore, Piaget, who agreed neither with nativist nor empiricist ideas on the origins of knowledge, developed a new solution to this philosophical problem; he posited that infants construct their understanding of the world, and this development is based on children's own activities and interactions with their surroundings (1951). Language is incorporated into, for example, symbolic play, and is part of a general developmental framework.

2.1.3.3 Vygotsky

Another theorist who integrated language acquisition theories with education is Lev Vygotsky (1896–1934). Although he died an untimely death and his work was not widely read until after the death of Stalin, Vygotsky's *Thought and Language*, originally written in 1934 but first published in English in 1962, has been extremely influential regarding language acquisition, cognition and education. Vygotsky emphasized the importance of interaction with others in cognitive development, and his idea of the "zone of proximal development" (1978) has important implications, not only in the classroom but also in any parent-child learning experience. Parents adjust their input to the

language ability of their children, thereby scaffolding their language development (see Section 3.2). Thus, Vygotsky's ideas are directly related to Study I in this thesis, which investigates parent-child interaction.

2.1.3.4 Summary

This section has traced historical approaches to the study of language. The role of nature versus nurture has occupied philosophers and scientists throughout history, from ancient to modern times, and has direct consequences for modern theoretical approaches to the study of language acquisition.

2.2 Theoretical approaches to language acquisition

Theories of child language acquisition have been greatly influenced by thinkers such as Chomsky, Piaget and Vygotsky (see Section 2.1). Today, theories can be roughly designated as belonging to one of two main approaches. The first main approach may be alternately labeled nativist, generativist or Universal Grammar (UG), which is one idea in this tradition. The second main approach may be called constructivist, emergentist, socio-pragmatic, functionalist or usage-based accounts. The way in which children learn words and grammar may be understood differently depending on the theoretical approach one ascribes to. The present thesis represents a theoretical standpoint in line with the second proposal, under which children actively develop language within the context of social interaction. This section will present a broad description of the two main approaches.

2.2.1 Generative/nativist accounts

Nativists see some aspects of children's linguistic knowledge as innate, rather than acquired. Generativists regard children's knowledge of grammar as consisting of a number of formal 'rules'. A UG approach, inspired by Chomsky, combines nativist and generativist standpoints, in that children have knowledge of a general grammar, applying to all languages in the world, at birth. These accounts give the acquisition of syntax a primary role. In this thesis, Study II investigates the role of word combinations in children's language development, and Study III examines the role of the early syntactic measure M3L.

According to Chomsky's poverty-of-the-stimulus argument (Section 2.1.3.1), input is not sufficient to help a child rule out the infinite number of ways to put the building blocks of language together. Therefore, generativist approaches, which include a large body of research, consider children's innate understanding of language (Universal Grammar) to include the knowledge of syntactic categories (nouns, verbs, etc.) and the rules for com-

binning these words into phrases and sentences. In addition, UG includes a number of principles regarding sentence structure rules and the way elements can be moved within sentences (e.g. subject-auxiliary inversion). To deal with those aspects of syntax which vary across languages, UG also has parameters which can be set for a specific type of structure. Thus, generativist approaches to grammar are also called principles-and-parameters theories. Recent research has questioned the value of parameters as an explanation of language acquisition.

2.2.2 Constructivist/usage-based accounts

Constructivist accounts have their beginnings in Piaget's (1951) proposal which posited that infants actively construct conceptual and linguistic structures from experience. Thus language acquisition must be seen as part of a social and cultural context, in which children learn the pragmatics of their specific language. Bruner (1975) was influential in further defining this standpoint:

Neither the syntactic nor the semantic approach to language acquisition take sufficiently into account what the child is trying to do by communicating. As linguistic philosophers remind us, utterances are used for different ends and use is a powerful determinant of rule structures. . . . One cannot understand the transition from prelinguistic to linguistic communication without taking into account the uses of communication as speech acts. (p. 283)

Bruner further developed his ideas concerning social interaction as a means for early language learning and introduced the LASS principle (Language Acquisition Support System) in answer to Chomsky's LAD principle (Language Acquisition Device), which was a precursor to the model of universal grammar (Bruner, 1983). Thus, most constructivist approaches are considered input-based. They are also often called emergentist, as the bases for children's development of sentences are not innate, but rather emerge in the context of interaction. The term socio-pragmatic refers to children's learning of language by following a speaker's focus of attention and making use of the speaker's communicative intentions.

According to constructivist approaches, language consists of a number of constructions or templates which all have communicative functions. In contrast to rules of generative grammar, the constructions can be learned from the input and stored in memory, as each construction is paired with a meaning. Constructions can also be learned one part at a time, beginning with unanalyzed whole utterances (also called frozen phrases), such as *Where'd it go* or *I want it*.

2.3 Ecological models

An acknowledgment of the dual influences of nature and nurture means that any model of language learning must take into account the role of the environment. The Emergentist Coalition Model presented in Section 3.1.4, for example, is just one model explaining how children use multiple inputs to learn words. Another is the Intentionality Model of Word Learning (L. Bloom, 2000) which stresses the central role of the child:

Language is created by a child in the dynamic contexts and circumstances that make up the child's world, and the heart of language acquisition is in the dialectical tension between the two psychological components of effort and engagement. A language will never be acquired without engagement in a world of persons, objects and events. (p.44)

This section presents two ecological models, one explaining how infants use multiple inputs in the early phases of language learning, and the second extending the ecological framework to the larger world surrounding the child.

2.3.1 Ecological Theory of Language Acquisition

The Ecological Theory of Language Acquisition (ETLA; Lacerda & Sundberg, 2006) presents early language acquisition as a consequence of the multi-sensory information available in adult-infant interaction settings. The theory is based on research carried out by others and at the Stockholm University Babylab, and focuses so far primarily on infant development.

Studies have shown that newborn infants exhibit a preference for spoken language. Adults' perceptions of infant babbling in an interactive context are influenced by adult knowledge and expectations of language, even though the anatomical make-up of an infant's vocal tract does not allow imitation of adult sounds. Thus, early on the infant's vocalizations are ushered into the communicative process. An infant is born into an environment with previously organized linguistic conventions and gains experience through early communicative attempts with adult speakers. Adults also make adjustments in the speech directed to infants, including repetitions of prosodic and lexical elements, exaggerated intonation and pauses between utterances. These modifications serve to engage the infant's interest and guide the infant towards language. Furthermore, Infant Directed Speech (IDS) contains repetitions of words, phrases and intonation patterns. The patterns of IDS match well with infants' abilities to discriminate between different speech sounds. However, in contrast to the isolated speech sounds used in studies assessing infants' speech discrimination abilities, the natural sounds directed to infants consist of long strings of connected speech. Speech perception studies in the late 1990s and early 2000s have measured infants' abilities to use statistical

probabilities of speech material to indicate preference for word candidates (e.g. Saffran, Aslin, & Newport, 1996; Saffran & Thiessen, 2003).

In ETLA, the infant is seen as a biological system integrated into and reacting to its environment. The environment provides input of a multi-sensory nature, including visual, auditory, olfactory, tactile and kinesthetic information. Language input is context-bound and coupled with sensory information (including characteristics of IDS) which enhances significantly beyond chance the opportunities for an infant to extract word candidates from the speech stream and match them with possible referents. The sheer number of repetitions in the input helps the infant map sensory input onto representation space, despite loss of representations to memory decay. Representations are only unanalyzed sound sequences to begin with, but eventually word candidates propel the infant on the path of language discovery. Linguistic entities thus emerge as a consequence of the interaction between the infant's multi-sensory experiences with the environment and its developing processing capabilities.

2.3.2 Bronfenbrenner's bioecological model

This section situates a child's language learning within the broader context of human development. Urie Bronfenbrenner developed his bioecological model of human development in a number of stages over a period of thirty years or so. In this model, Bronfenbrenner makes a distinction between parent-child interaction as merely part of the environment, and interactions being an essential part of the "proximal processes" surrounding a child. These processes are referred to as the "primary engines of development":

Especially in its early phases, but also throughout the life course, human development takes place through processes of progressively more complex reciprocal interaction between an active, evolving biopsychological human organism and the persons, objects, and symbols in its immediate external environment. To be effective, the interaction must occur on a fairly regular basis over extended periods of *time*. (Bronfenbrenner & Morris, 1998, p. 996)

In addition, the effect of proximal processes varies as a function of the characteristics of the individual child, those of the immediate and extended environment, as well as time. Bronfenbrenner divides the environment into a number of levels, or systems, which exert different degrees of influence on the individual (see Figure 2.1). The family is one element of the microsystem in which a child spends time. Bronfenbrenner (1994) describes the microsystem as follows:

A microsystem is a pattern of activities, social roles, and interpersonal relations experienced by the developing person in a given face-to-face setting with particular physical, social, and symbolic features that invite, permit, or

inhibit, engagement in sustained, progressively more complex interaction with, and activity in, the immediate environment. (p. 1645)

For the Swedish child, for example, the family, the preschool, visits to the child healthcare center, and the local playground are all part of the microsystem exerting the most immediate influence on the child. The mesosystem represents the interactions or interconnections between the different entities in the microsystem. The exosystem represents a wider sphere which exerts indirect influence on the child. The exosystem is itself influenced by the macrosystem, consisting of the cultural attitudes and ideologies of the society in which the child lives. In Sweden, these attitudes include a long tradition of investing in the lives of infants and young children (Bremberg, 2006) and the idea that childhood is a unique period in human life (Björck-Åkesson & Granlund, 2003). These ideas have contributed to Sweden having one of the lowest infant mortality rates in the world and a well-developed system of maternity and child healthcare clinics.

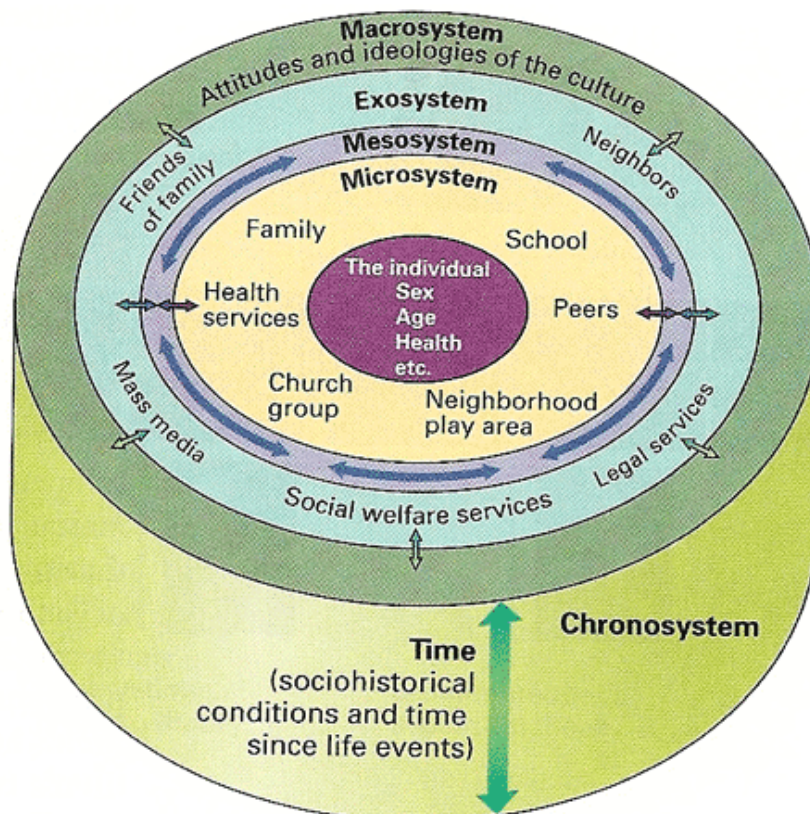


Figure 2.1: Bronfenbrenner's bioecological model of human development. Reprinted from "Child Development" by J. Santrock, 2007, p.29. Copyright 2007 by McGraw-Hill Education. Reprinted with permission.

2.4 Summary

This chapter has provided an historical background to the study of language development, including early ideas on the subject of nature and nurture, and early work on child language. An overview of theoretical approaches to the study of child language has also been given. In addition, two ecological models have been presented: ETLA describes early language acquisition as a consequence of multi-sensory inputs in infant-child interaction, and Bronfenbrenner's bioecological model widens the child's environment to include influences from various aspects of the surrounding world.

3 Child language development

This chapter on child language development provides the background for a thorough understanding of the three studies which comprise the thesis. Children learn language through communicative interaction with their environment. Communication, in a broad sense, occurs through verbal or nonverbal expression in the presence of others (Brodin, 2008). The human brain is wired to search for and create meaning from the sensory signals it receives (Gärdenfors, 2006). Thus, children begin communicating with their surroundings at birth, and gradually move from pre-speech or prelinguistic communication to linguistic communication, an abstract system involving symbols and representations. In learning words, children must learn to ‘map’ conceptual meanings onto word forms, a process which may occur at the first exposure to a word (fast-mapping) or after many exposures with expansion and elaboration (slow-mapping).

The language learning process involves developing skills in a number of interrelated language domains, which are in turn linked to overall cognitive abilities. This chapter presents each of these domains separately, although the interrelatedness of the domains means there is substantial overlap. Children may use skills gained in one domain to help them learn skills in another through a process referred to as ‘bootstrapping’ in the literature. For example, syntactic bootstrapping means that children use the syntax (grammar) of a sentence to help them learn the meanings of words. The domains below include speech perception, phonological production, gestures, lexical development, grammar and pragmatics. As a matter of necessity, this chapter will discuss some theoretical ideas of how children learn language, especially words. The discussion of each domain will begin with a definition of terms. Thereafter, examples of international and Swedish research within the domain will be given. The section will also include examples of deficits in the domain which may be present in certain developmental disabilities or language impairments, representing a dimensional distribution of skills across each domain. It is important to include atypical language development in this background, as knowledge of atypical development informs understanding of what can be considered typical (Rice, Warren, & Betz, 2005). Each section is concluded with a summary. Subsequent sections comprise language development within the context of social interaction, developmental outcomes associated with early language learning, as well as a section on modern language interventions to prevent or remediate language difficulties.

It is important to note that “the Average Child is a fiction” (Bates, Dale, & Thal, 1995, p.151). This is true for typically developing children, as well as children whose language development can be characterized as atypical. Studies from the past 30 years have highlighted the great overall variability observed in children’s early communicative development, which may be due to biological, social or environmental factors. However, certain patterns of development, with typical milestones of achievement, have been ascertained.

3.1 Developmental domains

Prior to the review of language learning in the various domains, several definitions will be offered regarding developmental language disorders. It is far from simple to attach a specific label to a child’s language difficulties, as various disorders often overlap (expressed by the term comorbidity), with “pure cases of impairment” rarely the norm (Bishop, 2004, p. 310; see also Section 3.1.6.2). However, Bishop (2004) suggests that, in general, specific language impairment (SLI) is diagnosed “when a child fails to make normal progress in language learning for no obvious reason” (p. 309). In the World Health Organization’s ICD-10¹⁰, SLI is included under the umbrella term “Specific developmental disorders of speech and language”. These disorders include, among others, expressive language disorder, characterized by low levels of expressive spoken language with age-appropriate comprehension, and receptive language disorder, where a child exhibits low language understanding, often accompanied by impaired expressive abilities. Some researchers distinguish between children with SLI and non-specific language impairment (NLI), that is, those not performing within normal age-limits on tests of nonverbal intelligence. The term language impairment (LI) is often used in clinical settings. Although SLI is the term most commonly used in research literature, there is currently an active debate regarding the most appropriate term (e.g. Bishop, 2014).

Developmental dyslexia falls first under the ICD-10 category of “Specific developmental disorders of scholastic skills” and then the subcategory “Specific reading disorder”. The previous “discrepancy definition” (where dyslexia was diagnosed when a child’s reading achievement was lower than age-norms and IQ) has been replaced by a number of diagnostic criteria. In short, dyslexia is a neurodevelopmental disorder susceptible to genetic and environmental influences, resulting in word decoding problems and difficulties with spelling and reading fluency (Snowling, 2013). Similar to SLI, dyslexia is not a straightforward diagnostic category, but often co-occurs

¹⁰ International Statistical Classification of Diseases and Related Health Problems 10th Revision-Version for 2010 (<http://apps.who.int/classifications/icd10/browse/2010/en>); see also Section 3.4.1 for information on the classification system ICF.

with other disorders, such as attention deficits. Moreover, it has been proposed that the relationship between dyslexia and SLI should be viewed as a two-dimensional model involving phonological and language comprehension skills (Bishop & Snowling, 2004). In this thesis, low language abilities are seen as an operational definition, and do not entail specific diagnoses. However, early language difficulties are presented as a risk factor regarding later development.

3.1.1 Speech perception

Speech perception can be defined as the way in which the sounds, in a broad sense, of language are processed. The development of speech perception takes place over a long period of time, starting in infancy and continuing until a child is approximately 12 years of age, and sometimes even longer. The processing of language sounds entails different kinds of abilities, including 1) segmenting and later manipulating sounds as phonemes and words, 2) discriminating distinct sounds, 3) identifying and 4) categorizing them. The skills involved in speech perception are distributed across several of the language domains, including phonology as well as the lexicon and syntax. For example, infants begin segmenting words during the first six months of life (Jusczyk, Houston, & Newsome, 1999). Speech processing skills are crucial for language development from early infancy, through the learning of reading and writing at school age to language achievement in adulthood. Finally, infants' speech perception may be linked to the type of speech often directed to them by parents (infant-directed speech, or IDS).

3.1.1.1 Statistical learning and segmentation

Figure 3.1 suggests a timeline of infants' perception and production over the first 12 months of life. Kuhl (2004) defines the concept of statistical learning indicated in the figure as follows:

Acquisition of knowledge through the computation of information about the distributional frequency with which certain items occur in relation to others, or probabilistic information in sequences of stimuli, such as the odds (transitional probabilities) that one unit will follow another in a given language. (p. 831)

These translational probabilities help infants to detect word candidates from the strings of speech they are exposed to (Saffran et al., 1996). Other cues that infants use to segment the speech stream into words include word stress, which differs among languages. While the majority of English multisyllabic words have stress on the first syllable (strong-weak, or trochaic stress pattern), languages such as Polish tend to have more words with the opposite

pattern (weak-strong, or iambic). Swedish word stress is somewhat more complicated; in general, however, word initial syllables are stressed. In addition, there are two different kinds of word accents (accent 1–acute and accent 2–grave).

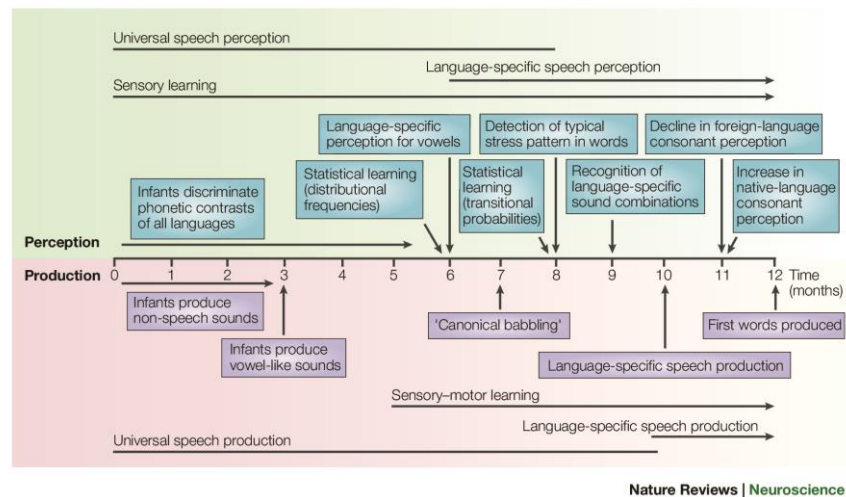


Figure 3.1: The universal language timeline of speech-perception and speech production development. This figure shows the changes that occur in speech perception and production in typically developing infants during their first year in life.

Reprinted by permission from Macmillan Publishers Ltd: *Nature Reviews Neuroscience*, "Early language acquisition: Cracking the speech code", by P. Kuhl, 2004, 5(11), p. 832, copyright 2004.

3.1.1.2 Discrimination and infant-directed speech (IDS)

Although infants have perceptual abilities that are not necessarily unique to humans, they prefer listening to human speech as opposed to non-speech sounds (Vouloumanos & Werker, 2004). Infants are faced with the task of discovering, or discriminating, the distinct elements, or phonemes, which are used in their native language. These phonemes comprise groups of equivalent sounds, called phonetic units, in a given language. In the early months of life, infants are able to discriminate phonetic contrasts in languages. By the age of 4 months, infants have learned to attend to the speech sounds of their own primary language (Gopnik, Meltzoff, & Kuhl, 1999; Kuhl et al., 1997) and they are especially interested in infant-directed speech (IDS), alternatively called 'motherese' or 'parentese'. In comparison to adult-directed speech, IDS is usually slower and has both higher average pitch and highly modulated pitch contours. A number of studies have suggested that IDS may make it easier for infants to learn speech sounds (Hartman, Bern-

stein Ratner, & Newman, 2014; Kuhl et al., 1997; Liu, Kuhl, & Tsao, 2003; Thiessen, Hill, & Saffran, 2005). Sundberg (1998) discussed phonetic aspects of mother-infant interaction with 3-month-olds, finding for example that characteristics of word accent 2 are enhanced in IDS as opposed to adult-directed speech (ADS).

3.1.1.3 Categorization

Besides discriminating the distinct elements used in language, infants must also learn to categorize sounds. The concept of categorical perception refers to infants' ability to "group perceptually distinct sounds in the same category" (Kuhl, 2004, p. 832). This means that infants can group as similar the pronunciations of phonetic units spoken by different speakers at varying rates of speech and in different phonetic contexts. At the age of 6 months, infants are able to categorize vowel sounds in their own language, showing that they are sensitive to the phonetic properties of native language input (Kuhl, Williams, Lacerda, Stevens, & Lindblom, 1992).

3.1.1.4 Phonological awareness

Speech perception is also related to the development of phonological awareness, which is of great importance for later literacy. The American National Academy of Science's report on the prevention of reading difficulties¹¹ gives the following definition of phonological awareness: "the ability to attend explicitly to the phonological structure of spoken words, rather than just to their meanings and syntactic roles" (Snow et al., 1998, p. 111). This includes the identification of alliteration, rhymes, words and syllables and, while correlated with age, is considered to be a strong predictor of future reading achievement (Elbro, Borstrøm, & Petersen, 1998; Puolakanaho, Ahonen, et al., 2007, 2008; Snow et al., 1998; Torppa et al., 2010). Phonological awareness may compensate for some deficiencies in language comprehension and production (Magnusson & Naclér, 1993). Magnusson and Naclér, who compared linguistic awareness in children with and without primary language impairment¹² from age 6;4 to 11;11, found likewise that children with good language comprehension and advanced syntactic production skills displayed better phonological awareness.

A more recent study on predictors of reading and spelling in different orthographies found that phonological awareness was more closely tied to early spelling than early reading skills (Furnes & Samuelsson, 2011). It is also generally understood that difficulties in developing phonological awareness are more common in children at risk for dyslexia (Carroll &

¹¹ The Consensus Project (Myrberg, 2003) can be seen as the Swedish equivalent of this report.

¹² This is another term for specific language impairment, referring to low language in children with otherwise typical development.

Snowling, 2004). Emerging phonological awareness can be measured as early as 3.5 years of age (Puolakanaho, Poikkeus, Ahonen, Tolvanen, & Lyytinen, 2003) and phonological awareness skills can be predicted by earlier language skills (measured between 1;2 and 2;2), such as verbal comprehension, vocabulary and inflectional skills (Puolakanaho, Poikkeus, et al., 2004). Torppa et al. (2007) found a reciprocal relationship between the development of phonological awareness and vocabulary and letter knowledge, and established a stronger relationship between home literacy activities and children's skill development in families at risk for dyslexia.

3.1.1.5 Predictive value of speech perception

Early speech perception skills have predictive value for later language skills, including comprehension of words and phrases, as well as language production (Tsao, Liu, & Kuhl, 2004). Similarly, deficits in speech perception predict language learning impairments in children, or rather, children with language impairment exhibit deficits in speech perception. Ziegler, Pech-Georgel, George, Alario, and Lorenzi (2005) tested speech perception in children with SLI and children with dyslexia (Ziegler, Pech-Georgel, George, & Lorenzi, 2009), finding that both types of impairment were associated with speech perception deficits under conditions of noise, while there were no deficits for the dyslexics in conditions of silence, and only subtle deficits for children with SLI. The children with dyslexia had the greatest difficulties with place of articulation, while those with SLI had greater difficulties with voicing¹³. Other studies have found that children with dyslexia are less categorical than average readers when discriminating speech sounds (Serniclaes, Sprenger-Charolles, Carré, & Demonet, 2001) and that even 6-month-old infants from dyslexic families needed a longer time to categorize speech sounds than infants from control families (Richardson, Leppänen, Leiwo, & Lyytinen, 2003).

3.1.1.6 Examples of speech perception deficits

Regarding deaf children who have received cochlear implants, Svirsky, Teoh, and Neuburger (2004) found that younger age of implantation (before the age of 2) was associated with better speech perception and language advantages. The authors state that their findings support the existence of a 'sensitive period' for language acquisition. Nitttrouer and Burton (2001) found that 8- to 10-year-old children with hearing loss developed better speech perception and language processing if they had attended a program with a strong auditory/oral approach during the preschool years. In a later study, the authors found that 5-year-olds with a history of chronic otitis media and low socioeconomic status, or both, exhibited difficulties in speech

¹³ Although voiced sounds can be produced in many different ways, voicing is essentially defined as the presence or lack of vocal fold vibration.

perception and phonological awareness compared to a control group (Nittrouer & Burton, 2005).

Other research suggests that there may be an underlying neurological link between deficits involved in the acquisition of social and speech perception in autism (Redcay, 2008). While typically developing infants prefer listening to infant-directed speech, children with autism spectrum disorders (ASD) prefer listening to nonspeech signals over ‘motherese’, with the degree of their preference predicting the severity of their autism symptoms (Kuhl, Coffey-Corina, Padden, & Dawson, 2005). Neuroimaging studies indicate that the visual cortex is activated in congenitally blind¹⁴ individuals when they are engaged in speech processing tasks, despite the lack of actual visual information (Röder, Stock, Bien, Neville, & Rösler, 2002). Although how the brain works is still not fully understood, this seems to be an example of remarkable brain plasticity.

3.1.1.7 Summary

Although speech perception is an often neglected aspect of language development, the domain comprises a cornerstone for the development of language comprehension and later reading comprehension. It is a long process which begins in early infancy and involves the development of processing skills throughout childhood. Speech perception is also crucial for the development of language awareness, most specifically phonological awareness, as well as lexical and syntactic development. There are differences in speech perception abilities in children with language impairments as compared to typically developing individuals.

3.1.2 Phonological production

The domain of phonological production is complex, comprising several abilities or functions.

3.1.2.1 Early infant speech production

An infant’s earliest vocal production consists of vegetative sounds such as crying and grunting. Vocal production is initially constrained by the anatomical structure of an infant’s vocal tract and progresses as the infant develops physically and cognitively. Babies move through stages of cooing and laughter onto babbling, which is characterized by the onset of rhythmic consonant-vowel syllables (or ‘canonical babbling’; Oller, 1980). Some have claimed that babbling patterns vary according to the language to which infants are exposed (Boysson-Bardies & Vihman, 1991). This is evidence of the infant’s perceptual abilities discussed in Section 3.1.1. Infants are thus

¹⁴ For more on language development in the blind, see Perez-Pereira and Conti-Ramsden (2013).

building up a repertoire of phonemes and syllables used in the native language. However, comparative studies indicate that early developmental patterns are similar across languages (Roug, Landberg, & Lundberg, 1989; Vihman, 2014). The first words produced are often imitations of adult word forms and may appear toward the end of the first year when infants are developing the ability to focus attention on a social partner (Trevvarthen & Aitken, 2001). Through babbling and imitation, infants are learning to produce a range of distinct sound patterns, establishing the phonetic prerequisites for word production (McCune & Vihman, 2001). It has been suggested that late onset of babbling may be a predictor of language delay (Oller, Eilers, Neal, & Schwartz, 1999).

3.1.2.2 Phonological skills: definitions

Children's phonological skills develop in parallel with other domains, including lexical, morphological and syntactic development (Schwarz, Burnham, & Bowey, 2006; Stoel-Gammon, 2011). Phonological production is also related to speech perception (e.g. DePaolis, Vihman, & Keren-Portnoy, 2011; Majorano, Vihman, & DePaolis, 2014). Further, phonological development refers to a child's system of speech sound production and the representations of these sounds in the child's mind. Individual sounds are called segments or phones, and phonemes are the sounds of a language. In addition to the vowel and consonant inventory, there are other language specific phonological aspects, such as phonotactical patterns (e.g. how phonemes may group themselves in different word positions), syllable structure and phonological rules (e.g. phoneme substitutions, deleting and assimilations). Prosodic elements, such as speech rhythm, intonation and stress patterns, may also be regarded as part of phonology. Articulation refers to how, or how accurately, a child produces individual speech sounds. The ability to articulate is linked to a child's developing speech apparatus (e.g. the larynx, which develops quickly) and motor abilities.

3.1.2.3 Phonology and word learning

Phonological production plays an important role in children's early word learning. The idea of an articulatory filter implies that children's first words may be those that are most pronounceable (Vihman, 1993). However, the will to communicate can override children's articulatory limitations. There is a reciprocal relationship between children's production patterns and the input to which a child is exposed. Thus, production affects the way a child listens to speech (DePaolis et al., 2011), and lexical input frequency affects the accuracy of production (Ota & Green, 2013). The sound structure of a language may also affect children's word learning. For example, Danish children, who are confronted with a very complex vowel structure, had lower comprehension scores than children speaking other languages in a cross-linguistic study (Bleses et al., 2008; see *Patterns of vocabulary growth* in

Section 3.1.4.3). Finally, the relationship between lexical and phonological development is a complex area which can be studied from various perspectives. There is no real consensus on the nature of this relationship. These perspectives include the bootstrapping effects of lexical and phonological variables on fast-mapping abilities (McKean, Letts, & Howard, 2013) and models which incorporate diverse findings into an explanatory framework (Werker & Curtin, 2005).

3.1.2.4 Phonological difficulties

Phonological difficulties, often expressed in articulation as well as in perception, are the most common type of problem in the preschool years (Nettelbladt, 2007). These difficulties are often a result of phonological simplifications. The degree of simplification varies with the degree of language impairment, with most simplification (and greatest lack of intelligibility) in children with the most serious impairments. In a study comparing language and phonological skills in children with risk for dyslexia or speech difficulties, it was found that both groups exhibited difficulties with phonological processing (Carroll & Snowling, 2004). However, the children with speech difficulties had the greatest problems regarding measures of output phonology, measured in a naming task and nonword repetition, while both groups had difficulties with input phonology, measured in a task of mispronunciation detection.

3.1.2.5

In summary, the domain of phonological production is complex and interrelated with children's word learning. Phonological difficulties are the most common type of language problem exhibited by children during the preschool years. More in-depth results regarding the phonological skills of children participating in the SPRINT project will be included in a forthcoming thesis¹⁵.

3.1.3 Gestures

The term "gesture" can refer to a number of body and facial movements, often used to express, or help express thoughts, emphasize speech and assist in interaction. The unity of gesture and speech, through the thought-language-hand link (McNeill, 2005), leads to gesturing even while talking on the phone. Although gestures contribute communicative information to the listener, they are not dependent on sight; even blind speakers use gestures when speaking to blind listeners (Iverson & Goldin-Meadow, 1998). When adults use gestures, they are produced in the context of speech more than 90% of the time (McNeill, 1992). Gestures are thus coordinated with speech

¹⁵ Ulrika Marklund (forthcoming)

and they also differ across cultures (e.g. Goldin-Meadow, So, Özyürek, & Mylander, 2008; Kita & Özyürek, 2003). There is a large body of research concerned with gesture use by children and adults alike, both as a precursor and accompaniment to speech and as a mode of communication on its own, for example in sign language. Special signs may be taught to children with or without special needs in order to enhance language development, for example “baby signs” (Acredolo & Goodwyn, 2002). Gestures develop together with speech (Goldin-Meadow, 1998) and change as children’s speech skills develop (Goldin-Meadow & Alibali, 2013).

In this thesis, the spontaneous gestures produced by children when communicating with others are in focus. The gesture section in the Communicative Development Inventories (CDI; Fenson et al., 1994, 2007; see Section 4.3.2) also includes different types of “games” children play such as “dancing” when the child hears music, driving with a toy car, etc. Despite the superficial difference among these behaviors, they constitute a scale with good properties.

Before infants actually produce words they are able to show that they understand language by using sounds, gestures and actions. From approximately 6 to 10 months of age, children communicate, for example, through pointing or giving gestures, or through the holding up of objects, gestures which are often called “deictic” gestures. These gestures may be accompanied by vocalizations such as “da!” (Iverson & Thelen, 1999). Children’s use of gestures in the prelinguistic period has been found to be predictive of later vocabulary skills (Bavin et al., 2008; Iverson & Goldin-Meadow, 2005; Longobardi, Rossi-Arnaud, & Spataro, 2011; Reilly et al., 2006; Rowe & Goldin-Meadow, 2009a; Rowe, Özçaliskan, & Goldin-Meadow, 2008). More specifically, the path to spoken words has been found to originate in a child’s experience with actions and gestures (Caselli, Rinaldi, Stefanini, & Volterra, 2012).

During the one-word period (approximately 10 to 20 months), gestures often accompany words and can have various functions. They may reinforce a word, disambiguate a word, especially nonspecific pronouns, such as “there” or “it”, or add information (when a child points to an object and says “want”). Rowe et al. (2008) found that gestures at 14 months were more strongly correlated with receptive vocabulary at 42 months than productive vocabulary at the same age. Gestures are also more frequent during early communicative development and become less frequent or change function as children use more spoken language (Capirci, Contaldo, Caselli, & Volterra, 2005). However, this decrease in early gestures is later followed by a “gesture explosion” at the age of 3 or 4, with output approaching adult levels, even though gesture types are still developing (McNeill, 2005, p. 193, 196). For example, metaphoric gestures and beats are produced later than deictic

and iconic gestures in children¹⁶ (McNeill, 1998). Gestures used by adults include those called Butterworth¹⁷ gestures (e.g. the hand grasping in the air in attempt to recall a word).

3.1.3.1 Gestures and grammatical development

A number of studies have documented the role of gestures in children's grammatical development. For example, Capirci et al. (2005) found that gesture-word combinations precede word-word combinations. In addition, the age at which children combine gesture and words to create a type of sentence (e.g. point at object + "want") has been shown to predict when two-word utterances will appear (Goldin-Meadow & Butcher, 2003; Iverson & Goldin-Meadow, 2005). Iverson and Goldin-Meadow (2005) reported that children combined gesture and word before they expressed the same type of meanings with word combinations only, while Mayberry and Nicoladis (2000) found that at the onset of two-word utterances, new types of gestures tend to develop, where in particular iconics (representational gestures) are of importance. Gestures that add information to speech can be likened to early noun or verb phrases and have been used to predict later grammatical abilities¹⁸ (Rowe & Goldin-Meadow, 2009b). Furthermore, gestures can also be seen as an indication of children's developing joint attention skills (see Section 3.2.4).

3.1.3.2 Swedish research on children's use of gesture

In Sweden, Allwood and Ahlsén (1999) discussed the use of communicative gestures in their case study of a Swedish child from 1;8 to 3;3. Gestures such as head nods, head shakes and shrugging shoulders, as well as certain informative actions were coded in two different interactive settings. The percentage of turns with communicative gestures or a high degree of reliance on communicative action was much higher during play with a jigsaw puzzle at child age 1;8 and 2;4 than in the book reading setting. There was less of a difference between the two settings at age 2;7 and 3;3.

Andrén (2010) documented the use of gestures in parent-child interaction by five Swedish children from the age of 18 to 30 months (three of the children were previously included in the Richthoff¹⁹ corpus. Andrén (2010) found that the children used more gestures in the earlier age range (18–24 months), with gesture+speech utterances being the most common, than the later range (24–30 months), where speech-only utterances were more com-

¹⁶ Metaphoric gestures create images of abstract ideas, while beats are flicks of the hand which indicate specific reference, or explanatory comments. Deictic gestures include pointing, and iconic gestures depict concrete events (McNeill, 1998).

¹⁷ Named for the researcher Brian Butterworth (McNeill, 1992, p.77)

¹⁸ Specifically, the number of gesture+speech combinations at 1;6 predicted IPSyn (syntax) scores at 3;6 (Index of Productive Syntax; Scarborough, 1990).

¹⁹ Richthoff (2000)

mon. 24 months marked a transition point, where the average mean length of utterance (MLU) reached 2, meaning that children were regularly combining words. Deictic²⁰ gestures were the most frequent type of gesture, peaking at 21 months of age. The children also used gestures while handling objects (object-gestures) almost as frequently as empty-handed²¹ gestures.

Gerholm (2007) included gestures in her thesis on verbal and nonverbal emotive expression in young children, although they were not the main focus of investigation. Results confirmed the changing role and frequency of gestures with child age. In a study based on parental report, Eriksson and Berglund (1999) reported on the use of early communicative gestures by Swedish infants (ages 8–16 months). SECDI: Words & Gestures includes a section devoted to first communicative gestures, games and routines, actions with objects, pretending to be a parent, and imitating other adult actions. Results showed clear developmental trends across ages in gesture use for all scales, similar to results obtained by other researchers (e.g. Caselli et al., 2012; Fenson et al., 1994; Kern, 2007). SECDI: Words & Gestures is used in the skills study (III) of this thesis in analyzing interrelations among communicative skills. Finally, Månsson (2003) investigated the relationship between gestures and semantic processes in Swedish children with and without language impairment (see next section).

3.1.3.3 Gesture use in atypical populations

Just as early gesture use has been found to predict later language skills, it has also been shown to indicate language delay (Iverson, Longobardi, & Caselli, 2003; Sauer, Levine, & Goldin-Meadow, 2010; Thal & Tobias, 1992). Thal and Tobias (1992) investigated gesture use in a group of late talkers²² and first found that the late talkers used significantly more communicative gestures than control groups. When they reanalyzed the data a year later, however, they found that it was the late bloomers (those who had caught up to children with faster early development) who used more communicative gestures, while the truly delayed children did not differ from controls in gesture use. The authors suggest that the late bloomers used more gestures to compensate for their lack of early vocabulary. Similarly, in Månsson's (2003) study, children with phonological and grammar difficulties used iconic gestures instead of words when they could not make themselves understood. They also used gestures to elaborate on words. In addition, the more the children with semantic and lexical difficulties struggled with word finding, the more they used iconic gestures. Although fairly uncommon in young

²⁰ Index-finger pointing, as well as gestures for give, show, and place

²¹ Study III in this thesis refers to these as empty-hand gestures.

²² Children are usually considered late talkers if they produce fewer than 50 words and/or are not combining words at age 24 months.

children (McNeill, 1992), iconic gestures, such as putting the hand to the ear for telephone, have been observed in children as young as 1;6.

One of the earliest theoretical and practical models involving the use of gestures and other signs is the Karlstad Model²³, developed in the 1970s by Iréne Johansson. The model is a specialized language intervention program for individuals with language disorders (Ingemarsson & Ovstebo, 2008). The program was originally developed for individuals with Down syndrome, and is now used with language learners of all ages. Caselli et al. (1998) found that children with Down syndrome were more advanced in their use of gestures (as well as in vocabulary comprehension) than vocabulary production. When Iverson et al. (2003) compared children with Down syndrome to language-age matched typically developing children, their results showed no overall differences in gesture use between the groups. The Down syndrome children produced gesture-word combinations at similar rates as the typically developing children, but no two-word combinations at a language age of 18 months. In addition, Zampini and D’Odorico (2011) found that the production of gestures is a reliable predictor of later vocabulary size in children with Down syndrome.

Children with autism have difficulties imitating and using gestures spontaneously (Ingersoll, Lewis, & Kroman, 2007). Thus, early gesture use can be helpful in early identification of autism spectrum disorders (Mitchell et al., 2006). However, autistic children can learn to use gestures as a means of communication. The fact that gestures add to the comprehensibility of speech is one reason for the increasing use of formal hand signals and signs for children with and without impairments. In Sweden, for example, TAKK²⁴ is commonly used to augment communication in preschool environments for all children (Heister Trygg, 2010).

3.1.3.4 Summary

The field of gesture research has grown significantly in the last 20 years, encompassing early development as well as cross-linguistic comparisons of adult use. Gestures are an important early communicative skill and play a role in children’s lexical and grammatical development. Children with various types of language impairment can use gestures to partially compensate for production deficits. There are relatively few reports on Swedish children’s early gesture use, compared to international research. Parent report provides one way of studying children’s early gesture use. The skills study (III) in this thesis discusses the interrelationships between gesture use at the

²³ For more information, see <http://www.karlstadmodellen.se/valkommen>

²⁴ Tecken som Alternativ och Kompletterande Kommunikation (Signs as alternative and complementary communication)

age of 12 months and other early communicative skills, including the distinction between object-gestures and empty-handed gestures.

3.1.4 Lexical development

The development of the lexicon is a process that is both multidimensional and dynamic. Thus, research on the lexicon is also a multifaceted process. Hall and Waxman (2004, p. xi) use the metaphor of weaving to illustrate the complex nature of the word acquisition process. Children are weaving together threads involving different kinds of knowledge and skills. As children do this at varying rates during infancy and childhood, the weave has a complex texture. Thus, lexical development encompasses much more than the learning of whole words and the meanings or referents of words (semantic representations). However, perceptual skills (Section 3.1.1), together with children's overall abilities to create meaning with respect to a referent, are a prerequisite for learning words. Semiotic theory (Ogden & Richards, 1923) connects the perception of something existing physically with the object or concept to which it refers, resulting in a representation in the child's mind. The image of a triangle is often used to express this idea, with the three points representing a concept, a referent and the linguistic sign. Thus, words come to symbolize objects, actions or events, comprising the important principle of reference. The word 'mapping' is widely used to denote reference, with meaning mapped onto words, either after the first exposure to a word (fast mapping) or after a longer period of iteration (slow mapping). However, there are researchers who prefer not to use such a metaphor (Tomasello, 2001).

Vocabulary knowledge involves both comprehending the meanings of words and learning to produce them, processes which continue throughout an individual's life. This section will concentrate on areas of interest for younger children, first outlining several theories which describe the process of word learning. Thereafter, the section presents developmental patterns of vocabulary growth and introduces the topic of vocabulary composition and stylistic variation in children's early vocabularies. These topics have been part of a spirited debate among researchers on characteristics of children's first words. Furthermore, some comparisons will be made regarding lexical development in other languages, as well as in children with atypical development.

3.1.4.1 Word learning

The domain of word learning cannot be described in terms of innate versus acquired capacities²⁵, as no child is born with an innate understanding of

²⁵ Mirroring the nature/nurture debate also expressed in modern theories of child language acquisition (see Section 2.2)

word meanings. A number of theories have been posited to explain how word learning occurs. These theories can be grouped into three main accounts: 1) lexical constraints/principles, 2) social-pragmatic, and 3) associative learning. These accounts have been formulated based on a wide range of experiments with infants and young children. The three accounts are summarized, followed by a proposed hybrid theory which aims to address the different strategies used by children in learning words (for more detail, see Hollich, Hirsh-Pasek, and Golinkoff, 2000a; Ambridge & Lieven, 2011).

Lexical constraints/principles

Under the lexical constraints account, word learning is guided by a number of assumptions, or constraints, regarding the hypotheses children form (e.g. Woodward & Markman, 1998). One theory is that children are more likely to assume that words refer to whole objects (e.g. *cat*), rather than parts of the object (e.g. *tail*) or their properties (e.g. *furry*). Another theory is that of mutual exclusivity; in other words, children prefer one label per object. A third constraints theory is that children tend to extend learned labels to other members of the same kind (e.g. shoes can come in many shapes and sizes).

Social-pragmatic approach

In contrast to the lexical constraints theories, the social-pragmatic approach emphasizes that children learn words in the context of social interaction (e.g. Akhtar & Tomasello, 2000; Tomasello, 2000; see also Section 3.2). Children use social-cognitive skills, such as following adults' eye gaze, to interpret the communicative intentions of others. Thus, in learning to attach labels to objects and actions, children are apprenticed to expert adult word learners.

Associative learning

A third theory to explain word learning is that children use associations and memory, just as one learns anything else (Smith, 2000). Rather than being guided by constraints, children notice those objects, actions and events which are most frequent in their environment. Thus, word labels are associated with the most salient candidate.

The emergentist coalition model

Any one of the above accounts alone is not sufficient to address the complexity of the word learning process. Thus, Hollich et al. (2000b) have proposed the emergentist coalition model (Figure 3.2), which is a hybrid approach, combining findings from the constraints/principles, social-pragmatics and associationistic standpoints. This model presents the multiple factors from different domains which account for children's word learning. The model is also emergent, as children progress "from using immature to mature word learning principles" (Hollich et al., 2000b, p. 26). In the earliest phase, children's attention is drawn to objects which are salient and por-

trayed with temporal contiguity (i.e. synchronization of sight and sound). In later phases, social cues such as eye gaze, pointing and speaker intention help children learn words. In addition, linguistic cues such as prosody and grammatical elements (e.g. articles or inflectional morphemes) help children find words in the speech stream.

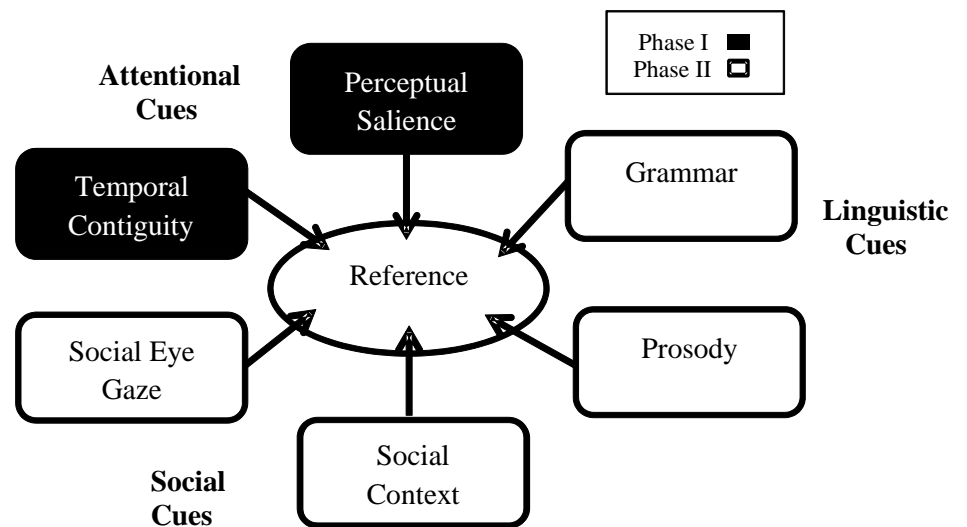


Figure 3.2: The coalition model implemented for reference: Children shift from a reliance on attentional cues, like perceptual saliency, to a greater dependency on social and linguistic cues, like eye gaze and grammar.

Reprinted from “II. The emergentist coalition model” by G. Hollich, K. Hirsh-Pasek, & R. M. Golinkoff, 2000, *Monographs of the Society for Research in Child Development*, 65(3), p. 24. Copyright 2000 by John Wiley and Sons. Reprinted with permission.

3.1.4.2 The word class debate

After a more general discussion of how children learn words, this section discusses whether nouns or verbs are universally learned first. Nouns and verbs exist in all languages of the world, and the question of which are easier to learn has occupied researchers for decades (Waxman et al., 2013). Another aspect of the debate concerns whether languages can be considered noun-friendly (e.g. English, German, Swedish and French) or verb-friendly (e.g. Mandarin, Korean and Japanese). Gentner (1982) was the first to claim the universality of the noun advantage (the ‘noun bias’), maintaining that nouns come first because their meanings are conceptually and perceptually more stable than verb meanings. In addition, most nouns are more concrete or imageable than verbs (Gentner, 2006; Ma, Golinkoff, Hirsh-Pasek, McDonough, & Tardif, 2009; McDonough, Song, Hirsh-Pasek, Golinkoff, &

Lannon, 2011). However, Nelson, Hampson, and Kessler Shaw (1993) reported that although children learned more nouns than other word classes, only half of these nouns could be considered object words. An argument supporting the necessity of learning nouns first is that the meanings of verbs often build on relationships among nouns; therefore a repertoire of nouns is needed before children can understand verbs (Gentner, 1982; Waxman et al., 2013; Waxman & Lidz, 2006). Another observation is that verbs have more variable meanings cross-linguistically than nouns (Gentner, 1982). Gestures often clarify the meanings of verbs, helping to offset their more abstract nature.

Within the debate regarding various parts of speech, it is important to note that descriptions of children's early vocabulary composition are based on functional categories characterizing adult speech. Infants and young children do not necessarily use words in the same way as adults do, reflecting the problematic nature of word-class categorizations of pre-syntax speech (L. Bloom, Tinker, & Margulis, 1993). Thus, a single early word may mean much more than an object referent. An additional difficulty is what actually counts as a word in child production. Must the word be an approximation of the adult form, have a consistent referent or show stability over time (L. Bloom, 1973; Vihman & McCune, 1994)? Another caveat regarding contrasts across languages is the difficulty in comparing studies conducted using different methodologies (see discussions in Bornstein et al., 2004; Tardif, Gelman, & Xu, 1999).

3.1.4.3 Empirical evidence

Results of studies providing evidence in the composition of children's vocabularies in general will be presented in three main areas: developmental patterns, the effect of culture and context on noun/verb acquisition, and the relative ease of acquiring nouns and verbs in different languages.

Patterns of vocabulary growth

Even in noun-friendly languages, nouns are not necessarily the first words to appear. Children's very first words are often embedded in babbling. Following Gentner's (1982) early work, researchers have come to describe typical vocabulary growth as having four distinct, developmental phases, at least in 'noun-friendly' languages (Bates et al., 1994; Caselli et al., 1995; Caselli, Casadio, & Bates, 1999; Fenson et al., 1994; all measured using parent report). The first words children learn typically include names of people and social routines, such as *hello/goodbye*, *yes/no* and *peekaboo*, although relative proportions may vary among languages (e.g. Caselli et al. (1999) found that Italian children initially use more social words than American children). Social words often include various sound effects and animal sounds in addition to terms for people. The term "social" is appropriate as the learning of first words often occurs in a play-like fashion (e.g. children will say *moo*

before they learn the word *cow*). Thereafter comes a reference phase, usually at vocabulary sizes up to 100 words, where children learn mostly nouns. The prediction phase comprises vocabulary sizes of 100–400 words and is characterized by the large growth of verbs during this period. The last phase, 400–700 words, can be called the grammar phase because of the large growth of function words, including prepositions, conjunctions and auxiliary verbs. Swedish children generally follow a similar pattern of vocabulary development (Berglund & Eriksson, 2000a; Eriksson & Berglund, 1999). Due to the variation observed among individual children regarding rates of acquisition, the age at which children reach these different stages will also vary. A study following the English-language acquisition of internationally adopted preschoolers found that the children followed the same developmental patterns as monolingual children matched for vocabulary size (Snedeker, Geren, & Shafto, 2007, using both parental report and language samples). However, the adoptees exhibited much higher rates of vocabulary acquisition during the first year compared to typical rates in infants.

Cross-linguistic comparisons, based either on samples of spontaneous speech or parental report, have shown mixed results with regard to the noun advantage. Some studies have reported higher proportions of nouns than verbs in early production vocabularies (Bates et al., 1995 for English; Bornstein et al., 2004 for seven languages; Caselli et al., 1995 for Italian; Kim, McGregor, & Thompson, 2000 for Korean; Maital, Dromi, Sagi, & Bornstein, 2000 for Hebrew). In contrast, Tardif et al. (1999) found that Mandarin-speaking children used relatively more verbs than nouns compared to children speaking English. Choi and Gopnik (1995) reported that Korean children said as many verbs as nouns at the one-word stage, with a ‘verb spurt’ occurring before a ‘noun spurt’ for some children. In a comparison of first words, Tardif et al. (2008) found that English-speaking children were more likely to produce common object nouns than Chinese speakers. Using a naming task, Kauschke, Lee, and Pae (2007) reported an overall noun advantage relative to verbs with German, Korean, and Turkish children, although there were differences between groups (e.g. German children were best at naming nouns).

Bleses et al. (2008) used 18 different CDI-studies (see Section 4.3.2) to compare the lexical development of children learning different languages. They found that developmental trends across languages²⁶ were similar, yet Danish children had consistently low comprehension scores, leading them to suggest the sound structure of the Danish language as an explanation for this difference. Danish is difficult for other Scandinavians to understand, as well as Danish children, due to factors such as the large number of vowels and

²⁶ The Cross Linguistic Lexical Norm (CLEX) website offers a searchable tool for those interested in the vocabulary development of children learning different languages. The website (<http://www.cdi-clex.org/>) is presented in Jørgensen, Dale, Bleses, and Fenson (2010).

half-vowels, unstressed syllables and rather inexpressive prosody (Grønnum, 2003).

Effect of culture and context

Varying results of children's noun/verb production can be explained by the effect of culture and context on the input they receive. For example, studies have reported that Mandarin-speaking mothers use more verbs (Tardif et al., 1999) and Korean-speaking mothers use as many verbs as nouns (Choi, 2000) in comparison to English-speaking mothers. However, while Tardif et al. (1999) found that both Mandarin- and English-speaking mothers used more nouns in a book reading activity and more verbs in play settings, Choi (2000) found that English-speaking mothers used more nouns in both settings and Korean-speaking mothers only in book reading. Setting effects with respect to input are discussed further in Section 3.2.5.1.

Ease of acquiring nouns and verbs

Recent studies have provided information regarding the ease with which children acquire nouns and verbs in different languages. 24-month-olds acquiring English, Mandarin and Korean showed similar ease in learning novel nouns, but much more varied results were obtained regarding novel verbs (Arunachalam, Leddon, Song, Lee, & Waxman, 2013; Arunachalam & Waxman, 2011). For example, there were differences in which linguistic contexts facilitated verb learning depending on the way languages express verbs. These results are similar to those reported for older children learning Chinese, English and Japanese (Imai et al., 2008). Thus, even in verb-friendly languages, nouns appear to be easier for children to learn.

3.1.4.4 Stylistic variation in vocabulary composition

Children can also exhibit great stylistic variation regarding the composition of vocabulary in relation to vocabulary size. The variation regarding percentage of nouns is greatest when vocabulary size is between 1 and 50 words (Bates et al., 1994; Lieven, Pine, & Barnes, 1992; Nelson, 1973; Pine, Lieven, & Rowland, 1997), with almost no variation when vocabulary size has grown to over 600 words. Nelson's (1973) classic study refers to children with a preference for object-oriented language with many nouns as having a 'referential style'. This is in contrast to children with relatively larger proportions of personal-social words (often short phrases) and function words, who exhibit an 'expressive style'. Nelson found that expressive children showed less rapid rates of acquisition than referential children, but had acquired ten phrases at an earlier age than those with a referential style. Other researchers later took issue with the referential-expressive distinction (L. Bloom et al., 1993; Lieven et al., 1992) and offered alternative models, such as a preference for nouns versus use of unanalyzed (frozen) phrases. Finally, the relationship between parental input characteristics and children's

stylistic variation/developmental patterns has also been examined (Hampson & Nelson, 1993; Pine, 1994; Pine et al., 1997, Richthoff, 2000). Relatively little research has been conducted on stylistic variation by scholars other than those mentioned here (Nelson, 2014). According to Nelson, the commonly held assumption that children learn mostly nouns (object names) during the second year is the reason for the lack of research: “This is held to be such a reliable truth that investigation of the acquisition of other kinds of words and phrases and other ‘styles’ of acquisition has been confined to a very few researchers” (2014, p. 98).

3.1.4.5 Lexical growth in children with atypical development

Just as there is no average child with typical language development, children with language impairments are also heterogeneous groups. Children with SLI may have difficulties with expressive or receptive language or both. The language profiles of children with dyslexia and SLI often overlap, with some dyslectics having oral language problems, and some children with SLI exhibiting the same poor reading comprehension skills seen in dyslectics (Bishop & Snowling, 2004). Some general characteristics observed in language disorders include the following (from Nettelblatt & Saleme, 2007, p. 14):

- less babbling,
- late first words,
- slow language development,
- lack of intelligibility,
- difficulties learning new words,
- word-finding difficulties,
- often impaired language comprehension, and
- limited language use.

Children with Down syndrome tend to have smaller expressive vocabularies in relation to their IQ and generally have delayed acquisition of words (Bates et al., 1995; Berglund, Eriksson, & Johansson, 2001). A small-scale study of deaf children acquiring sign language in adolescence showed that they exhibited patterns of language development similar to that of younger learners (Ramírez, Lieberman, & Mayberry, 2013). However, the adolescents had larger early vocabularies than deaf children learning sign language at younger ages (this is similar to patterns observed among international adoptees; see *Patterns of vocabulary growth* in Section 3.1.4.3).

3.1.4.6 Summary

The development of the lexicon is a complex and dynamic process, involving comprehension and production abilities. Although there is great variability among children, overall patterns of vocabulary development can be observed in diverse populations and across languages. Researchers have debat-

ed the question of children's early vocabulary composition and stylistic variation, with a spirited debate concerning the universality of the early noun advantage. Moreover, researchers have put forth various theories to explain how children learn words. The interaction study (I; Chapter 5) in this thesis includes analysis of a small number of Swedish children's vocabulary composition, while Study II (Chapter 6) investigates the composition of several hundred Swedish children's early vocabulary, linking this to timing of acquisition. Study III (Chapter 7) investigates relationships between early communicative skills, including comprehension and production vocabulary at different ages.

3.1.5 Grammar

The grammar of a language refers to the form, structure and function of words (morphology), as well as the form and structure of sentences (syntax), including rules governing this structure. Thus, grammatical development comprises the parallel growth of word combinations and morphology, encompassing both word formation (lexical morphology) and grammatical forms (inflectional morphology). Once children have acquired a vocabulary of approximately 50–100 words, they start combining words into sentences. This marks the emergence of syntactic development. Children's grammatical development progresses as they learn to use morphological markers (inflectional endings, for example) to express possession, tense, or in the case of Swedish, definiteness. Grammar also encompasses various transformations in a specific language, such as the formulation of questions or negation of utterances. In this thesis, analysis of syntactic development is limited to children's use of word combinations (Study II) and the so-called M3L measure, which indicates length and complexity of early sentences (Study III). Morphological development is analyzed using a combined measure of children's use of inflectional endings and tense (Study II).

A seminal study on the growth of children's grammar is Brown's (1973) five-stage model of syntactic and morphological development. Brown's (1973) study is based on observations and recordings of three American children's language development and uses mean length of utterance (MLU) as an indication of grammatical complexity. Sentences at Brown's (1973) Stage 1 are often two-word utterances, consisting mostly of content words (often nouns and verbs). The term 'telegraphic speech' (coined by Brown & Fraser, 1963) refers to these simplified early utterances that express more complex meaning. Examples include utterances such as 'Cookie want' or 'Mommy go bye-bye'.

3.1.5.1 Relations between grammar and other domains

Many studies have established strong associations between children's acquisition of lexicon and grammar (e.g. Bates et al., 1995; Bates & Goodman,

1997, 1999; Dionne, Dale, Boivin, & Plomin, 2003; Marchman & Bates, 1994), namely that the emergence of grammar is highly dependent on vocabulary size, and that development in the two domains is tightly coupled. This relationship between grammar and the lexicon holds for children who are early, as well as late talkers (Thal, 1991; Thal, Bates, Zappia, & Oroz, 1996). In a study comparing late talkers with typical talkers between 24 and 66 months, Moyle, Weismer, Evans, and Lindstrom (2007) found that syntactic growth may facilitate lexical development to a lesser extent in late talkers, despite strong lexical/grammatical associations for both groups. Typically developing children showed evidence of bidirectional bootstrapping while late talkers exhibited a predominance of lexical bootstrapping and less evidence of syntactic bootstrapping. There is also a growing body of knowledge regarding strong associations between the lexicon and grammar for children learning languages other than English. These languages include Dutch (Koster et al., 2005), Finnish (Stolt, Haataja, Lapinleimu, & Lehtonen, 2009; Stolt et al., 2007), German (Kauschke & Hofmeister, 2002; Szagun, Steinbrink, Franik, & Stumper, 2006), Hebrew (Maital et al., 2000), Icelandic (Thordardottir, Weismer, & Evans, 2002) and Italian (Caselli et al., 1999; Devescovi et al., 2005).

3.1.5.2 Swedish studies on grammar development

Of the Nordic languages, Swedish is most similar to Norwegian and Danish. It has a relatively restricted word order and a comparatively simple verbal inflection system (Josefsson & Platzack, 2003). However, the inflection system for nominals (nouns or word groups that function as nouns) is more complex. Compared to English, the Swedish language has more prevalent consonant clusters and also a different vowel and morphological structure, the latter making it easy to form new words by compounding once the basic words are learned. Furthermore, Swedish is less inflected than Icelandic, but not as morphologically complex as the agglutinative Finnish (which belongs to the Finno-Ugric language group).

An early project in Sweden involved detailed analysis of six children's syntactic development (Söderbergh, 1973). Several studies used data from this project, including Lange and Larsson (1977), who provided a comprehensive description of three Swedish children's grammatical development, including milestones such as first prepositions (*i* 'in', *på* 'on' and *med* 'with'), first inflectional morphemes on nouns (plural suffix, singular definite) and first verb inflections (present tense suffix and past participle). Santelmann (1995) also used the Project Child Language Syntax data for her study. Lindhagen (1976) investigated semantic relations in two Swedish children's early sentences and Lundin (1987) described subordinate clauses in young children's language. Platzack (1990) argued for a lack of functional categories (e.g. inflectional endings and auxiliaries) in Swedish child language (up to the age of 3; see Section 3.1.4.4), and also claimed that early

Swedish is closer to early English than adult Swedish is to adult English. Håkansson (1998) and Josefsson, Platzack, and Håkansson (2003) give overviews of grammatical development in Swedish.

Plunkett and Strömquist (1992) described the morphology and syntax (including feedback morphemes, such as *ja*, *hm* and *mm*) of Scandinavian languages, and offered examples of children's language development from longitudinal studies, including children in Strömquist's Swedish corpus. They also offered cross-linguistic information on Swedish and Scandinavian languages in general. Berglund and Eriksson (2000a) provided larger-scale information on Swedish children's grammatical development between the ages of 16 and 28 months, based on parent reports. Their results suggested that word combinations were the first grammatical skill to appear, and the genitive '-s' was the most frequently used suffix, followed by the definite singular inflection of nouns. By 28 months of age, 60% of the children used indefinite plurals and 54% used the definite plural.

3.1.5.3 Grammar and language impairment

Studies of the language abilities of children with SLI indicate that expressive and/or receptive skills in all domains except in grammar are similar to those of younger typically developing children (Bates & Goodman, 1997). This delay in grammar development, or disassociation between grammar and vocabulary, has also been reported for children with Down syndrome (Bates et al., 1995). Berglund et al. (2001) found that the overall median score for grammar skills in their sample of Swedish children with Down syndrome was not higher than 0 until after age 3;6 (cf. 6.3.3 in Study II).

Ellis Weismer et al. (2011) compared language development in 30-month-old autistic toddlers and 25-month-old late talkers without autism. These two groups were equivalent with respect to grammatical complexity and the proportion of toddlers combining words, but late talkers showed a stronger association between lexical and grammatical abilities. The composition study (II) in this thesis explores lexical and grammatical abilities in children with varying timing of acquisition, among them slower learners (the term describes children without an actual 'late talker' diagnosis). A number of Swedish studies have investigated grammatical development in children with language impairment (e.g. Hansson & Nettelbladt, 1995; Hansson, Nettelbladt, & Leonard, 2000; Håkansson & Nettelbladt, 1993; Håkansson, Salameh, & Nettelbladt, 2003; Salameh, Håkansson, & Nettelbladt, 2004), establishing significant delays particularly in the area of grammatical production, for example correctly using verb-second word order.

3.1.5.4 Summary

A large number of studies have established the strong association between lexical and grammatical development in children speaking many different languages, with the exception of children with language impairment. These

children, on the other hand, show greater delays in grammar as compared to vocabulary development. Grammatical development in Swedish children has been investigated to a great extent, but many of the earlier studies have been written in Swedish, thus not gaining an international audience. Adding to the body of knowledge about Swedish circumstances, Study II in this thesis investigates the relationship between lexical and grammatical development in Swedish children with different timing of vocabulary acquisition. Study III includes one measure of syntactic/grammatical development in the analysis of interrelationships among communicative skills over time.

3.1.6 Pragmatics

Another area of language that is crucial for children to develop is that of discourse pragmatics, or how the components of language (phonology, morphology, syntax and semantics) are used in functionally and socially appropriate ways. A child's early interaction with the environment, which includes parents and other caregivers, often begins with social games and routines. These social interactions are related to early gestures and can be measured using the gesture scale of the infant CDI (see Sections 3.1.3.2 and 4.3.2). In social interaction, a child learns, for example, how to use greetings, make demands, take turns in a conversation and eventually assume the perspective of others, or in other words, develop a theory of mind²⁷. Theory of mind thus refers, roughly, to the ability to ascribe mental states to oneself and other people. According to Trevarthen and Aitken (2001), theory of mind, social cognition, and the pragmatics of speech and language all encompass the innate ability to be receptive of subjective states in others, called "intersubjectivity" (p. 4). This ability is also essential in "developing a child's cooperative intelligence for cultural learning and language" (Trevarthen & Aitken, 2001, p. 3; see also Section 3.2.4).

3.1.6.1 Pragmatics in Swedish child language research

In addition to work on syntax and general language development, Ragnhild Söderbergh, the first professor of child language in Sweden, has described conversational structure in mother-child interactions (1979, 1988). She emphasized the importance of dialog, including ritualized language games, for early language development.

The usage of feedback morphemes, which differ across languages, provides a way for young children to participate in discourse. Feedback morphemes, such as *yes*, *no*, *mm* and *ok*, are commonly used in Scandinavian languages, including Swedish. Strömqvist and Richthoff (1999) compared the way in which two children give feedback in parent-child interaction, either through using feedback morphemes or repetition of other words, such

²⁷ The term 'theory of mind' was first used by Premack and Woodruff (1978).

as nouns. They conclude that the latter can be seen as a more advanced analysis of input on the part of the child. Study II in this thesis investigates early vocabulary composition, which can be linked to the use of different kinds of words in feedback. Children's stylistic variation may also account for differences in feedback use (see the general discussion for comments on the Strömqvist and Richthoff (1999) study).

Allwood and Ahlsén (1999) discussed how children learn to manage communication in interactions and investigated one child's use of linguistic feedback in two father-child interaction settings (the use of gestures in these interactions was mentioned in Section 3.1.3.2). The authors specifically examined the extent to which the child responded relevantly to different kinds of utterances by his father, coded according to mood. During interaction at earlier child age (1;8 and 2;4), the father's utterances comprise mostly identifiers (single words or onomatopoeic sounds), while his use of yes/no questions and wh-questions (QQ-question word questions in Allwood and Ahlsén) increase at the later child ages (2;7 and 3;3). The child has difficulties responding to wh-questions, although yes/no questions become easier with increasing age. The authors also noted differences in the type of utterances used by the father in the two settings. The interaction study (I) in this thesis will touch upon parents' use of questions in interactive settings (see Section 5.3.3).

3.1.6.2 Pragmatic impairment

Normal interactive development may be compromised in the case of premature birth, or when children are affected by autism spectrum disorders. The term "pragmatic language impairment" (PLI), earlier referred to as "semantic-pragmatic disorder", can be found in children with and without a formal diagnosis of autism, for example in children with SLI (Bishop & Norbury, 2002). Children with attention deficits may also have difficulties with the pragmatics of interaction (Bruce, 2010; Gillberg, 2005), resulting from difficulties with theory of mind (or intersubjective dysfunction). Pragmatics and language comprehension are more problematic than expressive language skill for children and youth with attention deficits (Bruce, Thernlund, & Nettelbladt, 2006). Furthermore, PLI has been associated with behavioral difficulties in children (Ketelaars, Cuperus, Jansonius, & Verhoeven, 2010). Finally, Berglund et al. (2001) found that children with Down syndrome lagged farther behind the typically developing control group in pragmatic skills²⁸ than in grammar skills, although the order in which they developed skills in both areas was similar to the control group.

²⁸ This is an operational definition in SECDI, where pragmatic skills are measured through parent report, with items denoting the ability to communicate about past or future events, about absent persons or objects, and to express ownership.

3.1.6.3 Summary

In summary, children's pragmatic development encompasses learning how to use language in socially appropriate ways. It is related to theory of mind and intersubjectivity and provides the basis for language learning in a social context. Pragmatic difficulties are a characteristic of most neuropsychiatric disorders. In this thesis, Study I investigates characteristics of parental interactive behaviors in parent-child interaction and sets these in relation to child vocabulary knowledge.

3.2 Social interaction

While Section 3.1.6 focused mainly on the child's verbal behavior in a social context, this section will look more closely at the role of social interaction in child language development.

Human beings are predisposed to use language as a communication tool, and learning through communication is made possible by social interaction (Kuhl, 2007). The importance of conversation in children's language development has been illustrated in many of Eve Clark's studies:

Conversation provides a forum for using language. It displays language embedded in larger systems for communication and so should present children with critical material for making sense of language as they try to understand others and make themselves understood. Conversational exchanges between children and adults should also be a forum for learning to become a member of the society and the culture. (2009, p. 6)

Moreover, studies have shown that infant learning occurs through live interaction, while televised or audio instruction is inefficient for the young learner (Kuhl, Tsao, & Liu, 2003), and that children learn more efficiently from direct interaction, rather than overheard speech (Oller, 2010; Weisleder & Fernald, 2013). However, children do benefit from overheard speech in non-Western cultures, or as secondborns (Oshima-Takane, Goodz, & Dereven-sky, 1996), probably to the greatest extent in situations where direct contact with the infant is rare²⁹. Furthermore, children learn best through experiencing the 'here and now' with high quality, referentially transparent speech (Cartmill et al., 2013). The present thesis analyzes vocabulary knowledge in the here and now situation with recordings of parent-child interaction and parent report of children's current comprehension and/or production.

²⁹ It must be mentioned here that most research on psychological phenomena (including social interaction) has been conducted in WEIRD cultures (Western, Educated, Industrialized, Rich and Democratic; Henrich, Heine, & Norenzayan, 2010), which limits the generalizability of results to wider populations.

Language learning is typically a social process (Tomasello, 2000), and parents can act as mediators of language in line with Vygotskian theory (Vygotsky, 1934/1986). Parent-child interaction is perhaps the most frequent of the many social contexts in which children learn language. The context, in addition to children's inborn capacities, impacts the rate and course of language development. Hoff (2006) offers an extensive review of social context factors influencing language development. These include cultural influences, socioeconomic status, ethnicity, childcare experience, schools and parents. Hoff (2006) concludes that the language acquisition mechanism requires environmental supports and that a significant portion of individual as well as group differences in development can be explained by the variation in these supports. Although some of the greatest obstacles for parents in improving child language may be general demographic characteristics (e.g. socioeconomic status), enhancing quite simple parental behaviors regarding language input, or even the direction of baby buggies, provides opportunities for promoting language development (Topping, Dekhinet, & Zeedyk, 2011; Zeedyk, 2008). This is not to say that parents who lack education or economic resources are unable to talk to their children in an appropriate manner. However, research has shown that poverty and low levels of education are complex factors which can have detrimental effects on children's language development. Studying interaction in a relatively homogenous population, as in this thesis, can be seen as a strong point in that confounding variables such as extreme poverty are absent.

3.2.1 Section overview

This section will first look at specific characteristics of Swedish children's early social environments. Thereafter, the focus turns to different characteristics of parental input which can influence children's language development. These include the amount and diversity of input, the concept of joint attention, as well as interactive patterns in the home, which may be influenced by different interactional settings. Then, social interaction will be situated within a model of human development based on the interaction between an individual and the environment. Thereafter, interaction involving children with delayed language onset and various disabilities will be discussed. The impact of input variables on language outcomes will be discussed throughout the section. Although the main focus of this section is on interaction between parent and child, it must be stressed that interaction patterns in childcare or clinical settings are equally important.

3.2.2 A Swedish context

Swedish parents are guaranteed 16 months of paid parental leave per child, and as of 2012, parents are allowed to receive parental allowance at the same

time for 30 days during a child's first year (Statistics Sweden, Women and Men in Sweden). Although mothers still take the majority of this leave, the proportion of fathers staying home with their children has increased in recent years, with 25% of the available parent leave days in 2013 used by men (Statistics Sweden, 2013). The Swedish Confederation for Professional Employees measures a yearly *pappaindex*, indicating the proportion of parental leave days used by men as well as overall numbers of men taking parental leave (TCO, 2013). The 2013 index rose to 44.5 from 43.8 in 2012 (if men and women shared parental leave equally, the index would be 100). Thus, Swedish infants are generally cared for by their parents during their first 12 to 18 months of life. Grandparents also play an important role in their grandchildren's lives and Swedish children's early words often include the names for paternal (*farmor, farfar*) or maternal (*mormor, morfar*) grandmothers and grandfathers. In addition, approximately half of all Swedish one-year-olds attend preschool. By the age of 2, this proportion has risen to 89% (The Swedish National Agency for Education, Official Statistics, 2013). It is quite common for siblings to attend the same preschool. Thus, the world of the Swedish infant is large, with ample opportunities for interaction with family members, as well as preschool peers and staff.

3.2.3 Amount and diversity of parental input

Characteristics of the social interaction between children and their parents, such as the amount and content of input, have been shown to influence children's language development. Studies have investigated the effects of parental input in families varying in socioeconomic status (SES) (Hart & Risley, 1995; Hoff, 2003; Hoff-Ginsberg, 1991, 1998; Huttenlocher, Vasilyeva, Waterfall, Vevea, & Hedges, 2007; Rowe, 2012; Rowe, Raudenbush, & Goldin-Meadow, 2012), or within low-SES samples (Pan, Rowe, Singer, & Snow, 2005; Weizman & Snow, 2001). A study replicating and extending Hart and Risley's (1995) original work investigated home language environment in a middle- to upper-class sample (Greenwood, Thiemann-Bourque, Walker, Buzhardt, & Gilkerson, 2010³⁰). There are relatively few input studies in the context of Swedish children's language development, e.g. Strömqvist & Richthoff (1999) and Richthoff (2000), the latter comparing parental input and child vocabulary production from child age 1;6 to 3;10. Sundberg (1998) investigated early parental vocal input (at child age 0;3). The interaction study (I) in this thesis adds to the international literature by investigating variability in parental input and correlating variability in children within a consistently high SES sample in an understudied language.

Differences in amount of parental input have been linked to corresponding differences in the size of children's vocabularies and rates of acquisition

³⁰ The study used LENA technology for automatic speech recognition (see Section 4.2.3).

(Bornstein, Haynes, & Painter, 1998; Hart & Risley, 1992, 1995; Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991). Hoff and Naigles (2002) found that the size of children's vocabularies was particularly influenced by parental MLU and Pan et al. (2005) found that the diversity of maternal vocabulary, measured in number of different words, had a stronger effect on toddlers' vocabulary than maternal talkativeness. Rowe et al. (2012) reported that input, as measured by the number of different words directed to children, helped reduce the effect of SES on children's vocabulary growth. Mothers' use of low-frequency sophisticated words has also been associated with better child vocabulary performance (Weizman & Snow, 2001). Rowe (2012) concluded that the amount and quality of input matters more at different times during a child's development: quantity is most important during a child's second year, diversity or sophistication during the third year, and the use of narratives or explanations during the fourth year.

A recent study (Cartmill et al., 2013) emphasized the importance of referential transparency (i.e. how easily word meaning can be inferred in the social context) in boosting children's vocabulary learning. The authors concluded that quality (highly informative speech) was more important than quantity for the size of children's comprehension vocabularies at 4;6 (measured with the Peabody Picture Vocabulary Test). However, talkative parents give their children potentially more opportunities for word learning. In a similar vein, Goodman, Dale, and Li (2008) found that, within lexical categories, higher parental frequency was related to earlier child acquisition. Greenwood et al. (2010) reported a strong correlation between adult word count and the number of conversational turns with children. Other studies have found significant relationships between adult-child conversations, measured in a similar way with LENA³¹, and children's language abilities (Gilkerson & Richards, 2009; Zimmerman et al., 2009). Finally, Huttenlocher, Waterfall, Vasilyeva, Vevea, & Hedges (2010) have linked the diversity of caregiver speech to the growth of corresponding structures in children's speech. Cameron-Faulkner, Lieven, and Tomasello (2003) analyzed specifically the structural components of adults' child-directed speech. Thus, previous research has investigated many different aspects of parental input in a wide range of populations, with many studies using new automatic speech recognition technology.

3.2.4 Joint attention

In addition to providing generous amounts of input, parents should preferably be attuned to a child's developmental level and focus of interest. At approximately 9 months of age, infants develop a new kind of "cooperative intersubjectivity" (Trevarthen & Aitken, 2001, p. 5), also characterized as

³¹ LENA stands for Language Environment Analysis.

person-person-object awareness³². At this age, children begin to engage in ‘person-person-object games’, where they are able to combine looking at objects with exchanging looks from another person. This is very similar to the concept of joint attention or engagement, which refers to the mutual focus of parent and child on the same object or activity. Carpenter, Nagell, Tomasello, Butterworth, and Moore (1998) found that 14- and 15-month-old children who could sustain joint engagement with their mothers experienced more rapid language development than other children. Differences in the time that mother-child dyads spent in joint attention before the children were 18 months of age has also been shown to predict later vocabulary growth (Carpenter et al., 1998; Laakso, 1999; Laakso, Poikkeus, Eklund, & Lyytinen, 1999). The ability to sustain joint attention stems from children’s ability to understand the communicative intentions of others. This is considered to be crucial for children’s ability to learn words (Akhtar, 2005; Tomasello, 2000).

3.2.5 Interaction patterns

Certain interaction patterns can also facilitate children’s language development. Some have used the term ‘contingency’ to denote responsive, sensitive caregiving, although the term is also used in other contexts. Parents produce contingent communication “when the intended recipient is fully oriented towards receiving and processing it” (Topping, Dekhinet, & Zeedyk, 2013, p. 413). According to Topping et al. (2013), research indicates that contingent behavior (Bornstein, Tamis-LeMonda, Hahn, & Haynes, 2008), activities supporting pre-literacy (Raikes et al., 2006; Tomopoulous et al., 2006) and parental elaboration of language, including narratives and explanatory talk (Tabors, Roach, & Snow, 2001) provide some of the strongest support of child language development. Parents can exhibit this behavior regardless of background or educational level. Parental reactions to children’s communicative attempts, including repetitions, expansions, reformulations or recasts, formulated either declaratively or interrogatively, play an important role in providing the feedback necessary for language growth (Bornstein, Tamis-LeMonda, & Haynes, 1999; Girolametto et al., 2002; Tamis-LeMonda, Bornstein, & Baumwell, 2001). Positive feedback, in terms of emotional tone and expansions of child utterances, is conducive of child vocabulary growth (Hart & Risley, 1995) and parental imitations of child vocalizations has been found to influence infant babble and provide support for children’s word acquisition (Goldstein, King, & West, 2003). Finally, the way parents ask questions is also part of their interactive styles. The type of questions parents ask may be more or less conducive to children’s language

³² This was named ‘secondary intersubjectivity’ by Trevarthen & Hubley (1978).

development (e.g. Hart & Risley, 1995; Salomo, Lieven, & Tomasello, 2013).

3.2.5.1 The effect of setting and gender

Parental interaction style can have differential effects on children's language learning in varied contexts (Crain-Thoreson, Dahlin, & Powell, 2001; Hoff, 2010; Hoff-Ginsberg, 1991; Whitehurst & Lonigan, 1998). These contexts include interactional settings such as playtime, mealtime or book reading. Hoff-Ginsberg (1991) found that maternal speech during book reading was most linguistically complex and supportive of interaction, compared to the other settings studied (mealtime, dressing and toy play). A reanalysis of the data showed that children also used richer (e.g. greater number of word types and more contingent topic-continuing utterances) language in the book reading setting (Hoff, 2010). Although Crain-Thoreson et al. (2001) also found that the language used during book reading was more linguistically complex, children did not participate as much in those conversations as compared to toy play and joint remembering. Soderstrom and Wittebolle (2013) reported that child vocalizations during story time were twice as high at home, as compared to book reading at daycare. In general, the authors found the highest amounts of language input during story time and organized playtime.

Interaction style may also vary with parent gender (Leaper, Anderson, & Sanders, 1998; Majorano, Rainieri, & Corsano, 2013; Pancsofar & Vernon-Feagans, 2006; Tamis-LeMonda, Baumwell, & Cristofaro, 2012). For example, Majorano et al. (2013) found that mothers' input was characterized by higher MLU and greater numbers of word tokens and word types than father input, even though fathers increased the numbers of tokens directed to children at the second observation. Tamis-LeMonda, Baumwell, and Cabrera (2013) discuss father involvement in children's language development in a modern perspective.

3.2.6 The transactional model of development

Parental behavior in interactional contexts is an important factor in offsetting direct genetic effects regarding child language abilities. There is currently consensus among most developmental scientists regarding the interaction of nature and nurture on children's development. However, according to Sameroff (2009), interaction alone is not enough to explain the concept of epigenesis, whereby genes can actually be changed as a result of environmental influence. Sameroff's transactional model (see Figure 3.3) displays the dynamic process in which the child and the environment influence each other over time. The model "stresses the plastic character of the environment and of the organism as an active participant in its own growth. . . . Developmental changes are defined by changes in the way the child interacts with experience" (Sameroff, 2009, p. 8). In recent years, twin studies have inves-

tigated genetic and environmental influences on language development (e.g. Bishop, Price, Dale, & Plomin, 2003; Byrne et al., 2009; Oliver, Dale, & Plomin, 2004; Samuelsson et al., 2008). For example, Bishop et al. (2003) found that transient language delay was mostly due to environmental influence, while persisting language problems were more heritable. They also discovered that cases where parents sought help for their children's language difficulties at age 2 were those involving significant genetic origin. In their sample of twins, heritability was estimated to be approximately 20% at age 2. However, Hayiou-Thomas, Dale, and Plomin (2014) found that language impairment (LI) at age 4 diagnosed by means of psychometric criteria³³ was a better indicator of language difficulties at age 12 than parent referral. Another aspect relevant to parent-child transactions is the ways in which genotypes may influence the experience of specific environments, either through passive, evocative or active effects prompted by individuals (Scarr & McCartney, 1983).

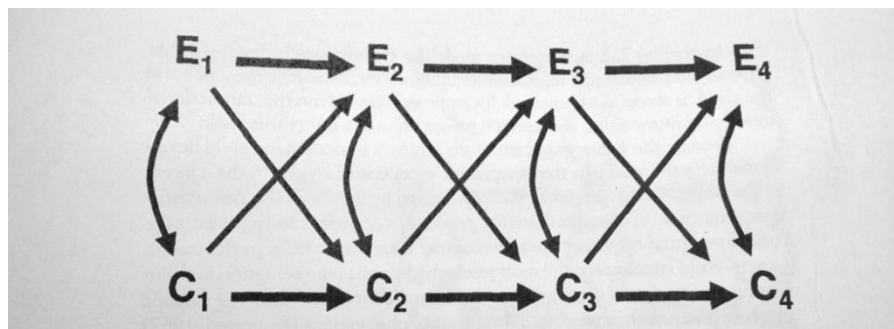


Figure 3.3: The transactional model, showing the continual interaction between child (C) and the environment (E) on development over time

Reprinted from "The transactional model" by A. Sameroff, 2009, *The transactional model of development: How children and contexts shape each other*, p.13. Copyright 2009 by the American Psychological Association.

3.2.7 Children with atypical language abilities

According to Sameroff (2009), the transactional model described in Section 3.2.6 may look different in children with developmental disabilities. The range of contexts which an individual can experience may vary greatly, as with deafness or blindness. In the case of cognitive disabilities, such as low intelligence or autism, children's functioning is limited, as they are not able to understand the complexity of their environment. This also means that it may be difficult to predict actual developmental outcomes because of the

³³ Psychometric LI was defined as low expressive vocabulary and syntax scores, i.e. lower than -1.25 SDs below the sample mean, approximately equivalent to the lowest 10% of the sample.

continual interaction between heredity and experience. However, successful interventions which mold experience to meet the needs of children with developmental disabilities make more transactions possible, thus advancing levels of functioning. For example, the type of interaction style used by speech and language pathologists has been shown to have differential effects on the language production of children with language impairment (Bruce, Hansson, & Nettelbladt, 2007; see Section 3.4 for more on methods used in language intervention). Thus, it is important that not only parental input, but all linguistic input in a child's environment, including childcare settings, is geared toward maximizing language development.

Parents of children with delayed language onset or disabilities may exhibit different interaction patterns than parents of typically developing children. For example, some studies imply that parents of late talkers may use statements that are longer than optimal (Paul & Elwood, 1991) or respond less often to child initiations (Vigil, Hodges, & Klee, 2005). In addition, differences have been found in the acoustic properties of maternal input to late talkers as opposed to typically developing children; for example, mothers of late talkers produced nouns with lower pitch frequency and used lower pitch contours than mothers of typically developing children (D'Odorico & Jacob, 2006)³⁴. Cultural differences have also been found in the way mothers respond to their late-talking toddlers (Girolametto et al., 2002). Girolametto and colleagues (2002) found, for example, that although Italian mothers spoke faster and used a greater diversity of words than Canadian mothers, they responded less often to their children's vocalizations than did the Canadians. Work by Conti-Ramsden (e.g. 1990, 1995) has indicated that parental input to children with SLI contains fewer recasts than input to children with typical language development, thus giving children fewer opportunities to compare their own production with more complex structures. Furthermore, studies conducted on interaction in childcare settings have reported differences in the way adults address children with and without developmental disabilities (Girolametto, Hoaken, Weitzman, & van Lieshout, 2000). Besides finding that speech addressed to children with disabilities was directive and not tuned to their expressive abilities, Girolametto et al. (2000) reported that adult-child interaction was promoted to a greater extent in a play dough activity as compared to book reading (cf. Section 3.2.5.1). During the play dough activity, the interaction was characterized by fewer directives, and the children interacted with others to a greater extent.

Certain types of parental responsiveness have been found to be conducive of language development in children with autism spectrum disorders (Haebig, McDuffie, & Ellis Weismer, 2013; McDuffie & Yoder, 2010). Johnson-Glenberg and Chapman (2004) compared parental input during play to chil-

³⁴ For a review of the literature on late-talking toddlers, see Desmarais, Sylvestre, Meyer, Bairati, & Rouleau (2008).

dren with and without Down syndrome, finding no difference between groups in the frequency of label requests. The authors suggest that this may explain why adolescents and young adults with Down syndrome have better comprehension skills in comparison to their productive and nonverbal cognitive abilities. In a study investigating predictors of language in children with various intellectual disabilities (including Down syndrome), optimal parental response was shown to predict productive language in all children (Yoder & Warren, 2004). In Sweden, Preisler, Tvingstedt, and Ahlström (2002) reported that communication between parents and deaf children with cochlear implants was enhanced by responsive parental interaction style. Further, Brodin (2008) has investigated communication in play situations involving children with multiple disabilities.

3.2.8 Summary

Language learning is a social process, which occurs in the context of social interaction. Parental input is one of many factors affecting child language development, but it is one over which parents of all backgrounds can exert control. Research has provided ample evidence of the effects of the quantity and quality of input in promoting optimal language development in different populations. Environmental factors and child characteristics interact with each other in a dynamic process over time, reflecting the sometimes unpredictable relationship between nature and nurture. This knowledge underpins the importance of working to ensure positive outcomes for all children. Further discussion of these topics will be presented in the studies and general discussion.

3.3 Developmental outcomes

As stated in Chapter 1, early language development lays the foundation for later language development, in turn affecting literacy achievement and academic success, as well as other long-term outcomes. Scholars refer to this phenomenon as a developmental cascade, which can be defined as follows:

. . . the cumulative consequences for development of the many interactions and transactions occurring in developing systems that result in spreading effects across levels, among domains at the same level, and across different systems or generations. Theoretically these effects may be direct and unidirectional, direct and bidirectional, or indirect through various pathways, but the consequences are not transient: developmental cascades alter the course of development. (Masten & Cicchetti, 2010, p. 491)

This section will give examples of longitudinal evidence regarding the importance of early language development. Anne Fernald, a researcher at Stan-

ford University, likens a child's early experience with language, 'early linguistic nutrition', to the physical nourishment in the first two years of life needed to prevent growth faltering³⁵. According to Fernald, a lack of early verbal input can cause growth faltering in a child's cognitive development. Studies have provided evidence that children's growth trajectories diverge early in life (Farkas & Beron, 2004; Ramey & Ramey, 2004). Law, Boyle, Harris, Harkness, and Nye (2000) state that children with early expressive and receptive language impairment

are likely to find it difficult to process incoming language, to initiate communication with others and to formulate their responses appropriately. Accordingly they are less likely to compensate for their difficulties and are most likely to find difficulty in coping with the demands of school. (p. 180)

The Longitudinal Study of Australian Children followed several thousand children from early childhood through to primary school, finding that children with early speech and language impairment had poor school outcomes on measures regarding literacy, numeracy and approaches to learning (Harrison, McLeod, Berthelsen, & Walker, 2009).

3.3.1 Communication difficulties as predictors of later outcomes

Several additional longitudinal studies have shown that communication difficulties in early childhood are associated with negative effects. It is not always possible to make claims about direct cause and effect, but research points to a number of connections. Results from the British Cohort Study indicate that children with language impairment at age 5 were more likely to have poor adult literacy skills, and were at greater risk for adult mental health difficulties and adult unemployment (Law, Rush, Schoon, & Parsons, 2009). Another study using the same cohort sample (Schoon, Parsons, Rush, & Law, 2010) examined more closely the influences of early environmental factors on the development of language skills. The authors found that children who displayed receptive language difficulties at age 5 were more likely to have disadvantaged family backgrounds and lack a stimulating early literacy environment at that age. However, they found that the majority of individuals with early language difficulties had achieved competent literacy levels at age 34, when adult literacy was assessed. Factors reducing the risk of persistent language difficulties in adulthood included having more highly

³⁵ In a talk entitled "The Poverty of the Stimulus: Why Early Experience with Language Really Matters", given at the XVIII Biennial International Conference on Infant Studies, Minneapolis, Minnesota, USA, 7–9 June 2012. The term 'growth faltering' is in reference to the 2-year window of prevention set by the World Health Organization's growth standards in 2006.

educated working parents, having more advantageous housing conditions and attending preschool.

Several 30-year follow-up studies of children with language impairment report that the subjects often experience negative consequences in adulthood. For example, Elbro, Dalby, and Maarbjerger (2011) found significantly higher rates of literacy difficulties, unemployment and low SES, and Clegg, Hollis, Mawhood, and Rutter (2005) reported very high unemployment and reduced ability to live independently. Further studies have reported persistent communicative difficulties for children with early language delay (Johnson et al., 1999; Stothard, Snowling, Bishop, Chipchase, & Kaplan, 1998). The study by Stothard et al. (1998) included a group of children whose early SLI had resolved by age 5;6. By age 15–16 these children were equally proficient as controls on measures of vocabulary and language comprehension, but the subjects still had lower phonological processing and literacy skills. Boys' early language ability (measured at 6, 18 and 24 months) has been shown to be significantly related to registered criminality through the age of 30 years (Stattin & Klackenberger-Larsson, 1993).

A Swedish study measured teenage outcomes for children with language impairment who had attended special preschools ten years earlier (Ek et al., 2012). A large number of the teenagers were found to have persistent language problems and many had been diagnosed with developmental disorders, such as autism or attention-deficit hyperactivity disorder (ADHD). The authors conclude that language impairment in the preschool years is an important marker for a number of developmental disorders, including intellectual disability and autism spectrum disorders.

Communication difficulties in childhood and social, emotional and behavioral difficulties (SEBD) often co-occur. Some researchers claim that language delay precedes SEBD (Stevenson, 1996), while others suggest that underlying neurodevelopmental delays are the cause of both conditions (Law, Plunkett, & Stringer, 2011).

3.3.2 Resiliency

Life is not a matter of holding good cards, but of playing a poor hand well.
Robert Louis Stevenson (1850–1894)

Psychologists define resilience as the ability to adapt and overcome risk and adversity. The interplay between nature and nurture is especially evidenced in situations where individuals rise above adverse circumstances. The Kauai Study followed a group of 837 children born on one Hawaiian Island in 1955, with data collected at birth, and then at 2, 10, 18, 32 and 40 years of age (Werner & Smith, 2001). Special attention was given to children who exhibited resiliency in the presence of various risk factors. Good verbal abil-

ity, as well as early reading and writing ability contributed to resiliency for at-risk children. On the other hand, if children and youth had low self-esteem and low belief in their own competence, they were less able to utilize their own intellectual resources. These factors may have relevance for whether or not interventions work (see Section 3.4).

3.3.3 Late talkers

Children with delayed onset of speech, often called ‘late talkers’, represent somewhat of a dilemma when it comes to predicting later outcomes. As mentioned earlier, children are usually considered late talkers if they produce fewer than 50 words and/or are not combining words at age 24 months. Late talkers at this age represent the lower end of the wide distribution regarding productive language abilities (Ellis Weismer, Venker, Evans, & Moyle, 2013). However, a diagnosis of SLI may be proffered when children continue to score below the normal range at later ages. Longitudinal studies have indicated that most late talkers achieve average language status by the age of 5, 6 or 7, yet many late talker groups still score lower on language assessments through adolescence (Rescorla, 2009, 2011). Some late talkers are only delayed in expressive speech, while others also exhibit delays in receptive speech. In some studies of late talkers, especially small-scale studies, children with hearing impairment, neurological disabilities or even receptive language delay are excluded. Large-scale epidemiological studies, on the other hand, may not exclude children with delays secondary to primary conditions (Rescorla, 2011). In the former, late talkers are a well-defined group, while in the latter, it may be difficult to distinguish effects of different variables such as disabilities.

3.3.3.1 Small-scale studies

One follow-up study of late talkers (Thal, Tobias, & Morrison, 1991) found that children with persisting delays were those who had shown delay in language comprehension one year earlier, as compared to the ‘late bloomers’ who had typical language comprehension at the earlier point in time. For a different group of children, Thal, Miller, Carlson, and Vega (2005) compared age 4 outcomes of typically developing children to late talkers who had productive vocabularies under the 10th percentile measured with the CDI at 16 months. At age 4, the late talkers scored lower than typically developing children on language and cognitive tests, as well as on a nonword repetition task. Fernald and Marchman (2012) found that late talkers were slower and less accurate in lexical processing at 1;6, and that late talkers who ‘bloomed’ by 2;6 were those who had been significantly faster and more accurate at word recognition tasks at 1;6 than those who remained delayed at 2;6. Moyle et al. (2007) reported that late talkers at age 5 had significantly lower scores on tests of oral vocabulary, grammatic completion and sentence

imitation than comparison children. Ellis Weismer et al. (2013) investigated fast-mapping abilities and found that late talkers had lower scores on novel word comprehension and production, as well as production of familiar words than a control group at 2;6. Furthermore, results from a larger study aiming to identify the precursors of dyslexia show that late-talking children at risk for dyslexia with both receptive and expressive delays at 2;0 and 2;6 scored below control groups on reading and spelling assessments at 5;6 (Lyytinen, Eklund, & Lyytinen, 2005).

3.3.3.2 Large-scale studies

The Early Language in Victoria Study (Reilly et al., 2010) found that adding late-talking status at age 2 to the other baseline predictors increased explained variation in expressive scores at age 4 by almost 10%, which indicates that it is a very important factor. However, latent class analysis³⁶ of data from the same population-based study underscored the difficulty of predicting children's early trajectories (Ukoumunne et al., 2012). The authors identified five separate developmental profiles of children between the ages of 8 and 48 months, including 1) "typical", 2) "precocious (late)", 3) "impaired (early)", 4) "impaired (late)" and "precocious (early)"; the category precocious denotes scores more than 1.25 *SDs* above the mean (8%), impaired more than 1.25 *SDs* below the mean (7%) and typical the middle 85% of scores on a composite of communication and language measures at each wave. Only the "typical" trajectories showed relative stability across the 40-month period; children with "impaired (early)" profiles had caught up to the "typical" children by 48 months, while "impaired (late)" children exhibited steadily decreasing scores up to 36 months; "precocious (early)" children had scores in line with "typical" children by 48 months, and "precocious (late)" children showed great gains from 8 to 24 months, ending up with the highest scores at 48 months.

In another study, Ellis and Thal (2008) reported on age 6 outcomes for 577 children divided into three groups at 16 months: typically developing (461), "late producers" (81) and "late comprehenders" (35). Of the 13 children (2.2%) later diagnosed with SLI at age 6, seven of the children had been typically developing, three had been late producers and three had been late comprehenders at 16 months. This further illustrates the complexity of early identification of children who will later be diagnosed as language impaired. The composition study (II) in this thesis will discuss differences between the early vocabulary development of slower learners and late bloomers.

³⁶ Latent class analysis is a multivariate statistical method which identifies classes in which participants have similar responses on a set of variables.

3.3.3.3 Summary

This section has outlined how early communication difficulties associated with developmental delay or disabilities may lead to negative later development in children, including poor cognitive growth and low literacy skills. Children with inadequate language skills are generally unprepared for learning in school. They face the difficult challenge of catching up to their better-prepared peers, risking low academic performance and long-term adverse outcomes, such as poor mental health, unemployment and social dependency. Thus, slow early language development may lead to negative cascading effects on later learning and life outcomes and may be seen as no less than a public health issue. However, the large variability in children's communicative development makes the prediction of impairment a complicated business.

3.4 Modern language intervention

The word 'intervene' comes from the Latin *intervenire*, meaning "to come between". Language intervention in the educational sense is an attempt to prevent the potential negative outcomes listed in Section 3.3 (e.g. literacy difficulties, mental health problems and adult unemployment) by either directly or indirectly providing treatment. Direct interventions are often provided by trained speech and language pathologists. Indirect interventions may involve special needs educators training parents to use certain interactive strategies with their children. Reasons to intervene include the moral obligation to ensure positive outcomes for all individuals, as well as the long-term cost-effectiveness of timely interventions. There are different kinds of intervention, for example home-based, clinical, preschool or school programs. Interventions may be focused on different language aspects and/or behavioral outcomes, which are often tied to communication difficulties. The decision to implement an intervention may be based on a clinical diagnosis or a clinical or pedagogical assessment. This section focuses in particular on interventions aiming to involve parents in stimulating early language development in children. The section will

- define the concept of early intervention,
- discuss advances in intervention research,
- discuss effective parent-implemented programs for language enhancement based on research outcomes, and
- discuss the question of language screening.

3.4.1 Early intervention

The concept of early intervention refers to a wide range of services provided during the first five years of life to children either with delays or at risk of developmental delays (Ramey & Ramey, 2003). In the United States, where modern early intervention practice was an outgrowth of the civil rights movement (Ramey & Ramey, 1998), legislative reforms starting in the 1970s and 1980s ensure the provision of federally-funded, individualized and specialized services to children and their families. Those eligible to receive these services include children of poverty, at-risk children and children with diagnosed disabilities (Ramey & Ramey, 2003). Early intervention programs typically aim to prevent disabilities, to provide treatment for conditions associated with disabilities and to support parents in meeting the needs of their children. Recommendations regarding early intervention in the United States often stress the importance of intervening early, often and effectively (Ludwig & Sawhill, 2007). Ramey and Ramey (1998, 2003) add the principles of program intensity (the more the better) and direct provision of learning experiences, rather than indirect methods, including parent education programs. However, the consensus among researchers is that early intervention programs must involve parents or entire families in order to be successful (Brooks-Gunn, Berlin, & Fuligni, 2000). For example, the Head Start and Early Head Start programs in the United States (reviewed in Love et al., 2005), as well as intergenerational literacy programs, are based on family involvement.

Due to the complex nature of language development, intervention effects are often confounded with developmental change. The preschool years are characterized by a period of fluidity, with children developing different skills at various ages. Therefore, in order to be effective and cost-efficient, early intervention must be targeted carefully, both with respect to the timing and the specific group of children, as well as the goal of the specific intervention program.

In Sweden, the county councils and municipalities together provide services of a preventive nature, first of all to promote the well-being and health of all children and families, as well as to identify children at risk (Björck-Åkesson & Granlund, 2003). The Child Health Centers and preschools play an important role in identifying children with delayed or impaired language development. When physicians, preschool personnel or parents have concerns about a child's language development, a consultation with a speech and language pathologist (SLP) is arranged. However, in practice, referrals of this nature are not always processed in a timely fashion. Many times, a 'wait and see' approach is adopted, rather than a 'watch and see' approach (Paul, 1996). Most SLPs are employed by regional authorities and work in hospitals or primary healthcare centers. Once a disability has been diagnosed, early intervention services aim to reduce the severity of the disability,

and reduce complications in the surrounding environment through training of staff and environmental adaptation. Björck-Åkesson (2007) stresses the importance of individual analysis regarding children's developmental or learning difficulties. As mentioned above, problems involving early language development are complex issues, resulting from the dynamic interactions between a child's inherent characteristics (including personality) and the environment (see Section 3.2.6), as well as the frequent co-occurrence of other disorders (comorbidity). Thus, intervention must be preceded by analysis of both the child's individual circumstances and the environment, in line with a relational approach to differences in children's abilities. The World Health Organization's International Classification of Functioning, Disability and Health³⁷ (ICF) provides a framework to describe the multi-faceted aspects of intervention within educational settings. The ICF is a complement to ICD-10 (International Classification of Diseases-diagnoses, mentioned in Section 3.1). With recent revisions of these documents, focus has changed from seeing communication difficulties as deviations and impairments to an increased focus on communicative activity and participation, as well as the interaction between health conditions and environmental factors. The revised Swedish preschool curriculum³⁸ emphasizes providing extra support and stimulation to children in relation to their needs (p. 5). Furthermore, one of the principle tasks of the preschool is to lay the foundation for lifelong learning, with an emphasis on a pedagogical approach, "where care, socialization and learning together form a coherent whole" (p. 9).

3.4.2 Advances in intervention practice

Key legislation passed in 1986 in the United States³⁹ extended the provision of early language intervention to infants and toddlers under the age of 3 (Kaiser & Roberts, 2011). This led to the development of strategies emphasizing prelinguistic forms of communication, and parents became increasingly involved in interventions in naturalistic settings. Research findings from the past 40 years have important implications for early intervention (Kaiser & Roberts, 2011):

- Social attention and prelinguistic communicative behaviors form the basis for spoken language.
- Parental linguistic input and interactional strategies have a positive effect on children's language development (see Section 3.2). Parent-implemented interventions to support language development in children with language impairments are effective (see Section 3.4.3).

³⁷ For detailed information, see <http://www.who.int/classifications/icf/en/>

³⁸ Curriculum for the Preschool Lpfö 98 Revised 2010, available at <http://www.skolverket.se/publikationer?id=2704>

³⁹ PL (Public Law) 99-457, the Infants and Toddlers with Disabilities Act of 1986

- Children's early language skills are crucial for learning to read (Dickinson et al., 2010). Language and reading outcomes can be improved with early language intervention.
- Behavior problems are often associated with language impairments. Intervention focusing on functional communication and language may increase positive behavior.
- Using alternative and augmented modes of communication (AAC) can improve communication and language in young children (Drager, Light, & McNaughton, 2010).

Kaiser and Roberts (2011) propose a number of principles that should guide early language intervention. Several are of specific importance for this thesis. First, it is important to remember that all children, irrespective of age or ability level, are communicators. Developing infants' early social communication is an important first step towards building comprehension and production skills. Furthermore, all children with language impairments can be helped by naturalistic interventions. Research has established that early language impairments have a detrimental influence on children's social development and later literacy. It is essential to engage parents and other caregivers in early communication interventions. It is also crucial to take a proactive approach. The next section will review some of the strategies which have proven successful in improving children's language skills.

3.4.3 Effective parent-implemented programs

*The issue from the perspective of language intervention researchers is not "does input matter?" but rather how can it be made to matter the most.
(Warren & Walker, 2005, p. 251)*

In contrast to interventions with parent involvement only, where parents play more of an observational or supportive role, parents are the primary intervention agents in naturalistic, parent-implemented (or parent-administered) intervention (Girolametto, 2006). Such interventions can be described as triadic in that a trained interventionist must first instruct parents in using special strategies with their children before the parents can implement them (Roberts & Kaiser, 2011). Some studies refer to this kind of intervention as Parent-Based Language Intervention (PBI; van Balkom, Verhoeven, van Weerdenburg, & Stoep, 2010) or indirect intervention (Girolametto, 2006). In addition, studying parent-based language interventions requires the measurement of 1) parent training, 2) parent implementation of strategies and 3) child language outcomes, all of which contribute to treatment fidelity. Results of the meta-analysis conducted by Roberts and Kaiser (2011) indicate that parent-implemented interventions are effective in increasing language outcomes for children with varying degrees of cognitive and language impairment. Eight of the 18 studies included in the meta-analysis used the

Hanen Parent Program⁴⁰ (Manolson, 1992), but all studies taught parents such strategies as responding to child communication, balancing adult-child turns and using certain language models.

3.4.3.1 Responsive interaction intervention (RII)

Kong and Carta (2011) carried out a research synthesis of interventions using responsive interaction (RII, i.e. a set of strategies including following a child's lead, establishing joint attention, responding contingently to a child's behavior, imitating child behavior, etc.) for children with or at risk for developmental delays. Kong and Carta found that implementation of programs using these strategies resulted in significant positive changes in adults' responsive behaviors as well as gains in children's emotional and social-communicative skills. Programs using RII include the Hanen Early Language Parent Program (Manolson, 1992; Weitzman & Greenberg, 2002), the Play and Learning Strategies Program (PALS; Landry & Smith, 1996, 2006), Enhanced Milieu Teaching (EMT; Kaiser, 1993) and Responsive Education/Prelinguistic Milieu Teaching (RE/PMT; Yoder & Warren, 2002). Milieu teaching strategies include techniques such as following the child's lead, arranging the environment to prompt more explicit child productions and targeting specific vocabulary or language structures. Kong and Carta's (2011) review comprised in total 26 studies, with interventions taking place in homes, clinics, classrooms, childcare centers or special schools. Parents were intervention agents in 20 of the studies.

Thiemann and Warren (2010) discussed interventions for children with severe language delays, secondary to autism or other developmental disabilities. They concluded that some programs are more effective than others, depending on child or parent characteristics:

- For children with MLU greater than 2.5, RII is more effective than milieu teaching.
- For children with MLU below 2, milieu teaching strategies are more effective (Yoder et al., 1995, Yoder & Warren, 2001).
- Children with highly responsive and more educated mothers respond better to prelinguistic milieu teaching (PMT) where parents are taught "to prompt, model and reinforce intentional communication" (Yoder & Warren, 2001), while children with less educated and less responsive mothers receive the most benefit from approaches where parents are taught to follow a child's lead and respond to their communicative attempts (responsive interaction).
- Treatment intensity is very important regarding children with autism⁴¹ (Dawson et al., 2010).

⁴⁰ Developed in Canada in the 1970s to give parents a primary role in improving children's communicative skills (see <http://www.hanen.org/Home.aspx>)

3.4.3.2 Interventions for late talkers

Late talkers, or children with late language emergence (Zubrick, Taylor, Rice, & Slegers, 2007) are typically in the 24–36 month age range and do not exhibit any underlying deficits. Cable and Domsch (2011) conducted a review of 11 late-talker intervention studies, seven of which had parents as the primary treatment providers. The studies used different treatment techniques, including the Hanen Program (focused stimulation approach) and the modeling of single words approach. Within a play context, a parent or clinician repeatedly presents certain words to a child. The child may or may not have to imitate the word. The authors reported that studies using the focused stimulation approach had medium to large effect sizes. In addition, the parent-implemented interventions conform to recommendations by the Royal College of Speech & Language Therapists⁴² (RCSLT; Gascoigne, 2006) and the American Speech-Language Hearing Association (ASHA; 2008) in that education of families is one of the important tasks of speech and language therapists.

Van Balkom et al. (2010) found that a parent-based intervention with Video Home Training was effective in improving language outcomes for children with language delay. In Germany, Buschmann et al. (2009) reported that an intervention with a highly structured parent component, consisting of interaction promoting shared reading, was a cost-effective way to reduce the rate of treatment for language impairment at three years of age. Although Law, Garrett, and Nye's (2004) meta-analysis of interventions for children with primary language delay only included three implemented by parents, their results indicate that parent interventions may be most effective in improving children's expressive language, especially vocabulary, rather than receptive language.

3.4.3.3 Parent interventions for language and literacy

Parents can also play an important role in improving their children's emergent literacy, which is highly dependent on early language skills (e.g. Scarborough, 2001). Emergent literacy comprises those skills which are precursors of formal reading, such as concepts about print and letter knowledge (Whitehurst & Lonigan, 1998). Reese, Sparks, and Leyva (2010) conducted a review of interventions involving parent-child book reading, parent-child conversations and parent-child writing, and found that all three kinds of programs led to positive outcomes in children's language and emergent literacy. The specific skills children developed were also dependent on the type of

⁴¹ The Hanen program "More Than Words" has been specifically designed for children with Autism Spectrum Disorder.

⁴² The following is a recommendation in the key area of delivering effective support: "Training of others, including parents, should be viewed a central activity for SLTs to maximise impact for the child and their family" (p. 6).

training parents received. The authors concluded that interventions benefiting typically developing children are similar in many ways to interventions for children with language delays.

As mentioned in Section 3.4.1, early services for families with young children in Sweden are often of a preventive nature. Parent education is offered to first-time parents at 98% of all maternity healthcare clinics (Bremberg, 2006), although the focus of these sessions may not be on communicative development. At one of the earliest visits to the child healthcare clinic with a newborn, parents receive a book to encourage reading to the infant, although once again, this may not necessarily include recommendations on reading strategies to stimulate language development. 99% of all parents regularly access child healthcare services and families have an average of 20 individual contacts, usually with nurses (Bremberg, 2006, p. 151). The nurses try to identify high-risk families, in order to provide specialized support. In addition, Swedish parents are able to stay at home with their young children at least during the first 12 months (see Section 3.2.2). Therefore, projects involving the child healthcare centers, open preschools and libraries have aimed to support children's early language development⁴³. Structured and unstructured parent groups are provided at healthcare centers and open preschools. Organizations such as Kod-Knäckarna⁴⁴ offer information on early language development and support programs for parents.

3.4.4 Language screening

Early language difficulties, whether expressed in delayed production or impaired comprehension, have consequences for later development. Therefore, it remains imperative to identify children at risk as early as possible. This is especially important in the case of impaired comprehension, as it is both more difficult to detect and treat, and can have far-reaching consequences for language development. It is also important to determine whether early language difficulties may be related to impaired hearing, particularly after bouts of ear infections. As stated above, research has indicated the importance of early intervention for preventing language impairment. The question of universal screening for language delay has been discussed (Law et al., 2000; Nelson, Nygren, Walker, & Panoscha, 2006). Law et al.'s (2000) literature review concluded that it is generally more difficult to accurately identify children with speech and language problems than to identify those without problems. A screening instrument with high sensitivity will be

⁴³ These include projects such as *Språket, typ – redan på skötbordet* (Language, like – already on the changing table) and *Språknätet* (The Language Web) in Uppsala County (see <http://www.lul.se/sv/Kultur/Lansbibliotek-Uppsala/Projekt/Spraknätet1/>).

⁴⁴ 'The Code Breakers' is a non-profit association aiming to prevent and minimize reading difficulties associated with dyslexia.

more likely to find the true positives (i.e. those with language problems). High specificity of an instrument, on the other hand, means that children without language problems will be identified as non-impaired. An important question regards the optimal age for early diagnosis of language delay and developmental disabilities.

As noted in Section 3.3.3, it is often difficult to predict whether children with late onset of productive vocabulary will remain delayed or whether they will ‘catch up’. Because many late talkers experience their vocabulary spurt after the age of 2, some researchers have recommended 30 months as the optimal time to diagnose language delay (Rescorla, Mirak, & Singh, 2000).

Swedish studies have demonstrated the ability to reliably identify children with language disability at 2;6 (Mattsson, Mårild, & Pehrsson, 2001) and 3;0 (Westerlund & Sundelin, 2000). Bruce, Kornfält, Radeborg, Hansson, and Nettelbladt (2003) reported that a screening instrument that included language comprehension and pretend play at 1;6 was useful in identifying children at risk for language impairment. One American study using the CDI has indicated that late talkers show group stability at measurements collected 6–7 months after initial data collection at 20 and 13 months respectively (Thal, Bates, Goodman & Jahn-Samilo, 1997). However, the authors were not able to predict outcomes for individual children (see also Dollaghan, 2013). Section 4.3.2.3 discusses the use of CDI instruments as a screening tool at different ages. The composition study (II) in this thesis also touches on the question of early diagnosis of late talker status.

3.5 Summary

Chapter 3 has focused on several areas which are of importance for the studies in this thesis. When children learn language, they are developing skills in a number of interrelated language domains. These skills are acquired through a process of social interaction. Children’s early language development lays the foundation for later literacy skills and academic achievement, and can affect lifelong developmental outcomes. It is therefore important to support children and families when language development is compromised for any number of reasons. Early language intervention has been shown to be an effective way of promoting positive outcomes.

4 Methods of data collection and analysis

This chapter will first give an overview of methods employed to investigate child language development, with a focus on methods used in the thesis studies. Brief attention is given to some new technologies and methods which in many areas are revolutionizing the study of child language, but the aim is not to provide a comprehensive description. The first three sections in the chapter cover laboratory methods, speech samples and parent report. Furthermore, the focus is on research methods, although some of the tools (such as the CDI) may also be used for clinical purposes. Likewise, a number of the tools used by clinicians may also be used for research purposes. For example, standardized tests are often used in research projects, e.g. to characterize research participants and determine whether they meet inclusion/exclusion criteria. This overview, however, will not include standardized tests or assessments used for clinical or pedagogical purposes.

Secondly, the chapter introduces the longitudinal SPRINT project at Stockholm University from which the data analyzed in this thesis was collected. The section on SPRINT presents an overview of the type of data collected and discusses ethical considerations. Finally, the chapter concludes with three sections outlining the materials and methods used in each of the three studies.

A researcher's choice of methods will depend on factors such as the purpose of the study, the study design, the research questions posed and the age and number of child participants. For example, a study may be conducted in a lab or in a more naturalistic environment, such as the home. Some studies may focus on describing a specific phenomenon, while other studies are designed to test a specific model or theory. Studies may be cross-sectional (e.g. Study I in this thesis) or longitudinal. Furthermore, studies conducted over time might be used to investigate cause-and-effect relationships. Longitudinal studies may be either prospective, where data is collected from the start of the study and forward in time, or retrospective, where the study examines events back in time. The data collected in this thesis were prospective in nature, using non-intrusive measurement techniques.

As the main focus of this thesis is children's vocabulary development, most emphasis in this chapter will be given to methods regarding lexical development. As mentioned in Section 3.1.4, the development of the lexicon is a complicated process. There are multiple methods with which children's lexical development can be studied. The choice of method will depend on

whether a researcher wants to study receptive vocabulary (comprehension) or expressive vocabulary (production) or both. It is impossible to study the entire lexicon, not the least in infants, as words may be ambiguous and different in scope as compared to adults for example.

4.1 Laboratory methods

A number of ingenious experimental methods have been devised to study children's language abilities in the laboratory. Most of these experimental setups include well-controlled stimuli and procedures, thus using behavioral techniques. They are often used in the testing of various models and can be used to measure different aspects of language, including infants' language processing abilities. Some methods, including habituation and head turn procedures, are typically used with infants. Preferential looking procedures are often used with infants and toddlers from approximately 6 months to 2.5 years. Neuroimaging methods and eye-tracking technology can be used with subjects ranging in age from infants to adults.

Recent advances in the fields of cognitive neuroscience, as well as the development of noninvasive neuroimaging technologies, have allowed child language researchers to "look into the brains" of infants. Functional neuroimaging methods use changes in brain activity to measure responses to language tasks. One method measuring the electrical activity of neurons is called the event-related potential (ERP) method. ERP can be used to measure sensitivity to different sounds, reactions to ungrammatical sentences or semantic processing. Magnetoencephalography (MEG) is a noninvasive imaging technology which measures the magnetic field of the brain. Functional magnetic resonance imaging (fMRI) and functional near infrared spectroscopy (fNIRS), measure the change in blood flow which accompanies neural activity. ERP and fNIRS technologies are considered the most child-friendly of these neuroimaging methods.

Head-mounted or remote eyetracking systems have been developed to automatize eye gaze direction and duration. Expensive systems can now easily do what otherwise takes hours of manual coding. This technology is used in experiments measuring a variety of language processing abilities such as semantic categorization and lexical comprehension.

4.2 Speech samples

Analysis of recorded speech samples allows researchers to investigate how a child may typically use sounds and structures in interactive speech production. If the aim is to study phonological production, it is imperative to use high-quality digital audio which allows inspection of the sound wave and

spectrogram while listening to sounds. This also facilitates accuracy of phonetic transcription. Phonological analyses are not included in this thesis, but forthcoming studies using the same material will examine some of these aspects of language.

Speech samples may be elicited by a researcher or may capture children's spontaneous speech. Samples of spontaneous speech are often considered observational measures, in contrast, for example, to parent report (see Section 4.3). Recorded speech samples may be collected to examine a number of questions regarding the grammatical features or diversity of words children use, how children's production relates to the input provided in different contexts or how children use gestures in conjunction with speech. Spontaneous speech samples can be collected in natural home contexts, or in a laboratory playroom. Samples may be recorded using audio or video technology or both.

Since the study of communicative gesture development in children involves the use of hands, face and body with and without speech, its role in communication is mostly analyzed through video recordings of interaction. Nowadays it is possible to link audio/video recordings to transcription/analysis systems which allow researchers to code movement frame by frame and link gesture to speech. One such system is ELAN⁴⁵, available through the Max Planck Institute.

Video recordings can also be used to study children's knowledge of grammatical aspects such as word order or the use of prepositions. So-called act-out tasks (e.g. Akhtar & Tomasello, 1997) allow researchers to test these skills, even when children are not yet able to produce multiword sentences themselves. Children are given a sentence with a novel verb and asked to enact the action. Akhtar and Tomasello found these tasks to be difficult for 2-year-olds.

4.2.1 Elicited speech

A child's sound production abilities may be studied through elicited production, either using standardized tests measuring articulation and phonology, or researcher-elicited tasks, where children are asked to name objects or pictures of words. The repetition of nonwords can be used to measure phonological short term memory or phonological working memory (Gathercole & Baddeley, 1989, 1990) or to ascertain differences between children with and without language impairment (e.g. Dollaghan & Campbell, 1998).

Various elicited production paradigms can test whether children are able to produce particular sentence forms or word forms. These paradigms can show whether children have abstract knowledge of a structure (Akhtar & Tomasello, 1997) or whether they have acquired a structure that they may

⁴⁵ <http://tla.mpi.nl/tools/tla-tools/elan/>

not produce spontaneously (Ambridge, Rowland, & Pine, 2008). Repetition or elicited imitation tasks (e.g. Kidd, Lieven, & Tomasello, 2006) can be used to indicate children's knowledge of structures that may be infrequent or too complex for them to produce spontaneously.

4.2.2 Transcribing and coding interaction

Depending on the type of questions researchers want to answer, or other aspects such as the size of the participant sample or resources available, researchers may choose to collect spontaneous speech samples in the form of audio or video recordings. An important question in collecting spontaneous speech samples deals with what proportion of a child's production is recorded. Longitudinal studies have typically used what is called thin sampling (Lieven & Behrens, 2012), in which approximately 1–2% of children's speech is captured. This is in part due to the extremely labor intensive nature of analyzing recorded speech. However, some researchers choose to make use of a technique called dense sampling, which aims to achieve a sampling level of between 5% and 20%. Dense sampling makes it possible to assess a child's vocabulary production more reliably than thin sampling and is more likely to collect rare items in production.

4.2.2.1 Studies with audio recordings

Roger Brown's classic (1973) study (see Section 3.1.5), which primarily focused on the morphological development of three children, used audio recordings of interactions between parents and the children in the home. One researcher was responsible for the recordings while another took detailed notes on the setting and interaction. The same researchers then transcribed and coded for morphology. Analysis of these transcripts resulted in Brown's (1973) five stages of morphological development for English-speaking children. Likewise, another seminal study used audiotaped recordings of parent-child interaction in 42 families, differing in socioeconomic status, to investigate children's lexical development (Hart & Risley, 1995). As in Brown's (1973) study, observers transcribed their own material and augmented the recordings with the copious notes taken during observation. Transcriptions were coded for parts of speech, syntax and discourse function. Results of this study (Hart & Risley 1992, 1995, 1999) documented large differences among social class groups in the amount of speech directed towards children and resulting differences in the size of children's vocabularies. These results have had an enormous impact on the study of child language and have spawned numerous projects in the USA, dedicated towards bridging the "word gap" among children of different social groups.

4.2.2.2 Video recordings

With advances in video technology, it has become common to video record parent-child interactions in order to study areas such as children's gesture use or discourse pragmatics. In a longitudinal study of children's speech act use, Snow, Pan, Imbens-Bailey, and Herman (1996) analyzed interaction between parent-child dyads in a laboratory playroom setting. Transcripts were coded for communicative intent, with results documenting developments in the number and type of social interchanges used by children from 14 to 32 months of age. Other prelinguistic communicative skills, such as the development of joint attention and symbolic play in preverbal infants, are commonly studied through video recordings.

4.2.2.3 Advantages/disadvantages

As mentioned above, the choice of recording mode (audio vs. audio/video) is related to the type of questions investigated. There are also advantages and disadvantages to using the various modes, as well as in the setting of data collection. Recording interaction in the home represents a more naturalistic setting than the laboratory, but an outsider doing the recording denotes an intrusion into the home environment. The interaction data used in this thesis (Study I) was recorded by the parents themselves, representing a minimum of intrusion by outsiders. This was also a cost-effective way to collect data on a large number of families. However, the use of audio recordings rather than video limits the ability of the researcher to understand nonverbal cues given by parents and children alike without a visual overview of the setting of the interaction. Therefore, assessment of parent-child exchanges entails a certain amount of interpretation. However, parent report of children's vocabulary knowledge provides a useful complement to audio recordings. Finally, any analysis of recorded speech/interaction is a time-consuming method. Sections 4.2.3 and 4.2.4 discuss advances in technology which are now revolutionizing methods of forthcoming data collection.

4.2.2.4 Transcription programs

The analysis and interpretation of recorded speech samples requires the use of special programs for transcription and coding. Existing transcription programs include SALT (Miller, 2010), ELAN (Max Planck Institute, 2010) and CHAT in the CHILDES system (MacWhinney, 2000), which is the program used in the interaction study (I; see Section 4.2.2.5). The various programs have conventions for transcribing different aspects of interaction, but what a researcher actually transcribes is dependent on the research questions asked. For example, analysis of phonological development will require a different kind of transcription than analysis of children's lexical development or the adult speech directed to children. The reliability of a transcription can be established by having several researchers independently transcribe a section

of recorded interaction and compare their results. Data such as the number of word tokens (number of words uttered), word types (number of different words) and mean length of utterance (MLU) can be automatically generated with transcription programs. However, analysis of some data may require the use of an existing coding scheme or one developed by the researcher.

4.2.2.5 Using the CHILDES system

Study I in this thesis presents analysis of interaction transcribed in the CHAT (Codes for the Human Analysis of Transcripts) format of the CHILDES system⁴⁶. Since it was first developed in the 1980s, the CHILDES system has had a great impact on the field of child language study. In addition to the CHAT transcription format, CHILDES includes a database with over 44 million words from 28 languages (as of 2007) and the CLAN (Computerized Language Analysis) programs to analyze data transcribed in CHAT. Comprehensive manuals for CHAT and CLAN are available on the CHILDES site for researchers. The CLAN programs used in Study I include the following:

- **FREQ** automatically computes frequencies of words for a given transcription line, or tier, in one or several files. The program also computes the total number of different word types used, the total number of word tokens and the type/token ratio (TTR).
- **TTR** is a function of the number of tokens in a transcript. Thus, samples with a higher number of tokens give low values for TTR and vice versa.
- **VOCD** computes another measure of vocabulary diversity in addition to TTR. The obtained D value is not a function of the number of tokens in the transcript, but rather shows how TTR varies when token size varies.
- **CHECK** verifies that transcriptions use the CHAT format correctly. This program should be run before any other analysis programs.
- **COMBO** searches for specified strings or words.
- **MLU** computes mean length of utterance.

These and many other programs can be used to analyze personally transcribed files as well as files from existing corpuses on the CHILDES website. One type of analysis not yet available to Swedish researchers is the automatic coding of morphosyntax through the MOR, POST and GRASP programs. It is hoped that these tools will be available for analysis of Swedish transcripts in the future, so that the painstaking, manual coding of morphosyntax in CHAT files can be avoided.

4.2.3 Automatic speech recognition technology

A recent technological advance making it easier to capture a child's vocalizations over the course of an entire day is the LENA system (Xu, Yapanel,

⁴⁶ Child Language Data Exchange System, <http://childes.psy.cmu.edu>

& Gray, 2009). It consists of a small pocket-sized device which can record for 16 hours at a time. The recorder is worn in a child's clothing and is able to tally child vocalizations for the target child and other children, female and male adult vocalizations, the number of conversational turns the participants engage in, as well as the duration of background television, for example. A number of studies have established the accuracy of token estimations for English-language recordings (Oetting, Hartfield, & Pruitt, 2009; Xu et al., 2009). LENA technology is currently being used in studies assessing the speech and language environment of typically developing children as well as children with developmental disorders⁴⁷ (e.g. Oller et al., 2010; Warren et al., 2010).

If languages other than English are involved, manual examination of the recordings is necessary (Oller, 2010). Complete transcripts must also be created manually. A recent study (Weisleder & Fernald, 2013) used LENA technology to compare the amount of child-directed input in low-SES Spanish-speaking families with the children's processing abilities and vocabulary growth. The recordings revealed large differences among families in the amount of speech directed to children, and these differences were neither related to level of maternal education nor the amount of overheard speech in the child's vicinity. Results indicated that children who heard more speech directed to them were more efficient at processing familiar words and had larger vocabularies at 24 months of age. Other studies have reported that vocabulary acquisition is facilitated by speech directly addressed to children and not simply overheard (Oller, 2010; Shneidman, Arroyo, Levine, & Goldin-Meadow, 2013; Shneidman & Goldin-Meadow, 2012).

4.2.4 The Human Speechome Project

Only in the Human Speechome Project⁴⁸ has an attempt been made to collect everything that a child says (Roy, 2009). The original pilot project entailed outfitting the author's own house with camera lenses and microphones to document his son's first three years of language acquisition. The resulting 230,000 hours of audio-video recordings have resulted in new analysis tools and other technological and engineering innovations. These include Blitzscribe, a new audio chunking system, which helps people transcribe more efficiently (four to six times faster than other available systems) and the portable Speechome recorder with two cameras, which enables more cost-effective longitudinal recordings than in the original Speechome project. In contrast to the LENA system, the Speechome methodology provides extensive documentation of the non-linguistic situational context.

⁴⁷ For more information on LENA and current studies, see <http://www.lenafoundation.org>.

⁴⁸ For more information and lists of publications, see <http://www.media.mit.edu/cogmac/projects/hsp.html>.

The Speechome corpus comprises transcriptions of interaction recorded from child age 9 to 24 months, with the exception of 44 days during that period. Early analysis includes the documentation of word births⁴⁹ (i.e. the first transcribed utterance of a word) and the relationship between input frequency and the age of acquisition of a word. Results indicate that the frequency of words in the input as well as prosodic features of those utterances helped the child learn words (Roy, 2009).

4.3 Parent report

Parent report deserves a separate section in this thesis, as data collection measuring children's vocabulary was undertaken with the Swedish version (SECDI; Berglund, 1999; Berglund & Eriksson, 2000a; Eriksson & Berglund, 1999) of the MacArthur-Bates Communicative Development Inventories (CDI; Fenson et al., 1993, 1994, 2007). As the closest observers of children's developing language, parents have long been relied upon to provide information to doctors or clinicians. There are different kinds of parent report, but the most common are diaries and checklists, such as the CDI. Parents are less reliable when it comes to remembering children's past performances than they are regarding a child's current level of abilities (Fenson et al., 2007, p.7). The CDI checklists measure early gesture use, vocabulary comprehension and production, as well as grammatical abilities. This section is about parent report as a research method in general. Exactly how parent report is used in the thesis studies is described in Sections 4.4 through 4.7.

4.3.1 Diaries

As mentioned in Section 2.1.2, most of the early studies of children's language development were diaries written by scientist parents. Diaries may attempt to capture most of what a child says, along with the relevant contextual details. Alternatively, targeted diaries compiled by parents may concentrate on a smaller set of utterances, such as children's production of verbs (Naigles, Hoff, & Vea, 2009). However informative diaries may be, they may also be biased and document the development of unrepresentative infants/children. In addition, the method is extremely labor intensive and requires linguistic training in order to accurately record and analyze child utterances. Although still used, the diary method is no longer as common as newer methods of obtaining spontaneous speech samples (see Section 4.2).

⁴⁹ See also http://www.ted.com/talks/deb_roy_the_birth_of_a_word

4.3.2 CDI/SECDI

In addition to the experimental methods described above, checklist measures can be used to measure children's comprehension of language (receptive skills) and/or production, as well as grammatical abilities to a certain extent. With the development of the MacArthur-Bates Communicative Development Inventories (CDI; Fenson et al., 2007), assessing young children's vocabulary knowledge by means of parent report has become both a common and reliable method (e.g. Dale, 1991; Fenson et al., 1994, Pan, Rowe, Spier, & LeMonda, 2004). As with any test instrument, it is important to document validity and reliability. Validity essentially means the degree to which the CDI measures what the authors claim it measures. Reliability refers to the consistency with which the items on a test or a subscale measure that which is claimed. Currently there are over 60 international adaptations of the CDI⁵⁰, a fact which enables cross-linguistic comparisons. The CDIs have been used to document the language abilities of children with various impairments including autism spectrum disorders (Charman, Drew, Baird, & Baird, 2003), Down syndrome (Berglund et al., 2001; Caselli et al., 1998; Mervis & Robinson, 2000) and Williams syndrome (Mervis & Robinson, 2000).

There are several different forms of the CDI, including the Words & Gestures form for children aged 8–18 months, and the Words & Sentences form for children aged 16–30 months. In addition, there are short forms of each of the above, as well as a CDI-III for children 30–48 months. The CDI checklist for infants (CDI: Words & Gestures) includes sections dealing with signs of early understanding and comprehension of phrases, use of communicative gestures, as well as understanding of words. In the vocabulary section, parents may check that their child only understands a word, or both understands and says the word. The toddler form (CDI: Words & Sentences) measures vocabulary production and grammar, including both morphology and syntactic skills. The Words & Sentences form includes a section where parents note the longest utterances children are capable of producing. M3L or MaxLU (maximum length of utterance) can be calculated by counting the number of words produced, as well as the use of inflectional endings such as plural markers (the skills study (III) in this thesis uses M3L as a measure of grammatical ability). In another section, parents give information on children's use of morphological markers for tense, plural endings, etc. Study II uses this grammatical scale in analyses of children's grammatical abilities.

The Swedish Early Communicative Development Inventories (SECDI) are Swedish adaptations of the MacArthur-Bates CDI. The SECDI versions include the Words & Gestures form (Eriksson & Berglund, 1999) and the Words & Sentences form (Berglund & Eriksson, 2000a). The validity and

⁵⁰ For a list of adaptations, see http://www.sci.sdsu.edu/cdi/adaptations_ol.htm.

reliability of the SECDI instruments have been demonstrated (Berglund & Eriksson, 2000b; Eriksson, 2001). The SECDI-III is presently under development; a pilot version was tested with SPRINT participants at child age 2;6–2;9, and a revised version has been completed by over 1000 families in a norming study. In adapting the vocabulary inventories, some words in the vocabulary list were deleted or added in order to be culturally appropriate. In addition, the grammar scale was changed to reflect Swedish morphology. Studies I and II included in this thesis use SECDI: Words & Sentences, while Study III uses both SECDI: Words & Gestures (at 1;0) and SECDI: Words & Sentences (from 1;6 to 2;6).

4.3.2.1 Advantages of parent report

There are many advantages to engaging parents in the assessment of their children's language abilities. First, parents are most familiar with the broad range of their children's communicative abilities as well as individual articulation patterns. This may make assessment with parent report more ecologically valid, with more representative data than laboratory or clinical tests (Crais, 1995). As expressed by Bates, Bretherton, and Snyder (1988), parent report may reveal "what the child knows", as opposed to what the child "is more likely to use" in home or laboratory observations (p.99). Second, there is no need to expose children to distractions such as video cameras, an unfamiliar laboratory setting or unfamiliar adult researchers. Thus, parent report should be less susceptible to such factors as child shyness or mood. Third, parent report is a cost-effective method of gathering data on large numbers of children. It can be used to measure both receptive and expressive vocabulary. Fourth, CDIs are versatile and efficient. Checklists can both be completed with paper and pencil or in online versions, and can be used to monitor changes in language over time. The widespread international use of CDIs, along with their use to measure language development in children with and without disabilities, provides evidence of this. Furthermore, they have been used in both clinical and research settings. Finally, the fact that CDI checklists are limited to current and emerging behavior, and rely on recognition, rather than recall of words used, contribute to the reliability of the method. Thus, parents are asked to check words from a list, rather than produce their own list of words children are currently able to understand or say.

4.3.2.2 Limitations of parent report

There are also limitations to using parent report to assess children's language abilities (Feldman et al., 2000; Fenson, Bates, et al., 2000; Tomasello & Mervis, 1994). For example, parents may under- or overestimate their child's abilities (Feldman et al., 2000; Arriaga, Fenson, Cronan, & Pethick, 1998). One study found that parents overestimated child production abilities compared to laboratory tests, but this may have been the result of context effects

on child performance (Ring & Fenson, 2000). Feldman et al. (2000) also criticized the great variability reported in CDI studies. However, comparisons of parent report and laboratory studies indicate similar large variability in children's early language development (Fenson, Bates, et al., 2000; Jahn-Samilo, Goodman, Bates, & Sweet, 2001). The use of checklists per se has been criticized as giving biased results of vocabulary composition, due to the overrepresentation of nouns on the list (Nelson et al., 1993). However, it must be said that nouns outnumber verbs by 5:1 in English (Oxford English Dictionary; Ambridge, 2009). On the other hand, checklists may eliminate parental reporting bias (e.g. in diaries) by limiting the sample of words from which to report (Pine, Lieven, & Rowland, 1996). Furthermore, using parent report to assess children's behavior, for example, has been found to be more vulnerable to bias than language (Reznick & Schwartz, 2001).

Bates et al. (1994) acknowledge the following limitations of parental report:

[W]e can say nothing here about phonological development (e.g. segmental v. suprasegmental approaches to the analysis of speech), nor about the frequency with which children use particular vocabulary types (i.e. type/token relations). We cannot distinguish between imitations and spontaneous speech, nor can we specify the range of contexts in which individual lexical items are used (e.g. flexible and productive use v. memorized frames). However, we can provide an exceptionally clear view of developmental changes in the composition of vocabulary from 0;8 to 2;6, and we can establish the boundaries of variation in vocabulary composition within and across levels of development. (p. 89)

Further, when testing bilingual children, it is important that checklists for both languages are used. For children over the age of 4, checklist measures may no longer be appropriate, as it is not possible to capture the breadth of their vocabulary knowledge.

4.3.2.3 CDI/SECDI as a screening tool

Feldman et al. (2000) also criticized the inability of CDI measures to predict language delay at early ages. Indeed, the great variability in children's early language acquisition can make it difficult to predict outcomes for late talkers. Thus, using the CDI as the sole instrument in identifying language delay in individuals may be problematic. Most researchers would agree that it is not possible to predict language delay as early as 12 months. In a review of the development and application of CDIs, Law and Roy (2008) concluded that although they are versatile, efficient and valid instruments, CDIs "should not be considered the panacea for all those wishing to assess language in very young children" (p. 204). In Sweden, the SECDI forms are used primarily as a research tool and not a clinical assessment tool, although a screening version (SCS18) has been developed and tested (e.g. Eriksson,

Westerlund, & Berglund, 2002; Westerlund, Berglund, & Eriksson, 2006). Westerlund et al. (2006) have indicated that using the screening tool for children aged 18 months does not reliably predict language delay as the sensitivity and specificity of the instrument is not sufficiently good. In addition to studying the concurrent validity of the CDI: Words & Sentences for late talkers at 2;6, Heilmann, Ellis Weismer, Evans and Hollar (2005) demonstrated that this longer version was effective in identifying low language ability (11th percentile and below) as well as children scoring above the 49th percentile. However, the study, which used likelihood ratio analysis to compare scores at 2;0 and 2;6, found that the CDI was less useful for predicting language status of children in the midrange.

4.4 SPRINT project

This section briefly presents the SPRINT project, with an emphasis on the data relevant to this thesis. The first phase of the project (“Effects of enhanced parental input on young children’s vocabulary development and subsequent literacy development”) aimed to investigate vocabulary development in Swedish children between the ages of 12 and 36 months⁵¹. A naturalistic family intervention using an education program for parents in video format was implemented in order to study the linguistic interaction between parents and children, as well as the potential effects on the children’s vocabulary development.

Recruitment for the project was based on mass mailings sent to the parents of 12-month-old children in the greater Stockholm area. A total of 4,900 invitation letters were sent to addresses obtained through the official population register. Interested parents were asked to access the project website and fill in a vocabulary inventory form online, as well as a background questionnaire. The total response rate was 13.2%; neither telephone calls nor reminder letters were used in the recruitment process. Results of an attrition analysis revealed two main reasons for the low response rate: first, parents were unwilling to commit to participation in a longitudinal study, and second, parents indicated a lack of time, even if they were interested. Another reason for the low response rate may be that data was primarily collected via the internet. Respondents were assigned to four different cohorts, three groups for participation in the intervention phase of the project and one control group where parents only filled in vocabulary inventories. A total of 48 families, in which neither parent spoke Swedish as their mother tongue, were excluded from the project after the initial phase of data collection. The remaining number of families distributed in the four cohorts was 599.

⁵¹ The SPRINT project was funded by the Swedish Research Council in a decision from 23 October 2008 [grant number 2008-5094].

The three intervention cohorts took part in a 3-month intervention period, with data collection before, during and after families' access to the education video material. Information and explicit instructions were provided at information meetings preceding each intervention phase. Follow-up meetings took place after each intervention period. Of the 599 families, approximately two thirds of the parents were university educated, while the remaining one third had either a high school education or some other kind of vocational training, which also could have been at the post-secondary level. As parent education level is one indicator of socioeconomic status, the parent participants in the SPRINT project are not necessarily representative of the general Swedish population. Parent education level in the three studies included in this thesis is similar to the overall level of parent education in the SPRINT project.

Due to the low response rate and absence of short-term intervention effects, proposed methods of data analysis were somewhat revised. For example, norming data from previous SECDI studies (e.g. Berglund & Eriksson, 2000a; Eriksson & Berglund, 1999; Eriksson & Berglund, 2002) were used for assigning children to various percentile groups. Table 4.1 gives an example of differences between the SPRINT sample as a whole and norming percentile scores for receptive and productive vocabulary at 1;0 and productive vocabulary at 1;6.

Table 4.1: Comparison of percentile scores for norming data and the SPRINT sample for receptive and productive vocabulary at 1;0 and productive vocabulary at 1;6

	Receptive voc. 1;0		Productive voc. 1;0		Productive voc. 1;6	
Percentile	Norms	SPRINT	Norms	SPRINT	Norms	SPRINT
10 th	11.0	14.0	0.0	0.0	8.0	14.0
20 th	15.0	26.0	1.0	1.0	13.0	23.0
30 th	22.0	37.0	1.0	3.0	19.0	31.0
40 th	32.0	51.0	3.0	4.0	26.0	44.0
50 th	44.0	61.0	4.0	5.0	35.0	58.0
60 th	58.0	80.0	4.0	7.0	48.0	73.0
70 th	74.0	95.0	6.0	9.0	65.0	104.0
80 th	93.0	115.0	8.0	14.0	93.0	135.0
90 th	127.0	157.0	11.0	19.0	144.0	212.0

With the exception of the 10th and 20th percentile scores for productive vocabulary at 1;0, all values for the SPRINT sample are higher than norming scores for the variables exemplified in Table 4.1. Similar percentile scores were obtained for the various subsamples of children analyzed in Chapter 6 and Chapter 7. The study on parental interaction (Chapter 5) used a smaller sample of children chosen specifically according to norming data percentile scores. Thus, in the first two studies, groups were formed based on the percentile scores from the norming study, rather than the actual positively

skewed scores. Therefore, percentile scores used in the studies are similar to those in the Swedish population as a whole.

4.4.1 Overview of data collection

The data analyzed in this thesis represent a subset of that which has been collected within the SPRINT project, and comprise child vocabulary measurements for all three studies, with the addition of audio recordings of parent-child interaction in Chapter 5. To a great extent, the studies involve quantitative measures, which have been analyzed with various statistical methods (see Sections 4.5, 4.6 and 4.7).

4.4.1.1 Vocabulary measures

Initial child vocabulary data at age 1;0 were collected using the parent questionnaire SECDI: Words & Gestures (Eriksson & Berglund, 1999). Subsequent parent reports of child vocabulary were collected with SECDI: Words & Sentences (from child age 1;6 through 2;6; Berglund & Eriksson, 2000a, 2000b). Figure 4.1 shows the vocabulary data used in this thesis as collected within the SPRINT project. Study I used a sample ($N = 15$) of the parent-reported vocabulary data collected within the first cohort of families from child age 1;6 to approximately 2;0. A sample from Cohort 1 was chosen, as these parents also provided audio recordings of parent-child interaction during this time period (see next section). The composition study (II) used measurements collected from Cohorts 2, 3 and 4 at child age 1;6 ($N = 262$) and 2;0 ($N = 200$). The original reason not to include Cohort 1 children in Study II was to avoid any possible intervention effects, as Cohort 1 parents were the first group to access the parent education material. The skills study (III) used measurements from all four cohorts, collected at 1;0, 1;6, 2;0 and 2;6, as it was then clear that no short-term intervention effects had been ascertained. A total of 348 children comprise the sample in Study III, representing the number of families providing vocabulary measurement on at least two occasions from child age 1;0 to 2;6. Some participants were lost to attrition and missing data after the distribution into four cohorts.

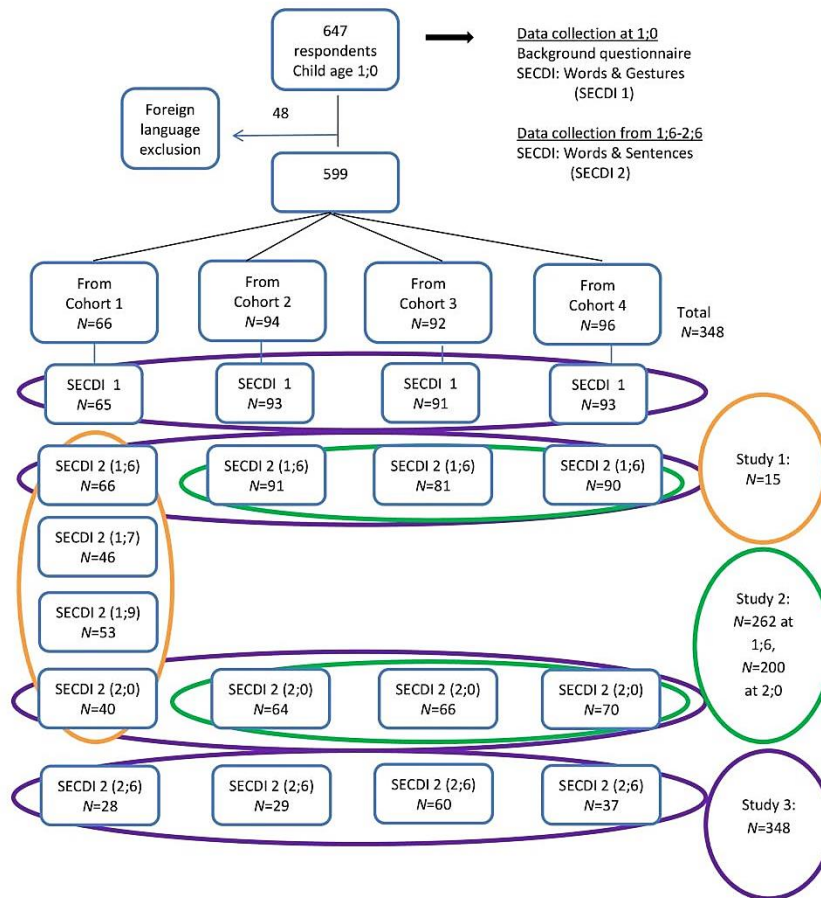


Figure 4.1: Vocabulary measurements used in the studies in this thesis, collected from SPRINT data

4.4.1.2 Recordings of parent-child interaction

Parent participants supplied audio recordings of parent-child interaction during each of the three intervention periods according to instructions given by the project researchers. Only recordings collected during the first intervention period (and only at child age 1;6) are analyzed in this thesis. Parents were given access to H2 Handy digital recorders⁵² at the information meetings mentioned earlier in this section. The parents received instructions on how to operate the recorders and practice time was included during the meetings. Parents were requested to record verbal interaction with their child in four different everyday situations: snack/meal, dressing, story time and play-time. Three sets of the four situations were recorded during the 3-month intervention period, with subsequent follow-up recordings 2 months after-

⁵² <http://www.zoom.co.jp/english/products/h2/>

wards. A total of 1,100 hours of recordings were collected from approximately 200 families. The interaction study (I) used recordings supplied by 15 families from Cohort 1 at child age 1;6. It was originally hoped that some sort of automatic speech recognition technology would be available to aid in the analysis of the large volume of recordings collected. However, this is still not the case at the present time, and the majority of the recordings are yet to be analyzed.

4.4.2 Ethical considerations

The SPRINT project was approved by the Regional Ethical Review Board in Stockholm on 28 May 2009 [2009/596-31/5]. According to the ethical principles set by the Review Board, participating families were given detailed information regarding the project in the original invitation letter. Families gave their consent to participate by accessing the project website and filling out the background form and initial vocabulary inventory. Parents were informed of the right to withdraw participation from the project at any time. During the data collection period, participating families were encouraged to contact researchers if they had questions or needed advice or encouragement. Vocabulary data and recordings are identified only by a randomly generated code which each family received in a welcome letter. This code was used to log in to the project website and upload vocabulary inventories and audio recordings, as well as to access the video material. All data is stored on computers and servers which are password protected. Information regarding the identity of participant families is only available to researchers involved in the SPRINT project. Any personal information provided by the families is used for research purposes only. The personal information and audio recordings are to be stored for a maximum of ten years. Thereafter the material will be submitted to the National Archives and only an anonymized version will remain at Stockholm University. The anonymity of individual families is ensured in any publications or public presentations of project data.

4.5 Methods and materials Study I

This section provides an overview of the materials and methods comprised in Study I, which compares parental input characteristics in three groups of children with varying vocabulary size. As measures of input and children's vocabulary knowledge are analyzed at one point in time, the study provides cross-sectional analyses.

4.5.1 Participants

Participants in this study are 15 families (80% of parents are college-educated) from the greater Stockholm area who represent a subsample of families participating in the longitudinal SPRINT project. Of the 30 mothers and fathers in these 15 families, only one parent (in the p 55–70 group) has a native language other than Swedish⁵³. However, the Swedish-speaking father provided all parental input in three of the recordings used in the analysis, and was also involved in the fourth. Parents completed SECDI: Words & Sentences at several time points between child age 1;6 and 2;0. From the first vocabulary measurement at 1;6, 5 children (2 females and 3 males) with scores in the lowest quartile (0–25th percentile (hereafter p 0–25), active vocabulary 4–15 words) were identified. 5 children (2 females and 3 males) from the 55–70th percentile range (p 55–70, active vocabulary 36–53 words) were chosen so that they matched those in the p 0–25 group, to the greatest extent possible, with regard to gender, number of siblings and other background characteristics, including birth weight, gestation age, ear infections and parental education. Thus, potential differences due to demographic influences could be minimized (Hoff, 2006; Hoff-Ginsberg, 1998). Similarly, 5 children (4 females, 1 male) from the 90–99th percentile range (p 90–99, active vocabulary 161–376 words) were chosen as a matching group. Information on whether the children had started to attend preschool by 1;6 was not available.

4.5.2 Data analysis

4.5.2.1 Adult-child interaction based on audio recordings

Analysis of parental interaction characteristics was based on audio recordings supplied by the parent participants (see Section 4.4.1.2) of parent-child interaction in four different everyday situations: snack/meal, dressing, story time and playtime. This method allowed collection of naturalistic interactions without the effects of an outside observer and a minimum of disruption to everyday life. According to instructions, each recording was to be 20–30 minutes long, although this varied in practice. A selection of the audio recordings was transcribed in CHAT format, which allows further analysis using CLAN (see Section 4.2.2.5). Transcriptions were made for 5 minutes of each recorded situation, starting directly after the parent's introduction explaining the setting of the recording.

As the length of the recorded situations varied greatly, the decision to transcribe from the beginning of each situation reflected an attempt to achieve uniformity across families. Only parent utterances directed to the

⁵³ In the other two studies, a larger number of parents with native languages other than Swedish are represented.

child participant were included in the transcriptions. In one case, where one situation was only 2.5 minutes, longer sections of three situations were transcribed in order to obtain an average of 5 minutes per situation. Ten of the fifteen families had recorded interaction in all the required situations. For the remaining five families, spread across all three groups, a duplicate setting was transcribed instead. This included two mealtime recordings for two families, two book recordings for two families and two playtime recordings for one family. Two families had substituted bath-time interaction for dressing. In all, the transcribed material in CHAT format analyzed in this study includes 20 minutes of child-directed utterances per family (in total, 5 hours) when the children were approximately 1;6.

Approximately 30% of the recordings across groups involved father-child interaction only, while 50% involved mother-child interaction only and 20% involved both parents. In this respect, the sample represents typical everyday interactions and reflects the growing numbers of Swedish fathers taking parental leave.

Transcription reliability was established by having a second researcher transcribe a total of 10 minutes, 2.5 minutes from each of four randomly selected situations. Agreement on utterance boundaries was 91%. At the word level, transcriptions were checked by running both the CHECK program and frequency analyses (FREQ) in CLAN.

4.5.2.2 Measures of quantity and diversity

The amount of parental verbal input addressed to the three groups of children was assessed using the following measures: number of utterances, number of morphemes, total number of words (word tokens) and mean length of utterance (MLU) in morphemes. The number of different words (word types) was used to measure the diversity of parental input. In addition to the type/token ratio of word types in relation to word tokens, a new measure of VOCabulary Diversity, VOCOD (McKee, Malvern, & Richards, 2000), was calculated for each family. Descriptive statistics (also called summary statistics) presented for each of the quantitative input measures include group means and standard deviations, indicating how widely individuals in the group vary.

Utterances

Only child-directed utterances, consisting of a single or multiclausal sentence, a clause, a phrase, a single word, or even a vocalization such as a feedback morpheme (*mm*, *hm*?) were included in the analysis. Utterances directed to siblings or other adults were not included, but could be mentioned in a comment. As 80% of the recordings comprised interaction between one parent and the child, the majority of situations consisted entirely of child-directed utterances. In the remaining 20%, where both parents were present, the small amount of talk between parents was not transcribed. Child

utterances were not transcribed as turns in the conversation, but their actions (as well as could be understood from the audio recordings) and verbalizations were noted as comments. Thus, the conversational turn-taking between parent and child determined in part the division of parental input into utterances. Grammatical structure, in addition to intonation, was used to determine the end of an utterance, which was indicated with a full stop, question mark or exclamation mark. Commas were used to indicate short pauses within utterances. However, syntax, rather than the length of a pause, was the final determiner in utterance division. Elements after a pause were judged to belong to one utterance if they were part of the same grammatical sentence. Conversely, if the speech flow consisted of more than one independent clause uttered without an intervening pause, the two clauses were considered separate utterances.

Word tokens

Word tokens were calculated using the *FREQ* program in *CLAN*. Words were transcribed orthographically, using standardized Swedish spellings. Conventions listed in the *CHAT* manual were followed to represent unpronounced sounds, truncated words, compound nouns, linkages, quoted utterances as well as unintelligible words and strings, denoted as *xx* and *xxx*, respectively⁵⁴. Interjections and onomatopoeic expressions were included as word tokens, but repetitions within such expressions were considered linkages so as not to inflate word counts. Interrogative feedback morphemes were transcribed as *hm*, while *mm* represents the affirmative.

Mean length of utterance (MLU) in morphemes

MLU in morphemes was calculated using the *MLU* program in *CLAN*. To facilitate this calculation, utterances were transcribed to reflect morphemic units in sentence elements, for example using hyphens before inflectional endings.

Word types

Word types were also calculated using the *FREQ* program in *CLAN*. Although Swedish is considered a morphologically limited language, it was important to ascertain the degree of complexity in parent utterances. Thus, inflectional variations of a given word (e.g. *äta*, *ät-er*, *ät*, *ät-it* = eat (infinitive), eat/eats, ate, eaten) were counted as different types. Admittedly, this is a different approach than in many other studies, but it reflects an attempt to further characterize the complexity of parent utterances. Inflectional forms

⁵⁴ According to the version of the *CHAT* manual originally followed (Oct. 5, 2010), strings denoted as *xxx* are excluded from word counts, but words denoted as *xx* are counted as morphemes in the *MLU* program.

of nouns, adjectives, articles and pronouns were also considered unique types. Multi-word expressions written as linkages were treated as one type.

Type/token ratio/VOCD

Type/token ratio, which has been used extensively in child language research as an index of lexical diversity, was calculated automatically using the *FREQ* program in *CLAN*. It is directly linked to the number of tokens from which it is calculated and, thus, is influenced by talkativeness and mean length of utterance (Richards, 1987, 1994). Analysis of *D* (the value of vocabulary diversity obtained from *VOCD*) was undertaken because the number of tokens uttered by parents varied across families. *VOCD* is calculated from *CHAT* transcripts and is based on the type/token ratio versus token curve calculated from the entire sample. The program plots this curve in three randomly chosen subsamples of words uttered by the speaker. The final value of *D* is the average of the three optimum values calculated. High values of the resulting *D* reflect a high level of lexical diversity, while lower values indicate less diversity.

4.5.2.3 Coding of feedback

In order to examine potential differences in how the three groups of parents used interactive feedback behaviors in conversations with their children, a feedback tier (%*FBC*) was added below the main tier line in *CHAT* transcription. These interactive feedback behaviors are parents' response to their children's activities, which include both vocalizations and actions. While the children in the high percentile group were already combining words, the children in both the low and medium percentile groups used only one-word utterances at this time, a stage in development which is in accordance with norming studies for Swedish children (e.g. Berglund & Eriksson, 2000a). The positive interactive behaviors coded here are the use of imitations, expansions of child utterances or actions, and affirmations. Several different feedback behaviors could be represented in one single utterance. Table 4.2 presents the definitions used to code parents' positive interactive behaviors.

Table 4.2: Coding of positive interactive feedback behaviors^a

Feedback behavior	Definition	Examples
Imitations	Parents repeat words or sounds uttered by the child	Child: <i>Där.</i> ('There.') Parent: <i>Ja, där.</i> ('Yes, there.')
Expansions (more than just giving a label to an object or action)	Parents expand upon a child's utterance or action by adding a phrase, adjective or adverb to a word	<i>Det är bandspelaren som jag pratade om.</i> ('That's the tape recorder I was talking about.') <i>Och blöta är de, dyblöt!</i> ('And they're wet, soaking wet!')
Affirmations	Parents affirm a child's communicative intent	Words such as <i>ja</i> and the variants <i>mm</i> and ingressive <i>hah^b</i> ('yes'), <i>just det</i> ('exactly'), <i>visst</i> ('certainly'), <i>bra</i> ('good'), <i>duktig</i> ('well done'), <i>tack</i> ('thank you')

^aA fourth feedback behavior, commentaries, was deleted because of insufficient reliability.

^bThe commonly used affirmative Swedish *ja* ('yes'), pronounced while inhaling a breath.

In order to assess reliability of the coding defined above, a second researcher coded nine randomly selected 5-minute situations from different families, three from each of the three groups. These situations represented 15% of the transcripts, as well as approximately 50% mother input and 40% father input. Results were calculated for each of the three positive feedback behaviors separately, as one utterance could include more than one type of feedback behavior. Percentage agreement represents the percentage of all utterances that the two coders gave the same code or non-code to, and was 99%, 98% and 95% respectively for imitations, expansions and affirmations. As the standard deviations in these small groups were large, group comparisons were conducted using the non-parametric Kruskal-Wallis test, for both the measures of amount and diversity and parental use of interactive feedback behaviors. All statistical analyses were performed using SPSS, version 20.0, with statistical significance established at the 5% level.

4.5.2.4 Parental use of questions

Question analysis also gives an indication of parents' interactive style. The total number of questions asked by parents included all utterances that ended in a question mark (see Section 4.5.2.2). The percentage of questions represented the ratio of total questions to total verbal utterances. Wh-questions were divided into two categories: receptive wh-questions begin with *var* ('where') or *vilken/vilket/vilka* ('which'), and allow the child to answer by pointing to an object, while productive wh-questions begin with *vad* ('what'), *vem* ('who'), *vart* ('where to'), *hur* ('how') or *varför* ('why'), and prompt the child to answer by providing a verbal response. The word *när* ('when') occurred only as a subordinate conjunction in questions, if at all.

Auxiliary-fronted yes/no-questions begin with a modal auxiliary and ask children, rather than tell them what to do. These are related to Hart and Risley's (1995) category of 'guidance style'. Other yes/no-questions included tag questions, single feedback morphemes, and questions beginning with finite verbs or auxiliaries other than modals, as well as other utterances where parents used question intonation.

4.5.2.5 Vocabulary composition

Variables were created for the sum and total percentage of common nouns, predicates (action verbs plus adjectives) and closed-class words in SECDI: Words & Sentences, following Bates et al. (1994) as well as social words, following Caselli et al. (1999). For a detailed description of this process (see Section 4.6.2.2). This study reports values for the children's vocabulary composition at age 1;6 only, as data at age 2;0 is missing for six of the 15 families. Furthermore, analysis of parental input is based on recordings made at child age 1;6.

4.5.2.6 Parental input: closed-class words and special verbs

Counts of parental use of some special verbs (including *se* ('see'), *titta* ('look'), *göra* ('make/do'), *ta* ('take')—used to capture children's attention and engage them in the task at hand—and *tro* ('believe') and *tycka* ('think'), which are used to gauge how much children understand in a certain situation) were obtained using the COMBO program in CLAN. The choice of these verbs was based on results reported in Richthoff (2000). Counts of closed-class words in parental input were obtained using the FREQ program. The choice of these function words was based on examination of group differences among parents and vocabulary composition of the children in this study, and include the following: *där* ('there'), *här* ('here'), *den/det* ('it/that', common and neuter gender), and *den där/den här* ('that one/this one').

4.6 Methods and materials Study II

Study II examines the role of vocabulary composition and grammatical abilities, as well as word combinations, in four groups of learners at two time points, child age 1;6 and 2;0. Summary statistics of vocabulary composition are given for all children. In addition, vocabulary composition is calculated in terms of percentages both as a function of vocabulary size and learner category. Percentage scores in the four different groups are compared using the non-parametric Kruskal-Wallis test. Correlations are calculated among composition and grammatical variables, as well as background variables, for all children as well as various groups of learners. Regression analysis is used to calculate the predictive value of the different variables at 1;6 for vocabulary size at 2;0.

4.6.1 Participants

Participants in this study are a larger subsample of families taking part in the SPRINT project. Approximately 90% of the parents have Swedish as their native language and there is at least one native Swedish-speaking parent in each family. In all, 21 languages other than Swedish are represented, with Finnish and English speakers comprising the majority. Approximately two thirds of the participating parents are college-educated, while 20% have a secondary school education.

This study examined the children's vocabulary composition and grammatical abilities, based on vocabulary measurements using SECDI: Words & Sentences at age 1;6 and 2;0. Data for 262 children comprise the sample at 1;6, while there are measurements for 200 children at 2;0. However, for analysis of development tracked over the 6-month period, only data for children with multiple vocabulary measurements was used ($N = 183$). Mean child age was 17.5 months at the first measurement (SECDI_1;6) and 23.6 months at the second measurement (SECDI_2;0).

4.6.2 Data analysis

4.6.2.1 Timing of acquisition

In order to examine the stability of children's vocabulary development over the 6-month period, vocabulary scores were grouped according to quartile divisions based on Swedish norming data (Berglund & Eriksson, 2000a), not the scores in the present analysis. This explains why there is an over-representation in the higher quartiles and corresponding under-representation in the lower quartiles. Additional variables were created to indicate children's movement (or stability) among percentile groups at the two vocabulary measurements. For example if a child originally scored in the lowest quartile (group 1) at SECDI_1;6 and remained in that same quartile at SECDI_2;0, they were coded as '11'. Likewise, if a child from the lowest quartile group advanced to the highest quartile at SECDI_2;0, they were coded as '14'.

In the analysis, children coded as 11, 12, 21 and 31 can be seen as 'slower learners'⁵⁵. Children with the codings 13, 14 and 24 are considered 'late bloomers', while those coded as 22, 23, 32 and 33 are classified as 'average learners'. Children coded as 34, 43 and 44 are considered 'fast learners'. Children with the codings 11, 22, 33 and 44 show group stability throughout measurements. There were no children at all in the 41 or 42 group. The four

⁵⁵ This is the author's own designation, which is not necessarily the same as the concept of late talkers, which is sometimes determined for children aged 24 months with scores under the 10th percentile for productive vocabulary on the CDI. Alternatively, late talkers are children aged 24 months or older using fewer than 50 words and/or no word combinations.

categories regarding timing of vocabulary development were used for analysis of both vocabulary composition and word combinations/use of grammatical features. For vocabulary size ranges for each quartile group used in the analysis, see Table 11.1. The gender distribution of the children with vocabulary measurements at 1;6 and 2;0 is displayed in Table 4.3. The table also presents the number of girls and boys in each of the four learner categories used in the analysis.

Table 4.3: Gender distribution in the various groupings used in the analysis

Group	Total no. children	Female	%	Male	%
SECDI_1;6	262	126	48.1	136	51.9
SECDI_2;0	200	93	46.5	107	53.5
Slower learners	22	5	22.7	17	77.3
Average learners	26	9	34.6	17	65.4
Late bloomers	15	6	40.0	9	60.0
Fast learners	120	68	56.7	52	43.3

Note: The children in the four categories of learners comprise the group of 183 children with measurements at both ages.

4.6.2.2 Vocabulary composition

In order to examine vocabulary composition in relation to vocabulary size and timing of growth, new variables were created for the sum and total percentage of common nouns, predicates and closed-class words in SECDI: Words & Sentences, following Bates et al. (1994) as well as social words, following Caselli et al. (1999). Percentage scores were calculated both as the absolute proportion of a child's total vocabulary (Bates et al., 1994; Caselli et al., 1999; Koster et al., 2005; Stolt et al., 2007), as well as the relative proportion of the number of words in each class on the checklist (word opportunity scores, Bornstein et al., 2004; Maital et al., 2000; Nelson et al., 1993; Stolt et al., 2007). According to Bornstein et al. (2004), using opportunity scores is a more conservative option and more appropriate for checklist data (see also Pine et al., 1996).

Common nouns included the categories 'animal names', 'vehicles', 'toys', 'food and drink', 'clothing', 'body parts', 'small household items' and 'furniture' (not 'games and routines', 'sound effects', 'names for people' and 'places to go'). This list comprised 309 nouns which made up 43% of the total 711 items on the inventory list (roughly similar to the American toddler checklist).

Predicates consisted of the sum of verbs ('action names') and adjectives ('descriptive words'), not including closed-class modifiers such as quantifiers, articles or pronominal adjectives. This list comprised a total of 167 words and 23% of the inventory list.

Closed-class items consisted of pronouns, prepositions, quantifiers, auxiliary verbs, connectives and question words (not ‘words about time’), for a total of 97 words and 14% of the inventory list.

Social words consisted of a total of 72 words, grouped from the three categories ‘sound effects and animal sounds’, ‘people’ and ‘games and routines’. They comprised 10.1% of the inventory list, compared to 9.7% of the American form and 9.85% of the Italian form (Caselli et al., 1999).

4.6.2.3 Grammatical abilities and word combinations

In order to analyze how children use grammatical features over the 6-month period, a new variable was created by summing the answers to five questions in SECDI: Words & Sentences regarding children’s use of the following: possessive ‘-s’, definite form singular, definite form plural, indefinite plural, and the past tense. The first four features are related to nouns, while the last one regards verb tense. This variable can have a maximum score of 10, as parents were instructed to answer ‘not yet’ (0 points), ‘sometimes’ (1 point) or ‘often’ (2 points). Children’s ability to combine words was considered separately, and the percentage of children able to combine words at the two ages was calculated by summing the values for ‘sometimes’ and ‘often’.

4.6.2.4 Lexical and grammatical development as a function of vocabulary size

In order to obtain a snapshot of the children’s lexical and grammatical development at age 1;6 and 2;0, all children with vocabulary measurements at these two time points were assigned a vocabulary level (in number of words) from one to eight following Bates et al., (1994). At 1;6, the groups were as follows: 0–50 ($n = 118$), 51–100 ($n = 61$), 101–200 ($n = 52$), 201–300 ($n = 19$), 301–400 ($n = 9$), 401–500 ($n = 3$). There were no children at levels seven and eight at 1;6. Due to small group sizes, the last three groups were combined for some analysis: 201–500 ($n = 31$). At 2;0, the groups were: 0–50 ($n = 11$), 51–100 ($n = 12$), 101–200 ($n = 21$), 201–300 ($n = 30$), 301–400 ($n = 28$), 401–500 ($n = 46$), 501–600 ($n = 38$), 601–700 ($n = 14$).

4.6.2.5 Prediction of vocabulary size

In order to confirm the prediction of vocabulary size 6 months later by composition and grammatical abilities at 1;6, a baseline stepwise regression was performed with vocabulary size at 2;0 as the dependent variable and the following covariates: vocabulary size at 1;6, child gender and parental education. Each parent’s level of education was coded according to the International Standard Classification of Education (ISCED) and the two numeric codes were summed to obtain one measure of parental education. Stepwise regression was also conducted with vocabulary size at 2;0 as the dependent variable and the percentages of common nouns, predicates, closed-class words and social words, as well as grammatical ability variables (word com-

binations and a summed grammar ability score) at 1;6 as covariates. To ascertain differences between the slower learners and the late bloomers, an indicator variable for group membership (0, 1) was included in a separate regression analysis. In addition, Pearson coefficients of correlation were calculated for all quantitative variables used in the analyses. Composition variables in the four learner categories were compared using the non-parametric Kruskal-Wallis test. Statistical analyses were performed using SPSS version 20, and the regression analyses were also conducted using the GLM procedure in SAS/STAT software. The level of significance is 5%.

4.7 Methods and materials Study III

Study III provides cross-sectional analysis as well as analysis over time of relationships between a number of communicative skills from child age 1;0 to 2;6. These skills include children's use of communicative gestures, receptive vocabulary, productive vocabulary and the grammatical/syntactic measure M3L, derived from the three longest utterances produced by children. Correlations are either bivariate (involving two variables at one point in time) or partial correlations, where the effect of one or more variables is removed. The latter technique is used when more than two variables are analyzed at a certain age, as well as with pairwise correlations across ages. Cross-lagged panel correlations are also presented for the communicative variables over time.

4.7.1 Participants

Participants in this study represent the largest subsample of families from the SPRINT project in the present thesis. Only children with families who filled in the SECDI inventories on two or more occasions are included in the study, with the sample comprising 348 children in total. As in the other two studies, the majority of parents are native Swedish speakers, with each family having at least one native Swedish-speaking parent. The parents responded to SECDI: Words & Gestures (Eriksson & Berglund, 1999) at 1;0 and SECDI: Words & Sentences (Berglund & Eriksson, 2000a) at 1;6, 2;0 and 2;6. The number of children in different age groups and age ranges varies as the families followed different schedules⁵⁶. Table 4.4 below presents the number of children from each cohort at the different age spans. There are measurements for 128 children at all four time points. Mean child age at the four measurement points was as follows: 1;0.8, 1;6.2, 2;0.3 and 2;6.4⁵⁷.

⁵⁶ This was due to families being distributed into different cohorts.

⁵⁷ This notation denotes child age in year;months.days.

Table 4.4: Number of children (girls/boys) included in each cohort with data at the various age spans, $N = 348$

Cohort	Number of children	Age span, months			
		12/18 Girls/Boys	18/24 Girls/Boys	24/30 Girls/Boys	12/18/24/30 Girls/Boys
1	66	30/35	22/18	14/12	14/12
2	94	45/45	29/33	13/16	13/15
3	92	36/44	26/32	18/29	17/25
4	96	43/43	34/30	19/15	17/15
Total	348	321	224	136	128

Note: The number of children in each column does not add up to the total number of children in the study ($N = 348$), as the total includes all children with data at two or more time points. 12/18, e.g., indicates children with records at 12 and 18 months.

Table 4.5 presents means and standard deviations (SD) for the various measures, including total number of gestures, receptive vocabulary, productive vocabulary and M3L, for the total sample as well as the 128 children with data at all four time points. In order to perform analyses of SECDI data with the cohorts as combined groups, one-way ANOVAs were performed to ensure that there were no significant differences among the cohorts for the variables analyzed. For the total sample, results yielded no significant differences among the cohorts at 12 months of age for productive vocabulary ($p = .816$), receptive vocabulary ($p = .182$) and gestures ($p = .988$), no significant differences at 18 months for productive vocabulary ($p = .777$) and M3L ($p = .321$), no significant differences at 24 months for productive vocabulary ($p = .916$) and M3L ($p = .862$), and no significant differences at 30 months for productive vocabulary ($p = .429$) and M3L ($p = .558$). Similar results were obtained for the 128 children with complete records over four time points. Owing to the large number of comparisons involved in these ANOVAs, a more stringent significance level was used (1%). Due to the lack of significant differences among the cohorts with respect to the dependent variables, the cohorts were combined in the following analyses.

Table 4.5: Means and standard deviations (SD) for the SECDI measures gestures (total), receptive vocabulary, productive vocabulary and M3L for the total sample (N = 348) and the 128 children with complete records. Measures are from SECDI: Words & Gestures at 12 months and SECDI: Words & Sentences 18–30 months.

N = 348				
	12 N = 342	18 N = 327	24 N = 241	30 N = 153
Gestures	25.54 (8.43)	-	-	-
Receptive.	74.31 (54.17)	-	-	-
Productive	8.55 (9.69)	88.25 (87.72)	360.60 (178.67)	539.56 (160.00)
M3L	-	1.92 (0.90)	4.75 (2.18)	7.68 (3.53)
N = 128				
	12	18	24	30
Gestures	24.13 (7.97)	-	-	-
Receptive	73.57 (57.02)	-	-	-
Productive	8.46 (10.37)	83.87 (81.49)	355.88 (181.46)	545.83 (155.77)
M3L	-	1.87 (0.91)	4.61 (2.30)	7.75 (3.57)

To explore whether the results could be applied to Swedish children in general, the present results were compared with the Swedish norming studies (Eriksson & Berglund, 1999; Berglund & Eriksson, 2000a). This comparison revealed that results were somewhat higher in the present sample than in the norming study. Therefore the results of this study should be interpreted to represent children with a communicative development somewhat faster than for typical Swedish children.

4.7.2 Data analysis

4.7.2.1 Vocabulary reception and production

These measures were the summarized score of the wordlist sections of SECDI: Words & Gestures when children were 12 months, or SECDI: Words & Sentences when the children were 18 months and older (only word production).

4.7.2.2 M3L

M3L was computed in three steps:

- 1) The number of inflections in each utterance was counted (if inflections were repeated in a word that occurred several times in an utterance, they were only counted once).
- 2) The number of words in an utterance was counted. If the utterance included repetitions, only one of the repeated words was counted. If the utterances included a list of names, only three names were computed as separate words. If the utterance included words of a song or a children's book, a maximum of four words were counted from this title or quote.

3) The numbers of inflections and words were added and divided by the number of longest sentences the parents had recorded.

If parents had not included any examples of long sentences but indicated that the child produced words in the wordlist, two scoring options were implemented: children with vocabularies of 50 or fewer words received an M3L value of 1. For children producing more than 50 words, the data of the child was counted as “missing”. At 18 months, 27 children had missing data according to the criteria, at 24 months there were 3 children with missing data, and at 30 months there were 10 children with missing data. Especially at 30 months, many parents commented that it was difficult to give examples of the longest sentences as their children were speaking constantly and unhindered.

4.7.2.3 Gestures

In addition to the total gesture score in SECDI: Words & Gestures, an analysis was performed of two subsamples of items in the gesture-section based on the procedure used by Sansavini et al. (2010). One subsample, denoted “empty-hand” (although some involve body parts other than hands), consisted of seven items chosen to match those used by Sansavini et al. (2010). The other subsample consisted of 11 items and was called “object-actions” (short for “object-related actions”). There were some minor differences between the Italian and Swedish gesture scales as indicated below.

Empty-hand

“Empty-hand” gestures, which are actions not involving objects, included the deictic gestures *request*, *show* and *point*, the routine gesture *blow a kiss*, and the conventional gesture *blow to indicate something is hot*. The gestures *clap hands* and *point to cheek for something tasting good* were not used, as they were not part of the Swedish inventory. Instead, *wave bye-bye* and *smack with lips in a yum-yum gesture* were added to include gestures of a similar nature.

Object-action

“Object-actions” included the actions *eat with spoon*, *wipe face*, *throw a ball*, *stir with spoon*, *put to bed*, *push in stroller*, *kiss and hug doll*, *sweep with broom*, *put a key in lock*, *write with a pen*, and *put on a necklace*, which were all included in the Swedish inventory and thus included in the analysis.

4.7.2.4 Word class analysis

The analysis of the interrelationships among gestures and nouns, verbs and closed-class items was based on the following sections of SECDI: Words & Sentences:

1) Nouns were counted as the summary score of sections 2–9 (‘animals’ to ‘furniture and rooms’).

- 2) Verbs comprised the total score of section 14.
- 3) Closed-class items comprised sections 16 and 18–21, that is ‘pronouns’, ‘prepositions’, ‘numbers and articles’, ‘auxiliary verbs’ and ‘connectives and question words’.

Vocabulary composition in terms of absolute percentages of these word classes was used in the analysis. Percentages were obtained by dividing the summary score for each word class by the child’s total vocabulary score at the same age (18 months). Study II used slightly different categories for composition analysis. There, predicates (verbs plus adjectives) were used, rather than verbs alone, and the category of social words was also included. In addition, analysis in Study II included vocabulary composition in terms of absolute percentages and opportunity scores (e.g. the sum of nouns divided by the number of nouns on the checklist).

4.7.2.5 Comparisons with American CDI data

The results obtained for the present sample of Swedish children were compared with correlations calculated from an American CDI data sample available on the CHILDES website⁵⁸. These data files represent American norming data for CDI: Words & Gestures ($N = 1,089$) and CDI: Words & Sentences ($N = 1,461$). As children of different ages were included in the files, correlations were calculated for subsamples corresponding to the ages of the children in this study.

4.7.2.6 Correlations

Interrelations among the various measures were explored over 6-month periods, using both bivariate correlations and the partial correlation technique. The latter makes it possible to single out significant sources of variation while keeping other measures constant, as all measures at the previous age were used as covariates in the calculations. Thus, the partial correlation technique was used when there were more than two variables examined, and with only two variables, bivariate correlations were calculated. The obtained results are presented in tables as well as figures describing overall early development of communicative skills. Correlations were calculated for the total sample as well as the 128 children with complete records. Cross-sectional correlations were calculated at each age, and pairwise correlations were calculated between similar measures at different ages, as well as in a cross-lagged panel design. All analyses were conducted using SPSS version 20.0. For correlation analysis, a significance level of 5% was used.

⁵⁸ <http://childes.psy.cmu.edu/tools/CDI/>

5 Parental verbal interaction characteristics and Swedish children's vocabulary knowledge at 1;6

5.1 Introduction

How can the way in which Swedish middle-class mothers and fathers talk to their 18-month-old children be characterized? Is the size or composition of children's vocabularies related to parents' verbal interaction characteristics, including the amount of input directed to them? If so, why is this important? Previous research has emphasized the importance of a child's early language abilities for later language and cognitive outcomes, which in turn affect later literacy skills and school achievement (see Section 3.3).

Children's language and communication development is affected by factors in the home and childcare environments, such as interaction patterns and characteristics of the input (see Section 3.2.5). Context effects also include interactional setting and parent gender (see also Section 3.2.5.1). Some researchers have stressed that the relationship between parental language input and children's language acquisition is most likely reciprocal (Huttenlocher et al., 2010). Child-directed parental speech can vary across cultures, and as a function of social factors or individual characteristics of the caregiver and the child. Research on parental input has documented variability in parental input and correlated variability in children's early language development, especially with respect to English-speaking families. Study samples have included families with a range of SES, and low-SES families, but fewer with consistently high SES samples. Hart and Risley's (1995) seminal study compared parental input and corresponding child outcomes in professional, working-class and welfare families. Their study provided impetus not only for a great deal of later research in the United States, but also inspired the SPRINT project, within which data for this thesis was collected. This study adds to the body of international literature in that it examines parental input in relation to child vocabulary knowledge in a sample of high-SES families, who additionally represent both an understudied culture and language.

Patterns of children's early vocabulary growth have been described in studies of English-speaking children as well as speakers of other languages (see Section 3.1.4.3). Variability with regard to the composition of children's early vocabularies has also been documented (see Section 3.1.4.4). This

study investigates children's vocabulary composition in relation to parental input at 1;6, while Study II describes the stability of children's vocabulary from 1;6 to 2;0, including composition variables.

In summary, research over the last 30 years has provided evidence that children's language development as well as child-directed parental input is characterized by great variety with regard to quantity and quality. Both quantity and quality can be measured in various ways and the input is influenced by culture, social factors and characteristics of the individual caregiver. Further, results of studies have indicated that the quality and interactive nature of caregiver input plays a very important role in child language development.

5.2 Aim

The overall aim of this study was to examine parental verbal interaction characteristics and input with respect to children's vocabulary knowledge in a sample of middle-class Swedish families, as based on analysis of audio recordings. In order to do so, a comparison was made of the parental verbal input directed to three groups of children ($n = 5$ in each group), chosen according to their vocabulary production scores at age 1;6. The three groups consisted of children with low (0–25th percentile), medium (55–70th percentile) and high (90–99th percentile) verbal scores according to normative scales for their age (SECDI measures, Berglund & Eriksson, 2000a). The following specific research questions were posed:

- Can group differences be ascertained in the nature of the verbal input directed to the children regarding amount and diversity of speech, parental interactive feedback behaviors, i.e. verbal responses to the children's activities, and parental use of questions?
- How is children's vocabulary knowledge expressed in terms of vocabulary composition in the three groups at 1;6?
- Are there differences in comparisons between special categories of words in parental input and children's production?

Detailed information regarding the methods and materials used in this interaction study are found in Section 4.5.

5.3 Results of Study I

Figure 5.1 presents the vocabulary development trajectories of all 15 children, with their scores from SECDI: Words & Sentences plotted over a period of 5–6 months. Division into the three groups was based on the first

measurement at approximately 18 months, and as can be seen, the groups are relatively stable, although individual trajectories vary. One noteworthy exception is Child B, originally in the p 0–25 group, who can be considered a late bloomer.

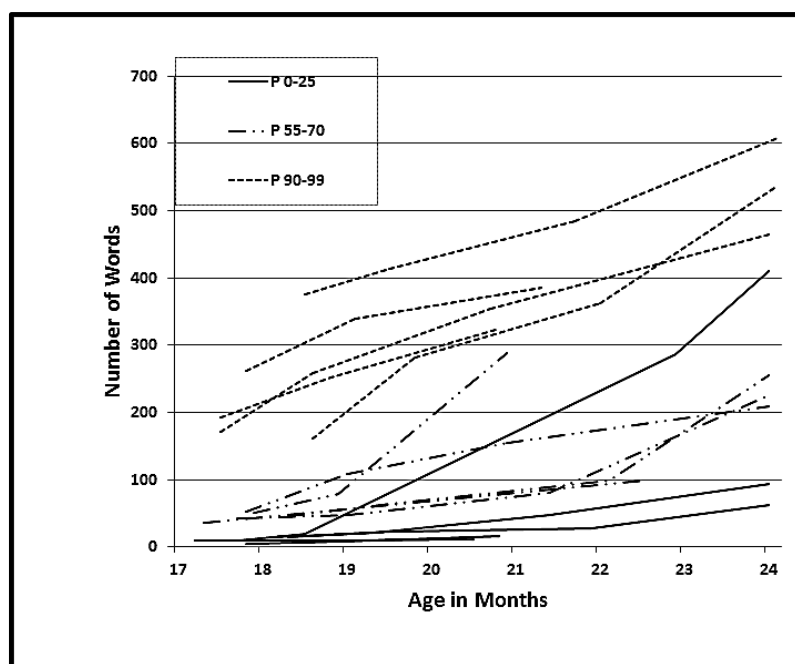


Figure 5.1: Vocabulary development trajectories of the three groups of children (p 0–25, p 55–70 and p 90–99), measured at 2–3 time points during a 6-month period with SECDI: Words & Sentences

In order to identify the clarity of speech addressed to children in the 15 families, the number of unintelligible words (xx) or strings of words (xxx) in the transcribed material was calculated. Table 5.1 gives these results, along with the number of word tokens uttered in the 20 minutes of transcribed child-directed utterances per family and resultant average number of words per minute. This can only be seen as a coarse estimate of rate of speech, as it does not take into account pause duration during the transcribed interactions. More specific analysis of the same data has revealed a correspondence between parental utterance duration and amount of linguistic content in utterances as measured by number of syllables; thus, there was no difference between the three groups in actual rate of speech (Marklund, Marklund, Lacerda, & Schwarz, 2014).

Table 5.1: Clarity and amount of speech per minute addressed to children by individual families in the three groups

Percentile group and child	No. of word tokens per 20 minutes	Average no. of words per minute	No. of xx	No. of xxx
P 0–25				
A	865	43.3	4	0
B	988	49.4	9	0
C	2022	101.1	33	8
D	811	40.6	29	4
E	893	44.6	11	4
P 55–70			Total = 86	Total = 16
F	1280	64.0	2	0
G	1451	72.6	9	3
H	1184	59.2	8	2
I	1298	64.9	9	0
J	1707	85.4	3	0
P 90–99			Total = 31	Total = 5
K	1488	74.4	16	5
L	1123	56.2	2	0
M	1469	73.5	7	0
N	1800	90.0	13	3
O	1405	70.3	9	3
			Total = 47	Total = 11

Note: 'xx' refers to unintelligible words, while 'xxx' refers to unintelligible strings of words.

There is clearly an outlier family in the p 0–25 group with both a greater lack of clarity in speech and greater average number of words addressed to the child (Child C). However, values for the parents of Child D indicate that lack of clarity may accompany lower amounts of speech per minute as well.

5.3.1 Amount and diversity of parental input

The first aspects compared here were the amount and diversity of the parental input directed to the three groups of children. Table 5.2 presents the computed values for the amount of input measured in number of utterances, number of morphemes, number of word tokens, and mean length of utterance in morphemes, as well as diversity measured in number of word types, type/token ratio, and D (VOCD). The obtained results reveal that the number of utterances, morphemes, word types and word tokens used by parents increased with child vocabulary size. The large standard variations in all variables for the p 0–25 group was mostly due to the same outlier family, which had the highest values for number of utterances, morphemes and word tokens of all parents. This family also had the fourth highest MLU of all families (only one of the families in the p 90–99 group had a higher value), the second highest score for word types, the lowest type/token ratio and second

lowest D-value (VOCD). As mentioned earlier, talkativeness can influence the calculation of the type/token ratio, as it is linked to the overall number of tokens used by the parents. Thus, the larger the sample from which it is calculated, the smaller the ratio. Due to the presence of this outlier, statistical comparisons were carried out with and without this specific family.

Table 5.2: Descriptive measures of parental input in the three groups

Measure	Group (<i>n</i> = 5 in each)					
	P 0–25		P 55–70		P 90–99	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
No. of Utterances	295.00	102.80	366.00	52.90	388.00	69.20
No. of Morphemes	1349.00	634.80	1673.00	268.50	1753.00	289.70
Word Tokens	1116.00	510.60	1384.00	204.30	1457.00	241.40
MLU (morphemes)	4.49	.76	4.61	.66	4.57	.64
Word Types	295.00	80.20	376.00	31.90	354.00	59.70
Type/Token Ratio	.28	.05	.27	.04	.24	.02
D (VOCD)	70.51	16.95	75.85	17.78	68.34	13.39

Note: Values without the outlier in the p 0–25 group are as follows: number of utterances, *M* = 249.8, *SD* = 17.9; morphemes, *M* = 1069.0, *SD* = 126.9; word tokens, *M* = 889.3, *SD* = 74.1; word types, *M* = 266.0, *SD* = 54.5.

Non-parametric group comparisons including the family-outlier revealed no significant group differences (*p*-values ranging from .151 for utterances to .970 for MLU). However, leaving out the outlier from the analysis, there were statistically significant differences between groups for number of utterances (*p* = .015), morphemes (*p* = .017), word tokens (*p* = .016) and type/token ratio (*p* = .042) at the 5% significance level. In addition, a significant group difference for word types was obtained at the 10% significance level (*p* = .050). Values for MLU and D (VOCD) were highest for the p 55–70 group, while type/token ratio was highest for the parents of the children with the smallest vocabularies.

In summary, analysis of the amount and diversity of parental input revealed that the number of utterances, morphemes, word types and word tokens increased with child vocabulary size. Results of a non-parametric Kruskal-Wallis test conducted for these four measures without the family-outlier showed that outcomes (*p*-values ranging from .015 to .050) differed significantly across the parent groups. Additionally, a significant difference was shown for type/token ratio.

If the outlier influences results of the group comparison (i.e. it is an influential observation), the natural question is what makes them to be so different from the other families. The audio recordings for all 15 families in the study gave evidence of loving attentiveness to their child's needs, and this family was no exception in this regard. However, in relation to the sheer quantity of input presented to the child in the transcribed material, parent talk was often uttered very quickly and unclearly (see Table 5.1). Analysis of

the number of words or strings of words deemed unintelligible (xx or xxx, respectively) in the transcribed material showed that this family had the largest score (41 instances). The parents in the p 0–25 group uttered a total of 102 unintelligible words or strings. In comparison, the parents of children in the p 55–70 group uttered 36 unintelligible word or strings, while there were 58 such instances for the parents in the p 90–99 group. Thus, parents of the children with the smallest vocabularies had 3 times as many unintelligible words or strings as the parents of children with average vocabularies, and twice as many as the parents of children with large vocabularies.

5.3.2 Interactive feedback behaviors

Figure 5.2 provides a graphic representation of differences among the parents' use of interactive feedback behaviors. Parents in the p 90–99 group used more imitations and expansions in interactions with their children than did the parents in the other two groups. The p 55–70 parents used the highest number of affirmations of all three groups. Group comparisons (including the outlier) using the non-parametric Kruskal-Wallis test revealed significant group differences in parental use of all three interactive behaviors: imitations ($p = .004$), expansions ($p = .007$) and affirmations ($p = .044$). Similar results were obtained without the outlier.

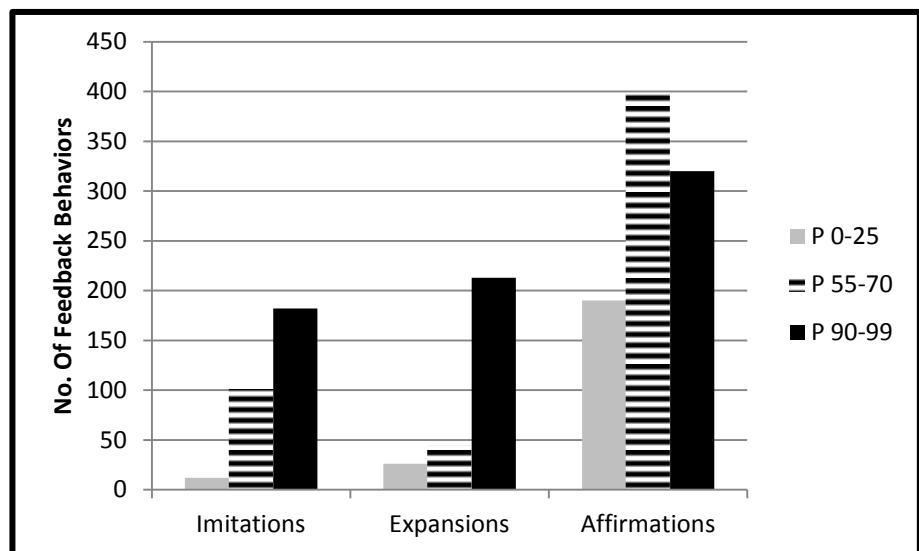


Figure 5.2: Interactive feedback behaviors directed to children in the three groups, divided according to vocabulary percentile scores at 1;6

A comparison of individual families revealed no clear outlier in the p 0–25 group for the interactive behaviors, while one family in the p 55–70 group used the greatest number of imitations in that group (a value above the mean of the p 90–99 group) and the greatest number of affirmations of all parents. While the family-outlier mentioned earlier used the greatest number of affirmations in the p 0–25 group, they also used the smallest number of imitations.

In summary, analysis of parental use of interactive feedback behaviors revealed that the parents in the p 90–99 group expanded upon their children's utterances significantly more often than the parents of both other groups. The p 90–99 and p 55–70 parents used imitations significantly more often than the parents of the children with small vocabularies. Parents of the p 55–70 group used significantly more affirmations than the p 0–25 parents.

5.3.3 Parental use of questions

An analysis of the kinds of questions used by the parents in the three groups was undertaken. Table 5.3 presents individual results for parents, as well as group totals, for the number of questions and a breakdown into types of wh-questions and yes/no-questions. For this analysis, wh-questions were divided into two categories: receptive and productive wh-questions. Receptive wh-questions begin with 'where' or 'which', and allow the child to answer by pointing to an object, while productive wh-questions begin with 'what', 'who', 'where to', 'how' or 'why', and prompt the child to answer by providing a verbal response. Yes/no-questions were either categorized as 'auxiliary-fronted' or 'other'. Auxiliary-fronted questions begin with a modal auxiliary and give children a choice, rather than telling them what to do. Other yes/no questions included tag questions, single feedback morphemes, questions beginning with finite verbs or auxiliaries other than modals, as well as other utterances where parents used question intonation. The proportion of questions to total number of utterances ranged from 20% to 37% in the three groups with the following group averages: p 0–25 = 33%, p 55–70 = 26%, p 90–99 = 33%. This concurs with previous findings that questions comprise approximately one-third of the input directed to children (Cameron-Faulkner et al., 2003).

Table 5.3: Individual and group results for total number of questions and different types of wh- and yes/no-questions in the three percentile groups

Percentile group and child	Total no. of questions	Type of questions			
		Receptive wh-? ^a	Productive wh-? ^b	Aux-fronted yes/no-? ^c	Other yes/no-? ^d
P 0–25					
A	97	5	23	17	52
B	80	4	13	20	43
C	137	53	21	29	34
D	89	0	8	37	44
E	72	17	6	21	28
	M = 95	M = 15.8	M = 14.2	M = 24.8	M = 40.2
P 55–70					
F	120	8	12	48	52
G	93	21	9	26	37
H	60	14	5	21	20
I	95	4	18	42	31
J	113	7	22	41	43
	M = 96.2	M = 10.8	M = 13.2	M = 35.6	M = 36.6
P 90–99					
K	166	2	50	73	41
L	94	7	8	53	26
M	139	6	20	42	71
N	152	6	35	27	84
O	99	7	34	18	40
	M = 130	M = 5.6	M = 29.4	M = 42.6	M = 52.4

^aReceptive wh-questions begin with ‘where’ or ‘which’, and allow the child to answer by pointing to an object.

^bProductive wh-questions begin with ‘what’, ‘who’, ‘where to’, ‘how’ or ‘why’, and prompt the child to answer by providing a verbal response.

^cAuxiliary-fronted yes/no-questions begin with a modal auxiliary and give children a choice, rather than telling them what to do.

^dOther yes/no-questions include tag questions, single feedback morphemes, questions beginning with finite verbs or auxiliaries other than modals, as well as other utterances where parents used question intonation.

Results indicate that parents of children with larger vocabularies tend to ask more auxiliary-fronted yes/no-questions, as well as more productive wh-questions than parents of children with smaller vocabularies. Parents in the latter group used the most receptive wh-questions.

5.3.4 Vocabulary composition

Figure 5.3 provides a graphic representation of the mean proportions of nouns, predicates, closed-class words and social words in the 15 children’s vocabularies at 1;6, while Table 5.4 shows mean values, standard deviations and the range in each percentile group. Children with the largest vocabular-

ies (p 90–99, 161–376 words) are in the predicate phase according to Bates et al. (1994), where the proportion of nouns starts to decrease and predicates start to increase. They have the least amount of variation within the group for three of the four categories, which is indicated by smaller standard deviations (*SD*) from the mean. In contrast, children in the p 55–70 group (36–53 words) are in the reference phase, but variation is large as three of the five children have vocabularies under 50 words. They are also still using more social words than children in the p 90–99 group. This middle group has the least amount of variation for percentage of predicates, and variation is larger than the mean for percentage of closed-class words. Children with the smallest vocabularies (4–15 words) show the greatest variation in proportions of predicates, closed-class words and social words, with variation in the percentage of predicates almost larger than the mean.

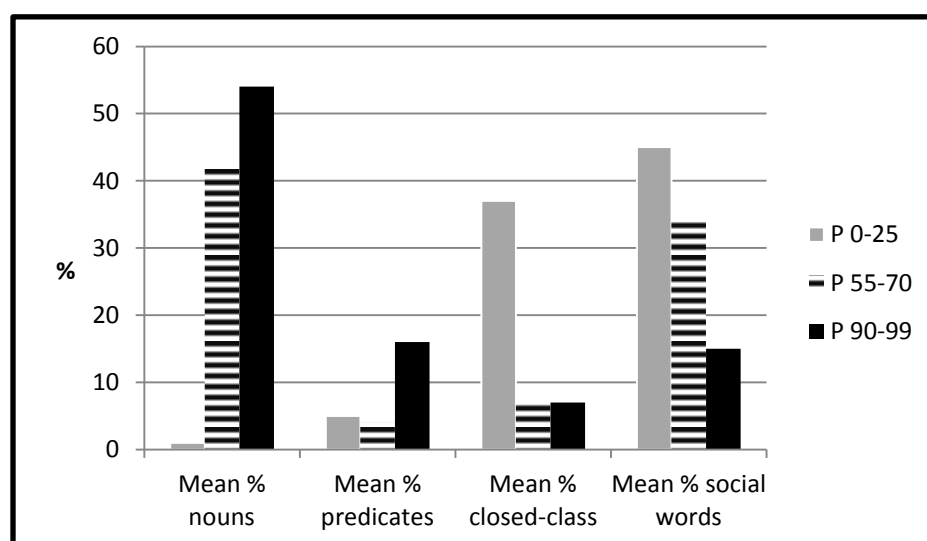


Figure 5.3: Vocabulary composition by percentile group ($n = 5$ in each group) at 1;6, as reported in *SECDI: Words & Sentences*

Table 5.4: Vocabulary composition by percentile group at 1;6 with mean values, standard deviations and range ($n = 5$ in each group)

Category	Percentile Group								
	P 0–25			P 55–70			P 90–99		
	<i>M</i>	<i>SD</i>	Min–Max	<i>M</i>	<i>SD</i>	Min–Max	<i>M</i>	<i>SD</i>	Min–Max
%Nouns	1.3	3.0	0–7	41.6	19.9	18–57	54.0	2.7	51–58
%Predicates	4.9	4.8	0–11	4.2	3.3	0–9	15.8	4.2	10–20
%Closed-class	36.9	16.1	11–50	6.6	6.9	0–18	7.4	2.3	5–10
%Social words	44.6	18.3	20–67	34.4	6.6	28–42	15.2	2.8	11–18

Note: Percentages do not add up to 100% as some sections of the checklist were not included in the analysis.

Table 5.5 represents another way to show the variation in vocabulary composition among the groups, giving the numbers of different words produced by children in each group. Sometimes only one child used a specific word (e.g. one child in the p 0–25 group could say *lampa*, ‘lamp’), while in other cases several children used the same word (e.g. three children in the p 0–25 group could say *titta*, ‘look’). However, while these children do not yet produce nouns, they do express object meanings through the use of sound effects and animal sounds, which are included in the social words category. As indicated in Section 4.6.2.2, social words comprise words from three categories on the SECDI checklist: ‘sound effects and animal sounds’, ‘people’ and ‘games and routines’. Animal sounds, for example, frequently occur in a play context and are often acquired earlier than animal names.

Table 5.5: Number of different words in each grammatical category produced per group

Category	P 0–25	P 55–70	P 90–99
	Different words		
Nouns	1	65	224
Predicates			
Verbs	1	6	66
Adjectives	0	2	27
Closed-class words	9	11	35
Social words	16	33	53

The relative progress of the p 90–99 group is expressed in the large numbers of different words produced in each category. For example, even though the vocabularies of this group comprise smaller absolute percentages of social words than the other two groups, children in the p 90–99 group use more than 3 times as many different social words than those in the p 0–25 group.

5.3.5 Parental input and special word categories

Counts of parental input in this study were obtained for special verbs and a sample of closed-class words as described in Section 4.5. Table 11.2 (in the appendix) shows the number of instances the parents in the three groups used these closed-class words, along with means, standard deviations, and minimum and maximum values for each word. The four most frequent words (*det*, *den*, *där* and *här*) were the same in all three groups, but not necessarily in the same order. Parents of children with smaller vocabularies used *där* ('there') to the greatest extent, while parents of children with larger vocabularies used the more specific *den där/den här* ('that one/this one'), as well as *här* ('here') more often. Parents in the p 90–99 group used the words *det* and *den* ('it/that', functioning either as deictic pronouns or definite articles, neuter and common gender) to a greater extent than the parents of the other groups (453 instances together, compared to 357 and 316 in the p 0–25 and p 55–70 groups, respectively).

Regarding production of these words by children, although children in the p 0–25 group have the greatest proportion of closed-class words in their vocabularies, the variety of words produced is mostly limited to the deictic *där* ('there') and deictic pronouns. In contrast, children with large vocabularies use a great variety of closed-class words in addition to those used by the p 0–25 group, including many different prepositions, adverbs, pronouns, determiners and auxiliary verbs.

Table 11.3 shows parental use of the special verbs described in Section 4.5.2.6. In the present study, *titta* ('look'), *se* ('see') and *ta* ('take') comprise the three most salient of these special verbs in each group. Parents of children with larger vocabularies use *ta*, *tycka*, *göra* and *titta* more often than parents of children with small vocabularies. Among these verbs, *ta* and *göra* indicate a greater use of action verbs. *Titta* is also the most frequent verb in child production, used by 10 of the 15 children at 1;6.

5.4 Discussion

The results of this study confirm relations between the quantity and quality of parental input and child vocabulary knowledge which have been established over the past 20–30 years. This includes research conducted in samples with varying SES, as well as work investigating input in middle-class families (e.g. Greenwood et al., 2010; Huttenlocher et al., 1991). However, this is the first study to document variability in input with associated variability in children in a consistently high-SES Swedish sample, an understudied language and cultural context. Despite the homogeneity in parental education across groups, and comparable opportunities available to parents in a relatively egalitarian society, these Swedish families exhibit variability in

child-directed input and child early vocabulary similar to that found in other groups. Although child vocabulary scores are reported for a 5–6 month interval in this study, showing (for the most part) distinctive, non-overlapping trajectories, parent and child speech are assessed concurrently. This does not allow the establishment of clear causal relationships. However, the fact that the current results support earlier findings can be seen as confirmation of the influence of input on child language development.

The small sample size in this study ($n = 5$ in three groups) is sensitive to the presence of outliers, as exemplified by the family-outlier in the p 0–25 group, and restricts the ability to generalize findings. Due to the large variability in all groups, group comparisons were conducted using non-parametric statistical methods. However, despite the small sample size, group differences were found for a number of the outcome measures as follows.

5.4.1 Amount and diversity of parental input

The number of utterances, morphemes, word types and word tokens used by the parents increased with child vocabulary size, while type/token ratio decreased. These group differences were all significant when comparisons were conducted without the family-outlier. Previous research generally links these measures of amount and diversity with larger child vocabularies (Hart & Risley, 1995; Hoff, 2003; Hoff & Naigles, 2002; Huttenlocher et al., 1991). Diversity measured with VOCD and MLU, however, were highest in the p 55–70 group. Interestingly, the parents of the child whose vocabulary trajectory shows a sharp increase after approximately 18.5 months (Child B, see Figure 5.1) had the third highest MLU. This may indicate input effects on the child's rate of acquisition at that age. In the composition study (II), children with this type of trajectory are considered late bloomers.

The family-outlier also had relatively high values for MLU (fourth highest of all parents), but also the highest values of all for numbers of utterances, morphemes and word tokens. The parents' large amounts of speech and accompanying lack of clarity may be a contributing factor to the child's small vocabulary size, with parental talkativeness allowing the child fewer opportunities to respond. Alternatively, the family-outlier simply provides an example of the great variation among parents regarding talkativeness and interaction style. The sample of parents in this study is, after all, very small. Yet the clarity of infant-directed speech is considered an important adjustment to the needs of infant language learners (Liu et al., 2003; Thiessen et al., 2005). Girolametto et al. (2002) suggest that parents may try to compensate for their children's small vocabularies by providing words their children are not yet able to produce. Thus, language development can be hampered through a mismatch between the nature of the child-directed input and the child's developmental level (Paul & Elwood, 1991; Vigil et al., 2005; Warren & Yoder, 2004). In cases where there is such a mismatch, support can be

given to parents to develop strategies aiming to simplify or clarify input. Other possible explanations for parental mismatch may be the influence of genetic factors, including mild language impairment, which is not known in this case, or a lack of responsive communication style.

5.4.2 Interactive feedback behaviors

Significant group differences were found with regard to parents' use of imitations, expansions and affirmations. The parents of children with large vocabularies used more imitations and expansions than both other groups, where the children only used one-word utterances at this time. There were thus relatively few child utterances for the p 55–70 and p 0–25 parents to expand upon. Individual family results show that the family-outlier in the p 0–25 group used the fewest number of imitations of all families, but the largest number of affirmations in the p 0–25 group. It is possible that a child's lack of productive vocabulary also limits the parents' use of communicative strategies, which are in turn known to promote linguistic competence in children. It is not known whether the children in the group with small vocabularies (other than the late bloomer) were later formally classed as late talkers; 1;6 is often too early to make a reliable prediction (see the general discussion). However, parents of late talkers have been found to adjust their conversational style to the communicative abilities of their children (Vigil et al., 2005). Especially with parents who express concern regarding their children's slow early language development, it is advisable to adopt a proactive approach, and encourage the use of specific strategies to stimulate interaction.

The results of this study concur with much of the previous literature. Hart and Risley (1995) stressed the importance of informative and encouraging quality interactions in facilitating children's language development. Weizman and Snow (2001) also coded mother-child interactions according to the degree that they were helpful or instructive for children's learning. Of course, even responsive parents may differ in the ways they respond, either affirming or describing, or the activities to which they respond, for example a child's verbal attempts or exploratory initiatives (Tamis-LeMonda et al., 2001).

5.4.3 Parental use of questions

With regard to parental use of questions, there is some indication that parents adjust their conversational style to their children's vocabulary level. Results of this study show that the p 0–25 parents asked more receptive wh-questions, which allow the children to answer by pointing, while the p 90–99 parents asked more productive wh-questions, which prompt children to answer using verbal responses. Allwood and Ahlsén (1999) found that wh-

questions were difficult for their child subject to answer, especially at the age of 1;8 (see Section 3.1.6.1) and Salomo et al. (2013) found that questions requiring one-word answers were easiest for children. An extreme use of receptive questions, however, may also indicate a greater tendency towards knowledge verification, evident not only in the number of these questions asked by the outlier family, but also in the nature of many of the family's yes/no-questions to their child. On the other hand, variation in use of questions may also indicate individual differences in parental interaction style. Finally, the parents of children with larger vocabularies used more auxiliary-fronted yes/no-questions than the parents in the p 0–25 group, also suggesting a guidance style more conducive to children's vocabulary development (Hart & Risley, 1995).

5.4.4 Vocabulary composition

The division of children's productive vocabularies into word categories (see Table 5.4) yields profiles similar to those reported in Bates et al. (1994), including greater variation in these categories among children with vocabularies under 50 words. The proportion of closed-class words in the vocabularies of children in the p 0–25 group ranged between 11% and 50%, Child C being one of two children with 50% values. Regarding input, the family-outlier had values for closed-class words which were much higher than the group mean, but this may be a function of the high frequency of these words in greater amounts of speech.

5.4.5 Parental input and special word categories

As previous research has indicated that frequency in input may influence child vocabulary production (Goodman et al., 2008; Richthoff, 2000), an analysis of parental use of two word categories (special verbs and closed-class words) was undertaken here. In accordance with Richthoff's (2000) results, the most common closed-class words produced by children in this study were also among the most frequent in parental input. However, there were differences between groups. It is interesting to note that parents of children with the largest vocabularies used the fewest instances of the relatively unspecific *där* ('there'), and the most instances of the more specific pronoun *den där/den här* ('that one/this one'), as well as the most instances of the word *det* (the pronoun 'it/that' or the definite article, neuter gender). It may be conjectured that the greater frequency of the latter is due to overall greater amounts of input, as the p 90–99 group had the largest number of utterances, morphemes and word tokens of the three groups. All groups used the word *det* more often than *den* (the pronoun 'it/that' or the definite article, common gender). Although common gender is predominant in Swedish, the word *det*

has more general uses, especially when it means ‘it’ or ‘so’, as in *Tycker du det?* (‘Do you think so?’).

The most common special verbs used by parents in Richthoff’s (2000) study were also among the most frequent used by parents in this study. The increased use of the action verbs *ta* (‘take’) and *göra* (‘do’) by parents of children with larger vocabularies may suggest that these children have greater knowledge of names for objects. Alternatively, children with large vocabularies are more able to understand when their parents use action verbs, which are more conceptually advanced and less concrete than nouns. In Richthoff’s (2000) material, parents of the child with the slowest development used these verbs at later child age than did parents of the two children with more typical language growth. Furthermore, while the deictic *titta* (‘look’) was generally used at earlier child ages, the ‘thinking’ verbs *tro* (‘believe’) and *tycka* (‘think’) appeared in the input at later child ages. In this study of 15 families, *titta* was most common in the input of the p 90–99 parents. It should be noted that *titta* and *där* are both used to direct a child’s attention, and are therefore very common in child-directed speech.

5.5 Conclusions

This study provides support for the idea that the type of input parents provide in interactions with their children plays an important role in children’s vocabulary acquisition. Parents who use greater amounts of input have children with larger vocabulary sizes. In addition, they use more of the interactive strategies which have been shown to stimulate children’s language development. As early vocabulary development in children lays the foundation for general language acquisition and later literacy development, parents need to involve their children in ample everyday conversation, characterized by clearly articulated, developmentally-appropriate input which affirms and expands the children’s communicative intentions. In addition, it is important for educators and child healthcare staff to be knowledgeable of research-based recommendations for promoting children’s language development.

Further research could focus on the role of culture and gender in parent-child interactions, as well as more comprehensive, longitudinal and qualitative analysis of child production and parental input. Specifically, it would be of interest to examine the later parental input directed to this sample of children and relate it to the children’s later vocabulary development. This would also shed light on the question of whether social status may help to compensate for slow early language development (Rowe et al., 2012). Regarding vocabulary composition, Study II (Chapter 7) extends the results of this study to a larger sample and reports composition in terms of both absolute percentages of a child’s vocabulary and the proportions of a certain category in relation to the number of words on the checklist (opportunity scores).

The small sample of families in this study is a limitation to generalization of the obtained results. However, even with a small sample, the results concur with those reported in previous research.

6 The role of vocabulary composition and grammatical abilities in Swedish children at 1;6 and 2;0

6.1 Introduction

It is well established that children's early language development proceeds at variable rates (Fenson et al., 1994, 2007; Huttenlocher et al., 2010; Rowe et al., 2012). This variability may be due to environmental contexts (see Chapter 3) and is evident in children's language comprehension, vocabulary production and composition (see Section 3.1.4.4), as well as processing efficiency (Fernald & Marchman, 2012; Marchman, Fernald, & Hurtado, 2010). Furthermore, early vocabulary development has been shown to have predictive value for later language and cognitive outcomes (Bates et al., 1988; Bornstein et al., 1998; Lee, 2011; Lyytinen & Lyytinen, 2004; Marchman & Fernald, 2008; Oliver et al., 2004), which in turn can have consequences for later literacy skills and the establishment of lifelong educational well-being (OECD, 2009; see Section 3.3). Thus, it is important to examine more closely what distinguishes children whose progress is not as rapid compared to those with more rapid development. This study offers unique, detailed analysis of Swedish children's early vocabulary development.

6.1.1 Lexical and grammatical development

Many studies have established strong associations between children's lexical and grammatical acquisition in different languages (see Section 3.1.5.1). Some studies have compared lexical and grammatical development in children of the same age, but with different languages (Bornstein et al., 2004; Thordardottir et al., 2002), while others have compared children of different ages speaking different languages (e.g. Caselli et al., 1999; Devescovi et al., 2005; see also *Patterns of vocabulary growth*). Still others have compared vocabulary composition in various groups of children speaking the same language (Koster et al., 2005; Lyytinen & Lyytinen, 2004; Stolt et al., 2007). An additional difference between studies is the method used to evaluate vocabulary composition; some studies have used CDIs or other checklists, while others have relied on recorded language samples (Kauschke & Hofmeister, 2002) or a combination of the two (Pine et al., 1996).

Developmental patterns in children's early vocabulary development have been documented in many studies (see Section 3.1.4.3). These trends show that children generally need to have a productive vocabulary before grammatical development starts in earnest. Although some researchers have questioned the idea of a 'naming explosion' or 'vocabulary spurt' (L. Bloom et al., 1993; P. Bloom, 2004), most children experience a rapid acceleration in word learning from 18 to 20 months of age through the end of the third year. However, Bates et al. (1994) found that for some children, the spurt occurs as early as shortly after 12 months of age. This increase in vocabulary size is considered to be a prerequisite for children's grammatical development (Bates et al., 1988; Plunkett & Marchman, 1991). Children generally do not combine words productively before vocabulary size has reached the 50-word point (Bates & Goodman, 1997; Marchman & Bates, 1994; Nelson, 1973) and combinations are not produced consistently until children gain a vocabulary of 100–200 words (Fenson et al., 1994). It has also been suggested that combinatorial speech co-occurs with the vocabulary spurt and actually facilitates word growth (Anisfeld, Rosenberg, Hoberman, & Gasparini, 1998).

6.1.2 Stylistic variation

Nonetheless, general trends do not always describe individual children, who vary in rates of acquisition as well as the composition and stylistic nature of their vocabularies (see Section 3.1.4.4). For example, some children may exhibit a preference for naming objects ('referential style'), while others may prefer to use personal-social words, including names of people ('expressive style'). The debate concerning this referential versus expressive distinction was especially active in the 1990s, but the question of the 'noun bias' or the 'relative prevalence' of word classes (Bornstein et al., 2004, p. 1120) continues to occupy researchers today (Waxman et al., 2013; see also Section 3.1.4.2).

In any case, it is this early variability which ultimately makes it difficult to predict which children will have persisting language delays (see Section 3.3.3). The interrelationship between children's early vocabulary composition and their grammatical abilities, tied to timing of acquisition, is an area that deserves more scrutiny in the field of early child language development. For this reason, and the fact that there is very little research on Swedish children's early vocabulary composition, this study adds to the growing body of knowledge regarding lexical and grammatical development in children learning languages other than English. Furthermore, it investigates vocabulary composition in measurements over time (from 1;6 to 2;0), at a critical time point in early language development.

6.2 Aim

The aim of this study was first, to examine the stability of vocabulary growth in a sample of young Swedish children, and second, to examine the role of vocabulary composition and grammatical abilities in different categories of learners (slower learners, average learners, late bloomers and fast learners) based on their development over a 6-month period. The obtained results were tested in light of previous models regarding vocabulary composition and stylistic variation (Bates et al., 1994; Lieven et al., 1992; Nelson, 1973; Pine et al., 1997). As both slower learners and late bloomers are potential candidates for later language impairment, special attention was given to these two groups.

The following specific research questions were posed:

- How stable is children's vocabulary development between 1;6 and 2;0? Can differences in variables measuring vocabulary composition and grammatical abilities at the two ages be ascertained in different learner categories (slower learners, average learners, late bloomers and fast learners)? Can specific differences be established in the vocabulary development of children who are slower learners as compared to those who start slow and 'bloom'?
- What is the predictive value of language-related variables at 1;6 (vocabulary size, vocabulary composition and grammatical abilities), as well as background variables such as child gender and parent education, for vocabulary size at 2;0?

Detailed information regarding the methods and materials used in this composition study are found in Section 4.6.

6.3 Results of Study II

6.3.1 Quartile stability

Table 6.1 presents children's stability or movement between quartile groupings at the two measurement points, 1;6 and 2;0 ($N = 183$). The greatest stability can be seen in the lower right-hand corner of Table 6.1, with almost 99% of those scoring in the highest quartile at 1;6 remaining there at 2;0 (the 44s). Of those children scoring in the second highest quartile at 1;6, 78% had moved up to the highest group at 2;0 (the 34s). Children originally in the lowest two quartiles were almost evenly distributed between all four groups, with 29% of those originally in the lowest quartile remaining there 6 months later (the 11s). Negative progress can be seen in those children who started

in higher quartiles at 1;6 and moved to lower quartiles at 2;0 (for example the 21s or 31s on the top row of the table).

Table 6.1: Cross tabulation representing children's movement between quartile groupings at 1;6 and 2;0, as measured by SECDI: Words & Sentences (N = 183)

Voc Quartile at 2;0		Voc Quartile at 1;6								Total	
		1		2		3		4			
		<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
1		7	29.2	6	23.1	1	1.7	0	0.0	14	7.7
2		8	33.3	8	30.8	2	3.4	0	0.0	18	9.8
3		3	12.5	6	23.1	10	16.9	1	1.4	20	10.9
4		6	25.0	6	23.1	46	78.0	73	98.6	131	71.2
Total		24	100.0	26	100.0	59	100.0	74	100.0	183	100.0

Note: Voc = Vocabulary

6.3.2 Vocabulary composition

For purposes of comparison, Table 6.2 presents means and standard deviations for the vocabulary composition (percentage of common nouns, predicates, closed-class words and social words) of all children at 1;6 and 2;0, as well as the proportion of children able to combine words. The percentage of common nouns at 2;0 (47.5%) is similar, for example, to results reported for Finnish children at the same age (48% in Stolt et al., 2009).

Table 6.2: Means (M), standard deviations (SD), minimum–maximum values (Min–Max), proportions of common nouns, predicates, closed-class words and social words calculated from total vocabulary size at 1;6 and 2;0

Measure	1;6 (N = 262)				2;0 (N = 200)			
	<i>M</i>	<i>SD</i>	Min–Max	%	<i>M</i>	<i>SD</i>	Min–Max	%
Vocabulary Size	88.8	90.0	2–448		361.1	177.3	6–681	
Common nouns	44.4	50.6	0–220	38.2	173.8	80.3	0–297	47.5
Predicates	12.0	19.6	0–104	8.9	79.2	48.1	0–161	19.2
Closed-class words	5.7	6.8	0–36	6.8	33.9	23.3	0–88	8.8
Social words	19.0	9.9	0–57	34.4	41.3	14.1	3–70	14.8
% Children combining words				39.5				93.5

Note: Percentages do not add up to 100% as some sections of the checklist were not included in the analysis.

6.3.2.1 Developmental trends

The mean percentages (absolute proportions) of common nouns, predicates, closed-class words and social words as a function of vocabulary size are presented in Figure 6.1, and these illustrate typical developmental patterns at 2;0. For means, standard deviations and minimum and maximum values for each of the vocabulary levels at 2;0, see Table 11.4. Figure 6.1 demonstrates how the proportion of nouns increases to a peak at vocabularies between 200 and 300 words and then decreases, relative to total vocabulary size. Here, variation, which is indicated by standard deviations from the mean, also decreases steadily. Predicates show a steady increase with vocabulary size, with the variation largest in smaller vocabularies, but not following a clear trend. Proportions of social words decrease with increasing vocabulary size, while values for closed-class words are larger for children with smaller vocabularies, but show a developmental increase after vocabulary size reaches approximately 300 words. Corresponding data for child age 1;6 show very similar trends, but the range within categories is larger at the smallest vocabulary level ($n = 118$), compared to age 2;0 ($n = 11$).

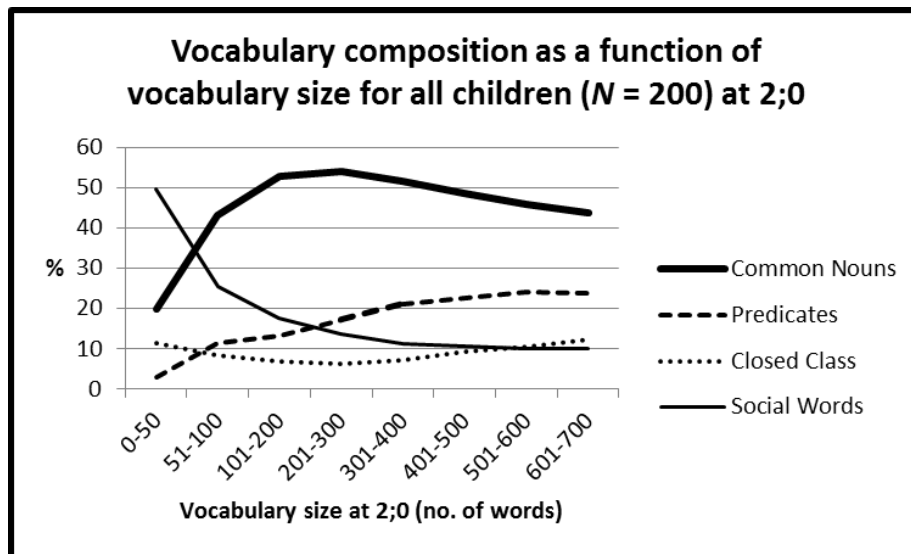


Figure 6.1: Mean percent (absolute percentages) common nouns, predicates, closed-class words and social words as a function of vocabulary size for all children ($N = 200$) at 2;0

Figure 6.2 also represents vocabulary composition as a function of vocabulary size at 2;0, presenting the proportions of various categories in opportunity scores, rather than absolute percentages. Opportunity scores give the proportion of each word category relative to the number of words on the

SECDI checklist in that category, rather than a child's total vocabulary size. The snapshot at 2;0 shows children with the largest vocabularies approaching ceiling for proportions of nouns, predicates and closed-class words, these categories having surpassed the relative proportions of social words on the checklist. 50% levels are reached at vocabulary sizes of 201–300 words for nouns, 301–400 words for predicates, and over 400 words for closed-class items. Children with very small vocabularies at 2;0 show similar profiles to those with small vocabularies at 1;6 (figure not shown). At 1;6, children with the largest vocabularies are already producing 50% of the common nouns and social words available on the SECDI checklist, while the percentages of predicates and closed-class words are at the 30% and 20% level, respectively. Children with the smallest vocabularies at this age are producing mostly social words.

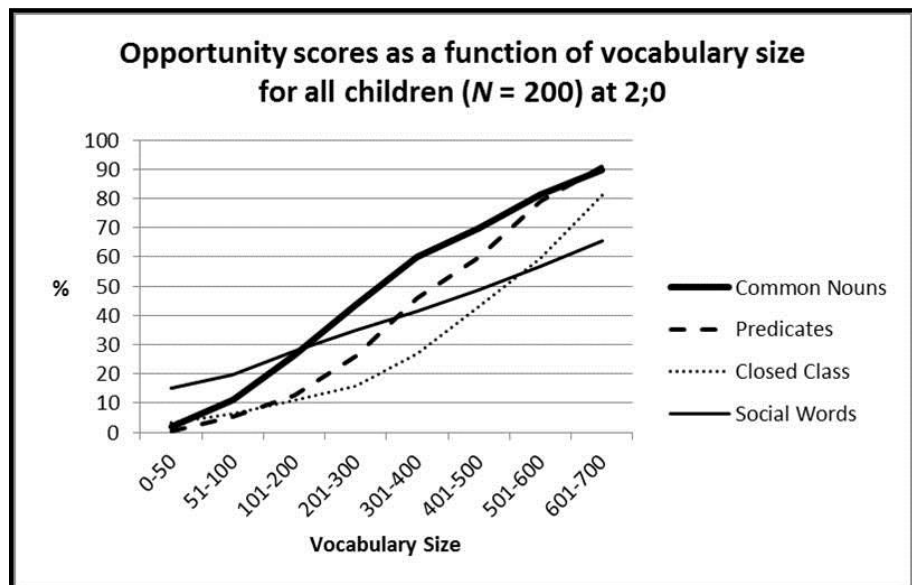


Figure 6.2: Mean percent (opportunity scores) common nouns, predicates, closed-class and social words as a function of vocabulary size for all children ($N = 200$) at 2;0

6.3.2.2 Differences among learner groups

Figure 6.3 provides a graphic presentation of the vocabulary composition in mean percent common nouns, predicates, closed-class words and social words (following Bates et al., 1994 and Caselli et al., 1999 for social words) for the four categories of learners at 1;6 ($N = 183$).

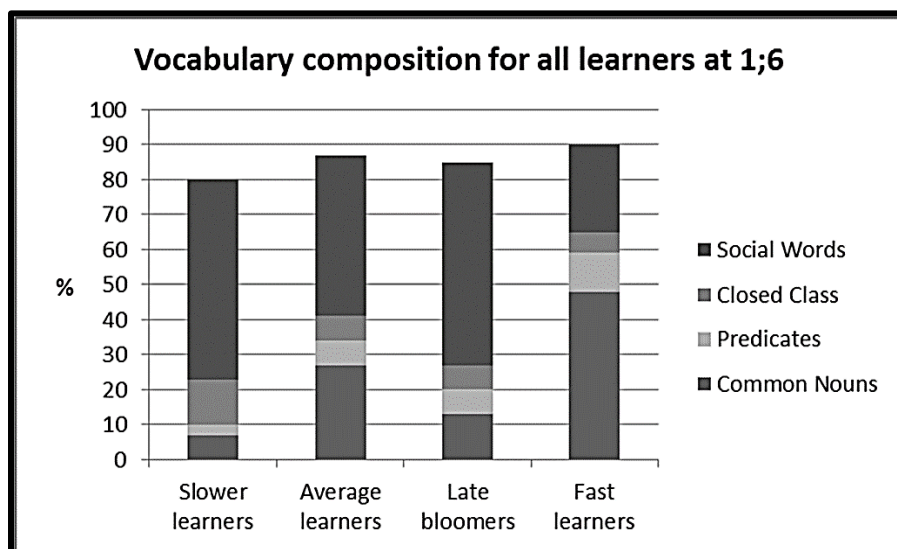


Figure 6.3: Vocabulary composition for all learners ($N = 183$) at 1;6 showing mean % common nouns, predicates, closed-class words and social words (absolute percentages). Slower learners, $n = 22$; average learners, $n = 26$; late bloomers, $n = 15$; fast learners, $n = 120$

Table 6.3 provides summary statistics of composition for the four groups of learners, calculated in absolute percentages. At 1;6, the vocabularies of slower learners have the greatest proportion of closed-class words, while the fastest learners have the greatest proportions of nouns and predicates in their vocabularies. Both the slower learners and late bloomers have large proportions of social words at this age and standard deviations greater than the mean for percentages of nouns, predicates and closed-class words. Furthermore, the late bloomers have proportionally fewer nouns, but more predicates and social words than the average learners.

Table 6.3: Variation in vocabulary composition (absolute percentages) by learner category at 1;6 ($N = 183$)

Mean %	<i>M</i>	<i>SD</i>	Min–Max
Slower learners ($n = 22$)			
Common nouns	6.6	11.9	0–42
Predicates	3.1	4.6	0–13
Closed-class	13.1	16.6	0–50
Social words	57.2	16.9	17–100
Average learners ($n = 26$)			
Common nouns	26.5	16.4	0–64
Predicates	6.8	4.5	0–17
Closed-class	7.3	5.9	0–18
Social words	46.4	12.2	24–67
Late bloomers ($n = 15$)			
Common nouns	12.6	14.6	0–44
Predicates	7.4	17.0	0–67
Closed-class	7.1	9.0	0–25
Social words	57.7	24.6	0–100
Fast learners ($n = 120$)			
Common nouns	47.9	12.1	3–72
Predicates	11.3	5.5	0–25
Closed-class	5.6	3.5	0–24
Social words	25.0	11.1	9–61

Table 6.4 shows variation in vocabulary composition (opportunity scores) by learner category at ages 1;6 and 2;0, as well as the results of group comparisons at both ages. When comparing statistics in Table 6.3 to Table 6.4, which shows variation in absolute percentages of children’s vocabularies, the clear lead of the fast learners is especially evident. These children are producing the largest relative percentages of all word classes at 1;6, and although their absolute percentages of social words are the lowest of the four groups, they are producing almost a third of these words on the checklist.

Table 6.4: Variation in vocabulary composition (opportunity scores) by learner category at 1;6 and 2;0 ($N = 183$) with group comparisons^a

	Child Age					
	1;6			2;0		
	<i>M</i>	<i>SD</i>	Min–Max	<i>M</i>	<i>SD</i>	Min–Max
Slower learners (1) $n = 22$						
Common nouns	0.50	1.07	0–4	11.30	11.04	0–34
Predicates	0.38	0.60	0–2	4.84	4.30	0–12
Closed-class	1.59	2.33	0–7	5.67	3.81	0–12
Social words	10.86	5.43	0–24	19.45	7.40	3–32
Average learners (2) $n = 26$						
Common nouns	3.16	2.81	0–11	30.92	8.92	14–46
Predicates	1.43	1.36	0–5	16.26	7.15	4–34
Closed-class	2.50	2.66	0–10	12.81	5.76	0–25
Social words	18.91	4.94	13–29	29.18	4.60	18–39
Late bloomers (3) $n = 15$						
Common nouns	0.69	0.92	0–3	56.22	13.38	37–79
Predicates	0.44	0.62	0–2	37.80	15.58	14–65
Closed-class	1.10	1.13	0–4	23.30	10.73	9–42
Social words	10.74	4.80	0–18	40.14	8.52	29–58
Fast learners (4) $n = 120$						
Common nouns	20.31	16.26	0–71	71.62	13.38	39–96
Predicates	10.15	11.85	0–55	64.30	18.35	25–96
Closed-class	7.10	7.05	0–37	47.53	20.15	10–91
Social words	32.03	11.48	14–71	50.69	9.40	28–72

Note: Means (*M*) and standard deviations (*SD*) are reported with two decimals in order to better enable comparisons between groups.

Group comparisons	<i>p</i> -values		Post-hoc results	
	1;6	2;0	1;6	2;0
Common nouns	<.001	<.001	4>1,2,3*	4>1,2,3*; 3>1,2*; 2>1*
Predicates	<.001	<.001	4>1,2,3*	4>1,2,3*; 3>1,2*
Closed-class	<.001	<.001	4>1,2,3*	4>1,2,3*; 3>1*
Social words	<.001	<.001	4>1,2,3*; 2>1*	4>1,2,3*; 3>1,2*; 2>1*

^aComparisons of means were performed using the non-parametric Kruskal-Wallis test. A Tukey post-hoc procedure has been used to adjust for multiple comparisons, with differences significant at the 5% level. 4>1,2,3*, for example, indicates that the fast learners had significantly larger group means than the other three groups of learners.

At 1;6, the average learners produce greater percentages of all word classes than the slower learners and the late bloomers, while the late bloomers produce greater relative percentages of nouns and predicates than the slower learners. Whereas the slower learners have the greatest absolute percentage of closed-class words in their vocabularies at 1;6 (see Table 6.3), their relative percentages (opportunity scores) are only greater than the late bloomers.

6.3.3 Grammar analysis

Before presenting more in-depth results regarding differences between slower learners and late bloomers, all children's use of grammatical features of the language are reported in this section. These abilities were analyzed using the combined variables described earlier. Figure 6.4 displays grammatical abilities for the four categories of learners at 2;0 using a boxplot. Each box represents the range from the 25th to the 75th percentile, with a horizontal line for the median. The vertical lines outside the box show the 10th and 90th percentiles. Only the fastest learners (the 44s) were using any of these grammatical features at 1;6 (not shown here), and rather minimally at that.

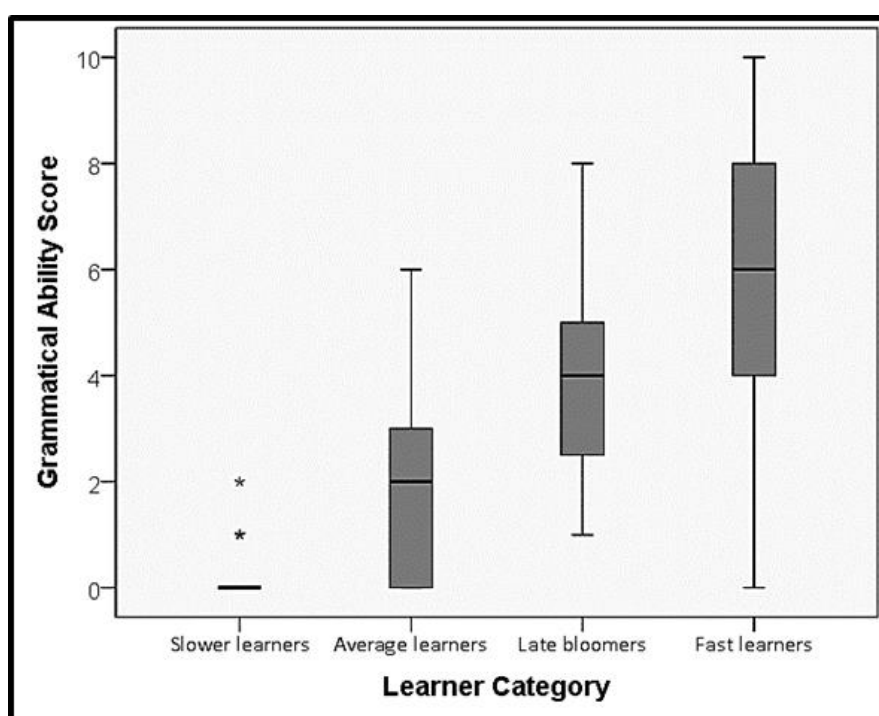


Figure 6.4: Mean group grammatical ability score for the four categories of learners at 2;0 ($N = 183$). Note: The score is the sum of five questions regarding children's use of the following: possessive '-s', definite form singular, definite form plural, indefinite plural, and the past tense. Max value = 10 (0 points for 'not yet', 1 point for 'sometimes' and 2 points for 'often').

The fast learners as a whole had the highest scores at 2;0, followed by the late bloomers, who have now surpassed the average learners. Only the slowest learners showed little or no evidence of using grammatical features at 2;0. The two stars represent individual outliers in the slow learner group, who deviate from the group average of 0.

Figure 6.5 shows the children's grammatical abilities as a function of vocabulary size at 1;6 and 2;0, revealing a close relationship between vocabulary size and grammatical ability; moreover, there is an age advantage for the children with smaller vocabularies at 2;0. These children use more grammatical features of the language than do children at 1;6 with vocabulary size between 100 and 400 words.

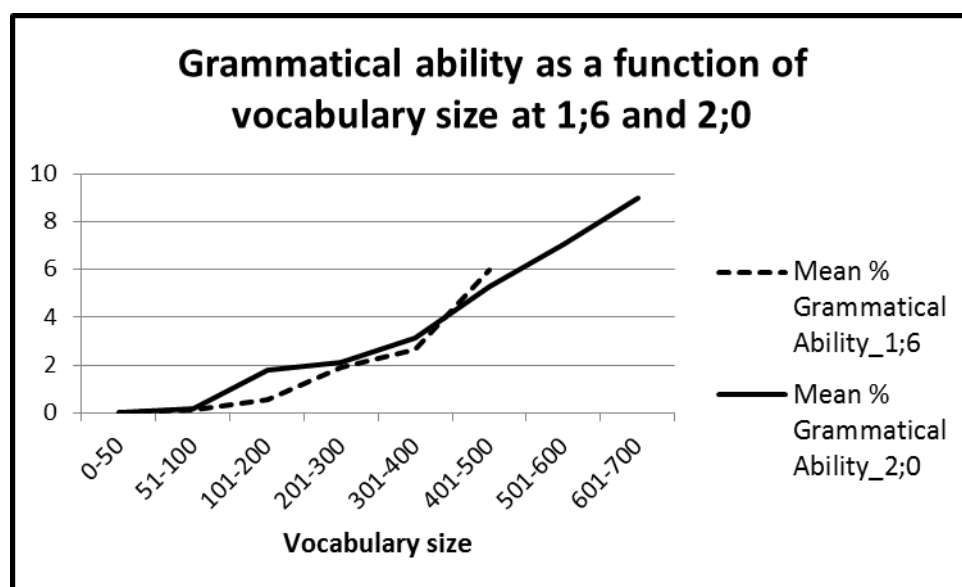


Figure 6.5: Grammatical ability as a function of vocabulary size at 1;6 ($N = 262$) and 2;0 ($N = 200$)

6.3.4 Word combinations

Parents were asked one question in SECDI: Words & Sentences regarding children's ability to combine words. Figure 6.6 illustrates word combinations in different groups at 1;6 and 2;0, respectively. More than half of the fastest learners, with the largest vocabularies at 1;6, are combining words on average as a group. As with the late bloomers, the slower learners have such small vocabularies at 1;6 that most of them are not able to combine words (one child in each group is able to do so). However, by age 2;0, most of the children who have progressed into the second quartile, as well as almost all those in the third and fourth quartiles, are able to do so.

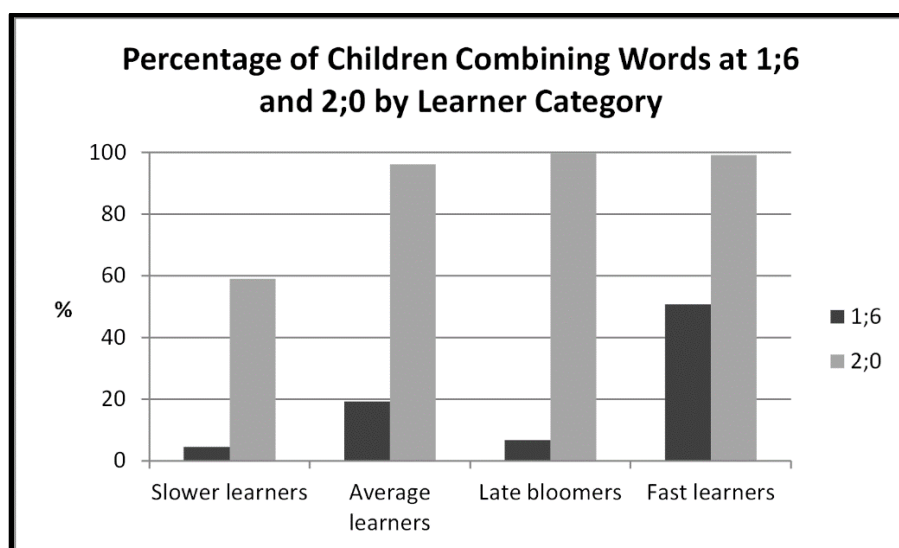


Figure 6.6: Percentage of children combining words for all categories of learners at 1;6 and 2;0

6.3.5 Prediction of vocabulary size

As a first step in analyzing the prediction of vocabulary size at 2;0, Pearson coefficients of correlation⁵⁹ were calculated among vocabulary size at 1;6 and 2;0 and background variables, as well as the composition (absolute proportion scores) and grammatical variables at 1;6. Correlations among these variables are displayed in Table 6.5. The relationship between vocabulary size at 1;6 and 2;0 was strong and highly significant ($r = .68$, $p < .01$), involving a clear ceiling effect⁶⁰, due to the instrument comprising only a limited number of words. The true magnitude of correlation may thus be even higher. Vocabulary size at 2;0 was highly correlated with all variables except parent education, although the relationship is significant at the 10% level ($p = .062$). Children's abilities to combine words at 1;6 were strongly correlated with both vocabulary size variables, as well as all composition variables at the same age. Children's grammatical ability scores at 1;6 were also highly correlated with vocabulary size, word combinations, and all composition variables except for the percentage of closed-class words. Word combinations and grammatical abilities were more highly correlated with vocabu-

⁵⁹ The Pearson correlation coefficient, r , indicates the strength of a linear relationship between two variables. The value of r can range between -1 and $+1$, with a value of 0 designating no linear relationship at all.

⁶⁰ Ceiling effects occur when there is a bunching of data at the highest possible levels reported by an instrument (in this case the SECDI). As children learn more words, the checklist can not possibly capture all the words a child can produce.

lary size at 1;6 than 2;0. Relationships between the composition variables, including the clear inverse relationship between the percentages of nouns and predicates and percentage of social words, reflect the developmental trends seen in Figure 6.1. More in-depth correlation analysis among communicative skills is presented in Study III (Chapter 7).

Table 6.5: Correlation coefficients for vocabulary size (as measured by SECDI: Words & Sentences), background variables, grammatical abilities and vocabulary composition measures for all children

Measure	1	2	3	4	5	6	7	8	9	10
1. Voc2;0	1									
2. Voc1;6	.68***	1								
3. Gender	-.28***	-.06	1							
4. Par. ed.	.14	.04	.00	1						
5. Combos	.42***	.63***	-.12	-.05	1					
6. Gramm	.42***	.75***	.03	.07	.52***	1				
7. N_1;6	.70***	.58***	-.11	-.00	.39***	.30***	1			
8. P_1;6	.42***	.62***	-.06	.02	.45***	.44***	.40***	1		
9. C_1;6	-.25**	-.09	.01	.02	-.04	-.01	-.33***	-.13*	1	
10. S_1;6	-.66***	-.68***	.11	-.01	-.47***	-.40***	-.86***	-.61***	.04	1

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

Voc2;0 = vocabulary size at 2;0; Voc1;6 = vocabulary size at 1;6; Par. ed. = Summed parent education score; Combos = Word combinations at 1;6; Gramm. = Summed grammatical ability score at 1;6; N_1;6, P_1;6... stand for the absolute percentages of nouns, predicates, closed-class words and social words at 1;6.

Regression analysis is used to predict a variable of interest (dependent variable) based on knowledge of one or more other explanatory variables (covariates or predictors). Stepwise regression is a specific method for automatic selection of independent variables, based on their significance for the regression model. Table 6.6 displays the results of two regression analyses performed to determine the predictive value of background variables, as well as composition and grammatical ability variables at 1;6, for children's vocabulary size at 2;0. Results of the baseline regression indicate that the size of children's vocabularies at 1;6 (baseline) accounted for the greatest share of the variation ($R^2 = 47.9\%$) in predicting vocabulary size at 2;0. Thus, the larger children's vocabularies are at 1;6, the more likely they will be large at 2;0. Gender added another 1.4% in explained variation, meaning that girls generally had larger vocabularies than boys ($B = -42.60$, $SE = 19.74$, p -value = .032). Here, the regression coefficient (B) is negative because male gender was coded as 2, and female gender as 1. The regression coefficient indicates how much a dependent variable (vocabulary size at 2;0) will change per unit change in the corresponding predictor variable (e.g. vocabulary size or % nouns at 1;6). The standard error (SE) is an estimate of the standard deviation of the regression coefficient. Although girls had higher mean vocabulary production scores than boys at both 1;6 and 2;0, gender explained less of the variation in this study compared to a previous study with a much larger

sample ($N = 1,019$) of Swedish children at 1;6 ($\text{Eta}^2 = 4.4\%$ in Berglund, Eriksson, & Westerlund, 2005).

Table 6.6: Regression analysis of vocabulary size at 2;0

Baseline regression ($N = 168$)			
Covariate	<i>B</i>	<i>SE B</i>	<i>p</i>
Vocabulary size at 1;6	1.43	.12	.000
Gender (males)	-42.60	19.74	.032
Regression with composition and grammatical variables ($N = 183$)			
Covariate	<i>B</i>	<i>SE B</i>	<i>p</i>
% nouns at 1;6	540.18	46.66	.000
Grammatical abilities at 1;6	34.13	9.91	.001

Note. $R^2 = .49$, $p < .001$ for baseline regression, with vocabulary size at 1;6, child gender and parental education as covariates. N does not equal 183 because of missing values for parental education. $R^2 = .53$, $p < .001$ for the regression with the absolute percentages of common nouns, predicates, closed-class words and social words, as well as word combinations and a summed grammar ability score as covariates.

In the stepwise regression using composition and grammatical variables as covariates, the percentage of nouns in children's vocabularies at 1;6 accounted for the greatest proportion of explained variance (49.5%) in vocabulary size at 2;0. Thus, the greater the proportion of nouns in children's vocabularies at 1;6, the larger their vocabularies were at 2;0 ($B = 540.18$). Children's grammatical abilities also had a positive, significant effect on vocabulary size ($B = 34.13$), although the contribution to the explained variance was much smaller (3.1%). Thus, if children could use more grammatical features of the language at 1;6, this contributed to larger vocabulary size at 2;0.

6.3.6 Slower learners vs. late bloomers

An additional stepwise regression was performed to determine the predictive value of background variables, vocabulary size, as well as vocabulary composition (absolute percentage scores) and grammatical variables at 1;6 (word combinations only), for the vocabulary size of slower learners and late bloomers at 2;0. Results for both groups together ($n = 36$) indicated that parental education accounted for 14.5% of the variance and an additional 13.4% was explained by children's use of nouns (see Table 6.7).

Table 6.7: Regression analysis of vocabulary size at 2;0 ($n = 36$), slower learners and late bloomers

Covariate	<i>B</i>	<i>SE B</i>	<i>p</i>
Sum Parent Education	49.42	17.45	.008
% nouns at 1;6	392.21	158.11	.018

Note. $R^2 = .28$, $p = .005$, with vocabulary size at 1;6, child gender, parental education, word combinations and absolute percentages of nouns, predicates, closed-class words and social words as covariates.

As displayed in Table 6.3, late bloomers had almost twice the proportion of nouns in their vocabularies at 1;6 as the slower learners, although standard deviations were high for both groups. The parents of the late bloomers had a higher value for the parent education score ($M = 9.7$, range = 8–10) than parents of the slower learners ($M = 9.0$, range = 6–11).

6.3.6.1 Correlation analysis: percentage scores

Bivariate correlation analysis⁶¹ with absolute percentage scores for the slower learners alone ($n = 22$) revealed a significant positive relationship between vocabulary size at 2;0 and parent education ($r = .48$, $p = .029$). This is a moderate correlation, indicating a moderately strong relationship between the two variables. In addition, several significant correlations were obtained in the analysis regarding composition variables at 1;6 and 2;0 (Table 6.8), most notably between the percentage of closed-class words at 2;0 and the percentages of nouns at 1;6 and closed-class words at 1;6. The correlation between closed-class words at both ages was positive, meaning that children with high percentages of these words at 1;6 were likely to have high percentages at 2;0. The correlation between closed-class words at 2;0 and nouns at 1;6 was negative, meaning that if a child had higher proportions of nouns at 1;6, they were more likely to have lower proportions of closed-class words at 2;0 and vice versa. Furthermore, the percentage of social words at 2;0 was highly significantly and negatively correlated with the percentages of nouns at 2;0 and predicates at 2;0. This indicates that children with low percentages of nouns and predicates at 2;0 were still in the stage with high percentages of social words instead.

⁶¹ Bivariate correlation analysis investigates the linear relationship between two variables.

Table 6.8: Correlation coefficients for composition variables (absolute percentages) for slower learners at 1;6 and 2;0 ($n = 22$)

Measure	1	2	3	4	5	6	7	8
1. N_1;6	1							
2. P_1;6	.39 [†]	1						
3. C_1;6	.31	.02	1					
4. S_1;6	-.35	-.34	-.39 [†]	1				
5. N_2;0	.21	-.15	-.38 [†]	.06	1			
6. P_2;0	.14	.09	-.08	.02	.39 [†]	1		
7. C_2;0	-.44*	-.08	.52*	-.07	-.52*	-.26	1	
8. S_2;0	-.10	.12	.24	-.03	-.90***	-.65**	.30	1

Note: N = nouns, P = predicates, C = closed-class words, S = social words

[†] $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

In contrast, correlation analysis with absolute percentage scores for the late bloomers alone ($n = 15$) revealed a significant positive relationship between vocabulary size at 2;0 and children's use of nouns at 1;6 ($r = .54$, $p = .036$), as well as significant negative relationships between the percentages of social words and nouns, and social words and predicates at 1;6 (Table 6.9). Thus, in contrast to the slower learners, the late bloomers have gone beyond the social word stage and are producing more nouns and predicates. The late bloomers also had highly significant negative correlations between the percentage of nouns at 2;0 and the percentages of predicates at 2;0 and closed-class words at 2;0, as well as the percentages of predicates at 2;0 and social words at 2;0. The magnitude of these correlations are similar to those found in the fast learner group, with the exception of the correlation between nouns and closed-class words at 2;0. For fast learners, the correlation is even stronger ($r = -.83$), indicating that the proportions of nouns are declining while those of closed-class words are increasing as children add more function words to their vocabularies.

Table 6.9: Correlation coefficients for composition variables (absolute percentages) for late bloomers at 1;6 and 2;0 ($n = 15$)

Measure	1	2	3	4	5	6	7	8
1. N_1;6	1							
2. P_1;6	.51 [†]	1						
3. C_1;6	-.49 [†]	-.25	1					
4. S_1;6	-.72**	-.73**	.02	1				
5. N_2;0	-.37	-.22	.21	.15	1			
6. P_2;0	.24	.02	-.34	.03	-.77**	1		
7. C_2;0	.29	.24	.02	-.23	-.67**	.20	1	
8. S_2;0	-.21	.01	.42	.07	.27	-.68**	.02	1

Note: N = nouns, P = predicates, C = closed-class words, S = social words

[†] $p < .10$, ** $p < .01$

Table 6.3 also shows that the late bloomers had a lower mean percentage of closed-class scores with less variation at 1;6 than the slower learners and

greater mean percentages of nouns and predicates. Although there were differences in the mean proportions of all word categories except for social words, the kinds of words children in the two groups used were quite similar. However, the 22 slower learners used 25 different nouns as a group, while the 15 late bloomers used a total of 28 different nouns. The late bloomers used more words pertaining to food (12 different words as opposed to seven for the slower learners) and more words for body parts (three vs. one). Both groups used seven different verbs, with the most frequent of these being the deictic *titta* ('look'). The slower learners used nine different closed-class words compared to the late bloomers' six.

Further comparison between the two groups of learners can be aided by the graphic representation of vocabulary composition, calculated as percentage scores in Figure 6.7 and opportunity scores in Figure 6.8. Percentage scores give proportions of each word class in relation to total vocabulary size, while opportunity scores give the relative proportion of words in each class on the checklist.

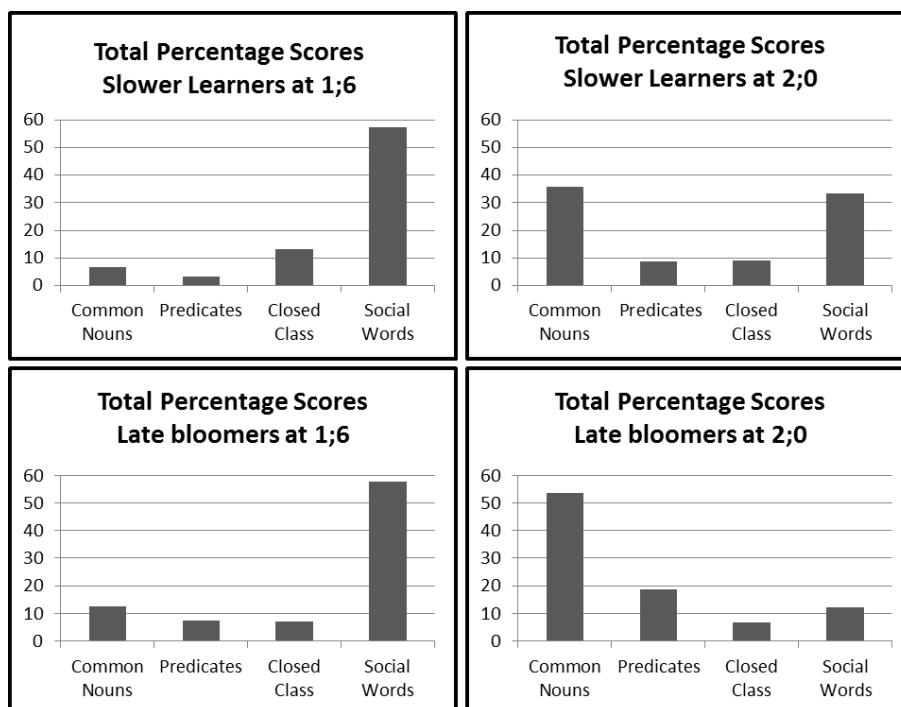


Figure 6.7: Vocabulary composition displayed as percentages (mean percent) of total vocabulary scores on SECDI: Words & Sentences for slower learners ($n = 22$) and late bloomers ($n = 15$) at 1;6 and 2;0

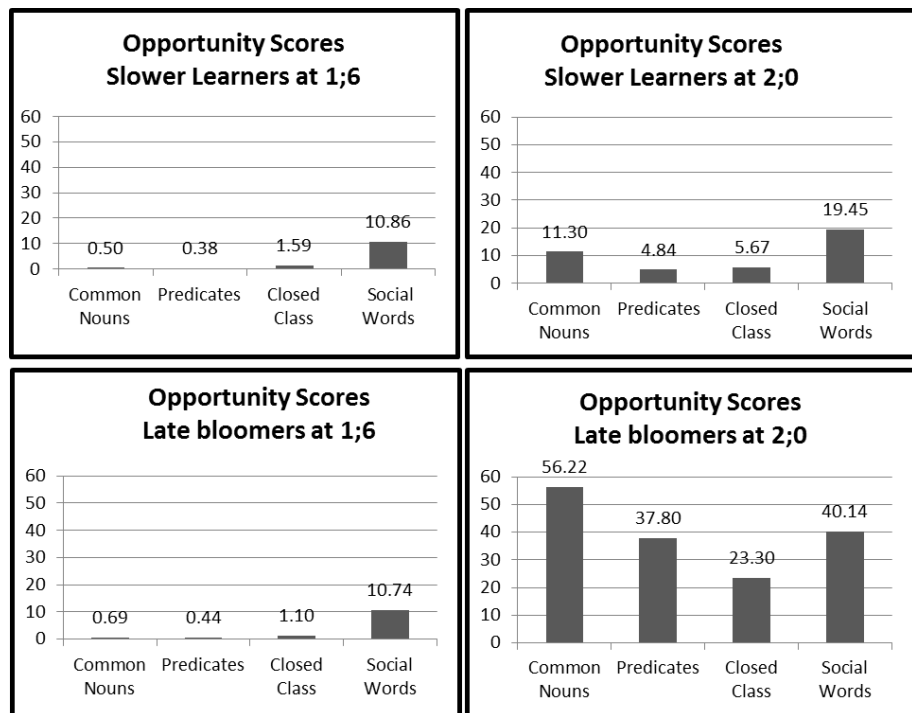


Figure 6.8: Vocabulary composition displayed as relative percentages (mean percent) of word categories on SECDI: Words & Sentences (word opportunity scores) for slower learners ($n=22$) and late bloomers ($n=15$) at 1;6 and 2;0

6.3.6.2 Correlation analysis: opportunity scores

Table 6.10 and Table 6.11 display results of bivariate correlation analysis among composition variables for slower learners and late bloomers at the two ages using opportunity scores. Compared to the correlations using absolute percentage scores, these results are somewhat different. For the slower learners, whereas the absolute percentage correlations show an inverse relationship between social words at 2;0 and both nouns and predicates at 2;0, the composition variables at 2;0 are mostly significantly correlated with each other. The one exception is the percentage of nouns with closed-class words, although this result is significant at the 10% level ($p = .057$). Composition variables at 1;6 are also significantly correlated with each other, with the exception of closed-class words. However, opportunity score correlations between nouns at 1;6 and closed-class words at 2;0 ($p = .059$) and between closed-class words at the two measurements are very similar to the percentage score correlations.

Table 6.10: Correlation coefficients for vocabulary composition variables (opportunity scores) for slower learners ($n = 22$) at 1;6 and 2;0

Measure	1	2	3	4	5	6	7	8
1. N_1;6	1							
2. P_1;6	.65**	1						
3. C_1;6	-.15	.22	1					
4. S_1;6	.44*	.63**	.20	1				
5. N_2;0	-.13	-.29	-.15	.11	1			
6. P_2;0	.00	-.13	.03	.14	.79***	1		
7. C_2;0	-.41 [†]	-.23	.52*	.10	.41 [†]	.53*	1	
8. S_2;0	-.11	-.07	-.05	.23	.79***	.72***	.47*	1

Note. [†] $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

N_1;6, P_1;6...stand for the percentages of nouns, predicates, closed-class words and social words at 1;6 and 2;0, respectively.

For the late bloomers, absolute percentage scores showed inverse relationships between social words at 1;6 and nouns and predicates at 1;6, as well as between nouns at 2;0 and predicates and closed-class words at 2;0, and between predicates at 2;0 and social words at 2;0. These relationships reflect the developmental trends seen in Figure 6.3 and are also similar to those seen in the fast learners. With opportunity scores, there are significant positive correlations between nouns at 1;6 and all composition variables at 2;0, as well as among all the variables at 2;0. The fast learners exhibit these relationships (not presented here), in addition to significant correlations among all composition variables already at 1;6.

Table 6.11: Correlation coefficients for vocabulary composition variables (opportunity scores) for late bloomers ($n = 15$) at 1;6 and 2;0

Measure	1	2	3	4	5	6	7	8
1. N_1;6	1							
2. P_1;6	.64**	1						
3. C_1;6	-.16	-.17	1					
4. S_1;6	.27	.02	.38	1				
5. N_2;0	.55*	.05	-.21	.38	1			
6. P_2;0	.54*	.24	-.38	.24	.74**	1		
7. C_2;0	.54*	.32	-.23	.13	.72**	.78*	1	
8. S_2;0	.72**	.27	-.03	.38	.84***	.70**	.82***	1

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

N_1;6, P_1;6...stand for the percentages of nouns, predicates, closed-class words and social words at 1;6 and 2;0, respectively.

Thus, it can be said that percentage scores and opportunity scores reveal different, complementary information about vocabulary composition, especially regarding small vocabulary size.

6.4 Discussion

The overall aim of this study was to examine vocabulary composition and grammatical abilities in a sample of Swedish children based on vocabulary measurements at age 1;6 and 2;0. Various factors predicting vocabulary size at 2;0 were considered, and special attention was given to the role of vocabulary composition, stylistic variation and grammatical abilities in children's timing of acquisition.

6.4.1 Vocabulary growth: group stability and variation

This study indicates that those children who have the earliest and largest production vocabularies at 1;6 retain or gain their positions in the top quartile 6 months later (see Table 6.1). There is less stability among quartile groupings for children who scored in the lower quartiles at the first measurement. Fernald and Marchman (2012) found that language group status was less stable for late talkers than for typically developing children. In this study, slower learners exhibit much less stability in vocabulary size and the greatest variation in vocabulary composition, trends which concur with previous research (e.g. Bates et al., 1994; Lieven et al., 1992; Nelson et al., 1973). Additionally, standard deviations for vocabulary size and all measures of vocabulary composition except for social words were greater than the mean for the sample as a whole at 1;6 (see Table 6.2). When vocabulary composition was examined by learner category, the slower learners and late bloomers had standard deviations greater than the mean for both absolute percentages of nouns, predicates and closed-class words at 1;6 (see Table 6.3) and relative percentages of the same classes of words measured in opportunity scores (see Table 6.4). However, even the average learners showed a standard deviation greater than the mean for closed-class words, and the fast learners for predicates measured in opportunity scores. At 2;0, all groups still showed large variation within composition variables, but the slower learners had standard deviations closest to the mean, indicating most variation.

6.4.2 Comparisons with other languages

Comparisons across languages may be hampered by the fact that studies use different classification systems for word categories, especially when measurements are based on different kinds of checklists or only observational data, or cluster children into various vocabulary size groups. For example, both Bornstein et al. (2004) and Nelson et al. (1993) used the Early Language Inventory and divided words classes into categories that differ from Bates et al. (1994) and Caselli et al. (1999), the classification system which was used in this study. Kauschke and Hofmeister (2002) based their study on

recordings of spontaneous speech, and used word class categories quite different than Bates or Caselli and colleagues. For example, the German word *da* ('there') was classed as a relational word, rather than a function word. The corresponding Swedish *där*, which is often among the early words used by Swedish children, is considered a closed-class word in this study. Also, while Gentner's (1982) classic study did not differentiate between proper nouns and common nouns, proper nouns are considered social words here. Furthermore, as comparisons between children of different ages may be problematic, it is better to compare profiles of children with similar vocabulary sizes, although maturational differences may play a role here.

A comparison of the Swedish children's vocabulary composition by vocabulary size with trends presented by Caselli et al. (1999) for American and Italian children reveals similar profiles, but with some differences. The Swedish children in this study with vocabulary size under 50 words have smaller mean absolute proportions of nouns than both Americans and Italians and larger proportions of closed-class words. However, the latter included children of many ages, although grouped by vocabulary size, which can make the comparison less than ideal. Results of Richthoff's (2000) investigation of Swedish children's early vocabulary production also indicated higher proportions of closed-class words than those reported for American children (Bates et al., 1994). Further, proportions of social words for Swedish children with small vocabularies fall in between those of American and Italian children. Caselli et al. (1999) found that Italian children with higher proportions of social words had lower proportions of nouns at small vocabulary size, which also seems to be the case for Swedish children. These differences, as well as the fact that Italian children used more closed-class words than American children for vocabularies up to 600 words, seem to indicate dissimilarities in both language structure and culture. Variation in use of social words for this sample of Swedish children was not as large as other word categories (see Table 6.2), indicating as well that these words are more important in Swedish culture.

Stolt et al. (2007) used a classification system similar to this study and also calculated vocabulary composition as both total percentage and opportunity scores. A comparison of word opportunity scores between the 11 children (born full-term) with vocabularies under 50 words at 2;0 in the Finnish study and 11 Swedish slower learners at 2;0 shows that the Swedish children have lower mean scores for percentages of social terms, common nouns and predicates than the Finnish children, but a higher mean for closed-class words. In addition, a comparison of opportunity scores according to vocabulary size for all Swedish learners at 2;0 in the present study (Figure 6.2) with Stolt's children born full-term ($n = 84$) reveal some interesting differences in trends. While trends for closed-class words and predicates are similar in shape, Swedish children have reached the 50% opportunity point (where 50% of the words in the respective category on the SECDI checklist have

been marked) at larger vocabulary sizes than the Finnish children. Most interestingly, Finnish children have produced 50% of both social words and common nouns on the CDI at a vocabulary size of approximately 175 words, and then the curves are almost identical as they increase to over 80% for vocabulary sizes of over 425 words. For Swedish children, the curves for social words and common nouns meet at 30% at a vocabulary size of approximately 200 words. From there, the curve for nouns rises sharply to approximately 90% for the largest vocabulary sizes, while social words only reach just over 60% of the words on the checklist.

6.4.3 Stylistic variation

The results of this study indicate that fast learners have the largest absolute proportions of nouns and predicates (and correspondingly smallest proportions of closed-class words and social words) in their vocabularies at 1;6. The percentage of nouns in children's vocabulary at 1;6 also accounted for the greatest proportion of explained variance for vocabulary size at 2;0, a finding which supports earlier claims of the advantage of early noun learning (Nelson, 1973; Bates et al., 1988). In their later study, after controlling for developmental changes in noun use, Bates and colleagues no longer reported a noun advantage, but found that, though not necessarily 'bad for children', high values of early closed-class use were associated with slower rates of development (1994, 1995). Similarly, early use of social words may be associated with an expressive style leading to a slower rate of learning words (Nelson, 1973). Although the early noun advantage has been debated by others (Kauschke & Hofmeister, 2002; Lieven et al., 1992; Pine et al., 1997; Waxman et al., 2013), it seems here that being able to produce many nouns at 1;6 is associated with more rapid vocabulary development. While Bornstein et al. (2004) reported results for vocabulary composition using categories that differ from those used in this study, parents in all seven countries indicated that their children also used greater proportions of nouns than verbs, adjectives and closed-class words.

Children with large proportions of closed-class words in their vocabularies might be considered non-referential children with a preferred use of frozen or unanalyzed phrases (e.g. *Where's it gone?* or *There it is*; Lieven et al., 1992). Early use of closed-class words may also be associated with an over-reliance on rote memory. In this study, the significant positive correlation between slower learners' proportions of closed-class words at the two time points indicates that they are still in the rote learning phase at 2;0. This is not the case for the late bloomers, for whom relationships among composition variables at 1;6 are analogous to those of the slower learners at 2;0. Bornstein et al. (2004), who used opportunity scores in correlation analysis, found that word classes were unrelated for children in the vocabulary spurt (51–100 words), which may also mean that late bloomers are in, or just be-

ginning their spurt. These children, who had more nouns and fewer closed-class words at 1;6 than the slower learners, gained some advantage from these relative proportions.

Fernald and Marchman (2012) found that late talkers who bloomed by 2;6 were those who had been significantly faster at language processing than other late talkers at 1;6. The authors underscore the cascading advantages for children who know more words at 1;6, as this facilitates even more vocabulary and grammatical learning, and claim that more experience with child-directed talk may help in this process. It is important that this parental input is clearly articulated and developmentally-appropriate, as well as affirmative of children's communicative intentions (Study I in this thesis). Pine et al. (1997) found that children whose parental input was characterized by clearer word boundaries tended to have fewer frozen phrases in their vocabularies. This may possibly mean fewer closed-class words and more nouns. On the other hand, higher percentages of closed-class words in the children with slower early vocabulary growth may also be the influence of high frequency in parental speech, despite these words often being unstressed and abstract (Richthoff, 2000). In addition, closed-class words in Swedish are often used deictically, thus comprising a great deal of typical Swedish parent-child interaction.

6.4.4 Grammatical abilities and the lexicon

The results of this study also provide support for the close association between grammar and vocabulary, as children with the largest vocabularies are those who combine words earliest and use grammatical features of the language to the greatest extent. Grammatical abilities at 1;6 was a significant predictor of vocabulary size at 2;0, and correlations between vocabulary size at 2;0 and children's ability to combine words at 1;6 were moderate and significant ($r = .42, p < .001$). Although the Swedish version of CDI: Words & Sentences does not have the same kind of grammatical complexity scale found in the American, Italian, Finnish and Icelandic forms, for example, results concur with previous research regarding the dependency of grammar on lexical development (e.g. Bates et al., 1995; Bates & Goodman, 1999; Caselli et al., 1999; Stolt et al., 2009; Szagun et al., 2006; Thordardottir et al., 2002).

6.4.5 Prediction of vocabulary size

Analysis of variables predicting vocabulary size at age 2;0 revealed that the size of children's vocabularies at 1;6 accounted for the greatest amount of variation, followed by a small proportion due to gender. This female advantage for girls (in full-term, typically developing children) has been demonstrated in many studies (e.g. Eriksson et al., 2012; Fenson et al., 1994;

Simonsen, Kristoffersen, Bleses, Wehberg, & Jørgensen, 2014). However, in a study comparing early language development in children with very low-birth weight to typically developing controls, the gender advantage for girls disappeared (Stolt et al., 2007). As displayed in Table 4.3, gender distribution in this study showed that girls comprised the majority of fast learners. There were more boys than girls among the slower learners and average learners. The late bloomer group consisted of more boys than girls and was the smallest group of those contrasted here. Although parent education was not a significant predictor of vocabulary size in the large sample, regression analysis for the slower learners and late bloomers alone, groups which had comparable vocabulary sizes at 1;6, showed that parental education, along with children's proportions of nouns at 1;6, explained the greatest amount of variation in vocabulary size at 2;0. Thus, despite the relative homogeneity regarding level of parental education in this sample of families, differences could be detected between outcomes for these two groups of learners.

6.5 Conclusions

This study has provided unique, detailed analysis of Swedish children's vocabulary composition and the role of composition and grammatical abilities in relation to vocabulary size at 1;6 and 2;0. The size of children's early productive vocabularies is strongly associated with later grammatical development. Although it is important to help children move from the early stages of using social words to the acquisition of nouns, which have a positive effect on further language development, an understanding of stylistic variation in children's word learning is also necessary. Parents and early childhood educators alike can employ strategies which not only facilitate the learning of nouns, but also develop adult-child interaction which takes into account a child's individual interests and personality. Furthermore, it is important to facilitate children's general knowledge of the world in which communication takes place. This may involve helping children learn more nouns, but most importantly, parents and other caregivers need to do this in conjunction with a child's focus of attention and interest.

Study III in this thesis (Chapter 7) further develops the correlation analysis conducted in this study, extending the analysis to different variables and over a longer period of time. Finally, similar studies of vocabulary composition in other languages may concur with the results of this thesis.

7 Interrelations among communicative skills in Swedish children from 1;0 to 2;6

7.1 Introduction

The development of efficient communicative skills is crucial for positive long-term outcomes in children (see also Section 3.3), as early communicative development can create cascading effects in the later development of the child. For example, Hart and Risley's (1995) input-driven measures of child vocabulary use and rate of growth at age 3 have been shown to be strongly predictive of language skills at age 9–10 (Walker et al., 1994), and Lee (2011) has demonstrated that expressive vocabulary at 24 months of age is related to later language and literacy skills up to grade 5. An elaborated understanding of the development of early communication in children is essential for many reasons. This knowledge is useful for the research field, teacher education, and applications of many kinds, including the design of efficient intervention programs. Thus, an important question for the present thesis regards how different communicative skills are related over time (cf. Bruce et al., 2003). This study investigates correlations over time among a range of communicative skills in samples of infants and toddlers in the age-range 12 to 30 months. The skills focused on are measured with the Swedish version of the MacArthur-Bates Communicative Development Inventories (SECDI), and comprise communicative gestures, receptive and productive vocabularies, and the syntactic/grammatical measure M3L⁶². The M3L score has been called MaxLU in some previous studies (e.g. Berglund & Eriksson, 2000a) and has been shown to be a reliable measure of grammatical skill in early child language (e.g. Devescovi et al., 2005; O'Toole & Fletcher, 2010; Pérez-Pereira & Resches, 2011). A study comparing early language skills in children from 10 different European countries found a slight advantage for girls in the development of gestures and productive vocabulary, as well as word combinations (Eriksson et al., 2012), a finding that has been reported in studies from many individual countries (e.g. Fenson et al., 1994, 2007; Simonsen et al., 2014).

⁶² M3L is the MLU score of the three longest utterances parents have heard their child say recently, where both different words and different inflections are counted.

7.1.1 Gestures and vocabulary

An overview of early gestures, including the relationship between gestures and other language domains, is given in Section 3.1.3. The relationship between language and gesture is also a reflection of that between language and motor development (Iverson, 2010). Iverson suggests that developing motor skills, such as changes in posture, independent locomotion and object manipulation (e.g. Lifter & Bloom, 1989), including the ability to combine objects, are associated with achievements in early language development. When infants carry out actions on an object which illustrate how the object is used (e.g. pretending to drink from an empty cup)⁶³, these actions are highly likely to become part of the infants' repertoire of representational (empty-hand) gestures and/or early words (Capirci et al., 2005; Volterra, Caselli, Capirci, & Pizzuto, 2005). However, Iverson (2010) stresses that the development of motor and speech skills are neither necessary, nor sufficient conditions for language to evolve, but they are “normally participatory” in language development (p. 255). In other words, language development may proceed in alternative ways in infants with various dysfunctions, and there is no guarantee that language will develop normally when all the motor skills are present.

In a study using a short form of the CDI, Sansavini et al. (2010) discuss how word reception, production and gestures are related. Their study split the conventional actions and gestures measures into one part with “empty-hand” gestures and one with “object-related actions”. Empty-hand gestures include the deictic gestures *request*, *show* and *point*, while object-related actions are routines or brief actions associated with an object (e.g. *stir with a spoon* or *put a doll to bed*; see also Section 4.7.2.3). Sansavini et al. (2010) performed partial correlations among the different scales in children from 10 to 17 months old, and found that empty-hand gestures correlated in three age-groups with word reception, and with word production in two of the groups. Object-related actions correlated with word reception in six age-groups and not at all with word production, and word reception correlated with word production at one age. Sansavini et al. (2010) identified the role of object-related actions as linked to the construction of meaning. It thus seems that the object-related actions give children experience with objects crucial for the understanding of concepts, while the empty-hand gestures are more closely related to word production.

7.1.2 Receptive vocabulary

Reception (comprehension) can be understood as linking knowledge about the world (semantics) with auditory patterns. Gestures and play, with or

⁶³ These actions are often called recognitory gestures in the literature.

without objects involved, are important in the development of receptive vocabulary. Comprehension is a major problem for individuals with language impairment, and comprehension is usually more important in later life than difficulties with pronunciation (Beitchman et al., 2008). Studies have generally shown that children's language comprehension precedes production (e.g. Simonsen et al., 2014). However, the relation between comprehension and production is not straightforward, a topic which is thoroughly discussed by Bates (1993). Instead, there are reports of dissociation, which means that some children exhibit a close relationship between reception and production, while others can have large receptive vocabularies, yet still only produce a few words (Bates, 1993; Charman et al., 2003; Fenson et al., 2007). Although the research methods mentioned in Section 4.1 have added to the scientific understanding of processes involved in infants' and children's language comprehension, there is still much to be learned (Kail, 2011).

7.1.3 Grammar knowledge

In early development, children may produce unanalyzed (frozen) phrases without fully understanding the meaning of individual words. This suggests that the earliest syntax scores in terms of MLU may be relatively unrelated to later syntax scores. Later on, children's learning of word meanings may be facilitated by listening to the phrases in which the words occur (syntactic/semantic bootstrapping). Work by Bates and Goodman (1997, 1999) has indicated the close association between grammar and productive vocabulary, including temporal asynchrony in development (that is, grammar development displays lexical dependency; see also 3.1.5.1). However, Dixon and Marchman (2007) hypothesize that the two domains develop in a synchronous way. This may mean that both domains are driven by underlying factors, including input, or general cognitive and processing abilities. Alternatively, the lexicon and grammar have a mutually reciprocal relationship across development.

7.2 Aim

The overall aim of this study was to explore interrelations among communicative skills in Swedish children aged 12–30 months, and based on the data, provide a descriptive analysis of this development. The following specific research questions were posed:

- What is the impact of gestures on vocabulary development over time in the early stages of acquisition, i.e. 12–30 months?
- What is the impact of children's production vocabulary on the development of grammar and syntax during this period?

- Can gender differences be seen in the size of children’s productive vocabulary from 12 to 30 months?
- What are the relationships among “empty-hand” gestures, “object-actions” (following Sansavini et al., 2010) and children’s receptive and production vocabulary at 12 months of age?
- What are the interrelations among children’s use of “object-actions” and “empty-hand” gestures at 12 months and their use of nouns, verbs and closed-class items at 18 months of age?

The results obtained in this study regarding the first two research questions will be compared with relationships between comparable variables available for American CDI data. Detailed information regarding the methods and materials used in this skills study are found in Section 4.7.

7.3 Results of Study III

The obtained results are first presented for correlation analysis within each 6-month period examined, followed by overall descriptive figures for the two samples. As detailed in Section 4.7.1, the correlation analysis was carried out for two groups of children: the total sample ($N = 348$) and the 128 children with complete records from 12 to 30 months. For purposes of comparison, the correlation results will be contrasted with bivariate correlations from American CDI data. Thereafter, results of the in-depth gesture analysis are presented, including relationships with receptive and productive vocabulary, as well as different word classes.

7.3.1 Cross-sectional results at 12/18 months

Cross-sectional correlations were calculated between the measures at each individual age. Table 7.1 presents the results obtained for the 12/18 month age span in both the total and smaller samples. There were highly significant correlations between gestures and both receptive and productive vocabulary at 1;0, as well as between productive vocabulary and M3L at 1;6. It should be noted that the number of children in the total sample varies with age (see Table 4.5).

Table 7.1: Correlation coefficients for measures at 1;0 and 1;6 (cross-sectional) in the total sample ($N = 348$) and the sample with complete records ($N = 128$)

		1;0		1;6	
<i>N</i> = 348		Gestures	Receptive	M3L	
1;0	Receptive	.49***		1;6	Productive
	Productive	.32***	.11*		
<i>N</i> = 128		Gestures	Receptive	M3L	
1;0	Receptive	.53***		1;6	Productive
	Productive	.33***	.13		

Note. * $p < .05$, *** $p < .001$

The magnitude and significance of correlations were similar in both samples, with the exception of the relationship between receptive and productive vocabulary in the smaller sample, which was no longer significant due to decreased power. However, this relationship between receptive and productive vocabulary was weak in both samples.

7.3.2 Pairwise correlations at 12/18 months

Pairwise correlations include those between the same measure at different ages, as well as cross-lagged correlations between different measures at different ages. All of the correlations in Table 7.2 are partial correlations, controlling for the other variables measured at the same age.

Table 7.2: Correlation coefficients for measures at 1;0 and 1;6 (pairwise) in the total sample ($N = 348$) and the sample with complete records ($N = 128$)

		1;0		
$N = 348$		Gestures	Receptive	Productive
1;6	M3L	.07	.01	.51***
	Productive	.12*	.03	.54***
$N = 128$		Gestures	Receptive	Productive
1;6	M3L	.23*	-.08	.44***
	Productive	.14	.02	.53***

Note. * $p < .05$, *** $p < .001$

The strongest correlations were between productive vocabulary at 1;0 and both M3L and productive vocabulary at 1;6. As with the cross-sectional correlations, the magnitude and significance of the correlations across ages were similar in the two samples, with the exception of those among gestures and variables at 1;6. In the small sample, the weak relationship between gestures and productive vocabulary at 1;6 is no longer significant, most likely due to the loss of power. However, the relationship between gestures and M3L is stronger and significant in the smaller sample. Descriptive statistics show that the mean values for gestures and M3L at 1;6 are both smaller in the sample with 128 children, but the range for both measures is greater in the

sample with 348 children. However, for the smaller sample, the standard deviation (*SD*) for gestures was slightly smaller and the *SD* for M3L slightly larger than the total sample.

In summary, the above results indicate that gestures are more strongly linked to children's concurrent word reception and word production. Gestures are also linked, albeit weakly, to future productive vocabulary development. Furthermore, productive vocabulary at 1;0 is strongly related to both productive vocabulary and M3L at 1;6. Thus, although there may be other underlying factors, early productive vocabulary appears to be important for the development of grammar and syntax.

7.3.3 Cross-sectional results at 24 months

At 24 months of age, the bivariate correlation between M3L and productive vocabulary in both samples was strong and highly significant. In addition, the magnitude was very similar (for $N = 348$: $r = 0.69$, $p < .001$; for $N = 128$: $r = 0.69$, $p < .001$).

7.3.4 Pairwise correlations at 18/24 months

For the age span 18/24 months, correlations among results at different ages, as well as cross-lagged correlations were calculated, all using the partial correlation technique (see Table 7.3).

Table 7.3: Correlation coefficients for measures at 1;6 and 2;0 (pairwise) in the total sample ($N = 348$) and the sample with complete records ($N = 128$)

		1;6	
$N = 348$		M3L	Productive
2;0	M3L	.18*	.46***
	Productive	.060	.54***
$N = 128$		M3L	Productive
2;0	M3L	.17 [†]	.51***
	Productive	.12	.54***

Note. [†] $p < .10$, * $p < .05$, *** $p < .001$

The strongest relationships were those between productive vocabularies at the two ages in both samples. The correlation between productive vocabulary at 1;6 and M3L at 2;0 was also highly significant, although the magnitude was slightly larger in the smaller sample. Correlations between M3L at both ages were weak and of similar magnitude in both samples, although the significance was lost in the smaller group. Correlations between M3L at 1;6 and productive vocabulary at 2;0 were very weak and nonsignificant in both samples.

In summary, results for the 18/24 month period support those from the 12/18 month age span. In both periods, productive vocabulary is a predictor for the development of more complex syntactic/grammatical constructions.

7.3.5 Cross-sectional results at 30 months

Finally, at 30 months of age, the bivariate correlations (r) between productive vocabulary and M3L were strong and highly significant in both samples. The following results were obtained: for $N = 348$, $r = 0.63$, $p < .001$; for $N = 128$: $r = 0.62$, $p < .001$.

7.3.6 Pairwise correlations at 24/30 months

Longitudinal partial correlations for the age span 24/30 months were very similar in both samples (see Table 7.4). Productive vocabularies at 24 and 30 months were highly significantly correlated, with stronger correlations compared to the previous age span. Similarly, values for M3L at the two ages were highly significantly correlated, with stronger correlations than the age span 18/24 months. The cross-lagged correlations between productive vocabulary at 2;0 and M3L at 2;6 were weaker than in the previous age span, but still highly significant. The relationship between M3L at 2;0 and productive vocabulary at 2;6 was nonsignificant.

Table 7.4: Correlation coefficients for measures at 2;0 and 2;6 (pairwise) in the total sample ($N = 348$) and the sample with complete records ($N = 128$)

2;0			
$N = 348$		M3L	Productive
2;6	M3L	.40***	.35***
	Productive	-.03	.72***
$N = 128$		M3L	Productive
2;6	M3L	.42***	.34***
	Productive	-.02	.72***

Note. *** $p < .001$

In summary, as in the previous age span, results for the 24/30 month period indicate a link between vocabulary and syntax. The somewhat weaker correlation can perhaps be explained by ceiling effects for the productive vocabulary measure, as suggested by the very strong correlations between values at 2;0 and 2;6 (see Figure 7.1 and Figure 7.2).

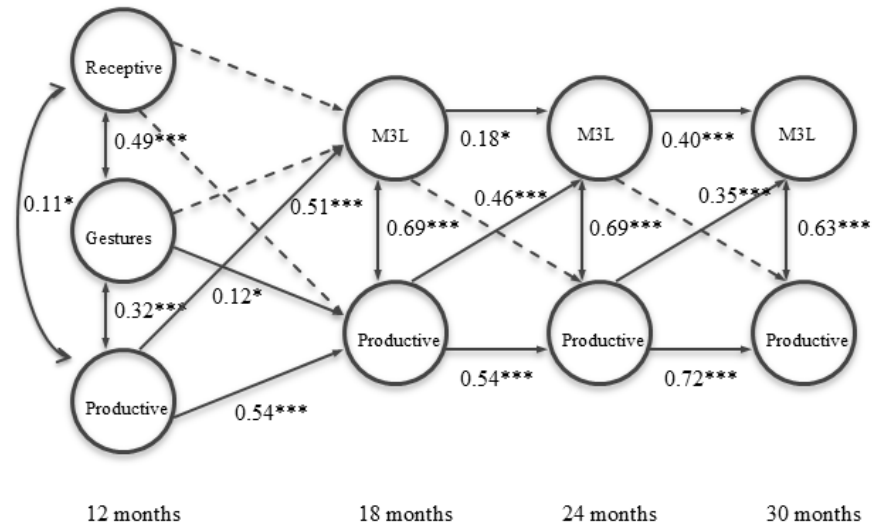


Figure 7.1: Interrelations among receptive and productive vocabulary, gestures and M3L scores at different ages for the total sample ($N=348$). Non-significant correlations are indicated with dotted lines. * $p < .05$; *** $p < .001$

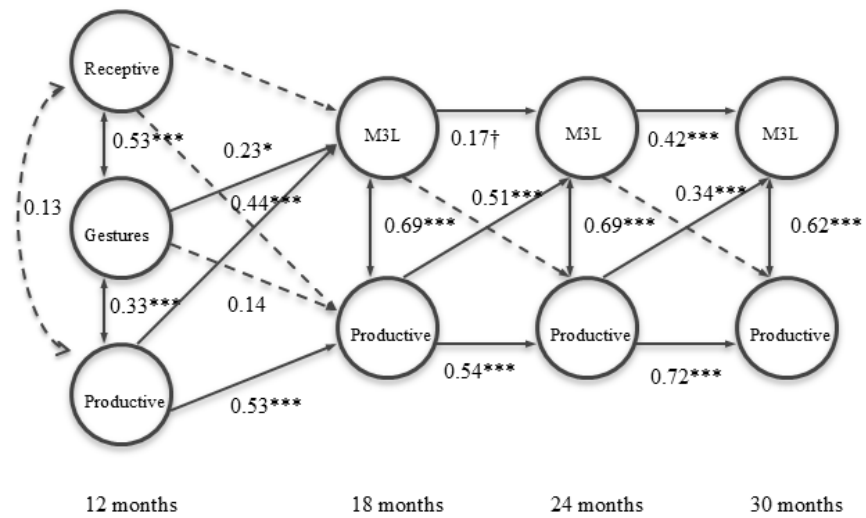


Figure 7.2: Interrelations among receptive and productive vocabulary, gestures and M3L scores at different ages for the sample with complete records ($N = 128$). Non-significant correlations are indicated with dotted lines. † $p < .10$, * $p < .05$; *** $p < .001$

The interrelationships among communicative skills expressed in Figure 7.1 and Figure 7.2 for the two different samples are very similar, with just a few exceptions. For the most part, magnitude of correlation and degree of significance is comparable. However, when significance is at the 5% level in the total sample (as in the relationship between receptive and productive vocabulary at 1;0, or gestures at 1;0 and productive vocabulary at 1;6), these relationships become nonsignificant due to less power in the small sample. However, an unexpected result is the change from a nonsignificant relationship between gestures at 1;0 and M3L at 1;6 in the total sample to a significant correlation in the small sample. Nevertheless, both figures show the strong relationship between productive vocabulary and grammatical development, both concurrently and predictively. Furthermore, the predictive value of early vocabulary for later vocabulary is evident in both samples, as well as the importance of gestures for early receptive vocabulary.

7.3.7 Gender differences

Figure 7.3 below presents group profiles in vocabulary production for boys and girls during the period from 1;0 to 2;6.

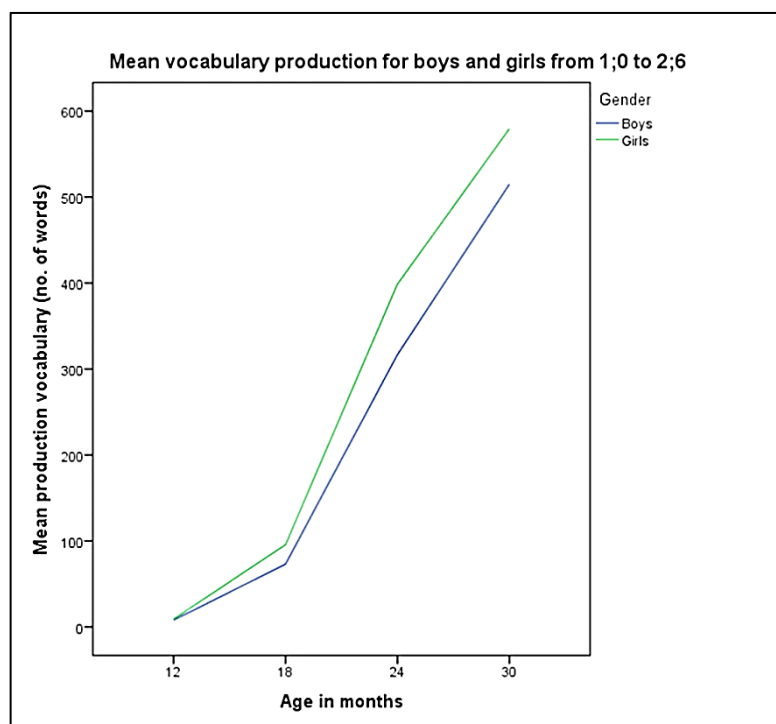


Figure 7.3: Mean vocabulary production for boys and girls from 1;0 to 2;6 ($N = 128$) based on measurements with *SECDI: Words & Gestures* (1;0) and *SECDI: Words & Sentences* (1;6–2;6)

As in numerous studies, Figure 7.3 shows that girls as a group have an early advantage over boys with respect to the size of early productive vocabulary. The analysis of complete records of 128 children indicates a significant difference in production profiles between boys and girls.

7.3.8 Cross-sectional correlations for American CDI data

Table 7.5 presents the cross-sectional correlations calculated from American CDI data at child age 1;0, 1;6, 2;0 and 2;6. The correlations calculated at 1;0 are partial correlations, while those calculated between measures at later ages are bivariate.

Table 7.5: Correlation coefficients for measures at 1;0, 1;6, 2;0 and 2;6 (cross-sectional) from American norming data

		1;0 (N = 153)		1;6	2;0	2;6
				(N = 102)	(N = 131)	(N = 70)
		Gestures	Receptive	M3L	M3L	M3L
Receptive		.39***		.65***	.73***	.49***
Productive		.28**	.38***			

Note. ** $p < .01$, *** $p < .001$

A comparison between the correlations for the Swedish sample in this study and the American norming data yields some similarities and some differences. Bivariate correlations between productive vocabulary and M3L at 1;6, 2;0 and 2;6 are most similar, while the differences are found in the measures at 1;0. At this age, correlations between gestures and receptive and productive vocabulary are stronger in the Swedish sample, while the correlation between receptive and productive vocabulary is much stronger in the American sample.

7.3.9 Interrelations among gestures and vocabulary at 1;0

Table 7.6 illustrates the interrelations among empty-hand gestures and object-actions, receptive vocabulary, and productive vocabulary at 12 months of age. The various partial correlations are all significant, with object-actions being particularly important for receptive vocabulary, and empty-hand gestures more important for productive vocabulary.

Table 7.6: Significant correlation coefficients for empty-hand gestures, object-actions, receptive vocabulary and productive vocabulary at 1;0

	Empty-hand	Object-actions	Receptive
Object-action	.33***		
Receptive	.18**	.31***	
Productive	.19***	.13*	.16**

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

7.3.10 The role of gestures in relation to word-class items

In order to determine relationships between the two types of gestures at 1;0 and children's vocabulary composition in absolute percentages (i.e. in relation to total vocabulary size) at 1;6, correlation analysis of the measures was undertaken. The results are presented in Table 7.7.

Table 7.7: Correlation coefficients for the subclasses of gestures (empty-hand and object-action) at 1;0 in relation to absolute percentages of nouns, verbs and closed-class words at 1;6.

	1;0	
1;6	Empty-hand	Object-action
% nouns	.15**	-.01
% verbs	.00	.13*
% closed-class	-.03	.03

Note: * $p < .05$, ** $p < .01$

Children's use of empty-hand gestures (those without objects) at 12 months of age was significantly, but weakly correlated with the percentage of nouns in their vocabularies at that age, whereas their use of object-action gestures was similarly correlated with the percentage of verbs.

7.4 Discussion

The results of the present study have demonstrated the interrelations among different communicative skills in Swedish children's early development. The results indicate that productive vocabulary is of great importance for the development of early syntax (cf. Bates & Goodman, 1997), while syntactic bootstrapping (that is, syntax as a means to increase vocabulary), seems not to be important in the period examined here for Swedish children. Furthermore, the results also demonstrate that games and gestures (as measured by SECDI) are of importance for children's early productive vocabulary, findings that are consistent with earlier work (e.g. Caselli et al., 2012; Reilly et al. 2006). As in the study conducted by Caselli et al. (2012), early gestures were more strongly correlated with receptive vocabulary than productive vocabulary. The obtained results also confirm an early gender advantage for

girls in the size of productive vocabulary (e.g. Eriksson et al., 2012; Simonson et al., 2014).

Comparisons between the results of this study and correlations calculated using the American norming data yielded both similarities and differences. For both languages, gesture use at 1;0 was more strongly correlated with receptive than productive vocabulary. However, in the American data, the correlation between receptive and productive vocabulary was much stronger than in the Swedish sample. Although the range for both receptive and productive vocabulary was larger for the Swedish children at 1;0, the American sample had greater means for both comprehension and production. Regarding standard deviations, the value for comprehension was greater with the Swedish children, while the value for production was greater with the American children. This is despite the fact that the American sample was smaller than the Swedish sample.

Correlations between productive vocabulary and syntax at 1;6, 2;0 and 2;6 were similar for both languages. However, while the American sample had a greater mean, standard deviation and range at 1;6, values for these statistics were greater in the Swedish sample at 2;0 and 2;6. The reason for this may be that the American norming sample is more representative of the population as a whole than is the Swedish sample in this thesis. Thus, while early vocabulary production starts somewhat more slowly for the Swedish children, they have surpassed the American children at 2;0 and 2;6, nearing ceiling on the SECDI checklist.

Interrelations among the communicative skills investigated in this study were calculated for both the total sample ($N = 348$) and the sample of children with complete records ($N = 128$). The results obtained also yielded similarities and differences. As mentioned in the results section, correlations which were not as strongly significant in the total sample become nonsignificant in the smaller sample, due to lack of power. However, in the smaller sample, there was a significant correlation between gestures at 1;0 and M3L at 1;6, while this relationship was nonsignificant in the total sample. Means for both measures were slightly smaller in the smaller sample, but for gestures, there was less variation for the 128 children, with both a smaller range and standard deviation. For M3L, the standard deviation for the 128 children was slightly larger, but the range was smaller. These differences may have been enough to cause a change in the significance level.

The more thorough investigation of the role of gestures, by dividing the section 'actions and gestures' in SECDI into two subclasses, was similar to earlier findings by Sansavini et al. (2010), showing that empty-hand gestures were more related to productive vocabulary, while object-actions were more related to receptive vocabulary. However, Sansavini et al. analyzed these relationships at eight time points from child age 0;10 to 1;5, enabling more fine-grained results. Looking at relationships over time, empty-hand gestures were more related to the development of nouns, while object-actions were

more related to the development of verbs. These are both results which have not been reported previously for Swedish children, at least to the author's knowledge.

7.5 Conclusions

The results of this study are important for the fields of research and teacher education and may offer inspiration in the designing of interventions for children with special needs, as the results point to the crucial role of productive vocabulary in the development of syntactic skills. Further understanding of the use of gestures in educational settings may also be needed, as empty-hand gestures, which most often are deictic gestures, are particularly useful for infants in enhancing their knowledge of objects and their names, while activities with objects are helpful in understanding the concepts related to actions, in particular verbs.

Knowing that comprehension is of utmost importance for the positive development of children's communicative skills (Beitchman et al., 2008), these insights into the role of gestures to improve comprehension in children are promising. In addition to observations of children's rapid actions demonstrating their understanding of concepts (that is, action words; Capirci et al., 2005; Volterra et al., 2005), the present results demonstrate that object-actions are of importance in particular for the development of verbs in children's vocabularies. This may be an inspiration for the use of play activities in preschools with the purpose of developing children's vocabulary concerning verbs.

The present study has supported a view of syntax as vocabulary driven, as well as one in which gestures are a means of facilitating vocabulary expansion. Further studies should employ the fruitful approach of dividing the gesture section of SECDI: Words & Gestures and exploring the role of different types of gestures in later vocabulary development. The ideas put forth in this study will be further discussed in Chapter 8.

8 General discussion

This chapter presents a general discussion of the results obtained in the present thesis. After a restatement of aims, a synthesis of the study results is undertaken. The chapter then moves through a section of final reflections on theory and methodology, followed by implications of the thesis and finally, avenues of future research.

8.1 Restatement of aims

The overall aim of this thesis has been to investigate the early vocabulary development of a sample of Swedish children, and examine this in relation to parental input and other early communicative skills. In the thesis, the term ‘vocabulary development’ has been used in a broad sense referring sometimes to development over a long time span, as well as in a more limited sense to refer to the vocabulary knowledge of the children studied here. The first four chapters of the thesis have provided background information which situates the studies in the field of child language research and sets the stage for the general discussion. The three studies have focused on various aspects of early language development with subsamples of differing size, using data collected by means of parental report and audio recordings of parent-child interaction.

Study I examined parental verbal interaction characteristics in 15 Swedish families divided into three groups according to child vocabulary size at 18 months of age. These interaction characteristics included amount and diversity of input, as well as parental use of interactive feedback behaviors and questions. These variables were investigated in relation to the size and composition of children’s vocabularies at 1;6.

Study II examined the role of vocabulary composition and grammatical abilities in a larger sample of over 200 children. These variables were investigated in groups of children with different vocabulary size at the ages of 1;6 and 2;0. In addition to the above analysis, prediction of vocabulary size at 2;0 was investigated, based on composition and grammatical variables as well as background variables such as child gender and parental education.

Study III investigated interrelationships among early communicative skills over time in a total sample of 348 children. These communicative

skills included early gestural use, receptive and productive vocabulary and the mean length of three longest utterances (M3L) from child age 1;0 to 2;6.

8.2 Review of results

Overall results of this thesis indicate the vital importance of early language development. This awareness is essential for many different groups in society, including parents, child healthcare personnel, preschool staff and researchers and practitioners in the special education field (see Section 8.4). Many results of the thesis support findings from previous international research, adding to them with a Swedish perspective. For example, Study III shows how important early productive vocabulary is for later vocabulary size and syntactic development. The interaction study (I) gives proof of variability in parental input as well as child vocabulary size in a relatively well-advantaged Swedish sample. It also emphasizes the importance of parental adjustment to a child's developmental level. In this section, the results of the studies presented in Chapters 5 through 7 are reviewed in an overall discussion. The results are consolidated under the following focal areas: vocabulary size, parent-child interaction, vocabulary composition and stylistic variation, grammar, and finally, gestures and vocabulary comprehension.

8.2.1 Vocabulary size

The size of children's early vocabularies is determined by a great number of variables, including biological, psychological and social factors. It is beyond the scope of this thesis to provide a comprehensive view of Swedish children's vocabulary development. Therefore, the studies have concentrated on different aspects which have been investigated in the various subsamples of children. The results of Study I have shown that differences in the quantity and type of parental input are associated with differences in child vocabulary size at 1;6. Study II investigated the stability of children's vocabularies at 1;6 and 2;0, as well as the role of vocabulary composition and grammatical abilities in early development. In this study, results indicate that children with the largest early vocabularies exhibited the most group stability, the least variability in vocabulary composition and the earliest grammatical development. As a reminder, the groups in Study II (slower learners, average learners, late bloomers and fast learners) were based on children's quartile membership at the two time points. A regression model for prediction of vocabulary size at 2;0 (Table 6.6) showed that vocabulary size at 1;6 accounted for the greatest amount of variation in children's vocabularies 6 months later. Gender was also a significant (yet small) predictor of vocabulary size at 2;0, with girls generally outperforming boys. Figure 7.3 in Study

III shows that girls have larger vocabularies than boys throughout the entire period of study (1;0 to 2;6).

Another regression model (Table 6.7) aimed to ascertain differences between the slower learners and late bloomers in Study II regarding predictor variables⁶⁴. This analysis indicated that parental education and the percentage of nouns in children's vocabulary together accounted for 28% of the variation in vocabulary size at 2;0. That is, the higher mean level of education of the parents of late bloomers was to some degree associated with their children's larger vocabularies at 2;0. Of course, this leaves more than two thirds of the variation unaccounted for, indicating the influence of other underlying variables. Yet, it is interesting that parental education becomes a significant predictor in this relatively homogeneous sample of Swedish families. One can also discuss what higher parental education actually implies. It does not necessarily indicate higher awareness of language, but may mean more economic resources which can allow parents to provide high quality daycare, enriching experiences, etc. On the other hand, parents with higher incomes may not spend quality time with their children because of long working hours. Likewise, parents with few economic resources may either be absent caregivers, or have very responsive interaction styles. Studies have investigated children's vocabulary development in families varying in socioeconomic status, and found not only SES-related differences in the children's language, but also large variation in parental input across SES groups (e.g. Hart & Risley, 1995; Hoff, 2003). One final result regarding vocabulary size was reported in Study III. Correlation analysis demonstrated that the size of children's productive vocabulary at early ages is not only significantly related to vocabulary size at later ages, but also to concurrent and later syntactic development.

The results from this thesis exploring Swedish children's early vocabulary development confirm previous results obtained for children speaking many other languages, underpinning the importance of early language for developmental outcomes (see also Section 3.3). In the words of Lee's (2011) study, yes, size matters! But, is size really everything? To begin with, size varies in individual children over time. The analyses in this thesis have generally involved group means, which tend to obscure the great variability observed in individual children's vocabulary development. Figure 5.1 in Study I gives one indication of how these individual trajectories may vary. Moreover, Ukoumunne et al. (2012; Section 3.4.4) demonstrated the variable development pathways observed in a large study of children over a 40-month time period. Another important point is that measuring productive vocabulary does not always indicate how much a child understands, or is able to express in nonverbal communication (see Section 8.2.5 below). Vocabulary

⁶⁴ Including gender and parental education, vocabulary size and composition, as well as word combinations at 1;6

size is an essential, but not all-encompassing, component of a child's communicative abilities. Children's early language variation can be seen as a result of the complex transactions between genetic and environmental factors, illustrated in Sameroff's model (Figure 3.3). Knowledge of the complex nature of vocabulary development in the context of social interaction has many implications for parents, preschool personnel and special needs educators (see Section 8.4).

8.2.2 Parent-child interaction

The results obtained in this thesis represent novel findings in that they document variability in parental input with associated variability in children in a consistently high-SES Swedish sample. Results also emphasize the importance of parental sensitivity to a child's developmental level. Due to the small number of studies on Swedish parent-child interaction written in English, Swedish can be considered an understudied language internationally. Thus, these results are of importance to the international research community. In Study I, parents who addressed larger and more varied amounts of speech to their children generally had children with large vocabularies (Section 5.3.1). However, as parent and child speech were assessed concurrently, this does not allow the establishment of causal relationships. It is most likely that the relationship between parental input and child language production is a reciprocal one (Huttenlocher et al., 2010). In terms of Scarr and McCartney's (1983) genotype/environment effects, talkative or highly social children may evoke certain responses from their parents, such as the interactive feedback behaviors which have been shown to facilitate child vocabulary development (e.g. Hart & Risley, 1995; Tamis-LeMonda et al., 2001). Examples of these are the imitations and expansions used more often by the parents of children with larger vocabularies in Study I (see Figure 5.2). The dialog which introduces this thesis also demonstrates how a father follows his son's lead and imitates the child's attempts to say the word 'yoghurt'. Additionally, parents may both initiate and respond to interaction in specific ways because of their own genotypes. Both of these situations reflect differences in personality and interactive style in parents as well as children (see also Section 8.2.3.1).

Further, results of this thesis underscore the importance of parental adjustment or accommodation to a child's communicative level and style. This may entail simplifying or slowing down input in order to promote a child's language development. For example, as in Study I, parents who address greater amounts of unintelligible speech or overall input to children with small vocabularies (see Table 5.1) may benefit from support aimed towards developing strategies to clarify input. It is interesting to note that one parent in Study I, whose input was extremely clearly articulated, also used signs with the child participant, as one sibling had a developmental disability

(Child F). Hartman et al. (2014) found a relationship between larger vowel space (considered an indication of clarity) in mothers' infant-directed speech at 18 months and children's vocabulary size at 24 months. However, the authors stress that the directionality of the relationship cannot be inferred; either vowel clarity really does help children learn more words, or this is evidence that mothers do adjust their speech to children's abilities.

The adjustment or "fine-tuning" of parental input also means that different types of input are more beneficial at different ages. For example, results from a longitudinal study show that repetition in input (with a resulting lower type/token ratio, TTR) at 7 months and a more rapid increase of MLU over time contributed to larger child vocabulary at 24 months (Newman, Bernstein Ratner, & Rowe, 2014). In this thesis, the parents of children with the largest vocabularies at 1;6 had the lowest mean group TTR, as well as the lowest value of D measuring lexical diversity. Although they had the largest number of word types as a group, the low D value may mean that they used more repetition. However, it is not possible to comment on the parents' MLU over time. Moreover, the parents of the child whose vocabulary trajectory shows a sharp increase after approximately 18.5 months (Child B, see Figure 5.1, Study I) had the third highest MLU. In Study II, children with this type of trajectory are considered late bloomers. This may indicate input effects on the child's vocabulary development. Furthermore, Rowe (2012) reported that quantity was most important during the second year of life, diversity or sophistication of input during the third, and the use of narratives or explanations during the fourth year. Finally, Tamis-LeMonda et al. (2001) found that maternal responsiveness at child age 13 months was more important than responsive interaction at 9 months. The importance of different types of input at varying child age also has didactic implications (see Section 8.4.4.2).

The type of questions parents ask in interactive situations can also be adapted to the children's language abilities. Parents of children with small vocabularies in Study I used more receptive wh-questions which can be answered by pointing, while the parents of children with large vocabularies used more wh-questions which require verbal responses (Table 5.3). It is important for parents to avoid an excessive amount of test questions, as in general, wh-questions can be difficult for young children to answer (cf. Allwood & Ahlsén, 1999; Salomo et al., 2013). However, auxiliary-fronted yes/no questions, used more by the parents in the p 90–99 group in Study I, are characteristic of a guidance style that asks children, rather than tells them what to do (Hart & Risley, 1995).

8.2.3 Vocabulary composition

The results in this thesis regarding vocabulary composition are also unique findings, as very little research in Sweden has investigated this area. The

obtained results allow one to see older studies through a different lens. For example, Strömqvist and Richthoff (1999) compared linguistic feedback giving (e.g. *yes*, *no*, *mm ok*) in two children with varying profiles⁶⁵. Markus is characterized as a slightly precocious learner, while Anton is a late learner. With respect to the findings in this thesis, Markus is a fast learner who is in the noun phase of vocabulary development at 1;9, when he uses many nouns as feedback (called ‘other-repetition’ by Strömqvist and Richthoff). He can also be considered a referential child (see the section on stylistic variation below) who uses fewer feedback morphemes in relation to those in his input. Anton, on the other hand, is a slower learner and still uses primarily social and closed-class words in interaction at 2;1. Anton’s parents also use more feedback morphemes in input than Markus’ parents.

Vocabulary composition in the present thesis was analyzed in a small sample of children in Study I at 1;6 and in a larger sample in Study II at 1;6 and 2;0. The results from Study I (see Section 5.4.4) provide complementary information to the larger scale results obtained in Study II, even though the group divisions are not directly comparable. For example, the composition profile of the p 0–25 group in Study I is similar to that of the slower learners in Study II (see Section 7.3.2.2) although the proportions are not exactly the same. Slower learners have larger ranges and proportions of nouns and social words, but this may be due to the greater sample size. In both studies, children with smaller vocabularies exhibit more variation (as expressed in greater values for standard deviations). The five p 0–25 children have a mean percentage of closed-class words that is much higher than the slower learners.

A comparison between the p 90–99 group and the fast learners reveals similar profiles, although the fast learners have a smaller proportion of nouns and a larger proportion of social words. Standard deviations for the fast learners’ nouns and social words are also much greater than for the p 90–99 group. One reason for these dissimilarities, in addition to differences in sample size, is that the five children in the p 90–99 group represent the top 10% according to norming data, whereas the 120 fast learners are not all in the top decile. The p 90–99 children have come to the point in their development where nouns and social words are inversely proportional and group variation is small. Group data do not reveal individual trajectories, or individual profiles, and in hindsight, it may have been informative to investigate individual patterns of development, both regarding timing and composition, in the slower learners and fast bloomers. However, vocabulary trajectories for the 15 children in Study I (see Figure 5.1) do exhibit relatively stable group membership, with the exception of one late bloomer in the p 0–25 group. An

⁶⁵ Transcripts of the longitudinal study of the two children, Markus and Anton, are available in the CHILDES database.

interesting complement to this would have been individual vocabulary composition profiles.

Vocabulary composition may also have consequences for later grammar development. In the longitudinal Dutch Dyslexia Program Study, Koster et al. (2005) found that children at risk for dyslexia exhibited both language delay and differences in vocabulary composition during the second year. These children had fewer verbs and closed-class words in their vocabularies, words which play a crucial role in syntactic and lexical development. Thus, this combined risk may indicate the difference between transient and persistent difficulties with grammar. Hence, awareness among preschool personnel of the importance of children's vocabulary composition may facilitate early detection of language difficulties.

8.2.3.1 Relation to stylistic variation and timing of acquisition

Important questions here are whether vocabulary composition is merely an expression of children's stylistic variation and whether it has direct consequences for the timing of children's vocabulary acquisition. One may also ask whether differences in vocabulary composition are the result of frequency effects in input or the interactive styles of caregivers. Children and parents alike have differing personalities and interests, which in turn influence interaction and word learning.

Section 3.1.4.4 introduced the topic of stylistic variation in vocabulary composition, including Nelson's (1973) characterization of 'referential' and 'expressive' children. As a reminder, referential children exhibit a preference for object-oriented language (e.g. nouns), while expressive children are those with larger proportions of personal-social words and function words in their vocabularies⁶⁶. Although some later work has discussed these distinctions (e.g. Lieven et al., 1992), there has been little work on the subject in recent years (Nelson, 2014). Lieven et al. (1992) have reservations about the characterization of children as either referential or social-expressive, as all early language is in essence social. The question is whether a child who utters a social phrase invites more input than one who hands an object to an adult and says the word. Similarly, are children with the most words necessarily sociable? Regarding children's preferences for naming objects vs. engaging in social interaction using memorized routines, Stephen Pinker remarks the following: ". . . babies are people, only smaller. Some are interested in objects, others like to schmooze" (1994, p. 267). Although children's personalities develop as a result of many transactions throughout life, the idea is that individual traits are often distinguishable at very early ages. This also has to do with the tendency to seek out environments that are compatible with one's genetic disposition (the concept of niche-picking).

⁶⁶ Work in the 1980s also included distinctions between 'analytic' and 'holistic' styles in children's language learning, but the present thesis does not include this discussion.

Further, Lieven et al. (1992) proposed an alternative to the referential-expressive distinction, i.e. between the relative proportions of common nouns and unanalyzed (frozen) phrases⁶⁷ in children's vocabularies, concentrating their study on children with 50 and 100 words in their vocabularies, rather than a specific age. Their results, based on analysis of maternal diaries and audio recorded material, indicated that the proportion of frozen phrases was positively and significantly related to children's productivity. However, Lieven et al.'s correlations between proportions of nouns and frozen phrases at the two ages were very similar to the inverse relationships seen between nouns and social words for all children at 1;6 in Study II of this thesis (Table 6.5). They also comment that absolute numbers as well as relative proportions of both common nouns and frozen phrases increase between 50 and 100 words, while the proportions of onomatopoeic, proper nouns and 'interactive' words (all considered social words in this thesis) decline. Figure 6.1 in Study II, which is similar to results presented by Bates et al. (1994), shows that, developmentally, common nouns increase between 50 and 100 words, while social words decrease. Thus, as mentioned earlier in this thesis, it is problematic to compare results of studies using different systems of categorization.

The question of how vocabulary composition influences the timing of acquisition is equally problematic. Nelson (1973) found that expressive style did not account for the large difference in age of acquisition of a vocabulary of 50 words or more (achieved on average by 1;5–1;6). However, the high proportions of closed-class words in children's early vocabulary may be linked with slower rates of development (Bates et al., 1994; Nelson, 1973). The slower learners in Study II (Section 6.4.3) had higher proportions of closed-class words in their vocabularies than all other groups (Table 6.3). It is possible that this is due to stylistic variation, with the children showing a preference for unanalyzed phrases, or it may be the result of frequency effects in input. Table 6.8 shows correlations among composition variables (opportunity scores) for the slower learners, where the percentage of closed-class words at 2;0 is negatively correlated with the percentage of nouns at 1;6 and positively correlated with closed-class words at 1;6. Social words at 2;0 are inversely proportionate to nouns and predicates at 2;0. Certainly these correlations show developmental relationships between word classes, but they may also be an indication of stylistic variation. More closed-class words mean more rote phrases, as well as more of an inclination towards the use of social words. In their 1994 study, Bates and colleagues conclude that "stylistic variance dominates in the period from 0 to 400 words, while developmental variance dominates after vocabulary reaches 400 words" (p. 114). Their results also indicate that variance in closed-class words after the 400 mark is

⁶⁷ However, their definition makes it hard to distinguish frozen phrases from multiword utterances.

a stable index of productive grammar, while there is no relationship between early closed-class use and the emergence of productive grammar.

Input effects regarding different word classes may be a result of language or cultural differences, or due to stylistic preferences of caregivers. In Swedish, closed-class words used deictically are very common in parental input. These include the pronouns *det* and *den* ('the') and *där* ('there'). The verb *titta* ('look') is also used extremely often by parents to direct their children's attention. In Study I, *det*, *den* and *där* were the most common words used by the children with small vocabularies. Interestingly, the parents of children with large vocabularies used the more specific words, *den där/den här* ('that one/this one') more often than the parents of children with small vocabularies. A previous study of early vocabulary in Sweden (Richthoff, 2000) reported a greater use of closed-class words by the Swedish children in comparison to American children (Bates et al., 1994). This can be seen when comparing Figure 6.1 in this thesis (with summary statistics presented in Table 11.4) to a comparable figure in Bates et al. (1994, p. 95) where the closed-class curve for American children starts at approximately 6% compared to over 11% for the Swedish children with the smallest vocabularies. One reservation is that Bates et al. (1994) reported results for children aged 1;4–2;6, while Figure 6.1 here reports vocabulary composition for children aged 2;0. However, statistics for Swedish children aged 1;6 (not presented in this thesis) show values of approximately 8% for closed-class words at the lowest vocabulary level.

Further, stylistic variation among parents and children may exert reciprocal influence. According to Nelson, ". . . word learning is a two person collaborative game" (2014, p. 100). There may also be a mismatch between the interactive styles of parent and child, as Nelson reported in her 1973 monograph. She documented examples of mother-child pairs with the same style, as well as mothers with a referential style regardless of whether the child was interested in naming. This specific mismatch is not beneficial for a child's language development. A later study (Hampson & Nelson, 1993) found that nominal mothers usually had nominal children, that is, children interesting in name learning.

Nelson has also recently commented on the lack of research regarding timing of acquisition, especially in light of the great variation observed in children's early language development: "I would have thought that this variability would have alerted researchers to ask what lay behind the lag of the slower learners, or led to the success of the early ones" (2014, p. 97). This thesis has contrasted slower and faster learners to a certain extent, but also specifically investigated differences between slower learners and late bloomers, both groups that may risk later language impairment. Nelson (2014) comments further:

. . . neglecting the alternative entry ways that children engage in has resulted in a misplaced assumption that noun learning is where all the action is. Ignoring the other kinds of words or phrases that appear in large numbers on the widely used MacArthur [*sic*] check list for toddlers, filled out by parents, leaves much of the data unaccounted for. (p. 98)

Yet, the results of this thesis indicate that the percentage of nouns in children's productive vocabularies at 1;6 was significantly associated with larger vocabulary size at 2;0. Children considered late bloomers in Study II also had greater proportions of nouns in their vocabularies than the slower learners at 1;6.

8.2.4 Grammar

Children's grammatical abilities were investigated in two of the studies in this thesis by means of parental report. Study II used a composite variable summarizing five questions regarding children's use of inflectional forms and tense. Additionally, one question asked parents whether their child was combining words. The skills study (III) used M3L, which measures words and inflections in children's longest utterances (see Section 4.7.2.2). The section on sentences and grammar in SECDI: Words & Sentences is much shorter than the American CDI, which has additional sections for word forms, word endings and sentence complexity.

The ability to combine words into multi-word utterances represents an important milestone in children's language development (e.g. Brown, 1973). As noted in Section 3.1.3, children's word-word combinations are usually preceded by gesture-word combinations. Further, both morphological knowledge and the length of children's utterances are important predictors of later reading development (e.g. Torppa et al., 2010; Walker et al., 1994). Overall results of this thesis indicate close associations between lexical and grammatical development, supporting previous research on this relationship (e.g. Bates & Goodman, 1997; see also Section 3.1.5.1). In Study II, children with the largest vocabularies are those who combine words earliest (see Figure 6.6) and use grammatical features of the language to the greatest extent. The latter can be seen for example in Figure 6.5, which shows that children need to build the size of their vocabularies before they start using inflections and tense markers. The figure also shows that grammatical development is somewhat more advanced for children with vocabulary sizes between 100 and 300 words at 2;0 than it is for children with comparable vocabulary size at 1;6. This may indicate the need for a certain maturity in perceptual and cognitive abilities, for example memory. However, Figure 6.5 presents mean ability scores and does not say anything about the variability that is also present in grammatical development. Figure 6.4, which shows variation in the grammatical ability score for the four learner categories in Study II, re-

veals an extremely large span for the fast learners. This means that even some children with large vocabularies are using few or even no grammatical inflections at 2;0, which may be another indication of stylistic variation. Thal et al. (1996) contrast the language production of two early talkers with very different MLU scores, depending on their preference for whole phrases or individual words. It is probable that this kind of variation is responsible for the large range of grammatical ability for fast learners in Figure 6.4. Even the slower learner group includes two outliers who are using inflections despite very small vocabularies.

According to Platzack (1990), Swedish child language up to the age of 3 is characterized by a lack of functional categories, and early Swedish is closer to early English than adult Swedish is to adult English. Cross-linguistic research indicates that children's early grammars are similar regardless of the input language⁶⁸ (Slobin, 1985). As mentioned earlier in this thesis, children do not use words in the same way that adults do. Thus, a single word, whatever the adult word class and possibly combined with a gesture, may express a noun or verb phrase. As Bates et al. (1994) acknowledge (see Section 4.3.2.2), CDI data cannot specify the differing contexts in which individual words are used. However, the checklists do allow parents to list examples of their children's three longest utterances, which form the basis of the M3L measure. Analysis in Study III has not included a breakdown of these utterances into word classes, but visual inspection of the types of utterances parents report indicate that they are very similar to early utterances produced by American children (e.g. Brown, 1973).

Results obtained in Study III regarding interrelations among communicative skills seem to indicate that productive vocabulary is more important for syntactic development than the other way around. In other words, there is more evidence of lexical bootstrapping than syntactic bootstrapping. Moyle et al.'s (2007) study comparing typically developing children and late talkers from 2;0 to 5;6, used CDI measurements at 2;0 and 2;6, thus allowing for some comparison with this thesis. However, they used both the M3L measure and grammatical complexity scores in correlation analysis, whereas Study III in this thesis only used M3L to measure syntax. Moyle et al. found evidence of bidirectional bootstrapping in the typically developing children; that is, both grammatical measures at 2;0 correlated significantly with the lexicon at 2;6, but lexicon size at 2;0 was only significantly correlated with the complexity measure at 2;6. In this thesis, the relationship between lexicon size at 2;0 and M3L at 2;6 was significant, but not M3L at 2;0 and lexicon at 2;6 (see Figure 7.1 and Figure 7.2). One reason for the lack of bidirectional bootstrapping in Study III may be the fact that only M3L was used. On the other hand, using the composite grammatical score from SECDI in addi-

⁶⁸ Slobin refers to a Basic Child Grammar with universally recognizable form and content, although surface forms will vary.

tion to M3L may still not have evidenced bidirectional bootstrapping given the differences between the grammar sections in the Swedish and American forms. However, in Study II, children's grammatical abilities at 1;6 were a significant predictor of vocabulary size at 2;0 (see Table 6.6). Compared to the typically developing children, Moyle et al. (2007) found that late talkers only exhibited lexical bootstrapping from 3;6 to 4;6 and 4;6 to 5;6, with no syntactic bootstrapping at any age. The analysis in Study III did not divide participants into typically developing vs. late talkers, but the number of children scoring at or below the 10th percentile at 2;0 according to Swedish norming data were as follows: for the total sample of children ($N = 348$), 11 (3%), and for the children with complete records at four ages ($N = 128$), 6 (5%). To give one more example of bootstrapping results, Dionne et al.'s (2003) twin study provided evidence of genetic correlations between vocabulary and grammar at age 2 and 3, with grammar showing greater heritability than vocabulary. The study used a short form of the CDI, and found both lexical and syntactic bootstrapping in operation between the two ages. The present results indicating the development of early syntax as vocabulary driven may not apply to children with SLI, who experience difficulties in grammatical processing (e.g. Hansson, Nettelbladt, & Leonard, 2000; see also Section 3.1.5.3).

8.2.5 Gestures and vocabulary comprehension

In the present thesis, relationships among children's gesture use at 1;0 and receptive and productive vocabulary were investigated in Study III. Novel results in the study include a confirmation of findings by Sansavini et al. (2010) regarding the associations between empty-hand gestures and productive vocabulary, and object-actions and receptive vocabulary. However, while the correlations obtained in this thesis were generally more strongly significant, those reported in the Italian study were of a much greater magnitude (ranging from .46 to .69). This may reflect the gesture-rich nature of the Italian language as compared to Swedish. The findings regarding the relationships between different kinds of gestures and word classes, namely that empty-hand gestures were correlated with nouns and object-actions with verbs, can also be considered novel. Furthermore, in this thesis, the full gesture scale at 1;0 correlated more strongly with receptive than productive vocabulary at the same age, results which concur with previous work (e.g. Rowe, 2008). Thal and Tobias (1992) suggested that children who are late bloomers use gestures to compensate for a lack of early productive vocabulary, a finding which is interesting in regard to Study II in this thesis. However, the present comparison between late bloomers and slower learners did not include analysis of gesture use.

Despite methodological advances, vocabulary comprehension is still not well understood (Kail, 2011). Poor receptive vocabulary is an indication of

risk for language impairment (Bruce et al., 2003) and has far-reaching consequences for later development (Beitchman et al., 2008). Language comprehension is difficult for children with delayed onset of language (Ellis Weismer et al., 2013), as well as children with attention deficits (Bruce et al., 2006). However, early comprehension is difficult to detect by means of parental report (Tomasello & Mervis, 1994). Therefore, the link between gestures and vocabulary comprehension represents an essential area of research and has important pedagogical consequences. Results obtained in Study III suggest that gestures, as well as play with objects, can help improve children's language comprehension.

8.3 Final reflections

This section presents final reflections regarding theoretical and methodological issues, as well as the limitations of this thesis and the generalizability of results.

8.3.1 Theory

Over the past 40 years, there has been a great deal of work on theories to explain how children learn language. It is beyond the scope of this thesis to give an in-depth review of all the different theories that have been advanced. However, Section 2.2 presents a broad outline of two main approaches to theories of child language acquisition. For the most part, generative/nativist accounts can be contrasted with constructivist/usage-based accounts, although there are not always conflicting views regarding every language domain. For example, while theories of grammar acquisition exhibit this theoretical divide, various theories of word learning do not. The theoretical standpoint represented in this thesis is a usage-based account, where children actively develop language through social interaction. Several word learning theories are outlined in Section 3.1.4.1, along with a model which attempts to combine the three theories into a hybrid model (the emergentist coalition model, Section 3.1.4.1, Figure 3.2; Hollich et al., 2000b). L. Bloom's (2000) intentionality model is also an attempt to combine earlier theories, with a focus on what happens in the mind of the child, within the context of social interaction.

Despite the plethora of theories proposed to explain word learning, much remains to be discovered. As P. Bloom (2002) remarks: "Nobody knows how children learn the meanings of words" (p. 262). Similarly, Hollich et al. (2000a) call the development of reference "a mystery" (p. 5), even when they propose the emergentist coalition model as an explanation for how children map words onto objects, actions and events. Although the mapping metaphor is widely used in the literature, some researchers take issue with it

(Nelson, 2014; Tomasello, 2001). Nelson (2014) claims that it “harms by making word learning seem easy and flawless, by attaching words to familiar concepts, rather than challenging and enlightening, leading into new fields of exploration” (p. 95). According to Nelson, the process of learning words and their meanings lifts children to “an entirely new level in the world of being and consciousness, socially, culturally, and mentally. It is the heart of language itself (the grammar and other parts being merely mechanics)” (p. 102). Nelson (2014) concludes, in agreement with P. Bloom, that the field of child language research has only begun to uncover the mysteries of meaning.

8.3.2 Methodological issues

The data analyzed in this thesis was collected within the SPRINT project at Stockholm University, with non-intrusive, naturalistic methods. These include the use of parent report (SECDI: Words & Gestures, SECDI: Words & Sentences) to gather child vocabulary data and recordings of parent-child interaction in the home supplied by parents. The use of CDI checklists is widely spread across the world, and the validity and reliability of these instruments have been demonstrated (see Section 4.3.2). It must be said, however, that adaptations of CDI checklists must conform to the general structure of the original instrument in order to be considered versions of the CDI. This means that although certain changes are made to reflect linguistic and cultural differences⁶⁹, there is limited freedom to change the actual structure of the instrument. This may be construed by some to be a limitation, but the development of the MacArthur-Bates CDI and its many adaptations has been a valuable contribution to the field of child language research and allows comparisons across languages. Although data using parental report may not be able to capture all aspects of a child’s language development (see Section 4.3.2.2 on limitations), the CDI has the potential to determine individual differences as well as universals that can be generalized across children and languages. In the words of Bates and colleagues, this dual approach serves “to locate the seams and joints of the language processor, i.e. components that can develop at different rates because they depend on different cognitive and/or neural mechanisms” (1995, p. 97).

8.3.2.1 Audio recordings

Parent participants in the SPRINT project were supplied with digital audio recorders to capture naturalistic parent-child interaction at home in four different everyday situations. These situations included snack/meal, dressing, story time and playtime, and parents received specific instructions on how to

⁶⁹ For SECDI this has mainly meant changes in the grammatical complexity scale and the word lists.

make the recordings and upload them to the project website (see Section 4.4). Having parents record interaction themselves was not only cost-effective, but also avoided any disruptive effects of outside observers on family life. Furthermore, it allowed for the collection of over 1,100 hours of recorded interaction, which provide a complement to the vocabulary data collected for the same children. However, this also means that details of the interaction setting and nonverbal communication are not observable for researchers. Moreover, analysis of the recordings without automatic speech recognition technology necessitates painstaking hours of transcription. This has had consequences for the number of participants included in Study I in this thesis ($N = 15$). However, it also means that there is great potential for further analysis of data collected within the project.

8.3.2.2 Recruitment methods

Recruitment of participating families was based on invitation letters sent to parents of one-year-old children. Those interested were instructed to log onto the project website and fill out background and vocabulary questionnaires. There were no reminder telephone calls made. These recruitment methods have led to a non-representative sample of the Swedish population; approximately two thirds of the parents are university educated. This bias has been common in studies of child language research and many recent efforts have been made to involve families of varying socioeconomic status. On the other hand, such a sample does not involve the confounding variables of low-education and poverty. It has also facilitated the demonstration of variation in both parental input and associated child vocabulary in a high-SES sample (see Section 8.2.2). The present author was not involved in the design of the SPRINT project, and had little influence over how the project was implemented. In order to offset the effects of a non-representative sample, norming data from previous SECDI studies were used for assigning children to various percentile groups (see Table 4.1).

8.3.2.3 Statistical analysis

The analysis of data in this thesis has primarily been quantitative in nature. In Study I, group comparisons of parental verbal interaction characteristics, including the quantity and quality of input, were made using summary statistics. The size and composition of children's vocabularies were also described quantitatively. An exception in Study I is that the coding of interactive feedback behaviors and decisions regarding what kinds of questions to analyze involved some qualitative examination. The small sample size in the interaction study (I) means that analysis on a group level was sensitive to the presence of outliers, especially considering the individual variation documented in both parental input and child vocabulary size. Due to the large variation within groups, non-parametric statistical methods were used. However, despite the small sample size, statistically significant group differences were

found for many of the outcome measures. Somewhat inconclusive results were obtained for analysis of lexical diversity using VOCD (Richards & Malvern, 1997). This statistical method is meant to complement type/token ratio (TTR) and give an indication of vocabulary diversity (D) that is independent of talkativeness and sample size. However, while TTR decreased with increasing amount of input directed to children in the three groups (see Table 5.2), D was largest for the parents of children with average vocabularies, smallest for the parents of children with large vocabulary size and in between for parents of children with small vocabularies at 1;6. One reason for this may be that analysis was based on the same length (20 minutes) of transcribed interaction for each family, although the actual amount of input varied by group. Another reason may be the large individual variation among parents regarding type and amount of input. Earlier (see Section 8.2.2) it was speculated that the low value of D for the parents of children with large vocabularies means that they used more repetition.

In Study II, statistical analysis included whole sample and group comparisons of variables measuring vocabulary composition and grammatical abilities, as well as regression analysis to determine the predictive value of these variables for vocabulary size at 2;0. SECDI norming data were used to divide children into four different groups according to vocabulary percentile scores at 1;6 and 2;0 (see Section 4.6.2.1). However, looking at vocabulary growth at only two time points 6 months apart did not allow for analysis of rates of acquisition. Rather, the two measurements can be seen as snapshots of variation in both composition and grammatical abilities in relation to vocabulary size. As in Study I, the size and composition of children's early vocabulary was characterized by large variation, and therefore statistical group comparisons were performed using a non-parametric test (see Table 6.4). Correlation analysis was also used to investigate linear relationships among variables in the total sample as well as different groups, in particular the slower learners and late bloomers. In addition, regression analysis was performed for the total sample and the slower learners and late bloomers alone. Thus, analyses for the two groups alone involved relatively small sample sizes, compared to whole group analysis. Although it may be hard to generalize results due to sample size, the specific examination of slower learner and late bloomer groups represent an important first step in identifying trends of importance for children with small vocabularies. Further, a decision was made to calculate vocabulary composition in terms of absolute percentages (relative to a child's total vocabulary size) as well as opportunity scores (relative to the number of words in each category on the checklist). Various studies have used one or the other, or both, and some researchers view opportunity scores as more appropriate for checklist data (e.g. Bornstein et al., 2004).

In Study III, correlation analysis was used to examine relationships among variables measuring early communicative skills (gestures, receptive

and productive vocabulary, and the syntactic/grammatical measure M3L) from child age 1;0 to 2;6. For cross-sectional analysis at the same point in time, either bivariate or partial correlations (at 1;0 when three measures were included) were calculated. For measurements across 6-month intervals, the partial correlation technique was used to control for the other variable(s) measured at each time point. Correlation analysis is limited in the sense that it cannot prove causal relationships, nor say anything about other underlying variables which influence or mediate the relationship. Correlations were also calculated for two separate samples: the total sample ($N = 348$) and the sample consisting of children with complete records for all four measurements ($N = 128$). This was done to ascertain whether there were differences among these two samples. Ideally, a method such as growth curve analysis could have been used to illustrate longitudinal development over the period in the sample with complete records (see Section 8.5).

8.3.3 Limitations of the thesis

Even though the sample of families studied in this thesis is skewed towards a more highly-educated group, results indicate variability in parental input and child vocabulary size. However, had there been more children with low vocabulary scores in the cohort with accompanying recordings of parent-child interaction at 1;6, Study I could have included a larger sample. Additional constraints of the thesis include the inability to report longitudinal development in the vocabulary knowledge of the children in the various studies. Parent-child interaction was investigated at one point in time, concurrently with descriptive analysis of children's vocabulary knowledge. Although children's vocabulary development trajectories were plotted over a period of 5–6 months, there was no analysis of parent input after child age 1;6. Additionally, the interaction study (I) did not separately analyze input by parent gender, or interactive situation, analyses which may have provided interesting results. In Study II, analysis was restricted to two time points, 1;6 and 2;0, also limiting longitudinal analysis of development. In the skills study (III), analyzing development from 1;0 to 2;6, 128 of the 348 children in the total sample had complete records. This is a sizeable number, and more in-depth growth analysis could have been undertaken. Furthermore, all three studies concentrated primarily on quantitative group data, and did not illustrate the great variety in individual children's development over time.

As the thesis used parental report as a means to collect data on children's vocabulary knowledge, this data alone cannot provide information on, for example, phonological development, or the frequency with which children use specific vocabulary items. Audio recordings are available for subsets of children in the various groupings at different child ages, but it was not feasible to augment SECDI data with recordings of spontaneous speech for larger numbers of participants. Although there were advantages to using audio

recordings (see Section 8.3.2.1), fine-grained analysis of interaction, including nonverbal communication such as eye gaze and gestures, is not possible without video data. However, this would also have been unrealistic given the large number of participating families in the SPRINT project. Moreover, nothing can be specifically said regarding the bilingual language development of those participating children who had one parent with a native language other than Swedish. For example, in Study II, these children comprised approximately 10% of the sample, with 21 different languages represented. Only these children's Swedish language development was studied.

8.3.4 Generalizability of results

Despite the limitations outlined above, results presented in this thesis expand existing knowledge of Swedish children's vocabulary development, thus also adding to the international body of literature. Some results have added novel outcomes, while others have supported previous research. It must be noted that the parent participants in the thesis studies are consistently well-educated⁷⁰, and the children have higher vocabulary scores in comparison to participants in SECDI norming studies. Furthermore, according to Henrich et al.'s (2010) definition, Sweden is a WEIRD culture (i.e. Western, Educated, Industrialized, Rich and Democratic). All these factors limit the generalizability of results to wider populations, not only in the Western world, but worldwide.

8.4 Implications

The results of this thesis on children's vocabulary development have implications for several groups of individuals, including parents, child healthcare personnel, preschool staff, as well as researchers and practitioners in general, and in special education. For all of the above, the most vital message is the importance of awareness of early language development. This thesis has confirmed previous findings regarding the great variability in child language acquisition, and specifically investigated the role of parental input, vocabulary composition and how various early communicative skills are related. It has been established that input matters, and for this reason, proactive strategies should be implemented by everyone in a child's environment. As in educational settings, where all children benefit from high quality education, all children benefit from high quality interaction, both verbal and nonverbal.

⁷⁰ Two thirds are university educated and approximately 20% have secondary schooling.

8.4.1 Parents

As noted above, an awareness of the vital importance of early language development is essential for parents, who can support their children's language learning in many ways. This includes engaging in parent-child interaction which is characterized by responsive feedback, rich linguistic input and sensitivity to a child's developmental level. Furthermore, it can be important to know that children benefit more from certain kinds of input at different ages. This can involve providing clearly articulated, relatively slow-paced input with more repetition during the first year. Increasingly large amounts of input can be added during a child's second year, when the learning of nouns and verbs accelerates. A more diverse, sophisticated input is especially beneficial during the third year. For older children, narrative abilities become increasingly important. Although studies have shown that book reading is especially conducive to the development of sophisticated language, rich input can be provided literally in any situation. Children are curious and eager learners, and gladly show sensitive parents what they are interested in.

Although most parents intuitively know how to interact with their children, being a parent in today's modern technological society can be complicated. The globalized society in which children are growing up not only requires well-developed language abilities, but also provides any number of distractions. In addition to the usual struggle to combine work and family, there is the added distraction of mobile devices which threaten to divert parents' attention from vitally important interaction with their children. In addition to finding that forward-facing baby buggies were associated with low levels of interaction, Zeedyk's (2008) observers commented on large numbers of parents either speaking solely with their partners or on their mobile phones. This scenario can most likely be found in countries worldwide. Sweden in particular is one of the most wired countries in the world⁷¹, both regarding individuals' use of technology and the proliferation of broadband and cellular networks. For example, according to a report from 2013⁷², three out of four Swedes use a smartphone daily. In addition, 63% of parents aged 36 to 45 with young children have a tablet. It is therefore of utmost importance that advances in technology do not lead to compromised language abilities in future generations.

Parents can also be encouraged to ask for information and support from child healthcare personnel regarding communication and language. Parents have a right to receive expert advice when they have concerns about their child's language development, and should not be told to 'wait and see' (see Section 3.4.1). Speech and language pathologists have the expertise to assess both the child's language abilities and the interaction style of parents. After

⁷¹ According to reports produced yearly by the World Economic Forum

⁷² The Swedes and the internet 2013 (<http://www.soi2013.se/en/>)

doing so, they can either adopt a ‘watch and see’ approach (also called ‘watchful waiting’), involving close monitoring of a child’s language development (Paul, 1996) or implement intervention strategies to help parents become even more sensitive caregivers.

8.4.2 Child healthcare personnel

As mentioned earlier in this thesis (Section 3.4.3), 99% of Swedish parents access child healthcare centers regularly. It is here that parents receive information and advice on preparing for a birth and caring for their newborn. Regular visits with nurses and doctors take place during a child’s first few years, and parents may be offered to join a special parent group. Throughout the country, there are several structured methods in use which focus on improving interaction between caregivers and children. However, practice varies as to how much emphasis is placed on early language development at the child healthcare centers. Awareness of the importance of early language is also vital for child healthcare personnel, who meet children and their caregivers on a regular basis.

As mentioned above, speech and language pathologists are experts regarding early language development, and healthcare personnel should be encouraged to engage their expertise in a timely fashion when they suspect that a family could benefit from support. As language development is so crucial for the individuals in a society, Sweden’s county and municipal governments need to ensure that there are enough SLPs to meet demands.

8.4.3 Preschool staff

Preschool staff can also adopt a proactive approach by providing an environment which promotes high-quality language experience. Studies involving children with and without language impairments have shown that interaction patterns in different contexts can affect child language (Girolametto et al., 2000; Soderstrom & Wittebolle, 2013). In cases where both children and their parents are language impaired, it is especially important that other input in the child’s environment (whether from speech and language pathologists or preschool staff) is characterized by high-quality interactions. It is important for staff to have knowledge of language development in both typically and atypically developing children (see also next section).

Children can be encouraged to use gestures and signs to increase comprehension skills which are vital for later language development. Moreover, staff can be aware of how different types of questions require different kinds of answers. This knowledge is useful for adapting questions to a child’s linguistic and cognitive abilities. Further, the results of Study III in this thesis indicate that gestures may help young children gain knowledge of objects and their names. Additionally, activities with objects can enhance children’s

understanding of verbs. Preschool personnel can also encourage the use of specific language in child requests, helping children to name objects rather than ask for ‘that one’. More research on children’s language development within the context of preschools is also needed (see Section 8.5).

8.4.4 Special education

The field of special education is broad and interdisciplinary with respect to research and practical applications. Special education aims to identify and meet barriers to development arising for any reason, whether the causes are biological, psychological or social. Researchers in special education join colleagues from many other disciplines, including psychology, linguistics and developmental science, in investigating child language development. For special education in particular, a critical focus is preventing language difficulties, as well as remediating them. The present thesis has implications for both researchers and practitioners in the field.

Results of this thesis have documented variability in early language development in a sample of children from relatively well-advantaged Swedish families. Variability in itself is not a new finding, but current questions are what implications this variability has for language screening and early intervention. As mentioned earlier, universal screening has been deemed unfeasible due to the difficulty of correctly identifying children with language problems (e.g. Law et al., 2000). However, the fact remains that it is vital to identify children at risk for developing language impairment as early as possible in order to prevent difficulties, and thus, the ‘wait and see’ approach is not the best course of action. On the other hand, this view also means that the benefits of early identification outweigh the harms of misdiagnosis (Dollaghan, 2013). When a screening instrument incorrectly identifies a child as language impaired (or clinically categorizes a child as a late talker), parents may be unduly alarmed, especially if the child’s difficulties resolve. Furthermore, an incorrect diagnosis can lead to stigmatization and wasted financial resources. It must also be noted that more boys than girls, and more laterborns than firstborn children exhibit late emergence of expressive skills.

Still, late talking is a risk factor for language impairment and must be taken seriously. Progress in language development should be monitored in all children. Rather than a single screening at one particular age, or an in-depth assessment, it may be more advantageous to use a series of brief assessments throughout the early years. These may include testing for language comprehension and abilities to engage in pretend play (Bruce et al., 2003). Within the field of special education, there has been significant debate on whether diagnoses should be made in domains such as reading ability or expressive language skills, where children’s abilities fall across wide distributions. However, a discussion of this debate is beyond the scope of this thesis. Re-

garding very young children, monitoring language development using a ‘watchful waiting’ approach is preferable to making premature diagnoses.

8.4.4.1 Language intervention

Variability in children’s early language development also has implications for language interventions. To be most (cost-) effective, interventions must target the right population at the right time with the right kind of measure and dose. In randomized controlled trials (RCTs), it is important to choose control groups carefully so that intervention effects can be properly measured. Research has shown that it is difficult to predict children’s language trajectories because of the fluidity of development in the preschool years (Ukoununne et al., 2012). Ukoununne et al. (2012) found that improving trajectories were more common in higher SES families, concluding that there is a greater need for language enrichment programs among disadvantaged groups. Thus, spending resources on relatively advantaged children with mild expressive language delays may not be cost effective. Ukoununne et al. (2012) also suggest that varying pathways of early development contribute to differences in long-term outcomes for children with and without language delay (see also Rescorla, 2009, 2011). In addition, knowledge of children’s varying trajectories can help to pinpoint the most effective time to implement an intervention. Various language behaviors (e.g. lexical, phonological, syntactic or morphological) have diverse characteristics at particular points in time. Therefore, it may be best to implement a very specific kind of intervention.

If children from relatively advantaged backgrounds with mild expressive delay are not those in most need, who should early intervention target? A symposium discussion at a recent international conference listed a number of red flags⁷³ which signal the need for early action. These include children with a family history of language impairment as well as those growing up in social and economic deprivation. Further indications are low language comprehension coupled with low-average nonverbal cognitive skills. Since low early expressive skills do not always lead to later impairment, special attention should be given to the children at the lowest end of the spectrum (below the 5th percentile). Finally, children who exhibit attention and/or behavior problems along with language difficulties are in need of early attention. However, children meeting these criteria are also those whose language development may never normalize. Therefore, interventions should be tailored to what children need in the world, with realistic goals such as developing certain strategies for increased communication.

Intervention effects vary not only as a result of the targeted population. Treatment effects may disappear with time, and sometimes there are sleeper

⁷³ From a symposium discussion (S. Reilly, chair) at the 13th International Congress for the Study of Child Language, Amsterdam, The Netherlands, July 14-18, 2014

effects, which become measurable only after a longer time lapse. Thus, long-term follow-up is needed for language interventions. This thesis has portrayed early language development as a public health issue, due to the fundamental role it plays in later outcomes. Therefore, early language should perhaps be targeted with campaigns similar to those for eradicating disease or anti-smoking. In Sweden, there is currently concern regarding school children's reading comprehension abilities. More emphasis on promoting optimal early language development in all children can help improve comprehension which is vital for literacy skills.

8.4.4.2 Didactic implications

Adopting a proactive approach to early language development means that mainstream and special needs educators need to be well-versed in how children learn language. Teacher training programs must prepare teachers to understand patterns of typical as well as atypical language development. Knowledge of the interrelated language domains reviewed in Chapter 3 comprises an important component of such programs. For example, children's comprehension of language generally precedes and is larger than expressive abilities, but sometimes this is not the case. Children with Williams syndrome exhibit greater verbal than nonverbal abilities, producing fluent language that they may not be able to understand (Rice et al., 2005). The relationship between gestures and comprehension is another area which is important for teachers to understand. Asking children to point to objects not only enables them to participate more fully in the classroom, but also deepens their language comprehension. This is applicable for children with atypical language development, as well as children who are second-language learners. The language development of these children can also be promoted when teachers ask questions which the children have the developmental ability to answer. Practical manipulation with objects can also improve comprehension. Furthermore, this thesis has outlined interaction patterns which stimulate language development. Knowledge of such strategies, including the differing ages at which they are most beneficial, is essential for teachers, as well as all caregivers. Additionally, an awareness of the role that vocabulary composition may play in children's language development is important for teachers.

8.5 Future directions

In conclusion, there is no single story of child language acquisition. Therefore, research must continue on the variable routes children take on their way to accessing language. More needs to be known about differences between children who are fast learners and those whose development is slower. Future research should include more work on children's individual develop-

ment profiles, both with respect to vocabulary size and composition. Even in studies using parental report, a more in-depth analysis of the different kinds of words and phrases that children use can be undertaken (see Nelson's (2014) comment in Section 8.2.3.1). This can include more detailed analysis of the words in the games and routines category in SECDI: Words & Sentences, as well as a closer analysis of parental report of children's three longest utterances. An additional way to augment parental report is to include observational measures such as audio/video recordings. Such detailed research will facilitate the design of specific interventions to promote the development of the slower learners.

Furthermore, more in-depth analysis of child and adult language in interaction needs to be undertaken. For example, a more qualitative approach to the analysis conducted in Study I of this thesis would provide important information. Further analysis could include a comparison of parental input at 2;0 and 2;6 in relation to children with varying vocabulary size at these ages. Additionally, later input to the children in Study I could be analyzed. Finally, more needs to be known about the importance of different kinds of input to children's language development at various ages.

Further research on the development of interrelated language domains can also shed light on the mechanisms at work in early language acquisition. This should include examining lexical and syntactic bootstrapping to find evidence of how vocabulary and grammar develop together. The development of a MOR grammar for Swedish (Section 4.2.2.5) would facilitate future analysis of morphosyntax in interaction transcribed in CHAT format. A planned extension of the studies presented in this thesis includes work on the relationship between reading and writing activities in the home and pre-school environments and 3-year-old children's vocabulary knowledge.

Longitudinal studies following children from birth through the first years at school provide valuable data on precursors to later development. Examples of such studies include the Jyväskylä Longitudinal Study of Dyslexia and the Dutch Dyslexia Project. Finally, there is a need for more longitudinal population studies with language development included as a variable. Such studies provide researchers with much needed data and can contribute to public awareness of the vital role played by early language development.

9 Sammanfattning på svenska

9.1 Inledning och bakgrund

Denna avhandling utforskar den tidiga ordförrådsutvecklingen hos ett sampel svenska barn i åldrarna 12–30 månader. Avhandlingen behandlar hur ordförrådsutvecklingen är relaterad till egenskaper i föräldrars språkliga och interaktionsmässiga beteende och den roll barns lexikala och grammatiska förmågor spelar för deras utveckling. Även sambanden mellan olika tidiga kommunikativa färdigheter såsom gester och ordförståelse undersöks. Avhandlingens problemområde är relevant för personal bland annat inom utbildningsväsendet och är av betydelse för hur samhället stödjer familjer med små barn. Tre studier är genomförda och undersöker olika aspekter av tidig lexikal förmåga: 1) jämförelse av olika egenskaper i föräldrars språk till tre grupper av barn med litet, mellanstort och stort ordförråd vid 18 månaders ålder, 2) analys av ordförrådssammansättning och grammatisk förmåga vid 18 respektive 24 månaders ålder, och 3) analys av barns kommunikativa utveckling från ett till två och ett halvt års ålder, med variabler såsom det receptiva och produktiva ordförrådet, gester och grammatisk/syntaktisk förmåga. Avhandlingens fokus är alltså barns lexikala förmåga, särskilt i form av ordförrådsutveckling. Denna utgör en viktig grund för barnens senare språkliga och kognitiva utveckling, inklusive läs- och skrivfärdighet. Avhandlingens resultat bidrar även till den internationella forskningen med nya rön i en svensk kontext. Datainsamlingen har skett inom ramen för ett större projekt vid Stockholms universitet: Språkinterventionsprojektet SPRINT, *Effekter av ett familjestödsprogram för att utveckla barns ordförråd och senare läs- och skrivförmåga*; finansierad av Vetenskapsrådet 2009-2012 [2008-5094]. Insamlade data består av ordförrådsmätningar via föräldrapport (SECDI, Swedish Early Communicative Development Inventories; Berglund & Eriksson, 2000a; Eriksson & Berglund, 1999) samt ljudinspelningar av föräldra-barn-interaktion.

9.1.1 Historik och teori

Genom historien har det funnits intresse för hur människans utveckling påverkas av arv och miljö. Förenklade idéer med ett antingen/eller-tänkande har idag ersatts av en fördjupad förståelse av det dynamiska samspelet mellan genetiska och omvärldsfaktorer i den individuella utvecklingen som hel-

het och inte minst inom språkutvecklingen. Bland forskare som varit inflytelserika i teoribildningen kring språkinläringen kan nämnas Skinner med sitt behavioristiska perspektiv och Chomsky med sina tankar om medfödda språkkunskaper. Piaget lyfte fram barnets egen roll i konstruerandet av kunskap genom interaktion med omgivningen, och särskilt viktig i pedagogiska sammanhang och inte minst i kontexten föräldra-barn-interaktion är Vygotskys idé om den proximala utvecklingszonen. Vad gäller språkutvecklingen kan den proximala utvecklingszonen innebära att en förälder justerar sitt språk till barnets kognitiva och språkliga nivå.

Skolbildningar angående språktillägnet kunde alltså tidigare grovt delas in i två olika inriktningar beroende på synen på arv och miljö. Det generativa eller nativistiska synsättet baseras på Chomskys syn på medfödda språkliga förmågor och har betytt mest för teorier kring den grammatiska utvecklingen. Det andra synsättet betonar den roll som barnet själv tillsammans med omgivningen spelar i språkutvecklingen, och betecknas alternativt som konstruktivistiskt, emergentistiskt, socio-pragmatiskt, funktionalistiskt eller "usage-based". Den teoretiska utgångspunkten i avhandlingsarbetet rymmer under den senare inriktningen, där barn ses aktivt utveckla språk inom ramen för social interaktion, men som också beaktar betydelsen av medfödda faktorer. Under de senaste 40 åren har många olika modeller och teorier utvecklats för att förklara hur barn lär sig ord. Det kan nämnas två exempel på modeller som beskriver språktillägnet i ekologiska sammanhang. Enligt ETLA (The Ecological Theory of Language Acquisition; Lacerda & Sundberg, 2006) uppstår den tidiga språkutvecklingen bland annat som en konsekvens av barnets multi-sensoriska möten med omgivningen. Bronfenbrenners (1994, 1998) bioekologiska modell visar vidsträckta influenser på barnets utveckling över tid från närmiljön till samhället i stort, och den modellen tillerkänner betydelse till andra än de primära vårdgivarna, exempelvis förskolor och BVC.

9.2 Barns språkutveckling

Barn lär sig språk genom interaktion med omvärlden och genom att utveckla förmågor inom interrelaterade språkomäner. Dessa omäner inkluderar sådant som språkperception, fonologi, gestik, ordförståelse och -produktion, grammatisk utveckling samt pragmatiska förmågor. Forskning har dokumenterat en stor variabilitet i hur barn utvecklar sitt språk, både när det gäller utvecklingshastighet och kapaciteter inom de olika språkliga omäner. Generellt gäller att barn tidigt utvecklar förmågor som har betydelse för den senare språkutvecklingen, inklusive läs- och skrivfärdighet. Exempelvis är barnets receptiva språkförmåga, till exempel fonologisk medvetenhet, av stor vikt för läsutvecklingen. Det är lika viktigt att studera språkinlärningsprocessen hos barn med typisk som atypisk utveckling, eftersom de vunna kun-

skaperna leder till en fördjupad förståelse till gagn för både teori och praktisk intervention. Att variabiliteten i barns tidiga språkutveckling är stor gör det svårt att tidigt avgöra huruvida en sen utveckling kommer att leda till senare språkliga svårigheter. Det är viktigt att vara uppmärksam på fall där föräldrar eller förskolepersonal uttrycker oro. Hellre än att 'vänta och se' kan man tillämpa ett 'watchful waiting'-synsätt (Paul, 1996) vilket innebär en beredskap att sätta in åtgärder när de behövs. Ett viktigt syfte med specialpedagogisk forskning och praktik, exempelvis som denna avhandling, är att öka förståelsen för hur man kan förebygga hinder för inlärnin g och undvika framtida språkliga problem.

Barn behöver kommunicera med andra för att lära sig språk och det omgivande samhällets kultur. Den språkliga samspelsstilen inom familjen är en av flera faktorer som betyder mycket för barnets språkutveckling. Forskning ger många exempel på hur ett rikt och varierat språkligt samspel med en uppmärksam och känslig omgivning bidrar till en god ordförrädsutveckling hos barn. Att lära sig kommunicera innebär både att förstå andra och att göra sig förstådd. Vid cirka 9 månaders ålder börjar barn kunna delta i intersubjektiva handlingar, där fokus på objekt kombineras med blickar riktade mot andra. Att barn och föräldrar har gemensamt fokus riktat mot ett objekt eller en handling, också kallat "joint attention", är av stor betydelse när barnet lär sig ord.

9.3 Metod och material

Kapitel 4 i avhandlingen summerar kortfattat olika metoder som används inom barnspråksforskning, med fokus på de metoder som används i studierna. Flera datainsamlingsmetoder, bland andra dagboksanteckningar, tar vara på föräldrars gedigna kunskaper om sina egna barn. Förutom dessa så kallade "baby biographies" har forskare dokumenterat de egna eller andra barns språkutveckling med inspelningar som sedan transkriberats. Så småningom utvecklades systematiska transkriptionsformat som CHAT inom CHILDES-systemet (MacWhinney, 2000). Under de senaste 30 åren har även föräldrapport blivit en mycket vanlig metod. Instrumentet som används i alla tre studier är SECDI (se ovan), den svenska versionen av det vitt spridda instrumentet CDI (MacArthur-Bates Communicative Development Inventories; Fenson et al., 1993, 1994, 2007). Det finns både för- och nackdelar med att samla data om barns ordförräds kunskap genom föräldrapport. Som nämnt ovan är föräldrar de som bäst känner till de egna barnens språkförmåga och med föräldrapporter som metod behöver barnen inte utsättas för främmande människor, miljöer eller situationer. Dessutom är metoden flexibel och kostnadseffektiv. Men checklistor som SECDI kan givetvis varken ge utömmande information om semantiska aspekter när det gäller orden som barn använder och inte heller deras frekvens i barnens tal. Det finns även en

risk att föräldrar under- eller överrapporterar om ord som barnen förstår och/eller säger, men flera studier vittnar om instrumentets övergripande reliabilitet och validitet (e.g. Fenson et al., 2007; Berglund & Eriksson, 2000b). Kapitlet presenterar SPRINT-projektet vid Stockholms universitet, ett samarbete mellan institutionerna för specialpedagogik och lingvistik, ett projekt som syftar till att undersöka ordförrådet hos svenska barn i åldrarna 12 till 36 månader. Projektet har tagit hänsyn till de etiska föreskrifter som reglerar forskning med människor och har godkänts av etikprövningsnämnden i Stockholm [2009/596-31/5]. De tre studierna använder olika sampel valda ur projektets insamlade data (se Figure 4.1). Nedan summeras de specifika metoder och material som används i de tre studierna.

Studie I: Parental verbal interaction characteristics and Swedish children's vocabulary knowledge at 1;6

I denna studie jämfördes verbala egenskaper i föräldrars interaktion med barn med olika stort ordförråd vid 18 månaders ålder, baserat på ljudinspelningar. Fem barn har litet ordförråd (0–25 percentil), fem har medelstort (55–70 percentil) och fem har stort ordförråd (90–99 percentil) enligt normeringsstudien för SECDI: ord och meningar (Berglund & Eriksson, 2000a). Föräldra-barn-interaktion skedde i fyra vardagliga situationer: matstund, påklädning, bokstund och lekstund. 20 minuters interaktion transkriberades i CHAT-format för varje familj (sammanlagt 5 timmar) och består av barnriktat tal från både mammor och pappor. Analysen genomfördes med CLAN-programmen i CHILDES-systemet och är mestadels kvantitativt: antal yttanden, morfem, ordtyper och antal ord riktade till barnen, samt föräldrarnas interaktiva beteenden såsom imitationer, expansioner och bekräftelser av barnens kommunikativa initiativ. Dessutom analyserades föräldrarnas användning av frågor och vissa typer av ord.

Studie II: The role of vocabulary composition and grammatical abilities in Swedish children at 1;6 and 2;0

I Studie II undersöktes stabiliteten i det tidiga ordförrådet hos cirka 200 barn vid 18 och 24 månaders ålder, baserad på SECDI: ord och meningar ($N = 262$ vid 1;6, $N = 200$ vid 2;0 och $N = 183$ med data vid båda mätningarna). Forskningsfrågor gäller prediktorer av ordförrådet vid 2;0, särskilt ordförrådets sammansättning och barns grammatiska förmågor. Barnen delades i den här studien operationellt in i fyra olika grupper utifrån kvartiltillhörighet enligt normdata vid de två mätningarna: *slower learners* ($n = 22$), barn med långsam utveckling vid både tidpunkter; *average learners* ($n = 26$), barn som befann sig nära medianen; *late bloomers* ($n = 15$), barn som började långsamt och sedan spurtade; och *fast learners* ($n = 120$), barn med snabb tidig utveckling. Ordförrådets sammansättning analyserades i enlighet med Bates et al. (1994) och Caselli et al. (1999) och omfattar både de absoluta och relativa proportionerna av substantiv, predikat (verb och adjektiv), funktionsord

och sociala ord i barnens ordförråd. Barns grammatiska utveckling mättes med två variabler: 1) poängsumman av fem frågor om barns användning av ägandeform, bestämd form, flertal och dåtid, och 2) förmågan att kombinera ord, exempelvis om barn kan säga *titta bil* eller *där lampa*. De statistiska analysmetoderna som användes var korrelation och regression. Ytterligare frågeställningar gällde potentiella skillnader bland barn som börjar långsamt och sedan uppvisar en snabb utveckling (*late bloomers*) kontra de med fortsatt långsam utveckling (*slower learners*), samt frågan om olika preferenser hos individuella barn angående sätt att kommunicera ("stylistic variation").

Studie III: Interrelations among communicative skills in Swedish children from 1;0 to 2;6

I denna studie undersöktes samband bland tidiga kommunikativa färdigheter i ett större sampel barn ($N = 348$ totalt) över ett tidsspann på ett och ett halvt år. I analysen ingick mätningar vid fyra tillfällen: vid 1;0 med SECDI: ord och gester; vid 1;6, 2;0 och 2;6 med SECDI: ord och meningar. Variablerna som ingick i analysen är följande: Barns användning av kommunikativa gester; det receptiva och produktiva ordförrådet; och grammatisk utveckling, mätt med M3L. M3L baseras på föräldrarnas rapportering om de tre längsta meningarna de hört barnen säga, och i måttet ingår både antalet olika ord och antalet använda böjningsformer. Korrelationsanalys utfördes på måtten vid samma ålder och parvis mellan 1;0 och 1;6, 1;6 och 2;0, samt 2;0 och 2;6. För 128 av de 348 barnen finns det mätningar från alla fyra åldrarna. I studien ingick också en jämförelse med amerikanska CDI-data och mera ingående analys av olika typer av gester och dess samband med substantiv, verb och funktionsord.

9.4 Resultat

9.4.1 Studie I

Resultaten från interaktionsstudien visar att egenskaper i föräldrars verbala interaktionsmässiga beteenden är relaterade till barnens ordförrådsutveckling, det vill säga antalet yttranden, morfem, ordtyper och antal ord i det barnriktade talet ökar med storleken på barnens ordförråd. En annan analys gällde hur tydligt talet var (baserat på antalet otydliga ord eller fraser som inte kunde transkriberas). Det visade sig att föräldrar till barn med litet ordförråd talade otydligare (se Table 5.1). Det fanns en outlier-familj i gruppen med litet ordförråd, där mamman och pappan producerade mest språk av alla föräldrar till sitt barn. På grund av outliern, men också för att det fanns stor variabilitet hos föräldrar när det gällde de deskriptiva måtten, användes en icke-parametrisk statistisk metod för gruppjämförelserna. Föräldrar till barn

med litet ordförråd använde signifikant färre antal positiva responser (imitationer, expansioner och bekräftelser) på barnens yttranden än föräldrar till barn med större ordförråd.

Analysen av frågetyper visar att föräldrarna till barnen med störst ordförråd ställde flest frågor sammanlagt, många ja/nej frågor som börjar med modala hjälpverb och fler frågor som krävde ett verbalt svar från barnen. En analys av barnens ordförrådssammansättning visar att barn som kan många ord har procentuellt flest substantiv och predikat (verb och adjektiv), och färre sociala ord (såsom *hej*, *mamma* och *nam nam*) i sina ordförråd, medan barn med litet ordförråd använde procentuellt flest sociala ord och funktionsord. Av de senare var ordet *där* mest frekvent, medan barn som kunde många ord använde ett stort antal olika typer av funktionsord. Det fanns några skillnader mellan grupperna angående föräldrarnas ordanvändning. Exempelvis använde föräldrar till barn med litet ordförråd ofta ordet *där*, medan föräldrar till barn med större ordförråd oftare använde de mer specifika *den där/den här* samt *här*.

9.4.2 Studie II

Resultaten från Studie II visar att barn med störst ordförråd vid 1;6 tenderar att ha fortsatt stort ordförråd sex månader senare, medan barn som kan få ord vid 1;6 är mer variabla när det gäller kvartiltilhörighet. Ordförrådets sammansättning studerades i relation till ordförrådsstorlek och i olika grupper barn vid 1;6 och 2;0. Ordförrådets sammansättning varierar enligt vissa generella utvecklingsmönster över tid, även om det finns en stor individuell variation också, särskilt hos barn med litet ordförråd. Till exempel består det tidiga ordförrådet ofta till stor del av sociala ord, men andelen minskar allt eftersom barn lär sig fler substantiv. Andelen predikat börjar öka snabbare när barn har byggt upp ett förråd av substantiv och slutligen tillkommer funktionsorden. Det tycks vara kulturella och sociala faktorer som påverkar dessa generella mönster. I denna studie tyder resultaten på att svenska barn har en större andel funktionsord än till exempel amerikanska eller italienska barn, även när ordförrådet är som minst. *Fast learners* har flest substantiv och predikat i sitt ordförråd vid 1;6, medan *slower learners* har störst andel funktionsord. I jämförelse med *slower learners*, har *late bloomers* flera substantiv och färre funktionsord i sitt ordförråd. Dessa skillnader är tydligast när sammansättningen räknas för varje ordklass i relativa proportioner till antalet ord inom kategorierna på SECDI ("opportunity scores"). *Fast learners* är också den grupp som tidigast uppvisade förmågan att använda böjningar och kombinera ord. Även om gruppmedelvärdet var större än i alla andra grupper fanns det ändå en stor individuell variation bland *fast learners*.

Regressionsanalys användes för att ta reda på vilka variabler som har störst prediktivt värde för ordförrådsstorleken vid 2;0. Signifikanta pre-

diktorer var ordförrådsstorlek vid 1;6 och kön (att vara flicka tenderade att bidra till större ordförråd), samt andel substantiv och grammatisk förmåga vid 1;6. En regressionsanalys med enbart *slower learners* och *late bloomers* visar att föräldrarnas utbildning tillsammans med andel substantiv vid 1;6 förklarade en knapp tredjedel av variationen mellan grupperna. Särskilda korrelationsanalyser gjordes också för att studera skillnader mellan de två grupperna. Till exempel visar analysen att det finns starkare samband mellan funktionsord vid 1;6 och 2;0 hos *slower learners* än hos *late bloomers*. Korrelationer hos de senare visar starkare samband mellan till exempel substantiv vid 1;6 och ordförrådsstorlek vid 2;0, och flera andra samband hos *late bloomers* fanns även hos *fast learners*. Ett sådant samband är att substantiv vid 1;6 är signifikant korrelerade med alla ordklasser vid 2;0. För både *late bloomers* och *fast learners* är alla ordklasser vid 2;0 starkt korrelerade med varandra.

9.4.3 Studie III

I Studie III studerades sambanden mellan flera olika kommunikativa färdigheter mellan 1;0 och 2;6. Gester mättes enbart vid 12 månader och M3L finns som variabel enbart i SECDI-formuläret Ord och satser (vid 1;6, 2;0 och 2;6 års ålder). Alla korrelationer beräknades både för sampeln som helhet ($N = 348$) och för de 128 barn med mätningar vid samtliga åldrar. Överlag var resultaten likartade i båda grupperna (se Figurerna 7.1 och 7.2). Resultaten visar att gester vid 1;0 är starkt korrelerade med både ordförståelse och ordproduktion vid samma ålder, men att sambandet med ordförståelse är det starkare sambandet. Gesternas samband med ordproduktion och M3L vid 1;6 är ganska svaga, och signifikansen var något olika i de två grupperna. Det finns likvärdiga, starka signifikanta samband mellan talat ordförråd och M3L vid 1;6, 2;0 och 2;6. Sambanden mellan ordproduktion vid 1;0, 1;6 och 2;0 och M3L vid 1;6, 2;0 och 2;6 är också starka och signifikanta, medan sambanden mellan tidigare M3L (det vill säga vid 1;6 och 2;0) och ordproduktion vid 2;0 och 2;6 inte är signifikanta. Parvisa korrelationer mellan ordproduktion vid 1;0 och 1;6, 1;6 och 2;0, samt 2;0 och 2;6 är starkt signifikanta. Sambandet mellan M3L vid 2;0 och 2;6 är starkt signifikant, medan det är svagt med en tendens till signifikans mellan 1;6 och 2;0.

Ordproduktionsutvecklingen över hela tidsspannet visar skillnader mellan pojkar och flickor. Efter 12 månader går utvecklingen isär och flickor som grupp har ett signifikant större ordförråd än pojkar vid 24 och 30 månader. En jämförelse gjordes mellan CDI-data för amerikanska barn och barnen i detta svenska sampel. Skillnader kunde ses i korrelationer vid 12 månader, där sambanden mellan gester och ordförståelse och ordproduktion var starkare hos svenska barn. Däremot var sambandet mellan ordproduktion och ordförståelse starkare bland de amerikanska barnen.

Den mera ingående analysen av gester delade in dessa (i enlighet med Sansavini et al., 2010) i *tom-hand-gester* och *handlingar med objekt*. Resultaten visar att *tom-hand-gester* hade ett starkare samband med ordproduktion medan *handlingar med objekt* var starkare korrelerade med ordförståelse. När gesternas relation till ordklasser analyserades, var *tom-hand-gester* vid 1;0 och substantiv vid 1;6, samt *handlingar med objekt* vid 1;0 och verb vid 1;6, mer signifikant relaterade till varandra.

9.5 Allmän diskussion

Övergripande resultat från denna avhandling stödjer tidigare forskningsresultat angående den stora betydelsen av den tidiga ordförrådsutvecklingen. Avhandlingen bidrar med nya resultat från ett svenskt perspektiv. Resultaten visar att storleken på det tidiga ordförrådet spelar roll för den senare språkliga utvecklingen. Studie I undersökte föräldrars sätt att tala med sina barn i relation till barnens ordförrådsstorlek vid 18 månaders ålder. Man kan inte säkert säga huruvida det är ett kausalt samband, men det fanns en tydlig association mellan hög andel av imitationer, expanderingar, antalet ord och olika ordtyper i föräldrars språk till barn med stort ordförråd. Även i detta relativt homogena sampel medelklassföräldrar var emellertid variationen stor. Dessutom visar avhandlingsresultatet vikten av att föräldrar anpassar sitt sätt att tala med de små barnen i förhållande till barnens språkliga och utvecklingsmässiga nivå. Detta gäller exempelvis talets mängd, hastighet och tydlighet, samt vilka typer av frågor föräldrarna ställer.

Det finns givetvis fler faktorer än ordförrådsstorlek som är av stor vikt. Exempelvis diskuterar avhandlingen det tidiga ordförrådets sammansättning i relation till variabilitet hos barn och föräldrar, och personliga preferenser angående kommunikationsstil. En del barn har större intresse för objekt, medan andra kan föredra att kommunicera med sociala fraser. Sådana preferenser kan ha betydelse för ordförrådets sammansättning. Skillnader i sammansättningen tycks ha betydelse för vad som sker när i den språkliga utvecklingen. Till exempel visade sig andelen substantiv i barnens tidiga ordförråd vara en signifikant prediktor för senare ordförrådsstorlek (Studie II). Vid vilken ålder barnet utvecklar olika språkliga förmågor kan ha betydelse för eventuell uppkomst av språkliga eller kommunikativa svårigheter. Även om de flesta barn med försenad ordproduktion (så kallade 'late talkers') har kommit ikapp andra barn i fyra-fem årsåldern har longitudinella studier pekat på kvarstående språkliga problem ända upp i tonåren.

Avhandlingen har också berört den tidiga grammatiska utvecklingen. Resultaten stödjer tidigare forskning som påvisat att det finns en stark relation mellan ordförråd och grammatik. I regel krävs det en viss storlek på det aktiva ordförrådet för att barn ska börja kombinera ord och använda böjningar. Men i Studie II visar resultatet på en omfattande variation vad gäller gram-

matiska förmågor även hos *fast learners*, som har börjat använda ordböjningar och olika tempus i större utsträckning än barn i de andra grupperna (se Figure 6.4). Orsaken till detta är oklart, men det kan möjligen hänga samman med en viss stilistisk skillnad i grammatisk utveckling. Vidare har Studie III visat ett positivt samband mellan ordförrådet och den grammatisk/syntaktiska utvecklingen, mätt med yttrandelängd i morfem (M3L). Sambandet är starkare vid en och samma ålder än mellan ordförråd och M3L vid efterföljande mätning. Det icke signifikanta sambandet mellan tidigare M3L och senare produktivt ordförråd skiljer sig mot resultat från andra studier (e.g. Moyle et al., 2007), möjligen beroende på skillnader i de mått för grammatik som användes i de olika studierna.

Studie III har också tagit upp relationen mellan ordförståelse och barns tidiga gester. Ett nytt resultat för svenska barn är den analys som delade gesterskalen i *tom-hand-gester* och *handlingar med objekt*. Gesternas betydelse för ordförståelse och de olika sambanden med substantiv och verb har implikationer för föräldrar och förskolepersonal. Resultatet tyder på att barns lek med objekt kan stimulera förståelsen för verb medan *tom-hand-gester* kan bidra till ökad kunskap om objekt och deras namn.

9.5.1 Avhandlingens begränsningar

De senaste 40 åren har inneburit stora framsteg inom barnspråksforskning, både när det gäller teoribildning och utveckling av forskningsmetoder. Trots att forskningen nått långt, är det mycket som återstår att undersöka om hur barn lär sig kommunicera. Mer kunskap behövs om hur de olika verbala och icke-verbala förmågor utvecklas. Denna avhandling har använt sig av metoder som utprovats sedan 1980-talet, och som möjliggör storskalig datainsamling om barns ordförråds kunskap från föräldrar, som känner barnen bäst. Dessutom har data om föräldra-barn-interaktion samlats in med ljudinspelningar som föräldrar bidragit med. På så sätt utgör de naturalistiska exempel på interaktion, utan störande inslag från forskare i hemmet. Men föräldrap rapporter som metod kan inte berätta allt om vad barn kan om språk eller hur de använder denna kunskap. Inte heller kan ljudinspelningar ge information om hela den kommunikativa situationen som även består av icke-verbal interaktion såsom gester och blickar. Därtill utgör familjer som deltagit i SPRINT-projektet ett sampel som inte representerar den svenska befolkningen som helhet. Föräldrarna är till två tredjedelar högskoleutbildade och barnens ordförrådsutveckling ligger högre än befintlig normdata för SECDI. För att hantera detta användes normdata för att dela in barnen i percentilgrupper i Studierna I och II. Skevheten i föräldrarnas bakgrund har först tyckts vara en svaghet, men visar sig vara en styrka. Avhandlingens resultat visar att långsam språkutveckling inte bara förekommer hos barn som tillhör socialt svaga grupper.

Analysen i studierna har mestadels varit av kvantitativ natur. Deskriptiva statistiska metoder, samt korrelation och regression har använts för att undersöka gruppskillnader, samband mellan olika variabler, samt dess prediktiva värde. Avhandlingens resultat är rimliga och stödjer både tidigare internationella resultat och bidrar även med nya resultat. Det finns starka indikationer på kausala samband mellan variabler även om dessa inte kan påvisas direkt utan att testas experimentellt. I Studie I är det exempelvis troligast att det förekommer påverkan i båda riktningar, det vill säga att både barn och föräldrar påverkas av varandra. Viktigt i detta sammanhang är att barn med litet ordförråd särskilt kan behöva positiv uppmuntran från sina föräldrar.

9.5.2 Vidare implikationer

En förhoppning är att avhandlingen bidrar till ökad medvetenhet i samhället och inte minst hos föräldrar om vikten av den tidiga språkutvecklingen. Moderna föräldrar lever i en värld där många krav ställs på deras tid och intresse. Det kan vara bra med en påminnelse om att något så enkelt som att använda en bakåtvänd barnvagn kan öka möjligheterna till interaktion med barnen. Kunskap om vikten av tidig språkutveckling är av stor betydelse för alla som arbetar med små barn i sina yrken. Alla barn har nytta av en rik språklig miljö som är anpassad efter barnets intresse och behov. Personal i utbildningsväsendet behöver också kunskap om olika riskfaktorer för språkliga svårigheter. Försenad ordproduktion kan leda till problem, men den kan också endast vara ett tecken för den stora naturliga variabiliteten i språkutvecklingen. I vilket fall är det önskvärt att varken föräldrar, BVC-personal eller förskollärare 'väntar och ser'. Logopedens experthjälp kan med fördel engageras så fort det finns oro angående ett barns kommunikativa utveckling. Frågan om allmän språkscreening och i vilken ålder man med säkerhet kan predicera språkliga problem är omstridd. Den bästa lösningen torde vara att vara medveten om riskerna och noga följa barnets utveckling. Hellre än att utföra ett stort screeningtest vid en viss ålder kan man sätta in kortare riktade bedömningar för att avgöra om behovet av en språklig intervention föreligger. Överhuvudtaget är den stora variabiliteten i den tidiga språkutvecklingen en utmaning för att välja den bästa typen av insats vid den tidpunkt den behövs mest. Det kan också vara viktigt att rikta insatser till barn som verkligen kan dra nytta av interventionen, exempelvis barn i utsatta sociala situationer eller med språkstörningar i familjen.

9.5.3 Framtida forskning

Avslutningsvis är det viktigt att veta att barns språkutveckling inte berättas med en enda historia. Framtida forskning kan med fördel syfta till att undersöka de många olika banor som individuella barn följer i språktillägnandet. Sådan kunskap behövs bland annat för att bättre kunna planera effektiva

interventioner. Storskaliga interventioner som innehåller språkkomponenter kan också ge viktig information om hur barn svarar på olika typer av insatser. När det gäller metodutveckling skulle flera verktyg som underlättar den morfosyntaktiska analysen av transkriberade filer i CHAT-format komma många forskare till godo. Dessutom behövs mer ingående kvalitativ forskning om föräldra-barn-interaktion vid olika åldrar, samt forskning om relationen mellan interaktion i hemmet och den vidare språkliga utvecklingen för barn inom förskolan – allt för att i möjligaste mån stödja barns så viktiga språkliga och kommunikativa utveckling.

10 References

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11 Appendix

Table 11.1: Number of children in each coded quartile group with vocabulary size ranges at 18 and 24 months, based on measurements with SECDI: Words & Sentences

Vocabulary Quartile Group	Number of children (<i>n</i>)	Vocabulary Size at 18 months in words	Vocabulary Size at 24 months in words	Mean gain in words per group over 6 months
11	7	2–13	6–81	25.4
12	8	8–15	91–165	122.6
21	6	18–28	27–66	24.7
31	1	31	76	45.0
13	3	6–15	209–241	215.7
14	6	3–14	267–447	316.0
24	6	17–25	274–488	360.8
22	8	18–24	92–161	111.6
23	6	16–27	172–239	176.7
32	2	31–51	116–148	91.0
33	10	31–67	183–242	171.1
34	46	30–67	261–646	359.0
43	1	103	255	152.0
44	73	69–423	257–681	341.4

Table 11.2: Parental use of closed-class words by percentile group with group totals, means, standard deviations, and minimum and maximum values.

Word	Percentile Group											
	P 0–25				P 55–70				P 90–99			
	Group Total	M	SD	Min- Max	Group Total	M	SD	Min- Max	Group Total	M	SD	Min- Max
<i>där</i> ('there')	120	24.0	24.0	8–65	183	36.6	19.3	11–65	87	17.4	6.8	10–26
<i>här</i> ('here')	64	12.8	12.1	5–34	77	15.4	3.5	11–20	83	16.6	7.4	7–27
<i>den</i> ('it/that')	141	28.2	32.7	7–86	136	27.2	8.6	14–35	155	25.0	17.4	11–54
<i>det</i> ('it/that')	175	35.0	12.5	25–56	221	44.2	14.0	27–60	298	59.6	29.3	24–104
<i>den där/den här</i> (‘that one/this one’)	22	4.4	2.1	2–7	46	9.2	3.8	4–14	81	16.2	9.1	5–27

Table 11.3: Parental use of special verbs by percentile group with group totals, means, standard deviations, and minimum and maximum values.

Percentile Group											
P 0–25				P 55–70				P 90–99			
Word	Group Total	M	SD	Min- Max	Group Total	M	SD	Min- Max	Group Total	M	SD
<i>se</i> ('see')	29	5.8	3.4	1–9	51	10.2	4.6	6–16	30	6.0	2.9
<i>titta</i> ('look')	35	7.0	2.6	5–11	32	6.4	4.6	1–12	54	10.8	7.2
<i>gòra</i> ('do')	15	3.0	2.9	1–8	29	5.8	3.1	1–9	29	5.8	3.9
<i>ta</i> ('take')	35	7.0	2.3	5–11	54	10.8	3.4	6–14	68	13.6	4.2
<i>tro</i> ('believe')	22	4.4	2.8	2–9	15	3.0	3.1	0–7	12	2.4	2.1
<i>tycka</i> ('think')	6	1.2	1.1	0–2	14	2.8	1.5	1–5	13	2.6	3.4

Table 11.4: Variation in vocabulary composition by vocabulary size at 2;0 ($N = 200$)

	<i>M</i>	<i>SD</i>	Min--Max
%	0–50 ($n = 11$)		
Common nouns	19.8	15.0	0–52
Predicates	2.8	4.0	0–11
Closed-class	11.3	7.8	0–24
Social words	49.5	9.9	33–65
	51–100 ($n = 12$)		
Common nouns	43.0	13.0	21–71
Predicates	11.3	6.1	3–21
Closed-class	8.3	6.1	0–21
Social words	25.4	5.6	17–36
	101–200 ($n = 21$)		
Common nouns	52.7	6.8	38–64
Predicates	13.3	3.7	6–22
Closed-class	6.9	2.9	2–13
Social words	17.7	3.1	12–24
	201–300 ($n = 30$)		
Common nouns	54.0	5.9	45–73
Predicates	17.2	5.3	0–25
Closed-class	6.2	2.4	0–11
Social words	13.7	1.8	10–18
	301–400 ($n = 28$)		
Common nouns	51.5	3.7	44–58
Predicates	21.2	2.6	16–28
Closed-class	7.3	2.3	4–14
Social words	11.2	1.3	9–14
	401–500 ($n = 46$)		
Common nouns	48.5	3.9	39–61
Predicates	22.5	2.8	15–27
Closed-class	9.4	2.1	4–16
Social words	10.6	0.9	9–12
	501–600 ($n = 38$)		
Common nouns	45.9	2.4	38–51
Predicates	24.2	1.9	17–29
Closed-class	10.5	1.6	7–14
Social words	10.1	0.7	9–12
	601–700 ($n = 14$)		
Common nouns	43.6	1.5	41–48
Predicates	23.9	0.9	22–25
Closed-class	12.4	1.3	9–14
Social words	10.0	0.5	9–11

Note: Percentage scores *denote* absolute values.



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