Language acquisition

Steven Gillis & Dorit Ravid
University of Antwerp/University of Tel Aviv

1. Introduction

The study of language acquisition is a multidisciplinary enterprise, in which various disciplines meet. Linguistics is a first discipline in this context: linguists describe children's language in terms of the structural characteristics of the child's language production and try to capture the commonalities shown by children acquiring different languages as well as differences in the acquisition process. They ask questions such as: how does typology influence the acquisition process? What are the individual differences between children acquiring the same language? Psycholinguists and psychologists study the social and cognitive underpinnings of language: the socio-cognitive dynamics of language acquisition (given that language is not acquired in a social vacuum), and the cognitive processes involved in language production and comprehension, such as the role of perception, memory, attention, etc. Neurolinguists try to unravel the genetic bases of language by studying brain development processes associated with the emergence of linguistic communication. The list of disciplines is not exhaustive: there are indeed audiological, biological, ethological, evolutionary, psychological, sociological and other aspects of language acquisition that are not properly captured by our initial enumeration of so-called 'hyphen-linguists'. And once we start thinking about delayed and disordered language acquisition, still other disciplines have proven their relevance, such as communications disorders, or medical informatics and robotics if we think of situations like hearing impaired children with a cochlear implantation, etc.

As a matter of course it is quite a haphazard enterprise to even try to get an overview of the main lines of the research in language acquisition, since the disciplines involved are so diverse and entwined in such complex ways. For instance, a novel discipline termed 'artificial life' has arisen since the early nineties. Researchers in that field are involved in fascinating programs like the construction of 'software agents' by 'evolutionary computation' and even 'hardware agents' or 'robots' that are meant to communicate with the outside world, travel in cyberspace (the 'world wide web') to gather information, learn language(s), and perform all kinds of tasks that are considered to be intelligent. Some of the questions faced by 'artificial life' are quite analogous with the ones formulated by researchers involved in 'real life' language acquisition, and, surprisingly, some of the answers that pop up in the artificial life literature remind the (psycho-) linguist of some of the relatively neglected areas in his/her own discipline, such as the relationship between ontogeny and phylogeny (since a society

of robots creates its own language, which develops and changes), or the consolidation of language varieties (dialects, sociolects, and the like).

Notwithstanding the inherently interesting nature of the research in these various disciplines, we will concentrate in this chapter on what we consider to be some of the main issues and current controversies in language acquisition research and theorizing.

In the first days of studying child language, interest focused virtually exclusively on the earliest stages of language acquisition, the period of birth to three years (Brown 1973). There were a number of reasons for this. First, this was perceived as the period when drastic changes are observed in the child, when the 'major action' so to speak takes place, the years that witness the emergence of language in children. Indeed, it was clear from the start that language learning taps the most fundamental cognitive resources in the child and that accounting for it involves probing the crucial relationship between language and cognition, universal principles and particular languages (Johnston 1985; Peters 1985; Slobin 1985). More important, the puzzle of language learnability clearly held one of the major keys for validating current models of language, providing evidence for controversial claims about linguistic theory, and most specifically, the nature of syntactic knowledge and its origin (Bates & MacWhinney 1987; Clahsen 1992; Goodluck 1986; Pinker 1984). This still constitutes the main motivation for linguists' continuing interest in language acquisition and learning (Gopnik 2001; Pinker 1994; Plunkett & Sinha 1992; Tomasello & Brooks 1999).

From a practical point of view, there was a huge need in the 1970s and 1980s for mapping out for the first time, using systematic and objective psycholinguistic tools, the highway to language in the sense of developing phonological and lexical inventories (Clark 1993; Locke 1986), breaking the grammatical code and relating it to semantics (Bowerman 1985, 1986; Carey 1982; Maratsos 1982), and interacting with their environment (Bruner 1981; Snow 1986). Core studies in English led to a proliferation of studies charting stages in language development across the world's languages from Hebrew to Swahili and the consequent establishment of models of universal steps in linguistic acquisition (Berman 1986; Slobin 1985, 2001). Expanding crosslinguistic evidence resulted in reawakened interest and further studies in the early stages of linguistic development in quest of understanding how language typology, cognition, and culture interface in acquiring linguistic concepts and categories (Bowerman & Choi 2001).

As soon as the early-years picture stabilized, it became clear that language development makes major headway beyond the age of three. Important morphological and syntactic constructions emerge and consolidate in the preschool years, accompanied by lexical reorganization and the emergence of narrative structure — all signs of ongoing changes in children's language systems beyond the age of 3 (Berman & Slobin 1994; Bowerman 1982a,b). A small number of early studies pointed the way towards the investigation of children's language after age 5, focusing especially on high-order cognitive changes and resulting late-emerging syntactic distinctions (C. Chomsky 1969; Karmiloff-Smith 1986). The picture that emerged at the end of the 1980's in the mainstream developmental psycholinguistic literature

was that the most important, interesting and relevant linguistic development takes place between birth and age 5, with some additional fine-grained morphological and syntactic acquisitions after it.

But is this the whole picture? Most researchers would agree that children growing up in a monolingual environment have access to the vast majority of morphological and syntactic structures of their language before they enter school age. Nonetheless, a five-year old hardly matches an adult or even a twelve-year-old in linguistic proficiency. Evidence has been accumulating to the effect that language acquisition is a protracted process, which is not over by age ten or twelve, and that considerable changes in all linguistic domains occur in the language of older children and adolescents (Berman & Verhoeven 2002; Nippold 1998; Ravid & Tolchinsky 2002). These in fact render the language of adults as different from that of adolescents as that of adolescents differs from the language of twelve — year-olds.

The aim of our chapter is thus to provide a comprehensive overview of linguistic development from infancy through childhood to late adolescence, embedded in various relevant theoretical and methodological contexts. We start with an overview of the main issues and controversies in the field.

2. Central issues and main controversies

Explaining child language acquisition has always been a fascinating and controversial endeavor, since this is the most important cognitive achievement in infancy and childhood, which underlies almost every other communicative, social and psychological ability. In this section we review some of the main controversies in the domain. We will start with the nativist theory of language acquisition that has reigned over the domain for several decades. We will show how the notion of nativism, as it 'emerged' from learnability theory, is currently being revised. First of all, it is not controversial anymore that some parts of humans' ability to acquire language is innate (Section 2.1). But *innate* in what sense? And what exactly is innate: linguistic knowledge, general cognitive or specific linguistic abilities? In Section 2.2 we introduce the issue of modularity (intimately tied to innateness), and we briefly sketch the state of the art of the debate about modularity, innateness, and domain specificity, taking into account the current neurobiological evidence and evidence from language acquisition pathology.

The 'cradle' of *nativism* is sited in grammatical, especially syntactic acquisition; however innate mechanisms and knowledge have also been proposed for what in the Chomskyan tradition was considered to be the only component of language that needed learning (rather than acquiring), namely the lexicon. The studies reviewed in Section 2.3 show a growing tendency of taking into account the structure of the ambient language in order to explain children's lexical acquisition and apparent crosslinguistic variation. The latter point brings us to the swing in current thinking about language acquisition from a nativistic to

an empiricistic or data-driven perspective. This shift of perspective was heavily influenced by the model of *connectionism* that we discuss in Section 2.4. The empiricist approach advocates a new learning mechanism, namely bootstrapping (Section 2.5): children start from imperfect information which they gather from various sources and which they compile in order to crack the linguistic code. Finally, in Section 2.6 we will highlight one of the current main emphases of acquisition research: cross-linguistic variation, variation among different children and variation within a single child.

2.1 Nativism

Since the seminal writings of Noam Chomsky, the notion of 'nativism' has been very prominent in the study of language acquisition. The gist of the argument that Chomsky (1965) put forth was that at least some aspects of language were innate: a child is born with a Language Acquisition Device which permits her to acquire the grammar of the ambient language. In later formulations (Chomsky 1986), the child is said to have an innate idea of Universal Grammar (UG), i.e., the universal principles that determine the form of any human language, and the parameters that determine the highly restricted variation between languages.

The main arguments leading to this proposal relate to the issue of the 'learnability' of language. The central and traditional 'poverty of the stimulus' argument stipulates that there is such an enormous discrepancy between the highly abstract grammatical knowledge that the child has to acquire and the underspecified nature of the phonetic strings that the child hears, that there must be an innately guided discovery procedure. The child's search space must be restricted in some way, otherwise it is inconceivable that a child can discover the grammar of her language in such a short period of time. Moreover, the language that the child hears is 'degenerate': it is competence (that is, shared and abstract language knowledge) filtered through performance (actual language usage) and, hence, ill-formed in various ways. (See Snow (1995) for an historical overview of how Chomsky's anecdotal evidence for the poverty and degeneracy of the input was challenged by research investigating the characteristics of Child Directed Speech (CDS); see also the 'twin' volumes Ferguson & Snow (1977) and Gallaway & Richards (1994).)

This formulation of *the logical problem of acquisition* should be distinguished from the *empirical* problem: language acquisition is a staged process. The child's language shows a growing complexity, which can be seen as a succession of grammars, each incorporating more and more aspects of the adult grammar. The growing complexity of the child's language is thus conceptualized as reflecting the growing complexity of the underlying grammar(s). Hence the empirical problem is: what determines the developmental sequence in language acquisition?

There are various answers to this question. One possible explanation is to assume that acquisition requires *maturation*: not all components of Universal Grammar are available

to the child from the start (Radford 1988, 1990), and it requires neurological maturation for this to happen. Another explanation stipulates that all required knowledge is present and available from the start of the learning process at birth, but interdependencies between grammatical parameters make it a protracted process: parameters are ordered and the setting of parameters follows a certain ordered path, in the sense that the fixing of one parameter is dependent upon the prior fixing of another parameter. This type of learning was proposed, for example, for prosodic development by Dresher & Kaye (1990). A third explanation is more lexically based. For instance, Clahsen (1990) proposes that the emergence of syntactic structures is dependent on the acquisition of certain lexical items. In particular, Clahsen et al. (1996: 6) claim that "[…] phrase structure positions are said to emerge gradually in children's grammars, and the creation of new positions and features in phrase structures is driven by the child's learning of words and morphemes".

Thus a concomitant topic is whether there is *continuity* between the child's grammar and the eventual end-state, the adult grammar. The *continuity hypothesis* (which has been formulated in various forms) assumes that the adult grammar is basically predefined, and that the child has to make a number of critical decisions (parameter settings); but essentially the child's linguistic knowledge is adult-like. On the other hand, it is assumed that the child's grammatical knowledge lacks essential pieces of information that have to be acquired in the long run, and this acquisition implies major restructurings (i.e., noncontinuity) of the grammar. Note that the issue of continuity is independent of the issue of innateness: no matter what point of view one takes, the question is whether the linguistic categories the child uses in her language production and comprehension are essentially the same as those used by adults. (Psycho-) linguists take this more or less for granted, be it only for the simple fact that an alternative is basically lacking and — to our knowledge — has hardly been explored.

We started this section with Chomskyan nativism, a theory that was formulated in the context of 'learnability'. However, over the years the notion 'innateness' was re-defined in quite different ways. Elman et al. (1996) provide an excellent discussion of the various definitions that have appeared, ranging from innate features or abilities common to many species (such as the ability for auditory discrimination that humans share with other species like chinchillas, Kuhl & Miller 1975), through species-specific innate features and abilities of humans in particular, to faculty-specific innate features and abilities of grammar acquisition such as those proposed by Chomsky. Locke (1999) adds to the notion of innateness an interesting thought, which in fact sets the stage for a research agenda that has only been implicit for many students of language acquisition. He notes that, ultimately, linguistic behavior is produced by our genes, maturation and experience; but, ultimately, all behaviors depend on genes, maturation and experience. Hence, to make this claim interesting at all, we have to find out how these factors interact to produce the linguistic capacity: if language is indeed a uniquely human ability, and/or if language requires faculty-specific abilities and features, a theory of language acquisition should look rather different from theories of behaviors that cut across

species and/or that cut across faculties. Or, as Braine (1992) phrased it: the fact that particular ingredients of language acquisition are innate is undisputed, but exactly how do we get from genes laid down at conception to syntactic categories two and a half years later? We are a long way from being able to answer this question (Bates 1999).

2.2 Modularity

Modularity refers to the compartmentalization of knowledge in the mind. A *module* is a specialized, differentiated and encapsulated mental organ, which, according to Fodor (1983), has evolved to take care of specific knowledge that is of crucial importance for the species. Language is one of these hardwired cognitive systems that is crucial for the species and has therefore evolved into a separate module. In essence this means that language is independent from other cognitive systems, and within the linguistic modules various modules (syntax, phonology) also operate independently.

Fodor (1983) pinpoints various criteria for distinguishing hardwired, independent modules from learned behaviors: modules process information in a characteristic way (encapsulated, fast, data-driven, unconscious, blind to all other information, indifferent to other cognitive modules, etc.). However, this type of information processing is also characteristic of learned behaviors that are largely automatic when reaching behavioral mastery. But modules also have a specific biological status: modules are built-up in a characteristic sequence and break-down in a characteristic way, and they are localized in the brain. Hence the language module is a kind of 'mental organ'.

The issue of modularity is closely connected to the domain-specificity of linguistic processing. For language acquisition, this question is as follows: Is language development a function of domain-specific or domain-general processes and representations? In other words, does a child use the same processes and/or knowledge structures for acquiring language as well as for learning other cognitive skills? Or does language acquisition require a dedicated module, a 'mental organ'? This question is high on the research agenda of the community, and input from the neurolinguistic front is currently throwing important light on the issue.

Liz Bates (1994, see also Bates 1999; Bates et al. 1992) argues that in fact three issues are confounded in the debate: *innateness*, *localization*, and *domain specificity*. As to innateness, the claim is that something about language (acquisition) is innate — a claim which has to be true, since we are the only species to acquire language in its fullest sense (symbolic lexicon and syntax, Deacon 1997). As to localization: the claim is that there are specific areas in the brain that are dedicated to language processing. This claim also appears to be uncontroversial, judging from the neurolinguistic literature, though there is accumulating evidence of brain plasticity and reorganization when the default conditions do not hold. Bates (1994: 136) argues: "The real debate revolves around the mental organ claim. Are the mental structures that support language 'modular', discontinuous and dissociable from all

other perceptual and cognitive systems? Does the brain of a newborn child contain neural structures that are destined to mediate language, and language alone?".

This issue has not yet been fully cleared out. On the one hand, consider the deficit commonly referred to as Specific Language Impairment (SLI), a disability that is claimed to be purely linguistic, since there are no concomitant cognitive or neurological deficits. Fletcher (1999) claims that SLI occurs because language development depends upon domain-specific processes, with the consequence that it is possible for a child to exhibit impaired language development while showing no other psychological or cognitive impairments. Thus SLI seems to point at modularity and domain-dependence.

On the other hand, Bates et al. (1992) review an impressive amount of developmental neuro(bio)logical studies that seem to contradict the notion of specific brain regions solely responsible for linguistic processing: first of all, the evidence point out that particular brain regions that mediate language acquisition in the first year of life are not necessarily the regions that mediate processing and maintenance of language in adults (p. 24). Secondly, instead of a straightforward one-to-one correspondence between neurological developments that 'cause' linguistic developments in the child, there is accumulating evidence for a complex bidirectional interaction between neural and linguistic (or more general: behavioral) developments.

2.3 Lexical principles

Innate knowledge and/or mechanisms have also been proposed for other domains than grammar or syntax. For example, consider the ongoing debate about children's construal of novel word reference. The rapidity with which young children acquire words has led to contradictory models of how a novel word is inferred. One view attributes knowledge of the conceptual difference between discrete objects and substances to language learning which informs the child on the grammatical distinction between count nouns and mass nouns (Quine 1960). On this view, individuation of objects comes from the linguistic domain of noun quantification in natural languages (Carey 1994). An opposing view holds that such knowledge exists prior to language acquisition, and that it constrains and guides children in novel word learning early on (Soja et al. 1991).

Proponents of universal built-in constraints in lexical acquisition have made specific assumptions about linguistic learning mechanisms that are supposed to help children cope with the inductive problem involved in learning novel nouns. According to this view, children have innate lexical biases such as the whole object constraint, the taxonomic bias and the shape bias (Golinkoff et al. 1994; Markman 1994; Woodward & Markman 1998). Together these constraints predict that a child encountering a new noun will assume that its label refers to the whole object rather than to its parts or to properties associated with it; that there are other whole objects sharing the same category with it; and that the shape rather than the size or texture of a count noun will determine what other nouns will be

regarded as sharing the same category. An alternative account of such mechanisms is proposed by Bloom (1994), who argues that syntactic distinctions of mass vs. discrete reference of nouns correspond to aspects of abstract cognition, and that young children are able to exploit such innate syntax/semantic mappings in order to learn new words, and specifically, types of new nouns.

Recent work on the early acquisition of noun reference denies the existence of innate lexical biases to explain how children handle the almost infinite number of possible interpretations logically possible for every novel noun (Landauer & Dumais 1997; Smith 1998; Tomasello et al. 1996). These studies suggest that initial lexical learning is guided by cognitive knowledge, parental guidance, world knowledge, and by attending to language-specific properties of words provided in the input. In a series of crosslinguistic studies, Gathercole & Min (1997), Gathercole, Thomas & Evans (2000) and Gathercole et al. (1999) also propose that children's lexical biases are a symptom of their reliance on regularities they discover about their own particular language in interaction with linguistic and cognitive factors.

Considerable work has been done in relation to these claims on nouns referring to collections. Collective nouns such as *forest* or *audience* are count nouns, since, for example, they take the indefinite article in English, and they can be quantified. But they are not the prototypical kind of nouns referring to discrete whole objects, since they refer to a single entity made up of a collection of other entities (*trees*, *people*). Therefore they are predicted to be problematic in acquisition in all languages, if indeed all children learning any language are motivated by built-in biases such as the whole object constraint.

A number of studies have found that collective nouns are difficult to acquire in English-speaking children. Bloom's studies on the acquisition of collectives (Bloom 1996; Bloom & Kelemen 1995; Bloom et al. 1995) present evidence that preschoolers do not differentiate between individual object and collective reference of novel nouns even when syntactic and pragmatic cues are provided unless there is explicit visual information. More evidence on children's difficulty in providing collective reference for superordinate terms and novel nouns is supplied by Huntley-Fenner's 1995 study of three- and four-year olds. Bloom emphasizes the importance of a noun with a collective reference having "an independent causal role in some conceptual domain" in order for it to be construed as an individual (1994: 319); that is, a physical entity such as a forest, for example, or a social group such as the family that has a coherent place in the structure of reality and about which children might have a 'naïve theory'. Bloom & Kelemen (1995) propose that the absence of such pragmatic cues, together with children's lower sensitivity to syntactic cues than adults, may explain their results.

These findings, however, may be an artifact of the fact that the data on acquisition of nouns with collection references initially come from English-speaking participants. Recent cross-linguistic studies comparing aspects of the acquisition of nouns in English with Mandarin Chinese (Tardiff et al. 1999), and with Japanese (Imai & Gentner 1997)

suggest that culture-specific input factors in maternal speech and language-specific factors such as count/mass syntax affect children's performance.

The studies that Gathercole and her colleagues have conducted compare children's construal of noun referents in English, Korean, Spanish, and Welsh, four languages with varying degrees of overt singular/plural and count/mass marking and with distinct properties of marking nouns in context: many individuated contexts in English and Spanish, fewer Welsh nouns in individuated contexts, contrasted with nouns with collective reference, and few individuated contexts in Korean. Children acquiring these different languages gave different response patterns consistent in various degrees with the whole object, taxonomy and shape biases. English- and Spanish-speaking children were found to favor same-shape responses and to perform more in line with the whole object approach. In contrast, Korean-speaking children favored same-substance responses, and Welsh-speaking children did not perform in accordance to the whole object approach. These studies also indicate that as soon as children understood the task at hand, they responded to new words in ways that are consistent with the adult language and that consistent and obligatory singular/plural syntax affects children's response patterns (Gathercole & Min 1997; Gathercole et al. 1999; Gathercole et al. 2000).

2.4 Empiricism

Contrary to the position that the bulk of the child's grammatical knowledge is actually pre-wired and is discovered by special procedures, there is the position that the child comes equipped with particular processing strategies to the task of language acquisition, however much of what is learned emerges through the interaction of the child's mind and her environment.

Take as an example the development of speech perception. Newborns have been shown to be able to discriminate all human speech sounds, and their perception is categorical (Eimas et al. 1971). This ability to discriminate attested universal distinctions in phonetic space seems to point at an innate and highly specialized 'speech detector' (Eimas 1985). However, it has also been shown that soon after birth children are able to discriminate their native language from a foreign language and not able to discriminate two foreign languages (Mehler et al. 1988). Moreover, newborns have been shown to prefer their mother's voice and to react to recurrent mother's speech pre-natally (De Casper & Fifer 1980; De Casper et al. 1994; Moon et al. 1993). These abilities can hardly be characterized as 'innate': even though children are born with a propensity to listen to speech, the details of the child's abilities at birth seem to indicate unambiguously that they have learned from what they heard. These findings suggest that even before birth, children are learning from the ambient language, exploring the regularities that appear in the 'noise' that they hear.

During the first few months of life, infants acquire an impressive amount of knowledge about their environment, and especially about their native language. For instance, inter- or

cross-modal knowledge reaches a surprisingly high level. Kuhl & Melzoff (1984) showed that two-, to three-month-olds can detect discrepancies between a speech sound and the visual display of a face that they see. In order to test this, they placed infants in front of two visual displays, one of which showed the face of a person pronouncing an /a/ and the other a person pronouncing an /i/. In between the two displays was a loudspeaker; when one of the speech sounds was played, the infants looked significantly longer at the display with the face that matched the sound that they heard, thus suggesting that already at this young age, they were able to link the 'mouth' that produces a sound and the actual sound (a form of 'lip reading', so to speak). Again, even if children are born with a propensity to integrate cross-modal knowledge, the details of their behavior at two months of age suggest that they must have learned a lot from their experience with sounds and faces.

During the first year of life, the child's universal discrimination abilities seem to erode: distinctions that the child was able to make in the first half year seem to have disappeared. Instead, the child homes in onto the ambient language and becomes especially sensitive to relevant features of the language she hears. Quite a number of researchers point at a development of children's preferences for the ambient language at the segmental as well as the supra-segmental level: children exhibit a preference for the predominant stress pattern of the native language (Jusczyk et al. 1993). The vowels of the language act as 'a magnet' (Kuhl 1993; Kuhl et al. 1992 showed this for English and Swedish children), and children acquire knowledge about the phonotactics of their native language, as shown by their preference for typical consonant clusters (e.g., the word-initial clusters [kn] and [sχr] for Dutch, and [θr] and [skw] for English, as shown in Jusczyk et al. 1994; Jusczyk 1997). Thus, even before children utter their first meaningful words, they have acquired a store of knowledge about the sound structure of the language they are acquiring, or at least knowledge about the statistical regularities in the speech signal they are exposed to.

These and many other findings have given rise to an interest in the possibilities of a data-driven or empiricist approach to language acquisition. Two common themes recur in this context: (1) what is the nature of linguistic knowledge? As shown in the previous paragraphs, children acquire knowledge in their first year, but what is the nature of this acquisition? Is it symbolic, i.e., does an eight-month-old have access to highly abstract knowledge about the phonotactics of his native language? (2) What is the nature of the learning mechanisms? Can knowledge about language structure and use be abstracted from the input language? Can the child generalize over the input to arrive at a grammar of the language? Or, are innate mechanisms required for restricting the possible grammars that the child may construct?

Instrumental in this interest in data-driven approaches to language acquisition was the rise of *connectionism*, marked by the highly influential work of McClelland & Rumelhart (1986). It culminated in a volume written by Elman, Bates, Johnson, Karmiloff-Smith, Parisi and Plunkett in 1996 entitled *Rethinking innateness*, in which the ideas about innate linguistic knowledge and processing were questioned, critically analyzed and put into an

empiricist perspective: not a simple denial of nativism, but a simple denial of a nativist learning theory without a learning subject as it figures in a Universal Grammar approach.

Connectionism has put a data-driven approach to language acquisition firmly on the research agenda: alternative models and conceptualizations of acquisition have been proposed (i.a. Broeder & Murre 2000), and the fundamental thinking about acquisition has now been rephrased in terms of 'the emergence of language' (MacWhinney 1999) in a basically cognitive-functionalist view of language (Tomasello 1998).

Why would a bottom-up approach of language acquisition be possible, given the principled denial of its feasibility in the nativist UG tradition? One important factor, highlighted by Seidenberg (1997), is the availability of large language samples (such as those available through CHILDES, see Section 3.1) and computational resources required for discovering the major statistical regularities of language and speech. Statistical pattern matching has been quite successful in areas such as speech recognition by computers. Although various recent connectionist approaches differ quite extensively in the details of their implementation, they share the view that acquisition requires the exploitation of the statistical regularities of the language that the child hears. And, analogous to the approach taken in speech recognition, the task of the learner is not the identification of a particular grammar, but the performance of a particular task.

A number of exciting findings about children's perceptual development in the first year of life and fine-grained studies of their early language production show that children are indeed able to extract the main regularities from the speech signal and that there is more than an indirect link between language input and children's early productions.

Investigations of children's speech perception in the first year of life indicate that they become attuned to the regularities in the language that they hear from very early on (Jusczyk 1997; Werker & Tees 1999; Kuhl et al. 1992). One of the most convincing findings in this respect brings grammar learning into the picture. Saffran, Aslin & Newport (1996) exposed eight-month-olds to 'words'. These words were actually strings of syllables that looked like 'bida kupa doti…', some of which presented in a random order while others were presented in a fixed order (see Aslin et al. 1998 for an elaboration on conditional probability statistics in the stimuli). The stimuli were presented while the children were playing with toys on the floor. The words were pronounced by a monotonous synthesized female voice at a rate of 270 syllables per minute. After they had heard the 'words' for two minutes, the children were tested in the following way: either the same stimuli were presented to them, or they heard exactly the same syllables but in different orders, thus breaking up the statistical structure (defined by conditional probabilities) of the original 'words'. The result was that the eight-month-olds were able to detect the regularities in the input: they discriminated reliably the 'words' that obeyed the statistical regularities in the 'words' they had heard from the 'words' they had not heard before. Hence, even after two minutes of exposure, babies are able to induce the statistical regularities in the input without reinforcement and without paying particular attention to the input. These findings were replicated: young

children were shown to be able to induce 'implicitly' the finite-state grammar underlying sequences of events (such as the syllables making up words in the Saffran et al. experiment), and they were shown to be able to do that with sequences of tones (Saffran et al. 1999) and visual displays (Kirkham et al. 2002).

Thus children appear to be sensitive to the regularities that show up in the input language. These regularities also show up in their own language production. First of all, there appears to be a close overlap between the language children produce themselves and that they hear from their parents. Parisse & Le Normand (2000) studied the lexical overlap between child and adult language, and they conclude that "it is plausible that up to 90% of the combinations used by children have been heard at least once" (p. 290). More specifically, they compared 33 hours of speech produced by Philippe and the adults he is talking to (data taken from the Léveillé database in CHILDES). They show that "72% of the bi-words [i.e., two consecutive words] produced by Philippe at 2;1 (in type, and 82% in tokens) correspond exactly to adult bi-words", indeed a high overlap between the two, which may turn out even higher if a more extensive database is investigated.

This reliance on the input clashes vigorously with the view that language acquisition amounts to acquiring a collection of abstract grammatical knowledge. It leads to a number of critical questions. How can one of the generative credos, namely the creativity or generativity of the grammar, be explained in a view that stresses reliance on input patterns? Which learning mechanisms are invoked to account for language acquisition? These questions constitute the core of current acquisition research. In what follows we will briefly review some of the directions that have been taken.

Do children acquire abstract grammatical knowledge? This issue is not resolved yet: at least the view that abstract grammatical categories underlie children's language production is now seriously questioned (compare Hirsh-Pasek & Gollinkoff 1996 with Tomassello 2000). In an empiricist approach of acquisition, the possibility is explored that children start with lexically-based patterns borrowed from the input. 'Formulaic frames' (Peters 1995), 'slot-and-frame structures' (Lieven et al. 1997) are hypothesized to be children's privileged way of constructing their first complex multi-word utterances: constructions such as *See X* or *Daddy's Y* are the kind of limited scope formulae that characterize early linguistic use and that form the basis for later generalization (Braine 1963, 1976; Tomasello 2000). Under this view, abstract grammatical categories are seen to emerge only later in development.

What is currently needed in the field of language acquisition is research that starts from different analyses of particular acquisition phenomena, draw contrasting predictions from the models and empirically test these predictions. Exemplary in this respect is the study of Theakston et al. (2001) who investigate the early acquisition of verb-argument structures; it offers an analysis that relies on children's memory of input structures, contradicting Valian's (1991) model which uses abstract syntactic structures. Similarly, the study of Wijnen et al. (2001) is exemplary in that it investigates to what extent children's so-called optional infinitives can be explained in terms of input factors (as opposed to innate syntactic knowledge

proposed in a UG approach). They conclude that indeed input may be a determining factor, but that also information from other sources appears to play a role, which brings us to the bootstrapping operations that we discuss below.

Creativity or *generativity* appears to be a crux for empiricist approaches to acquisition (or to language processing in general). If children rely on their memory of input patterns, how is generalization possible at all? Indeed, the standard approach emphasizes the observation that the grammar, though finite, can be used to generate an infinite set of sentences, and this capacity to generalize has provided the classical evidence that knowledge of a language involves rules (see Berko-Gleason 1958; Pinker 1999). The controversy over this issue has not yet been resolved: it has produced an enormous amount of research investigating, for instance, the use of rules in a symbolic dual-route model of morphology versus the exclusive use of associative memory in a single-route model (see e.g., Plunkett 1995 for a selective review, and a theme issue of *Cognition* on 'Rules and Similarity in Human Thinking', vol. 65 (2/3)). A crucial notion that has gained credibility in this respect is 'analogy': connectionists have brought analogical learning under the spotlight; several operationalizations have consequently been proposed and applied to language acquisition and processing (Broeder & Murre 2000).

The notion of *bootstrapping* in acquisition research has been used to describe how children use correlations between different aspects of language to infer structure. Connectionist approaches provide a generalization and formalization of this notion, which is seen to play a key role in the child's entry into language, providing the basis for identifying words, their meanings and grammatical functions, as well as the kinds of structures they participate in (Seidenberg 1997).

2.5 Learning mechanisms: Bootstrapping

Bootstrapping is a mechanism proposed to deal with the problem of how the child 'breaks' into a particular linguistic system. Assuming the child has a notion of 'objects in the world', she may use that information as an entry into the domain of parts-of-speech or lexical categories: for example, words referring to objects are of a particular kind termed 'nouns'. Thus, on the basis of already existing knowledge and processing capacities, the child uses that information in the linguistic and non-linguistic input to determine the language-particular regularities that constitute the grammar and the lexicon of her native language (Weissenborn & Höhle 2001). As the example above of 'objects in the world' and 'nouns in the language' already implies, one of the main problems with bootstrapping is that most of the time there is no completely transparent interface between the domains at hand: on the one hand, nouns do not always refer to objects alone, while on the other hand, not only objects are referred to by nouns. But: no matter how imperfect the parallelism between two knowledge domains is, bootstrapping is considered to be a useful initial aid for the language learning child.

Various bootstraps have been proposed in the literature, as we show below. Understanding how each bootstrap works derives from three interrelated queries: (1) what are the cues that can bridge two domains? (2) Is a child aware of those cues? (3) Can the child actually use those cues?

2.5.1 *Distributional bootstrapping*

Maratsos & Chalkley (1980) propose the notion of correlational learning (also referred to as 'correlational bootstrapping'), namely that children are sensitive to a set of 'distributional' properties of the language they hear, such as serial position, position relative to other words, inflections, and to certain semantic notions encoded in sentences. The child may start out by recording which words have which properties in the input. When a sufficiently large set of words are noted to have a highly overlapping set of properties, the equivalent of a grammatical category exists, and the child may then generalize. Specifically, any subsequent word observed to have one property in the intersection set is assumed to have the remaining properties automatically.

2.5.2 *Semantic bootstrapping*

Pinker (1984, and 1989 for a further elaboration) proposes 'semantic bootstrapping' as a mechanism children use for breaking into the syntactic structure of the language. The idea is quite simple: the child hears adults talk, and because she understands the scene they are talking about, she can start figuring out what the language structure is like. In other words, cognitive capacities are invoked as a bootstrap into syntactic structure. For instance: if the child witnesses a scene in which an actor is performing a particular action ('John is running', 'Mary is cleaning', 'The baby is crying',…), she may notice that the actor is the first one to be mentioned, and that the action follows. And witnessing scenes in which utterances occur such as 'John gives a book to Mary', 'The baby throws a bottle on the floor', etc., the child may notice that the thing something happens with is mentioned after the actor and the action. In so doing, the child may eventually hit upon the generalization that the relationships she understands are expressed by the order of constituents, and that the order is SVO in the language she hears. Thus, Semantic Bootstrapping claims that "the child uses the presence of *semantic* entities such as 'thing', 'causal agent', 'true in past,' and 'predicate-argument relation' to infer that the input contains tokens of the corresponding *syntactic* substantive universals such as 'noun', 'subject', 'auxiliary', 'dominates', and so on" (Pinker 1987: 407). Pinker invokes an elaborate set of innate concepts and devices in order to be able to make the bootstrapping approach work; he argues that the child is innately equipped with a large number of the components of grammar: syntactic categories like 'noun' and 'verb' are innate, and furthermore Pinker assumes that there are innately given 'linking rules' that link those syntactic categories to thematic categories such as agent, theme, etc.

The idea underlying 'semantic bootstrapping' bears some resemblance to work in the early seventies that deals with the relationship between Piagetian concepts, Fillmoreian case-like relations and the usefulness of the former in acquiring the latter (i.a. Edwards 1973). It is also quite close to the concept-first view: the child has a conceptual grasp of the world, she entertains certain concepts and these are helpful in shaping the child's linguistic knowledge.

Slobin (1986, 1991) developed the idea of prototypical scenes and their expression in terms of canonical sentence types. According to Slobin, children pay particular attention to prototypical situations in the world of reference, which constitute highly salient event types such as object transfer, physical manipulation and voluntary movements. These basic cognitive representations are encoded by various languages in a canonical way, such as SVO order in English or use of the accusative inflection in Turkish. In development children pair the event and the canonical structure, expanding the former in various ways while adhering to the grammatical form. Slobin (1981) provides evidence that markers of highly transitive scenes are acquired early on in a number of languages. For example, the ergative marker on agent nouns in Kaluli marking nouns in sentences like 'Father is cutting wood' is already present by age 26 months in Schieffelin's 1979 data. In the same way, the Russian accusative suffix marking semantic patients already occurs by age 23 months, but is restricted to sentences describing physical manipulation of objects.

The semantic bootstrapping approach is not unproblematic, though, be it only for the simple fact that the language children hear contains more than mere canonical sentence types; that the language expresses more than prototypical scenes; and that there is no straightforward relationship between concepts, meaning, and formal linguistic categories (cf. Bowerman 1989; Maratsos 1992, 1999 for critical considerations). Compare for instance English 'John *runs/is running* fast' with two equivalents in a verb-second language such as Dutch in which the main verb easily switches position ('Jan *loopt* snel'/'Jan is snel aan het *lopen*').

2.5.3 *Syntactic bootstrapping*

Syntactic bootstrapping exploits the form-to-meaning relationships in the language, as opposed to semantic bootstrapping that exploits meaning-to-form relationships. On this view, the child who understands the semantic implications of syntactic environments can recover aspects of the meanings of unknown verbs (Bloom 1994; Landau & Gleitman 1985; Gleitman 1990; Gleitman & Gillette 1995; Naigles 1990, 1996). For instance, if the novel verb *gorp* occurs in an NP-V-NP-PP sentence, it can be safely inferred that the verb encodes an action that causes an affected entity to move or change in a certain way (John *gorped*/put/dropped/… the ball into the basket). Gleitman (1990) demonstrated that adults are quite accurate at guessing what a nonce verb means when it occurs in a particular syntactic frame: if one hears 'John is gorping', the verb is not likely to mean something like 'hit' but more likely to mean something like 'scratch'. Gleitman also established that adults are fairly poor in guessing what verb was uttered when watching a scene without actually hearing

what is said. In other words, learners have difficulties identifying a verb's meaning from observation of its extra-linguistic context alone.

Is this procedure useful for a language-learning child? Does the set of syntactic environments offered by mothers to the learning child inevitably place the child in the correct semantic neighborhood? Lederer et al. (1995) show that indeed the linguistic information provided by mothers is refined enough to support learning from verb frame ranges. They examined the 24 most frequently used verbs in lengthy conversations of mothers with their 12 to 25 month olds, and each verb was found to be unique in its syntactic range, and hence to provide good cues to the verbs' meanings.

The syntactic bootstrapping approach is not unproblematic either. There is still a gap to be closed: adults and children indeed appear to use structural information to figure out (part of) the meaning of a verb, and adults do seem to provide children with consistent cues. The question remains if children who do not yet know language can actually use those cues.

2.5.4 *Prosodic bootstrapping*

Prosody may be a useful bootstrap for breaking into syntax. There are indeed some prosodic cues, such as pauses, that signal major syntactic constituents, and the child may use those prosodic indicators for identifying syntactic constituents. Thus, prosodic bootstrapping suggests that acoustic cues associated with prosodic groupings in the speech stream may provide a partial bracketing of speech input into syntactically relevant units (Gleitman et al. 1988; Gleitman & Wanner 1982; Morgan 1996). Of course, prosody is not a flawless cue, not every prosodic boundary marks a major syntactic constituent: in 'The dog/chased the cat' (where the slash indicates a pause), the pause coincides with a major syntactic boundary (the one between the subject-NP and the VP), but the latter is not true in 'He chased/the big old cat' (Gerken 2001).

Young children appear to be sensitive to the prosodic structure of their mother tongue. Already in their first year of life, they differentiate utterances with a 'natural' prosody (clause structure and prosodic structure coincide) from utterances in which the prosody was manipulated for the sake of the experiment, resulting in a conflict between syntactic and prosodic boundaries (Hirsh-Pasek et al. 1987). This prelinguistic ability of the child may be a good way to crack open the high-level syntactic structure of utterances (Kemler Nelson et al. 1989).

But also other prosodic, and more general, phonological cues may assist the child in breaking into the linguistic system: there is accumulating evidence that in the prelinguistic period, roughly speaking the first year of life, children become familiar with the predominant stress pattern of the language they hear, acquire knowledge about the segmental structure of the language (such as: which segments occur? which combinations of segments occur?), and they use this type of information for tasks like word segmentation. For instance, Cutler and her colleagues (Cutler 1994; Cutler & Norris 1988) proposed that adult speakers use a Metrical Segmentation Strategy whereby they identify the onsets of new words with the

occurrence of strong syllables in English utterances. These word segmentation abilities have been shown to exist in children in the first year of life, and they may facilitate the discovery of the syntactic organization of utterances: the child's developing word segmentation abilities may enable the learner, for instance, to track the distribution of grammatical morphemes within the boundaries of prosodic phrases (Jusczyk 2001).

Segmental and syllabic information may also be useful as a bootstrap. There is a growing body of evidence showing that the link between phonology and grammatical class is not entirely arbitrary. Kelly (1986) showed that there are reliable phonological cues for the assignment of nouns and verbs in English. He thought that these cues were language specific. However, Morgan and colleagues (Morgan et al. 1996; Shi et al. 1998) investigated if various 'pre-syntactic cues' such as number of syllables, presence of complex syllable nuclei, presence of coda, syllable duration, and the like are sufficient to guide assignment of words to rudimentary grammatical categories. Their investigation of English, Mandarin Chinese and Turkish shows that sets of distributional, phonetic and acoustic cues distinguishing lexical and functional items (closed- vs. open-class lexical items) are available in infant-directed speech across such typologically distinct languages. Durieux & Gillis (2001) explicitly address the question of how far the language learner can get in exploiting this type of phonological bootstrapping as a strategy in acquisition. They show that on the sole basis of segmental information and stress pattern, words can be reliable classified in one of the open class categories in 67% of the cases in English and in 71% of the cases in Dutch.

This last finding leads us to the following conclusion. What all the bootstrapping approaches have in common is that they assume a systematic relationship between properties of the input and a specific linguistic (sub-)domain. They also share the finding that the relationship is systematic, though it is not perfect (see the figures mentioned by Durieux & Gillis). This leads to the question of how these various bootstraps, that is various sources of information, are used together in order to figure out the linguistic structure of the language.

Moreover, there is a developmental question that remained untouched, namely if and how the bootstrapping strategies and their interrelations change over time. It may well be that the bootstraps are useful for initially 'cracking the linguistic code' and become less useful later on. This type of foregrounding specific types of bootstraps is to be expected, given the expanding linguistic and nonlinguistic knowledge base of the child. Moreover, changes in the bootstrapping capacities of the child may also be the result of changes in her information processing capacities, such as changes in memory and attentional resources (Weissenborn & Höhle 2001: viii), as indicated by the frequency effects for phonotactic patterns noticed in prelinguistic infants (Jusczyk et al. 1994).

2.6 Variation

Variation in language acquisition is a multifaceted phenomenon. At the level of description, variation among children acquiring the same language has received considerable attention, as well as crosslinguistic variation.

2.6.1 *Crosslinguistic variation*

To start with the latter, the monumental work of Dan Slobin (1985–1997) describes language acquisition in children from various linguistic backgrounds, focusing on the universal and the language specific patterns and on the mechanisms that can account for observed variation. The approach taken in comparing acquisition paths is intra-typological as well as cross-typological (Slobin 1997).

In an *inter*-typological approach, a group of languages is studied that shares a common set of typological features, thus making it possible to investigate variation along specified dimensions. Slobin (1997) shows that by selecting languages that belong to one typological group (an intra-typological approach), it is often possible to pull apart features that co-occur in any particular language of the type. A case in point is the acquisition of the Slavic case system. Smoczynska (1985) describes the acquisition of the case system in Polish and in Russian, which are almost identical in the two languages. It takes children acquiring Russian a very long time to differentiate all of the grammatical forms of each case suffix, with massive overgeneralization and errors. Children acquiring Polish, in contrast, use the correct form of each gender and case from the very beginning, almost without any errors. This finding is rather strange: one would expect that if the systems look alike to the linguist, the acquisition task is similar, and thus acquisition is expected to follow a similar (time-) path. The comparison of the actual input data is the key to this enigma: in Polish, unstressed vowels are not reduced, whereas they are reduced to schwa in Russian. This explains why children acquiring Polish have a more straightforward task than children acquiring Russian: the former hear clearly distinct and perceptually consistent and salient forms in the input, while the latter do not. Slobin (1997: 7–8) concludes: "What is especially important is not the fact that Russian is difficult, but that Polish is easy. We have here a clear demonstration that an inflectional paradigm based on arbitrary phonological criteria can be acquired by two-year-olds if the criteria are transparent and consistent". Thus, Slobin points out one of the determining factors of ease of acquisition, and consequently a possible source of crosslinguistic variation established by intra-typological comparisons.

In a cross-typological approach, languages from possibly very distinct typologies are compared on a specific dimension with respect to a particular phenomenon. A case in point is provided by a number of studies conducted by Gillis and Ravid (Gillis & Ravid 2001; Ravid & Gillis 2002). They compare the acquisition of spelling in Dutch (a Germanic language with sparse morphology) and Hebrew (a Semitic language with a rich morphology). The phenomenon they investigate is the spelling of homophones, and more specifically pairs like ⟨bepaald⟩ ('determined') and ⟨bepaalt⟩ ('determines') in Dutch. Such homophonous pairs have a distinct orthography, which reflects an underlying phonological distinction, but both members are pronounced in exactly the same way. In both languages, a continuum can be devised along the dimensions 'morphological function' (e.g., root letter versus function letter) and 'recoverability' (using morpho-phonological cues to aid the learner in discovering the correct spelling of ⟨bepaald⟩ or ⟨bepaalt⟩ when these words occur in a

sentence). In spelling tests administered with children in primary schools in Israel and Belgium, Gillis and Ravid found that Hebrew-speaking children were amazingly sophisticated in solving spelling problems using morphological procedures, whereas their Flemish agemates were notoriously weak in that respect almost throughout primary school. This means that children acquiring a morphologically rich language like Hebrew find it easy to use morphological cues in spelling, while children learning a morphologically poor language like Dutch find it very difficult. Consequently, learners of Hebrew seem to be able to easily transfer the morphological abilities and strategies already required in forming their first spoken words and sentences to the domain of spelling; while Dutch-speaking children, who have hardly ever had to focus on morphological puzzles, do not have a similar ability which they can transfer to written language, if needed. This finding illustrates what Slobin (1997) calls 'the operating principle strengthening' in acquisition, which can be paraphrazed as: 'whenever a solution works for one puzzle, apply the same solution in solving another puzzle'.

2.6.2 *Inter-individual variation*

Variation among children acquiring the same language was studied in detail in several studies concentrating on rather small populations (see Lieven 1997 for an overview) as well as in large sample studies (for instance the CDI study of 1,800 American children, Fenson et al. 1993). A rock-solid conclusion that can be drawn from these studies is that variation among children is vast: if one looks at onset time and the growth rates of word comprehension, word production, first word combinations, and stages of grammar acquisition, there is enormous individual variation (Bates et al. 1995). Note that we are talking about what is considered to be the 'normal' population: individual variation highlights the problem of identifying what is 'normal' and what is 'deviant', cf. the growing literature about 'early' and 'late talkers' who are at the extremes of the frequency distribution, and who should be distinguished from genuinely 'deviant' populations such as SLI children, on the one hand, and from children with clearly identifiable syndromes such as Down's, Williams' syndrome or focal brain injury, on the other.

In addition to these quantitative differences, there are also marked qualitative differences among children. Individual children vary in the sounds that they seem to babble preferentially (Vihman 1993; Vihman & Greenlee 1987; Vihman et al. 1994). In very early language development children vary in the extent to which they pick up the 'major tunes' of the language, while other children tend to produce shorter and more clearly articulated utterances, often identifiable single words (Peters 1977, 1983, 1997). The former appear to concentrate more on prosody, i.e., identifying larger chunks in the language they hear, and the latter on syllables and segments, geared towards smaller entities in the ambient language. This classification also appears in Nelson's (1973) study of early vocabulary acquisition (the first 50 words): she identifies *expressive* children who use a large proportion of 'personal-social' words and *referential* children who predominantly use 'words for objects'. These two styles actually coincide with the relative proportions of common

nouns — predominantly used by referential children — and frozen phrases — predominantly used by expressive children (Lieven et al. 1992).

There is also a noticeable difference of style in children's early multiple-word speech: some children make extensive use of schwas, fillers, and reduplication to achieve meaningful prosodies, where the fillers can be seen as precursors of grammatical morphemes (Peters 1997). Others move from clear single-word utterances to juxtaposed single-words, creating the well known 'telegraphic speech'.

These and other differences that have been described in the literature (see Bates et al. 1995; Lieven 1997) raise the question of whether stylistic differences underlie each child's language acquisition, and furthermore, what causes them.

As to the first question, two learning styles have been identified, namely an *analytic* and a *holistic* style. Analytic children prefer to break up the speech stream into small units, analyze those units and then synthesize them. Holistic children, on the contrary, prefer relatively large chunks that they start using before actual analysis has taken place. This difference in approaching the task of language acquisition can be detected at all ages and in all linguistic domains (and even across cognitive domains). This finding has led to the conclusion that the two styles reflect two fairly general complementary learning mechanisms: an analytic mechanism that serves to break up units into segments, and a holistic mechanism that makes it possible for the child to remember and reproduce relatively large segments of speech before these segments have been fully analyzed and understood (Bates et al. 1992, 1995). However, research has not yet revealed a clear continuity in children's stylistic characterization: as Lieven (1997: 209) notes, there is a number of 'suggestions' in the literature such as the suggestion that "highly referential children are more likely to look telegraphic in their two-word utterances while the early learning of frozen phrases might be related to a greater tendency to produce pivot-type utterance structures in the early multiword stage". But these 'suggestions' require further scrutiny, and we are far from establishing long-distance links between learning style at the onset of language and characteristics of later language development. Moreover, establishing longitudinal stylistic differences brings along particularly difficult methodological problems (Bates et al. 1988, 1995).

As to the causes of inter-subjective variation, various proposals have been formulated: differences in the input (maternal style differences, social class differences, etc.), endogeneous factors (such as the child's temperament), explanations that focus on linguistic and cognitive factors, neurological explanations, etc.

At present we can only conclude that at least some of the relevant inter-subjective variability has been identified and charted out, but questions like the longitudinal stability of stylistic differences and their causal explanation still remain unanswered.

2.6.3 *Intra-individual variation*

Some attention has been devoted in the literature to crosslinguistic variation and variation among children learning the same language as well as to the crosslinguistic validity of

those differences. The fact that a single child's speech production at a particular moment may also contain a lot of variation has been mentioned quite frequently in particular in the literature on phonological development (Ferguson 1979; Macken 1978; Menn 1976). This type of variation has not received systematic attention, though it is of special importance. For instance, in a model of acquisition that envisages the setting of parameters as the learning mechanism, the occurrence of intra-individual variation over an extended period of time is quite troublesome. In the UG tradition, parameter setting is an (almost) instantaneous process that does not allow for extended periods of oscillation. Intraindividual variation, or the lack thereof, is also crucial for acquisition models that highlight memory as a crucial factor.

3. Methodologies

How is language acquisition studied? On the whole, the literature makes two types of clear distinctions in investigating child language acquisition. One is between a *cross-sectional* method, which usually applies across a large sample of the population and compares linguistic features in groups of children of various ages (or other characteristics such as clinical or environmental characteristics), versus a *longitudinal* method, in which a (usually small) sample of subjects is investigated over a long period of time. In the first case one can acquire a large body of data from many subjects, whereas in the second one a wealth of well-situated developmental information is available from a few children or even a single child (*case study*). In both cases the researcher can draw trustworthy conclusions about the nature of language development, though the perspectives are different.

Another, albeit related, distinction is usually made between an *experimental* versus a *naturalistic* approach to language learning. In the first case, tasks are carefully constructed and populations controlled to elicit and evaluate specific target phenomena, which may not occur often enough in 'real life' to be accessible to the interested observer/researcher. However, subjects often draw on different cognitive resources (e.g., access to metalanguage) during experimental conditions, which may confound results, and there is a clear lack of supporting contextual information that may help in explaining results (Ravid 1995). Cross-sectional studies are often, though not always, experimental in nature. In the second case, naturalistic, usually spontaneous data is elicited from the child in his/her natural environment with as little interference as possible. Despite the fact that target linguistic phenomena cannot be controlled and elicited at will, this method provides us with a rich contextual background against which to evaluate the desired phenomenon (Gillis 1984; Gillis & De Schutter 1986a).

As a multidisciplinary enterprise, the study of language acquisition has 'borrowed' a broad range of methods from various disciplines, also depending on whether the researcher wants to study language *comprehension* or *production*. It is often the case that spontaneous

speech studies are used to investigate children's language *production*. In that case audio/video recordings of children's speech are made, transcribed and coded (see below). Both elicited imitation or spontaneous production can be used as a procedure: the investigator leads the child to produce a particular kind of utterance without actually modelling it. A well-known example of elicited imitation is the WUG-test (Berko-Gleason 1958). In this procedure, the child is shown a picture of a cartoon bird and is told 'This is a wug'. Then the investigator shows a picture with two or more of those creatures and says: 'Here are two/more…'. The child is expected to give the plural of the pseudo-word 'wug'.

Various experimental techniques are also used in the study of language *comprehension*, ranging from the traditional picture-naming task (in which the child is asked to point at a picture depicting a word or a sentence); the act-out task (whereby the child is invited to act out a particular word or sentence herself, with puppets, or other toys and props); the truth-value judgment task (where the child witnesses a scenario in a cartoon or acted out with puppets, and is invited to judge the truth of a linguistic prompt), etc. Recently the 'preferential looking paradigm' has been used for studying lexical and syntactic acquisition. In its bare essence, the procedure goes as follows: the child is shown two stimuli (e.g., a horse and a cow) and hears a linguistic stimulus (e.g., 'Here is a horsie!'). The child's fixation time on one of the stimuli is measured; a clear finding is that children 'prefer' to look at the stimulus that matches the sound (Hirsh-Pasek & Golinkoff 1996; Krikhaar & Wijnen 1995).

A comprehensive sample of research methods is discussed in Menn & Rattner-Bernstein (2000); McDaniel et al. (1996). Experimental methods that are specifically suitable for testing (very) young children are reviewed in Jusczyk (1997).

In the last decades, major breakthroughs have taken place in the study of language acquisition through the emergence of new methods. We will highlight three of them, namely the establishment of large electronic corpora, the use of simulations and the use of brain imaging techniques.

3.1 Large-scale corpora collections

One of the bottlenecks in language acquisition research is the collection of large longitudinal corpora. Ultimately researchers want to investigate corpora that contain all the utterances a child produces as well as the language she hears. It would be very beneficial if corpora existed that contained all language uttered by and addressed to a child from birth till, say, five years of age. Such an effort would be applauded by the research community, but would require an incredible amount of research funding. For the sake of comparison, consider the corpus of spontaneous spoken Dutch currently being collected. The aim of the project is to collect 10 million words of adult speech. The required budget for the collection of the data, the production of basic annotations such as an orthographic transcription and part-of-speech tagging, as well as the linking of the speech signal to the orthographic transcription at an utterance level, requires approximately 5 million Euros/dollars. Roughly speaking, the corpus will contain 1000 hours of speech, which is only a small fraction of

the corpus envisaged: all language addressed to and produced by a child in the first five years of life.

Nevertheless, quite a few researchers have collected and currently are collecting somewhat more sparse data of children's language, concentrating on a more restricted age range with a recording frequency which is typically around one hour of speech every two weeks. From the mid-eighties onwards, an effort has been made to trace and collect child language corpora, to transform them in an electronic format and to make them available to the research community via the internet. CHILDES, the *Child Language Data Exchange System* (MacWhinney & Snow 1985, 1990; MacWhinney 1991 and later editions) is currently the most elaborate collection of child language data. The CHILDES database contains corpora of monolingual and bilingual children between the ages of one and eight years as well as corpora from clinical populations (SLI, Down syndrome), spontaneous (unscripted) speech as well as narratives. The languages currently represented in the monolingual corpora are the following: Afrikaans, Cantonese, Catalan, Danish, Dutch, English, Estonian, French, German, Greek, Hebrew, Hungarian, Irish, Italian, Japanese, Mambila, Mandarin, Polish, Portuguese, Russian, Spanish, Swedish, Tamil, Turkish and Welsh. Bilingual span the following pairs of languages: Arabic-Dutch, Catalan-Spanish, Chinese-English, Chinese-Hungarian, Danish-Japanese, Dutch-English, English-Polish, English-Russian, English-Spanish, French-English, French-Greek, and Turkish-Dutch. In addition there are two trilingual corpora, namely English-Portuguese-Swedish and English-Hungarian-Persian.

Three crucial features make CHILDES a very important tool for language acquisition researchers. First of all, the corpora share a common representation formalism, that is, all corpora represented use a standard representation formalism, called CHAT. This means that, in principle, the general format as well as the fine details of the transcriptions and the codings are uniform across all corpora. Secondly, CHILDES also offers a set of software tools that allow users who are less skilled in computer programming to perform basic operations on the corpora they analyze. The CLAN software offers broad functionality: basic operations such as frequency counts, Boolean search, combinatorial search, etc. are at the fingertips of even naïve users. A third crucial feature is that CHILDES offers elaborate on-line documentation: all corpora are properly described, the representation formalism CHAT is defined and the ins and outs of the CLAN software is described in a detailed way.

It speaks for itself that CHILDES is a valuable tool for researchers: it broadens the empirical crosslinguistic scope of research, it permits the re-usability of expensive data, shortens the path between hypothesis formulation and testing, and provides a shared framework of analysis for the community.

3.2 Computer simulations

The availability of computer readable corpora and tools for the analysis of these corpora permits computer assisted analyses of child language data. A second methodological innovation which is just emerging as a research tool also involves the use of computers. In

domains of cognitive science like Artificial Intelligence, the use of computer simulations is taken for granted. But it was not until the advent of the connectionist revolution (McClelland & Rumelhart 1986; Rumelhart & McClelland 1986) that language acquisition researchers became aware of computer simulations as tools for testing hypotheses and for proposing radically different architectures for cognition and language acquisition and processing than the ones which had held sway for many years. Nevertheless, as Bates & Elman (1993) elucidate in a very elegant paper, our thinking about language processing and the acquisition of knowledge (including language acquisition) has been heavily influenced by the serial digital computer: this is a symbolic machine which takes symbols as input and applies a series of stored algorithms (i.e., programs) to that input, to produce other symbols as output. These operations are supervised by a central processor. Bates and Elman show how connectionism turned upside down this serial computer metaphor and the implications it has/had for our thinking about language processes and language acquisition.

Another quite interesting methodological evolution that computer simulations have brought to the research community is the in-depth scrutiny of theories of language acquisition. An example comes from prosodic phonology. In the generative tradition, the acquisition of phenomena such as word stress is considered to be quite analogous to the acquisition of syntax. It requires an innate store of prosodic knowledge comprising of metrical or prosodic parameters, and each parameter needs to be tuned to the rules of the ambient language (Dresher & Kaye 1990; Dresher & Church 1992). In order to write a computer program that takes the words of a language as input and produces a correct setting of the metrical parameters, the researcher has to make fully explicit how the program goes about setting the parameters, how the program distinguishes rules and exceptions on the basis of random input data, etc. Writing such a program proved to be very complicated (Dresher & Kaye 1990). Moreover, in an empirical test of the program, Gillis et al. (1996, 2003) showed that even for a UG model with fully specified parameters, learning the stress system of particular existing languages is impossible, thus laying bare the shortcomings of the UG model. This type of empirical test of a theory shows great potential: the kinds of problems faced by a UG model that Gillis et al. (1996) and Durieux et al. (2003) discuss could never have been established unless the computational strength of powerful computers is employed.

3.3 Brain imaging techniques

In the last decades a number of techniques have been developed that allow researchers to study the brain by 'watching it work'. One technique measures event-related potentials (ERP), and it can be used to study brain-behavior relationships by measuring electrophysiological correlates of brain activity with electrodes encased in saline-soaked sponges placed on the subject's skull. ERP is characterized by a complex waveform that varies in amplitude and frequency over time and is thought to reflect ongoing brain processing (Molfese et al.

2001). Brain processing that is measured in this way can also be localized as a function of the position of the electrodes on the skull.

Positron Emission Tomography (PET) and Functional Magnetic Resonance Imaging (fMRI) are two other techniques used to localize brain activity by monitoring blood circulation. These two techniques have been used quite extensively with adults in order to describe the neural networks associated with particular linguistic processes and the identification of regions consistently activated for a particular task, such as phoneme discrimination or lexical decision (Kent 1998). A sophisticated example of such studies is provided by the examination of auditory and visual information processing. The McGurk-effect is a well-known psycholinguistic phenomenon: close your eyes and play a tape on which the syllable [da] is repeated. You will definitely hear the syllable [da]. Now repeat the tape and with your eyes open, you watch a movie (without the concomitant sound) of a person pronouncing the syllable [ba]. The amazing fact is that now you will start to 'hear' [ba] (the visual stimulus) instead of [da] (the auditory stimulus). This experiment also works in the opposite direction: first see someone pronounce [da] without sound and then hear the stimulus [da]. In a number of fMRI studies it was shown that the auditory cortex is not a singular region, nor is it restricted to information from the auditory system: visual information from lip movements can modify activity in the human auditory cortex (DiVirgilio & Clarke 1997; Rivier & Clarke 1996; Sams et al. 1991).

A huge selection of adult PET and fMRI studies is reviewed by Cabeza & Nyberg (2000). Studies with children and babies are still sparse for the simple reason that a technique like fMRI requires the subject to be able to hold still, lying down in a gigantic machine which emits a lot of noise, etc.; not exactly the right circumstances for young children to feel at ease and to cooperate.

In contrast, ERP studies with children have led to quite remarkable results by providing support for previous behavioral findings. For instance, Eimas and colleagues (Eimas et al. 1971) discovered that prelinguistic children show 'categorical perception', i.e., they readily discriminate between consonants from different classes (e.g., voiced versus voiceless stops), whereas it is very hard for them to discriminate two consonants belonging to the same phonetic category. ERP studies have indeed revealed that from at least two months of age the infant's brain appears capable of discriminating voiced and voiceless stops: the ERPs are different for the two types of stimuli. Thus the behavioral evidence provided in the Eimas et al. study is confirmed by ERP studies (see Molfese et al. 2001 for an overview). ERP studies have also revealed age-related differences between children as well as differences related to their level of language acquisition: ERPs measured with thirteen-month-olds are different for words children know and for those they do not yet know, but once children start acquiring new words at a fast rate at around 18 months (see below), there are dramatic changes in the topology of the ERP patterns of 'known' versus 'unknown' words (St. George & Mills 2001). This means that a particular step in language

acquisition goes hand in hand with dramatic reorganizations in the way the brain handles language, in this case at the lexical level. St. Georges & Mills (2001) also recorded ERP responses to open and closed class words (content and function words) in children from 20 to 42 months. They discovered that initially the response to both types of words was the same, however subsequently the response gradually differentiated, establishing a clear link between the acquisition of lexical and grammatical knowledge. Furthermore, ERP studies are just beginning to be predictive: Molfese et al. (2001) review a number of longitudinal studies in which differences in children's linguistic abilities at age three or four are tracked back to differences in the ERPs to speech at birth.

4. Early language development: A quantitative description

Both researchers and practitioners (like speech clinicians) have the need to divide the process of language acquisition into different stages or phases. For instance, for the purpose of psycholinguistic experiments, one may want to investigate the linguistic behavior of relatively homogeneous groups of subjects in order to chart out the path of acquisition of a particular linguistic phenomenon, such as inflectional morphology (Dressler 1997). Or in order to characterize the language development of a child as 'normal', 'deviant' or 'delayed' it is of crucial importance to have a measure for language development which, ideally, can be correlated with the child's chronological age (Miller & Klee 1995).

A first proposal in this respect came from Nice (1925), who introduced the Average Length of Sentence (ALS) as a means for delineating stages in language acquisition. ALS is the mean number of words in the spontaneous language production of a child. This crude measure was further developed in Brown (1973) who proposed to calculate the Mean Length of Utterance (MLU) not in terms of words, but in terms of morphemes. Charting out a child's MLU results in a graph that shows a steady increase as the child's language production gets more complex, i.e., as her sentences grow longer. Brown also figured out that the stages he initially determined arbitrarily (Stage I = MLU 1.0–1.99, Stage II = MLU 2.0–2.49, etc.) were in fact characterized by distinct linguistic behaviors (Table 1, adapted from Ingram 1989: 50).

A one-dimensional index such as MLU can be calculated very easily, and it is still used rather frequently in the literature. However it is clear that this index relies heavily on language-specific rules for analyzing (morphemizing) the child's utterances (Arlman-Rupp et al. 1976; Hickey 1991), and the links that Brown disclosed between growing MLU and particular structural characteristics are also tied to the peculiarities of the language, i.c., English. In a morphologically rich language such as Hebrew or Finnish, morphological structures will turn up much earlier and will be initially more diverse than in English (Dromi & Berman 1982).

Table 1. Brown's five stages of early grammatical development

Stage	MLU range	Description
		The period of single-word utterances: The use of single words without any grammatical knowledge
I	1.0–1.99	*Semantic roles and syntactic relations*: The onset and acquisition of the basic semantic relations in language like Agent, Patient. Word order is the first syntactic device acquired.
II	2.0–2.49	*Modulation of meaning*: The child begins to acquire inflections and grammatical morphemes.
III	2.50–2.99	*Modalities of the simple sentence*: The active acquisition of the English auxiliary as it appears in yes-no questions, imperatives, and negative questions.
IV	3.0–3.99	*Embedding of one sentence within another*: Complex sentences appear with object noun phrase complements, embedded wh-questions, and relative clauses.
V	4.0 and up	*Coordination of simple sentences and propositional relations*: The active development of sentence, noun phrase, and verb phrase coordination with the use of conjunctions.

In addition to a simple structural index such as MLU, various other measures have been proposed: (1) quantitative sentence scoring measures such as the Developmental Sentence Score (DSS, Lee 1974), or the Index of Productive Syntax (IPSyn, Scarborough 1990); and (2) profile analyses, which attempt to plot out the child's developmental profile in a particular domain on the basis of spontaneous speech data (grammar, e.g., LARSP, Crystal et al. 1990; phonology, e.g., PACS Grunwell 1985) These measures are all language dependent, and hence have been adapted to particular languages.

Straightforward measures have also been proposed in the area of vocabulary (or lexical) development. The most popular is the type/token ratio (e.g., Hess et al. 1984 correlate TTR with a standardized vocabulary acquisition test). Note, however, that Richards (1987) questioned the use of TTR as a valid measure of lexical diversity and adapted it so as to accommodate methodological inconveniences (Richards & Malvern 1997).

A number of factors highlight the problematic nature of assessing children's language by their chronological age: variation within the pace of acquisition in a single child, immense variation among children of the same age, structural and semantic differences among languages. Chronological age is thus not a reliable yardstick and should be accompanied by language-internal measures that cast the child's progress in language acquisition. These measures have to take into account typological differences among languages as well as specific language-dependent criteria in order to be useable at all.

The best estimate of lexical development as related to chronological age comes from the MacArthur Communicative Development Inventories (CDI, Fenson et al. 1993), a

parental questionnaire that was constructed in order to assess communicative (mostly lexical, to a lesser extent, morphosyntactic) behaviors in young children up to 30 months. CDI is a large-scale standardization project in which a vast population was investigated and which resulted in a highly detailed picture of lexical development in relation to age as well as lexical variation in the population (Bates et al. 1994; Dale & Fenson 1996; Fenson et al. 1994; Fenson et al. 2000; Arriaga et al. 1998; Thal et al. 1999). In the meantime, CDI was adapted for Basque, Catalan, Mandarin Chinese, Cantonese, Croatian, Danish, Dutch, English (American, British, New Zealand), German (in Austria and Germany), Finnish, French (European, Canadian), Galician, Greek, Hebrew, Icelandic, Italian, Japanese, Korean, Malawian, Polish, Spanish (European, Mexican, Cuban), Swedish, Welsh, as well as American Sign Language and Sign Language of the Netherlands.

5. Early language development: A qualitative description

From the point of view of description, early language development can be divided into several stages. The most obvious division is between the *prelinguistic* and the *linguistic* stage. The border between these stages can be drawn at the point where the child acquires her first meaningful word. This point cannot always be easily determined, since at the end of their first year of life, children produce word-like vocalizations in relatively consistent ways specifically bound to particular contexts, such as 'brrrr' when pushing toy cars around, 'boem!' when throwing things, or 'ham' for food (cf. Dore et al. 1976; Gillis & De Schutter 1986b; Plunkett 1993; Vihman & McCune 1994). At that point the child already comprehends quite a few words, although at first this ability to relate sound and meaning in comprehension is also tied to specific contexts, such as responding to his/her own name, or routines like 'byebye', etc.). Fenson et al. (1994) report that according to American parents' estimates, their children comprehend an average of 67 words at 10 months, 86 words at 12 months and 156 words at 14 months.

Most children pass through a well-delineated *one-word* stage. At this time, toddlers' words are phonologically simplified and often unstable, semantically holistic amalgams, which do not belong to discernible (or formal) grammatical categories (Berman 1986). At some point in the one-word stage, a 'vocabulary spurt' characteristically occurs, i.e., a rapid acceleration of the acquisition rate of words (Clark 1993; Dromi 1987, Gillis 1986; Mervis & Bertrand 1995; but also see Goldfield & Reznick 1990; Fenson et al. 1994 who found a more smooth developmental pattern in some children). Based on a parental report study, Fenson et al. (1994) found that at 12 months children have a cumulative expressive vocabulary of — on average — 10 words, 64 words at 16 months, 312 words at 24 months and 534 words at 30 months.

The stage at which the child only produces isolated words is followed by a stage in which first *word combinations* occur (a two-word stage is clearly identifiable in some children, but not in others, Pine & Lieven 1993). Typically word combinations take the form of 'telegraphic

speech', i.e., utterances lacking many of the required grammatical morphemes and function words. These combinations indicate the emergence of the break into the grammatical system, and are accompanied by first morphological alternations, especially in languages with rich morphologies (Berman 1981). Cross-linguistic comparisons of these early utterances have revealed that by-and-large a common set of basic meanings is encoded: existence (appearance, disappearance), basic event relations like agent-action-object, change of state or location, reference to sortals, etc. (Bowerman 1973; Braine 1976).

A further (general) division of language acquisition into clearly delineated stages is not easy to achieve. After the child produces her first word combinations, there is a spurt in grammatical development, which is brought about by both a larger lexical inventory and the growing ability to compare the internal structure of words so as to start the acquisition of word morphology. At the same time, word order becomes gradually more guided by syntactic structure and less by pragmatic considerations, and first 'sentences' appear. Children learning typologically different languages pay more attention to those features of their language which carry the most valid and salient information load. Thus, for example, children learning Dutch, a morphologically sparse language, will pay more attention to word-order and lexical meaning, while children acquiring Hebrew, a morphologically rich language, will also focus on word-internal structures (Berman 1985). At any rate, it is usually the case that inflectional (grammatical) morphology (i.e., markers of gender, number, person, case, tense, etc.) emerges earlier on than derivational morphology (which constructs and relates lexical entries) due to its relative regularity, transparency, predictability, productivity, obligatoriness and general applicability (Bybee 1985). Once started, morphosyntactic development takes place at an amazing speed and various different syntactic constructions are acquired in such pace that children are said to have acquired the basic grammar of their mother tongue before the age of five. This includes the structure of simplex clauses and some complex constructions, agreement elements in the NP and the clause, most frequent and salient function words (articles, pronouns, prepositions and connectors, etc.), obligatory grammatical morphemes and basic derivational morphology, and the underpinnings of discourse (Berman & Slobin 1994).

6. Later language development

Recent studies indicate that language continues to develop through later childhood, adolescence and adulthood, so that adults' language is both qualitatively and quantitatively different from that of adolescents (Berman 2002; Nippold et al. 1997). During this period, most marked, literate lexical items and morpho-syntactic structures that characterize adult language emerge and consolidate, accompanied by complex constructions, which serve syntactic and textual functions in specific text types encountered in the course of formal education. The changes that occur in children's language are not isolated linguistic phenomena; rather, they interact with complex cognitive, social, affective and behavioral transformations which characterize late childhood and adolescence (Berzonsky 2000).

Moreover, the attainment of literacy — learning to read and write, and using reading and writing in order to learn — is a key linguistic milestone which makes a major contribution to the nature of later language acquisition.

Tracing the long developmental history of particular constructions across childhood and adolescence is particularly rewarding when considering what it means for language users to have actually 'acquired' a construction: when they can succeed on an experimental task? When they can understand it in a text? When they can actually it them in appropriate contexts?

To illustrate the importance of continuing to investigate language development beyond its early formative years, consider the acquisition of the construction of denominal adjectives in Hebrew, derived from nouns by attaching the adjectival suffix *-I* to the nominal stem, e.g., *beyti* 'domestic' (from *báyit* 'house'), *tinoki* 'babyish' (from *tinok* 'baby'), or *prati* 'private' (from *prat* 'individual'). Naturalistic data indicates that this is the last adjectival construction to be acquired in preschoolers (Ravid & Nir 2000). Denominal adjectives first emerge in children's spontaneous speech around age 6, usually in ill-formed constructions. For example, Assaf (5;2) described a sports car (adult N-N compound *mexonit^sport*) as *óto spórti* 'sportive car', and at age 4;9 he termed a mountainous area *ezor hari* for adult *ezor harari* (from *har* 'mountain'); Sahar (6;8) defined crying about a funny situation as *béxi cxoki* 'laughy crying' from *cxok* 'laughter'; and Itamar (7;0) called himself *yéled savlanuti* 'patiency child' for adult *yéled savlani* 'patient child' (from *savlanut* 'patience'). But can children who make such initial attempts at producing denominal adjectives be said to have *acquired* them?

As the next step, consider the production of denominal adjectives under experimental conditions. Levin et al. (2001) used a structured design to elicit N-A_{den} constructions (e.g., *halixa dubit* 'bearlike walk' from *dov* 'bear') in preschoolers (aged 5–6) and first graders (aged 6–7). Figure 1 shows that correct denominal adjective scores significantly increase from about 67% in kindergarten to over 80% in first grade. This leads to the expectation that denominal adjectives should be mastered in the next year or two, towards the middle of gradeschool. But continuing to watch out for the usage rather than the elicited production of Hebrew A_{den}s shows that this is not the case.

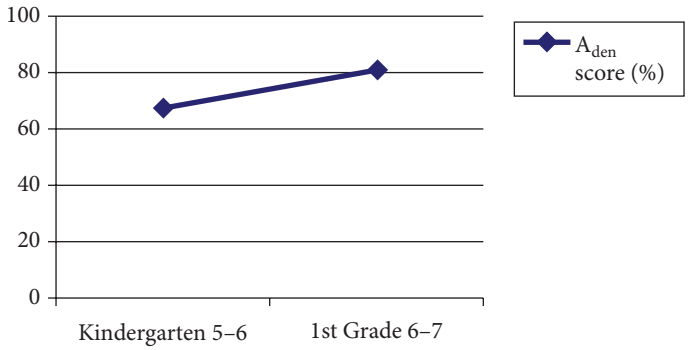

Figure 1. Increase in correct production of denominal adjectives from kindergarten to first grade (data taken from Levin et al. 2001)

Figure 2 traces the occurrence of denominal adjectives in spoken and written Hebrew texts of two genres — biographies and expositories — produced by children, adolescents and adults. These contexts foster the usage of adjectives, especially in N-A constructions (Biber 1995: 79; Shlesinger 2000). To neutralize different text length, denominal adjective occurrence was calculated over the total number of clauses in each text. Contrary to what could be expected from an over 80% success in an experimental task in first grade, denominal adjectives emerge in actual usage around age 16 in *written* texts alone, and statistically significant development continues to adulthood. This comparison teaches us not only that linguistic development indeed extends over a long period of time, but also that its nature changes in important ways over this period.

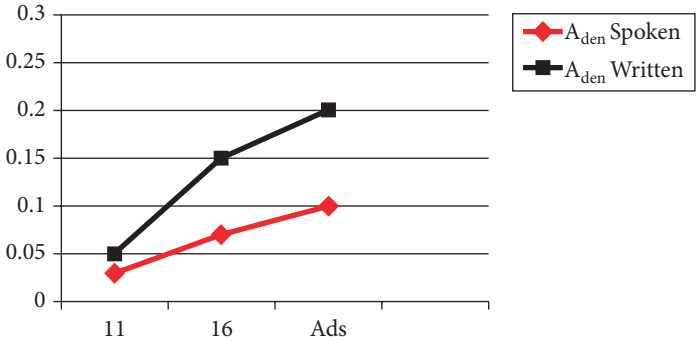

Figure 2. Occurrence of denominal adjectives per clause in spoken and written texts across adolescence (data from Ravid & Zilberbuch, in press)

Thus, in order to provide a complete and adequate account of children's development and its wider implications, we believe the research scope of language acquisition should be extended in terms of the age range, from focus on preschoolers alone to the investigation of language development until young adulthood; in terms of the domains of inquiry, from focus on the acquisition of basic morpho-syntactic categories to include later derivational morphology, the literate lexicon and complex 'written' syntax; in terms of modality, from focus on spoken language to the inclusion of written language knowledge; and in terms of the scope of inquiry, from focus on the acquisition of isolated constructions to a motivated integration of bottom-up and top-down linguistic properties of discourse. We believe that this expansion of our shared research domain may yield a better understanding of how language develops and how it interacts with the acquisition of literacy.

6.1 Development during the school years

Later language development is not an isolated phenomenon: it is firmly anchored in other major changes that occur in children and adolescents. According to our view,

linguistic change is firmly anchored in four development phenomena in school-aged language users.

General cognitive development is one domain where children undergo radical changes. These involve the Piagetian shift from late 'pre-operational' to 'concrete' and then to 'abstract' operations. This means school-aged children already use semiotic systems such as language and imagery, and that they have flexible reversible reasoning which allows them to think systematically and quantitatively in terms of formalized logical structures. Adolescence ushers in the ability to deal with scenes, ideas and dimensions from a number of perspectives, to integrate different knowledge sources, to extract underlying patterns and to process hypothetical material (Meadows 1993). During later childhood and adolescence, information-processing capabilities increase significantly, leading to consequent increase in the ability to solve problems. Though scholars differ on the issue of whether it is changes in the size of the information-processing capacity or in the strategic use of this capacity, it is clear that older children and adolescents differ from younger ones in the speed, exhaustiveness and flexibility of their cognitive operations. These include the development of executive control and self-modifying production systems — the abilities to set goals, search and evaluate options, plan and monitor procedures, detect and repair problems, select strategies, eliminate inconsistencies and redundancies. The growth of information-processing capabilities derives from improvement in attentional resources and in the perception, representation, organization and integration of information (Eysenck 2001; Keil 1989). Changes in reflective thinking in adolescents enables higher-order abstract knowledge structures (metacognition) where the synthetic content of conscious knowledge becomes the target of conscious thought and subject to analysis and deliberate changes. Adolescent cognition is characterized by more complex and dense structures, on the one hand, with a higher degree of explicitation and increased accessibility to knowledge, on the other (Karmiloff-Smith 1992). Similar and concurrent changes occur in the linguistic systems available to children.

Social and affective development is another important domain which accompanies linguistic change. The Vygotskyan point of view emphasizes the central role of social interaction and guided participation as scaffolds promoting cognitive change. School-aged children experience direct and indirect interaction with more experienced partners, processes which lead to learning culturally valued skills and to reorganizing children's current knowledge structures. A Piagetian perspective points at the peer group as the main social context of development, where peers provide each other with new information, mutual feedback, evaluation and debate that contribute to better problem solving (Gauvain 2001). Erikson's model describes how development brings on a consolidated sense of ego identity, that is, a perceived sense of inner sameness and self-continuity. During schoolage children participate in learning valued skills while adolescents achieve a stable sense of personal identity and self-knowledge (Berzonsky 2000). All three models characterize the period of

later language development as a time of fundamental social, affective and cognitive changes fostered by social interaction.

Schooling is a third factor in constructing the underpinnings of later linguistic development. The transactional and complex nature of human cognitive development requires the symmetrical (peer) and asymmetrical (teacher-student) interaction typical of school (Gauvain 2001). Beyond the changes brought on by the acquisition of literacy (see below), school learning is crucial in providing young language users with three important extra-linguistic sources of language-relevant knowledge. One is a systematic disciplinary foundation in world-knowledge necessary for interpreting spoken and written texts. Another is a large lexically-specific vocabulary relating to different arts and sciences extending the stock of nouns, verbs and adjectives in the advanced lexicon. A third school-based language aid is the encounter with a variety of genres (narratives, poems, expositions, instructions, informative texts, mathematical problems, historical texts, biographies, scientific treatises, etc.). This encounter familiarizes children with the language characteristics typical of various text types.

Literacy. Learning to read and write is a key intellectual achievement accomplished in the early school years (Olson 1994) which has major implications on language development. The basics of reading and writing are acquired in the early grades of primary school, while in later grades children already use literacy to appropriate school knowledge. But beyond its obvious role as the main instrument of learning, literacy is crucial in fostering the advent of later language acquisition in directing learners' attention to *written* language as their primary source of information about language.

Literacy provides access to written language in two different routes (Ravid & Tolchinsky 2002): written language as *discourse style* and writing as a *notational system*. Written language as discourse style involves the variety of genres appropriate for 'language in writing', such as legal discourse, academic writing, or newspaper reporting, each with its typical thematic content, global structures and linguistic features. Writing as a notational system, in contrast, involves an ordered set of graphic signs used for composing messages in the written modality (Harris 1995).

Learning to read and write establishes links between the internal representation of phonemes, syllables and morphemes and their written representations (Bentin 1992; Goswami 1999; Fowler & Liberman 1995; Rubin 1988). Concomitantly, written representations modify these very same internal linguistic representations (Gillis & de Schutter 1996; Levin et al. 2001). Abilities requiring more integrated knowledge such as reading comprehension are also related to analytic metalinguistic skills (Demont & Gombert 1996; Yuill 1998). Sensitivity to specific language domains, such as derivational morphology, has been shown to play a significant role in reading ability in gradeschool and highschool as well as among college students (Henry 1993; Mahony 1994; Smith 1998).

Learning to view language and use it from these two written perspectives changes the perception and use of language in adults fundamentally and permanently. While children's

perception of language is mostly based on its oral form, adults' language knowledge mostly derives from their understanding and use of both spoken and written language (Nippold 1998). In this mature linguistic world, spoken language is delegated to the realm of online communication and is assigned mostly an illocutionary and affective role. Written language now constitutes a major source of linguistic items and constructs and the vehicle for metacognitive and especially metalinguistic thought processes (Karmiloff-Smith 1992; Olson 1994). Developing literacy provides learners with the ability to copy, summarize, organize, revise, edit, and integrate linguistic material as well as relate it to other texts, in interaction with a host of literate reference sources such as dictionaries, encyclopedias, guides and manuals, concordances, journals and the Internet.

Later language acquisition is thus closely related to the cognitive and social developmental trends taking place in middle childhood and adolescence, and is promoted by the qualitative and quantitative increase in school-based knowledge described above.

6.2 The nature of later linguistic acquisition

Later language development takes place on two distinct planes. On the one hand, linguistic *abilities* undergo fundamental changes towards metalinguistic control, rhetorical expressiveness and a higher order of semantic flexibility. On the other hand, the acquisition of linguistic *knowledge* continues in the lexical, morphological, syntactic and discourse domains.

6.2.1 *Developing reflective linguistic abilities*

Language knowledge in children is essentially *implicit*. In everyday interaction, this complex system is typically *used* rather than *addressed* as a separate body of knowledge (Chafe 1994). In this natural context of discourse, speakers normally focus on maintaining or changing the discourse topic and their role as speaker or addressee, rather than on the linguistic form (Lambrecht 1994). The purpose of a linguistic transaction is usually informative, and so language users focus on content to achieve their communicative goals. Therefore, while talking, as in performing any other 'natural' and authentic linguistic act where language is used rather than analyzed, linguistic knowledge is applied *holistically*, to construct (or comprehend) a totality that integrates phonology, morphology and lexicon, syntax and semantics in a given context. Language users may pay explicit attention to discourse topic, to prosodic features or to lexical choice, but not to choice of syntactic construction or morphological form. While language users may be aware of their tone and intonation, pitch and volume during conversation, they are not aware of NP structure or verb aspect in the same way. These three features of *language use* — implicit, holistic and content-directed — constitute part of the natural linguistic heritage of any language speaker, and characterize speech from early on (Ravid & Tolchinsky 2002).

With increasing experience in different linguistic contexts, language knowledge takes on a more explicit and analytic character (Gombert 1992; Karmiloff-Smith et al. 1996; Van Kleeck 1982). Young children display emergent metalinguistic awareness in natural interaction through spontaneous self-repairs, 'practice' sessions, questions and observations about language. Children's ability to perform structured linguistic tasks such as inflectional changes in non-natural, experimental contexts also implies a rudimentary metalinguistic capacity (Ravid 1995). The onset and development of phonological awareness in preschoolers is an essential precursor to literacy acquisition since it involves the ability to form mental representations of distinct abstract phonological elements such as phonemes, syllables and sub-syllables and to relate them to orthographic representations (Perfetti 1987; Goswami 1999; Goswami & Bryant 1990). During the school years, other types of metalinguistic awareness develop — lexical, morphological, syntactic, pragmatic, textual — which all involve representing, introspecting about, analyzing and discussing various linguistic dimensions as separate domains of analysis (Carlisle & Nomanbhoy 1993; Ravid & Malenky 2001; Smith 1998; Wysocki & Jenkins 1987). Evidence comes from tasks requiring controlled, analytical, explicit verbalization of linguistic processes and constructs, which are beyond the capacities of young children, and which are not fully achieved before adolescence (Nippold 1998; Smith 1998).

Language awareness increases in explicitness and concurrently involves *representational reorganization* into more coherent and more accessible forms during the school years (Karmiloff-Smith 1992). For example, Ravid (1996) and Ravid & Shlesinger (2001) show that educated, literate Hebrew-speaking adults, and they alone, are able to make full conscious use of phonological information in the form of vowel diacritics in text comprehension, and that only literate adults possess both normatively prescribed as well as currently standard forms in their mental lexicon.

The linguistic abilities which develop during middle childhood and adolescence lead to a denser, more coherent, explicit and accessible format of language (Karmiloff-Smith 1992). This permits cognitive control over the form of linguistic production and implies a detachment from content, the ability to select appropriate linguistic forms, morpho-syntactic constructions and lexical expressions, to weigh alternatives, and to access non-default, less productive, marked options. Being able to reflect on one's own usage of structures and their meanings in various contexts is necessary for the cognitive activities associated with writing. The emergence and consolidation of these reflective powers in language foster the most important characteristic of mature language, which Slobin (1977) calls *rhetorical expressiveness* and which we may term *linguistic flexibility* (Ravid & Tolchinsky 2002). This is the ability to shift through modalities and registers, to access, weigh and select alternative linguistic constructs, with the view not only to provide referential information but also to language a useful tool in expressive communication. This includes not only making more interesting and witty conversation, maintaining discourse topic, using language skillfully

in persuasion and negotiation, but also the growing ability to detect and correct ambiguity, comprehend and produce texts of various genres for different purposes, and to employ jokes, similes and metaphors, idioms and proverbs in their proper contexts (Berman & Verhoeven 2002; Nippold 1998).

6.2.2 *Continuing linguistic development*

Concurrent with these crucial changes in the representation and use of language, the very linguistic systems undergo fundamental changes during later linguistic development. These are of course all dependent on the particular language being learned, but general trends can be pointed out.

The most basic system which underlies all other linguistic systems is *the lexicon*. Syntactic processes employ words, and a greater variability in lexical components is necessary for constructing more complex and diverse syntactic architecture. Moreover, richer and more informative textual structures crucially depends on enhanced lexicality (Ravid & Zilberbuch in press; Ravid et al. 2002). A comprehensive report in Anglin (1993) indicates that during the school years English-speaking children's vocabularies increase at a rate of several words per day, amounting to thousands of words per year. The overwhelming majority of words in the literate vocabulary come from written language, and many of these words are learned in the context of advanced school learning and with the diversification of knowledge disciplines.

Not only does the later lexicon expand exponentially, it also changes in critical ways. Later-acquired words tend to become longer in syllables and letters (Strömqvist et al. 2002). Compare, for example, *if* with *unless*, *but* with *however* and *nevertheless*, or *much* with *considerable*. Words also become more complex, so that much of the lexicon in the school years are derived multimorphemic and multilexemic words rather than root words, e.g., *seabound*, *stipulation*, *hypercritical*, *readmission*, *bashfulness*, *salinification*, *whole wheat*, *northeast coast indian* (Anglin 1993). Even in a highly synthetic language such as Hebrew, which encodes ideas in word-internal form and does not represent all vowels in its script, longer words such as *adraba* 'on the contrary', *hitmaktse'ut* 'becoming professional', *yam ha-mélax* 'Dead Sea (literally: sea of salt)' and *beyt gidul* 'habitat (literally: house of raising)' mostly occur in written texts produced by older children and adolescents. This of course implies increased access to a wide range of morphological devices in the language, as discussed below. Much of the lexical inventory in later language development consists of larger chunks of linguistic material (collocations, prefabricated units) which are rote-learned, on the one hand, but are composed of much more than what is traditionally is viewed as a single 'word', e.g., *raise hopes, trigonometric function, staff sergeant major, give X some slack, Olympic gods, instrument landing, NATO, UNICEF*. These complex 'words' are in their overwhelming majority school-based, literate items relating to diverse disciplines, requiring broad and current world knowledge, encoding complex sub-categorized meanings such as *telephone operator*.

Two central features of the 'learned' or later lexicon are register and abstractness. Many of the new words learned from written language are rarer and marked by higher register (Andersen 1990; Biber 1995), and many of them are abstract in various ways. As a result some changes in the later-language lexicon do not have quantitative outcomes in the actual number of words since they involve expanding concrete to more abstract and metaphorical meanings, such as extending the meaning of *hot* from reference to concrete to topics, people's tempers, etc. Many complex multi-word lexemes have metaphorical meanings, e.g., *homemaker* (Anglin 1993). In fact, each of the lexical categories in the later-language lexicon undergoes specific changes. The nominal lexicon acquires more abstract nouns and derived nominals such as *knowledge*, *intensification* and *hostility* (Ravid & Avidor 1998). Verbs become more lexically specific (e.g., *trot*, *canter*, *gallop* to describe horses' movement) and the verbal lexicon acquires items which refer to linguistic and cognitive processes such as *predict*, *infer*, *imply* and *hypothesize* (Olson & Astington 1986.). Later-acquired adjectives refer to abstract and internal features of the noun described (Ravid & Nir 2000).

The acquisition of morphology and syntax does not end in the preschool years, though the major breakthroughs are indeed achieved in early childhood. In English, a language with sparse morphology, much of the early lexicon is of Germanic origin and consists of short and simple words; while many of the complexities of the derivational system are learned while acquiring longer and more morphologically complex words of Romance origin in primary school and especially in highschool (Anglin 1993; Smith 1998). In Hebrew, a synthetic language with rich and complex morphology, later-emerging morphology includes, for example, optional bound suffixation of genitive nouns (e.g., *armona* 'palace-her' — cf. analytic *ha-armon shela* 'the-palace hers') and of accusative verbs (e.g., *re'itiv* 'I-saw'him', cf. analytic *ra'iti oto* 'I-saw him'). These bound morphological options of Classical Hebrew origins are available to older speaker/writers, but do not emerge in children before school-age since they are pre-empted in early acquisition by their analytic and transparent syntactic counterparts, which are much more frequent in everyday discourse (Berman 1997; Levin et al. 2001). Though less work has been done on school-age morphology, we should expect that later-emerging systems in any language would be less transparent, salient and frequent than ones characterizing early language acquisition, and that they should be typical of more literate and specific discourse types less likely to be encountered by children.

The changes in syntactic knowledge in later language development were noticed as far back as at the beginning of the study of language acquisition. C. Chomsky (1969) noted that children under 8 were not able to process opaque constructions such as 'the doll is hard to see' and those containing verbs such as *promise* as in 'Dan promised Mary to drink the medicine'. Beyond the comprehension of such constructions, syntactic acquisitions in later language development mostly belong to two types. Some involve the consolidation of syntactic constructions which constitute alternative rhetorical options serving specific discourse functions such as passive voice and conditionals (Reilly et al. 2002). But much of

the syntactic development in the school years results in longer, more complex and diverse constructions which appear in extended discourse (Ravid et al. 2002).

Finally, the most 'visible' change in later language development is the acquisition of discourse. Beyond the ability to produce narratives (Berman & Slobin 1994), children and adolescents learn to comprehend and eventually to produce a variety of textual types constrained by different communicative purposes, such as commercials, contracts, drama, field notes, instruction manuals, Internet chats, jokes, legislative documents, lists, literary reviews, manuals, medical case reports, myths, personal letters, personal narrative, petitions, prayers, recipes, resumés, riddles, scientific writing, textbooks — to name only a few (Paltridge 1997). The ability to access and employ lexical items and morpho-syntactic constructions appropriate for each genre is the ultimate test of later language development.

References

Andersen, E. (1990). *Speaking with style: The sociolinguistic skills of children*. Routledge.

Anglin, J. (1993). Vocabulary development: a morphological analysis. *Monographs of the Society for Research in Child Development* 58(10).

Arlman-Rupp, A.J., D. Van Niekerk-De-Haan & M. Van De Sandt-Koenderman (1976). Brown's early stages: Some evidence from Dutch. *Journal of Child Language* 3: 267–274.

Arriaga, R., L. Fenson, T. Cronan & S. Pethick (1998). Scores on the MacArthur Communicative Development Inventory of children from low and middle income levels. *Applied Psycholinguistics* 19: 209–223.

Aslin, R., J. Saffran & E. Newport (1998). Computation of conditional probability statistics by 8-month-old infants. *Psychological Science* 9: 321–324.

Barrett, M. (ed.) (1999). *The development of language*. Psychology Press.

Bates, E. (1994). Modularity, domain specificity and the development of language. *Discussions in Neuroscience* 10: 136–149.

——— (1999). Plasticity, localization and language development. In S. Broman & J. Fletcher (eds.) *The changing nervous system: Neurobehavioral consequences of early brain disorders*: 214–253. Oxford University Press.

Bates, E., I. Bretherton & L. Snyder (1988). *From first words to grammar*. Cambridge University Press.

Bates, E., P. Dale & D. Thal (1995). Individual differences and their implications for theories of language development. In P. Fletcher & B. MacWhinney (eds.): 96–151.

Bates, E. & J. Elman (1993). Connectionism and the study of change. In M. Johnson (ed.) *Brain development and cognition: A reader*: 623–642. Blackwell.

Bates, E. & B. MacWhinney (1987). Competition, variation and language learning. In B. MacWhinney (ed.): 157–194.

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

Bates, E., D. Thal & J.S. Janowsky (1992). Early language development and its neural correlates. In S.J. Segalowitz & I. Rapin (eds.) *Handbook of neuropsychology*, Vol. 7: *Child Neuropsychology*. Elsevier.

Bentin, S. (1992). Phonological awareness, reading, and reading acquisition: A survey and appraisal of current knowledge. In L. Katz & R. Frost (eds.) *Orthography, phonology, morphology and meaning*: 193–210. Elsevier.

Berko-Gleason, J. (1958). The child's learning of English morphology. *Word* 14: 150–177.

Berman, R. (1981). Regularity vs. anomaly: The acquisition of Hebrew inflectional morphology. *Journal of Child Language* 8: 265–282.

——— (1986). A step-by-step model of language acquisition. In I. Levin (ed.) *Stage and structure: Reopening the debate*: 191–219. Ablex.

——— (1997). Preschool knowledge of language: What five year olds know about language structure and language use. In C. Pontecorvo (ed.) *Writing development: an interdisciplinary view*: 61–76. John Benjamins.

——— (2002). Crosslinguistic comparisons in later language development. In S. Strömqvist (ed.) *The diversity of languages and language learning*: 25–44. Lund: Center for Languages and Literature.

Berman, R. & D. Slobin (1994). *Relating events in narrative: A crosslinguistic developmental study*. Erlbaum.

Berman, R. & L. Verhoeven (2002). Crosslinguistic perspectives on developing text production abilities in speech and writing. *Written Languages and Literacy* 5: 1–44.

Berzonsky, M. (2000). Theories of adolescence. In G. Adams (ed.) *Adolescent development: The essential readings*: 11–27. Blackwell.

Biber, D. (1995). *Dimensions of register variation*. Cambridge University Press.

Bloom, P. (1994). Possible names: The role of syntax-semantics mappings in the acquisition of nominals. *Lingua* 92: 297–329.

——— (1996). Theories of word learning: Rationalist alternatives to associationism. In T.K. Bhatia & W.C. Ritchie (eds.) *Handbook of language acquisition*: 249–278. Academic Press.

Bloom, P. & D. Kelemen (1995). Syntactic cues in the acquisition of collective nouns. *Cognition* 56: 1–30.

Bloom, P., D. Kelemen, A. Fountain & E. Courtney (1995). The acquisition of collective nouns. In D. MacLaughlin & S. McEwen (eds.) *Proceedings of the 19th annual Boston University Conference on Language Development*: 107–117. Cascadilla Press.

Bowerman, M. (1973). *Early syntactic development: A crosslinguistic study with special reference to Finnish*. Cambridge University Press.

——— (1982a). Starting to talk worse: Clues to language acquisition from children's late speech errors. In S. Strauss (ed.) *U-shaped behavioral growth*: 101–145. Academic Press.

——— (1982b). Reorganizational processes in lexical and syntactic development. In E. Wanner & L. Gleitman (eds.): 319–346.

——— (1985). Beyond communicative adequacy: From piecemeal knowledge to an integrated system in the child's acquisition of language. In K.E. Nelson (ed.) *Children's Language*, vol. 5: 369–398. Erlbaum.

——— (1986). What shapes children's grammar? In D. Slobin (ed.): 1257–1319.

——— (1989). Learning a semantic system: What role do cognitive predispositions play? In M. Rice & R. Schiefelbusch (eds.) *The teachability of language*: 133–169. Brookes.

Bowerman, M. & S. Choi (2001). Shaping meanings for language: Universal and language-specific in the acquisition of spatial semantic categories. In M. Bowerman & S. Levinson (eds.): 475–511.

Bowerman, M. & S. Levinson (eds.) (2001). *Language acquisition and conceptual development*. Cambridge University Press.

Braine, M. (1963). On learning the grammatical order of words. *Psychological Review* 70: 323–338.

——— (1976). Children's first word combinations. *Monographs of the Society for Research in Child Development* 41.
——— (1992). What sort of innate structure is needed to "bootstrap" into syntax? *Cognition* 45: 77–100.
Broeder, P. & J. Murre (eds.) (2000). *Models of language acquisition*. Oxford University Press.
Brown, R. (1973). *A first language: The early stages*. Harvard University Press.
Bruner, J. (1981). The pragmatics of acquisition. In W. Deutsch (ed.) *The child's construction of language*: 39–56. Academic Press.
Bybee, J. (1985). *Morphology*. John Benjamins.
Cabeza, R. & L. Nyberg (2000). Imaging cognition II: An empirical review of 275 PET and fMRI studies. *Journal of Cognitive Neuroscience* 12: 1–47.
Carey, S. (1982). Semantic development. In E. Wanner & L. Gleitman (eds.): 347–389.
——— (1994). Does learning a language require conceptual change? *Lingua* 92: 143–167.
Carlisle, J. & D. Nomanbhoy (1993). Phonological and morphological awareness in first graders. *Applied Psycholinguistics* 14: 177–195.
Chafe, W. (1994). *Discourse, consciousness, and time*. The University of Chicago Press.
Chomsky, C. (1969). *The acquisition of syntax in children from 5 to 10*. MIT Press.
Chomsky, N. (1965). *Aspects of the theory of syntax*. MIT Press.
——— (1986). *Knowledge of language: Its nature, origin and use*. Praeger.
Clahsen, H. (1990). Constraints on parameter setting: A grammatical analysis of some acquisition stages in German child language. *Language Acquisition* 1: 361–391.
——— (1992). Learnability theory and the problem of development in language acquisition. In J. Weissenborn, H. Goodluck & T. Roeper (eds.) *Theoretical issues in language acquisition*: 53–76. Erlbaum.
Clahsen, H., C. Kursawe & M. Penke (1996). Introducing CP: Wh-questions and subordinate clauses in German child language. In J. Koster & F. Wijnen (eds.): 5–22.
Clark, E. (1993). *The lexicon in acquisition*. Cambridge University Press.
Clark, E. (ed.) (1995). *Proceedings of the Twenty-seventh Child Language Research Forum*. CSLI Publications.
Crystal, D., P. Fletcher & M. Garman (1990). *The grammatical analysis of language disability*. Singular.
Cutler, A. (1994). Segmentation problems, rhythmic solutions. *Lingua* 92: 81–104.
Cutler, A. & D. Norris (1988). The role of strong syllables in segmentation for lexical access. *Journal of Experimental Psychology: Human Perception and Performance* 14: 113–121.
Dale, P. & L. Fenson (1996). Lexical development norms for young children. *Behavior Research Methods, Instruments & Computers* 28: 125–127.
Deacon, T. (1997). *The symbolic species: The co-evolution of language and the human brain*. Penguin Books.
Decasper, A. & W. Fifer (1980). On human bonding: Newborns prefer their mothers' voices. *Science* 208: 1174–1176.
Decasper, A., J. Lecanuet, M. Busnel, C. Granier-Deferre & R. Maugeais (1994). Fetal reactions to recurrent maternal speech. *Infant Behavior and Development* 17: 159–164.
Demont, E. & J.-E. Gombert (1996). Phonological awareness as a predictor of recoding skills and syntactic awareness as a predictor of comprehension skills. *British Journal of Educational Psychology* 66: 315–332.
Deutsch, W. (ed.) (1981). *The child's construction of language*. Academic Press.

Divirgilio, G. & S. Clarke (1997). Direct interhemispheric visual input to human speech area. *Human Brain Mapping* 5: 347–354.
Dore, J., M. Franklin, R. Miller & A. Ramer (1976). Transitional phenomena in early language acquisition. *Journal of Child Language* 3: 13–28.
Dresher, B.E. & K. Church (1992). A learning model for a parametric theory in phonology. In D. Levine Robert (ed.) *Formal grammar*: 290–326. Oxford University Press.
Dresher, E. & J. Kaye (1990). A computational learning model for metrical phonology. *Cognition* 34: 137–195.
Dressler, W.U. (1997). *Studies in pre- and protomorphology*. Austrian Academy of Sciences.
Dromi, E. (1987). *Early lexical development*. Cambridge University Press.
Dromi, E. & R. Berman (1982). A morphemic measure of early language development: Data from modern Hebrew. *Journal of Child Language* 9: 403–424.
Durieux, G. & S. Gillis (2001). Predicting grammatical classes from phonological cues: An empirical test. In J. Weissenborn & B. Höhle (eds.): 189–229. John Benjamins.
Durieux, G., S. Gillis & W. Daelemans (2003). Acquiring language from the input: Tuning prewired knowledge or shaping memory? Ms., University of Antwerp.
Edwards, D. (1973). Sensory-motor intelligence and semantic relations in early child grammar. *Cognition* 2: 395–434.
Eimas, P. (1985). The equivalence of cues for the perception of speech by infants. *Infant Behavior and Development* 16: 297–316.
Eimas, P.D., E.R. Siqueland, P.W. Jusczyk & J. Vigorito (1971). Speech perception in infants. *Science* 171: 303–306.
Elman, J., E. Bates, M. Johnson, A. Karmiloff-Smith, D. Parisi & K. Plunkett (1996). *Rethinking innateness: A connectionist perspective on development*. MIT Press/Bradford Books.
Eysenck, M. (2001). *Principles of cognitive psychology*. Psychology Press.
Fenson, L., E. Bates, P. Dale, G. Goodman, J. Reznick & D. Thal (2000). Measuring variability in early child language: Don't shoot the messenger. *Child Development* 71: 323–328.
Fenson, L., P. Dale, J. Reznick, D. Thal, E. Bates, J. Hartung, S. Pethick & J. Reilly (1993). *The MacArthur Communicative Development Inventories: User's guide and technical manual*. Singular Publishing Group.
Fenson, L., P. Dale, J. Reznick, E. Bates, D. Thal & S. Pethick (1994). Variability in early communicative development. *Monographs of the Society for Research in Child Development* 59(5): 1–173.
Ferguson, C.A. (1979). Phonology as an individual access system: Some data from language acquisition. In C. Fillmore (ed.) *Individual differences in language ability and language behavior*: 189–201. Academic.
Ferguson, C. & C. Snow (eds.) (1977). *Talking to children: Language input and acquisition*. Cambridge University Press.
Fletcher, P. (1999). Specific language impairment. In M. Barrett (ed.): 349–371.
Fletcher, P. & M. Garman (eds.) (1986). *Language acquisition*. Cambridge University Press.
Fletcher, P. & B. MacWhinney (eds.) (1995). *The handbook of child language*. Blackwell.
Fodor, J. (1983). *The modularity of mind*. MIT Press.
Fowler, A. & I. Liberman (1995). The role of phonology and orthography in morphological awarenes. In L. Feldman (ed.) *Morphological aspects of language processing*: 157–188. Erlbaum.
Gallaway, C. & B. Richards (eds.) (1994). *Input and interaction in language acquisition*. Cambridge University Press.

Gathercole, V. & H. Min (1997). Word meaning biases or language-specific effects? Evidence from English, Spanish and Korean. *First Language* 17: 31–56.
Gathercole, V., E. Thomas & D. Evans (2000). What's in a noun? Welsh-, English-, and Spanish-speaking children see it differently. *First Language* 20: 55–90.
Gathercole, V., E. Thomas & S. Kim (1999). Cue coordination: An alternative to word meaning biases. In B. Fox, D. Jurafsky & L. Michaelis (eds.) *Cognition and function in language*: 120–135. CSLI.
Gauvain, M. (2001). *The social context of cognitive development*. The Guilford Press.
Gerken, L. (2001). Signal to syntax: Building a bridge. In J. Weissenborn & B. Höhle (eds.): 147–165.
Gillis, S. (1984). *De verwerving van talige referentie*. Ph.D. Diss, University of Antwerp.
——— (1986). *This child's Nominal Insight is actually a process: The plateau stage and the vocabulary spurt in early lexical development*. University of Antwerp.
Gillis, S. & G. De Schutter (1986a). Le long cheminement vers le premier emploi des mots. *Lingvisticae Investigationes* 10: 67–83.
——— (1986b). Transitional phenomena revisited: Insights into the nominal insight. In B. Lindblom & R. Zetterström (eds.) *Precursors of early speech*: 127–142. Stockton Press.
——— (1996). Intuitive syllabification: Universals and language specific constraints. *Journal of Child Language* 23: 487–514.
Gillis, S., G. Durieux & W. Daelemans (1996). How to set parameters: Analysis of a learning theory. In C. Koster & F. Wijnen (eds.): 217–226.
Gillis, S. & D. Ravid (2001). Language-specific effects on the development of written morphology. In S. Bendjaballah, W. Dressler, O. Pfeiffer & M. Voeikova (eds.) *Morphology* 2000: 129–136. John Benjamins.
Gleitman, L. (1990). The structural sources of verb meanings. *Language Acquisition* 1: 3–55.
Gleitman, L., H. Gleitman, B. Landau & E. Wanner (1988). Where learning begins: Initial representations for language learning. In F. Newmeyer (ed.) *Linguistics: The Cambridge Survey*, vol. 3: 150–193. Cambridge University Press.
Gleitman, L. & J. Gillette (1995). The role of syntax in verb-learning. In P. Fletcher & B. MacWhinney (eds.): 413–427.
Gleitman, L. & E. Wanner (1982). Language acquisition. In E. Wanner & R. Gleitman (eds.): 3–48.
Goldfield, B. & S. Reznick (1990). Early lexical acquisition: Rate, content, and the vocabulary spurt. *Journal of Child Language* 17: 171–183.
Golinkoff, R., C. Mervis & K. Hirsh-Pasek (1994). Early object labels: The case for a developmental lexical principles framework. *Journal of Child Language* 21: 125–155.
Gombert, J.-E. (1992). *Metalinguistic development*. Harvester Wheatsheaf.
Goodluck, H. (1986). Language acquisition and linguistic theory. In P. Fletcher & M. Garman (eds.): 49–68.
Gopnik, A. (2001). Theories, language, and culture: Whorf without wincing. In M. Bowerman & S. Levinson (eds.): 45–69.
Goswami, U. (1999). The relationship between phonological awareness and orthographic representation in different orthographies. In M. Harris & G. Hatano (eds.) *Learning to read and write: A cross-linguistic perspective*: 134–156. Cambridge University Press.
Goswami, U. & P. Bryant (1990). *Phonological skills and learning to read*. Erlbaum.
Grunwell, P. (1985). *Phonological Assessment of Child Speech (PACS)*. Windsor: NFER-Nelson.
Harris, R. (1995). *Signs of writing*. Routledge.
Henry, M. (1993). Morphological structure: Latin and Greek roots and affixes as upper grade code strategies. *Reading and Writing* 5: 227–241.

Hess, C.W., K.P. Ritchie & R.G. Landry (1984). Type-Token Ratio and vocabulary performance. *Psychological Reports* 55: 51–57.
Hickey, T. (1991). Mean length of utterance and the acquisition of Irish. *Journal of Child Language* 18: 553–569.
Hirsh-Pasek, K. & R. Golinkoff (1996). The preferential looking paradigm reveals emerging language comprehension. In D. McDaniel et al. (eds.): 105–124. MIT Press.
Hirsh-Pasek, K., D. Kemler Nelson, P. Jusczyk, K. Cassidy, B. Druss & L. Kennedy (1987). Clauses are perceptual units for young infants. *Cognition* 26: 269–286.
Huntley-Fenner, G. (1995). The effect of the whole object bias on preschoolers' understanding of collective nouns. In E. Clark (ed.): 145–156.
Imai, M. & D. Gentner (1997). A crosslinguistic study on constraints on early word meaning: Linguistic influence vs. universal ontology. Cognition 62: 169–200.
Ingram, D. (1989). *First language acquisition: Method, description and explanation*. Cambridge University Press.
Johnston, J. (1985). Cognitive prerequisites: The evidence from children learning English. In D. Slobin (ed.): 961–1004.
Jusczyk, P. (1997). *The discovery of spoken language*. MIT Press.
——— (2001). Bootstrapping from the signal. In J. Weissenborn & B. Höhle (eds.): 3–23.
Jusczyk, P., A. Cutler & N. Redanz (1993). Infants' preference for the predominant stress patterns of English words. *Child Development* 64: 675–687.
Jusczyk, P., P. Luce & J. Charles-Luce (1994). Infants' sensitivity to phonotactic patterns in the native language. *Journal of Memory and Language* 33: 630–645.
Karmiloff-Smith, A. (1986). Some fundamental aspects of language development after age 5. In P. Fletcher & M. Garman (eds.): 455–473.
——— (1992). *Beyond modularity*. MIT Press.
Karmiloff-Smith, A., J. Grant, K. Sims, M. Jones & P. Cuckle (1996). Rethinking metalinguistic awareness: Representing and accessing knowledge about what counts as a word. *Cognition* 58: 197–219.
Keil, F. (1989). *Concepts, kinds and cognitive development*. MIT Press.
Kelly, M. (1986). The role of phonology in grammatical category assignment. In J. Morgan & K. Demuth (eds.): 249–262.
Kemler Nelson, D., K. Hirsh-Pasek, P. Jusczyk & K. Wright-Cassidy (1989). How the prosodic cues in motherese might assist language learning. *Journal of Child Language* 16: 55–68.
Kent, R. (1998). Neuroimaging studies of brain activation for language, with an emphasis on functional magnetic resonance imaging: A review. *Folia Phoniatrica et Logopaedica* 50: 291–304.
Kirkham, N., J. Slemmer & S. Johnson (2002). Visual statistical learning in infancy: Evidence for a domain general learning mechanism. *Cognition* 83: B35–B42.
Koster, J. & F. Wijnen (eds.) *Proceedings of the Groningen Assembly on Language Acquisition* 1995. Groningen: Centre for Language and Cognition.
Krikhaar, E. & F. Wijnen (1995). Children's categorization of novel verbs: Syntactic cues and semantic bias. In E. Clark (ed.): 197–206.
Kuhl, P. (1993). Early linguistic experience and phonetic perception: Implications for theories of developmental speech perception. *Journal of Phonetics* 21: 125–139.
Kuhl, P. & A. Meltzoff (1984). The intermodal representation of speech in infants. *Infant Behavior and Development* 7: 361–381.
Kuhl, P. & J. Miller (1975). Speech perception by the chinchilla: Voice-voiceless distinction in alveolar plosive consonants. *Science* 190: 69–72.

Kuhl, P., K. Williams, F. Lacerda, K. Stevens & B. Lindblom (1992). Linguistic experience alters phonetic perception in infants by 6 months of age. *Science* 255: 606–608.
Lambrecht, K. (1994). *Information structure and sentence form*. Cambridge University Press.
Landau, B.S. & L.R. Gleitman (1985). *Language and experience — evidence from the blind child*. Harvard University Press.
Landauer, T. & S. Dumais (1997). A solution to Plato's problem: The Latent Semantic Analysis theory of acquisition, induction and representation of knowledge. *Psychological Review* 104: 211–240.
Lederer, A., H. Gleitman & L. Gleitman (1995). Verbs of a feather flock together: Semantic information in the structure of maternal speech. In M. Tomasello & W.E. Merriman (eds.) *Beyond Names for Things: Young Children's Acquisition of Verbs*: 277–297. Erlbaum.
Lee, L. (1974). *Developmental sentence analysis*. Northwestern University Press.
Levin, I., D. Ravid & S. Rappaport (2001). Morphology and spelling among Hebrew-speaking children: From kindergarten to first grade. *Journal of Child Language* 28: 741–769.
Lieven, E. (1997). Variation in a crosslinguistic context. In D. Slobin (ed.): 199–263.
Lieven, E., J. Pine & G. Baldwin (1997). Lexically-based learning and early grammatical development. *Journal of Child Language* 24: 187–219.
Lieven, E., J. Pine & H. Dresner-Barnes (1992). Individual differences in early vocabulary development-redefining the referential-expressive distinction. *Journal of Child Language* 19: 287–310.
Locke, J. (1986). Speech perception and the emergent lexicon: An ethological approach. In P. Fletcher & M. Garman (eds.): 240–250.
——— (1999). Towards a biological science of language development. In M. Barrett (ed.): 373–395.
MacKen, M.A. (1978). Permitted complexity in phonological development of one child's acquisition of Spanish consonants. *Lingua* 44: 219–253.
MacWhinney, B. (1991). *The CHILDES project: Computational tools for analyzing talk*. Erlbaum.
MacWhinney, B. (ed.) (1987). *Mechanisms of language acquisition*. Springer.
——— (ed.) (1999). *The emergence of language*. Erlbaum.
MacWhinney, B. & C. Snow (1985). The child language data exchange system. *Journal of Child Language* 12: 271–296.
——— (1990). The child language data exchange system: An update. *Journal of Child Language* 17: 457–472.
Mahony, D. (1994). Using sensitivity to word structure to explain variance in high school and college reading ability. *Reading and Writing* 6: 19–44.
Maratsos, M. (1982). The child's construction of grammatical categories. In E. Wanner & L. Gleitman (eds.): 240–266.
——— (1992). How the acquisition of nouns may be different from that of verbs. In N. Krasnegor, D. Rumbaugh, R. Schiefelbusch & M. Studdert-Kennedy (eds.) *Biological and behavioral determinants of language development*: 67–88. Erlbaum.
——— (1999). Some aspects of innateness and complexity in grammatical acquisition. In M. Barrett (ed.): 191–228.
Maratsos, M. & M. Chalckley (1980). The internal language of children's syntax. In K. Nelson (ed.) *Children's language*, Vol. 2: 127–213. Gardner.
Markman, E. (1994). Constraints on word meaning in early language acquisition. In L. Gleitman & B. Landau (eds.) *The acquisition of the lexicon*: 199–228. MIT Press.
McClelland, J. & D. Rumelhart (eds.) (1986). *Parallel distributed processing: Explorations in the microstructure of cognition. Volume 2: Psychological and biological models*. MIT Press.

McDaniel, D., C. McKee & H. Cairns (eds.) (1996). *Methods for assessing children's syntax*. MIT Press.
Meadows, S. (1993). *The child as thinker: The development and acquisition of cognition in childhood*. Routledge.
Mehler, J., P. Jusczyk, C. Lambertz, N. Halsted, J. Bertoncini & C. Amiel-Tison (1988). A precursor of language acquisition in young infants. *Cognition* 29: 143–178.
Menn, L. (1976). *Pattern, control, and contrast in beginning speech: A case study in the development of word form and word function*. Ph.D. Diss., University of Illinois.
Menn, L. & N. Ratner-Bernstein (2000). *Methods for studying language production*. Erlbaum.
Mervis, C. & J. Bertrand (1995). Early lexical acquisition and the vocabulary spurt: A response to Goldfield & Reznick. *Journal of Child Language* 22: 461–468.
Miller, J. & T. Klee (1995). Computational approaches to the analysis of language impairment. In P. Fletcher & B. MacWhinney (eds.): 545–572.
Molfese, D., D. Narter, A. Van Matre, M. Ellefson & A. Modglin (2001). Language development during infancy and early childhood: Electrophysiological correlates. In J. Weissenborn & B. Höhle (eds.): 181–229.
Moon, C., R. Cooper & W. Fifer (1993). Two-day olds prefer their native language. *Infant Behavior and Development* 16: 495–500.
Morgan, J. (1996). A rhythmic bias in preverbal speech segmentation. *Journal of Memory and Language* 33: 666–689.
Morgan, J., R. Shi & P. Allopena (1996). Perceptual bases of rudimentary grammatical categories. In J. Morgan & K. Demuth (eds.): 263–283.
Morgan, J. & K. Demuth (eds.) (1996). *From signal to syntax*. Erlbaum.
Naigles, L. (1990). Children use syntax to learn verb meanings. *Journal of Child Language* 17: 357–374.
——— (1996). The use of multiple frames in verb learning via syntactic bootstrapping. *Cognition* 58: 221–251.
Nelson, K. (1973). Structure and strategy in learning to talk. *Monographs of the Society for Research in Child Development* 38.
Nice, M., M. (1925). Length of sentences as a criterion for child's progress in speech. *Journal of Educational Psychology* 16: 370–379.
Nippold, M. (1998). *Later language development: The schoolage and adolescent years*. PRO-ED.
Nippold, M., L. Uhden & I. Schwarz (1997). Proverb explanation through the lifespan: A developmental study of adolescents and adults. *Journal of Speech, Language, and Hearing Research* 40(2): 245–254.
Olson, D. (1994). *The world on paper*. Cambridge University Press.
Olson, D. & J. Astington (1986). Children's acquisition of metalinguistic and metacognitive verbs. In W. Demopoulos & A. Marras (eds.) *Language learning and concept acquisition*: 184–199. Ablex.
Paltridge, B. (1997). *Genre, frames and writing in research setting*. John Benjamins.
Parisse, C. & M. Le Normand (2000). How children build their morphosyntax: The case of French. *Journal of Child Language* 27: 267–292.
Perfetti, C. (1987). Language, speech, and print: Some asymmetries in the acquisition of literacy. In R. Horowitz & S. Samuels (eds.) *Comprehending oral and written language*: 355–369. Academic Press.
Peters, A. (1977). Language learning strategies. *Language* 53: 560–573.

——— (1983). *The units of language acquisition*. Cambridge University Press.
——— (1985). Language segmentation: Operating principles for the perception and analysis of language. In D. Slobin (ed.): 1029–1067.
——— (1995). Strategies in the acquisition of syntax. In P. Fletcher & B. MacWhinney (eds.): 462–482.
——— (1997). Language typology, prosody, and the acquisition of grammatical morphemes. In D. Slobin (ed.): 135–197.
Pine, J.M. & E.V.M. Lieven (1993). Reanalysing rote-learned phrases: Individual differences in the transition to multi-word speech. *Journal of Child Language* 20: 551–571.
Pinker, S. (1984). *Language learnability and language development*. Harvard University Press.
——— (1987). The bootstrapping problem in language acquisition. In B. MacWhinney (ed.): 399–441.
——— (1989). *Learnability and cognition*. MIT Press.
——— (1994). *The language instinct*. William Morrow.
——— (1999). *Words and rules*. Basic Books.
Plunkett, K. (1993). Lexical segmentation and vocabulary growth in early language acquisition. *Journal of Child Language* 20: 43–60.
——— (1995). Connectionist approaches. In P. Fletcher & B. MacWhinney (eds.): 36–72.
Plunkett, K. & C. Sinha (1992). Connectionism and developmental theory. *British Journal of Developmental Psychology* 10: 209–254.
Quine, W.V.O. (1960). *Word and object*. MIT Press.
Radford, A. (1988). Small children's small clauses. *Transactions of the Philological Society* 86: 1–43.
——— (1990). *Syntactic theory and the acquisition of English syntax*. Blackwell.
Ravid, D. (1995). *Language change in child and adult Hebrew: A Psycholinguistic perspective*. Oxford University Press.
——— (1996). Accessing the mental lexicon: Evidence from incompatibility between representation of spoken and written morphology. *Linguistics* 34: 1219–1246.
Ravid, D. & A. Avidor (1998). Acquisition of derived nominals in Hebrew: Developmental and linguistic principle. *Journal of Child Language* 25: 229–266.
Ravid, D. & S. Gillis (2002). Teachers' perception of spelling patterns and children's spelling errors: A cross-linguistic perspective. In M. Neef, A. Neijt & R. Sproat (eds.) *Consistency in writing systems*: 71–93. Niemeyer.
Ravid, D. & D. Malenky (2001). Awareness of linear and nonlinear morphology in Hebrew: A developmental study. *First Language* 21: 25–56.
Ravid, D. & M. Nir (2000). On the development of the category of adjective in Hebrew. In M. Beers, B. van den Bogaerde, G. Bol, J. de Jong & C. Rooijmans (eds.) *From sound to sentence: Studies on first language acquisition*: 113–124. Groningen: Center for Language and Cognition.
Ravid, D. & Y. Shlesinger (2001). Vowel reduction in Modern Hebrew: Traces of the past and current variation. *Folia Linguistica* 35: 371–397.
Ravid, D. & L. Tolchinsky (2002). Developing linguistic literacy: A comprehensive model. *Journal of Child Language* 29: 419–448.
Ravid, D., J. Van Hell, E. Rosado & A. Zamora (2002). Subject NP patterning in the development of text production: Speech and writing. *Written Language and Literacy* 5: 69–94.
Ravid, D. & S. Zilberbuch (in press) Morpho-syntactic constructs in the development of spoken and written text production. *Journal of Child Language*.

Reilly, J., H. Jisa, E. Baruch & R. Berman (2002). Modal expression of propositional attitudes. *Written Language and Literacy* 5: 183–218.
Richards, B. (1987). Type/Token Ratios: What do they really tell us? *Journal of Child Language* 14: 201–209.
Richards, B. & D. Malvern (1997). *Quantifying lexical diversity in the study of language development*. University of Reading.
Rivier, F. & S. Clarke (1996). Multiple auditory areas in man: Evidence from cytochrome oxidase pattern. *European Journal of Neuroscience* 9: 90.
Rubin, H. (1988). Morphological knowledge and early writing ability. *Language and Speech* 31: 337–355.
Rumelhart, D. & J. McClelland (eds.) (1986). *Parallel distributed processing: Explorations in the microstructure of cognition. Volume 1: Foundations*. MIT Press.
Saffran, J., R. Aslin & E. Newport (1996). Statistical learning by 8-month-old infants. *Science* 274: 1926–1928.
Saffran, J., E. Johnson, R. Aslin & E. Newport (1999). Statistical learning of tone sequences by human infants and adults. *Cognition* 70: 27–52.
Saffran, J., E. Newport & R. Aslin (1996). Word segmentation: The role of distributional cues. *Journal of Memory and Language* 35: 606–621.
Sams, M., R. Aulenko, M. Hamalainen, R. Hari, O. Lounasmaa, S. Lu & J. Simola (1991). Seeing speech: Visual information from lip movements modifies activity in the human auditory cortex. *Neuroscience Letters* 127: 141–145.
Scarborough, H. (1990). Index of productive syntax. *Applied Psycholinguistics* 11: 1–22.
Schieffelin, B. (1979). A developmental study of word order and casemarking in an ergative language. *Papers and Reports on Child Language Development* 17: 30–40.
Seidenberg, M. (1997). Language acquisition and use: Learning and applying probabilistic constraints. *Science* 275: 1599–1603.
Shi, R., J. Morgan & P. Allopena (1998). Phonological and acoustic bases for earliest grammatical category assignment: a cross-linguistic perspective. *Journal of Child Language* 25: 169–201.
Shlesinger, Y. (2000). *Journalistic Hebrew: Stylistic aspects of Hebrew newspaper sections* [in Hebrew]. Ben Gurion University of the Negev Press.
Slobin, D. (1977). Language change in childhood and in history. In J. MacNamara (ed.) *Language learning and thought*: 185–214. Academic Press.
——— (1981). The origin of grammatical encoding of events. In W. Deutsch (ed.): 185–199.
——— (1985). Crosslinguistic evidence for the language-making capacity. In D. Slobin (ed.): 1157–1279.
——— (1986). Universal and particular in the acquisition of language. In P. Fletcher & M. Garman (eds.): 128–172.
——— (1991). Learning to think for speaking: Native language, cognition and rhetorical style. *Pragmatics* 1: 7–25.
——— (1997). The universal, the typological, and the particular in acquisition. In D. Slobin (ed.): 1–39.
——— (2001). Form-function relations: How do children find out what they mean? In M. Bowerman & S. Levinson (eds.): 406–449.
Slobin, D. (ed.) (1985). *The crosslinguistic study of language acquisition* (2 vol.). Erlbaum. D. Slobin (ed.) (1997). *The crosslinguistic study of language acquisition*, Vol. 5. Erlbaum.

Smith, M. (1998). *Sense and sensitivity: An investigation into fifth grade children's knowledge of English derivational morphology and its relationship to vocabulary and reading ability*. Ph.D. Diss., Harvard University.

Smoczynska, M. (1985). The acquisition of Polish. In D. Slobin (ed.): 595–686.

Snow, C. (1986). Conversations with children. In P. Fletcher & M. Garman (eds.): 69–89.

——— (1995). Issues in the study of input: Finetuning, universality, individual and developmental differences, and necessary causes. In P. Fletcher & B. MacWhinney (eds.): 180–193.

Soja, N., S. Carey & E. Spelke (1991). Ontological categories guide young children's inductions of word meaning: Object terms and substance terms. *Cognition* 38: 179–211.

St. Georges, M. & D. Mills (2001). Electrophysiological studies of language development. In J. Weissenborn & B. Höhle (eds.): 247–259.

Strömqvist, S., V. Johansson, S. Kriz, H. Ragnarsdóttir, R. Aisenman & D. Ravid (2002). Toward a cross-linguistic comparison of lexical quanta in speech and writing. *Written Language and Literacy* 5: 45–68.

Tardif, T., R. Gelman & F. Xu (1999). Putting the "noun bias" in context: A comparison of Mandarin and English. *Child Development* 70: 620–535.

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

Theakston, A., E. Lieven, J. Pine & C. Rowland (2001). The role of performance limitations in the acquisition of verb-argument structure: an alternative account. *Journal of Child Language* 28: 127–152.

Tomasello, M. (2000). Do young children have adult syntactic competence? *Cognition* 74: 209–253.

Tomasello, M. (ed.) (1998). *The new psychology of language: Cognitive and functonal approaches to language structure*. Erlbaum.

Tomasello, M. & P. Brooks (1999). Early syntactic development: A construction grammar approach. In M. Barrett (ed.): 161–190.

Tomasello, M., R. Strosberg & N. Akhtar (1996). Eighteen-month-old children learn words in non-ostensive contexts. *Journal of Child Language* 22: 1–20.

Valian, V. (1991). Null subjects in the early speech of American and Italian children. *Cognition* 40: 21–81.

Van Kleeck, A. (1982). The emergence of linguistic awareness: A cognitive framework. *Merrill-Palmer Quarterly* 28: 237–265.

Vihman, M. (1993). Variable paths to early word production. *Journal of Phonetics* 21: 61–82.

Vihman, M. & M. Greenlee (1987). Individual differences in phonological development: ages one and three. *Journal of Speech and Hearing Research* 30: 503–521.

Vihman, M., E. Kay, B. De Boysson-Bardies, C. Durand & U. Sundberg (1994). External sources of individual differences? A crosslinguistic analysis of the phonetics of mothers' speech to 1-year-old children. *Developmental Psychology* 30: 651–662.

Vihman, M. & L. McCune (1994). When is a word a word? *Journal of Child Language* 21: 517–542.

Wanner, E. & L. Gleitman (eds.) (1982). *Language acquisition: The state of the art*. Cambridge University Press.

Weissenborn, J. & B. Höhle (eds.) (2001). *Approaches to bootstrapping*. John Benjamins.

Werker, J. & R. Tees (1999). Influences on infant speech processing: Towards a new synthesis. *Annual Review of Psychology* 50: 509–535.

Wijnen, F., M. Kempen & S. Gillis (2001). Bare infinitives in Dutch early child language: An effect of input? *Journal of Child Language* 28: 629–660.

Woodward, A. & E. Markman (1998). Early word learning. In W. Damon, D. Kuhn & R. Siegle (eds.) *Handbook of child psychology*. Volume 2: *Cognition, perception and language*: 371–420. Wiley.
Wysocki, K. & J. Jenkins (1987). Deriving word meanings through morphological generalization. *Reading Research Quarterly* 22: 66–81.
Yuill, N. (1998). Reading and riddling: The role of riddle appreciation in understanding and improving poor text comprehension in children. *Current Psychology of Cognition* 17: 313–342.