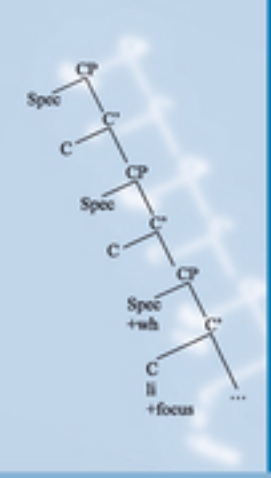

Potsdam Linguistic Investigations
Potsdamer Linguistische Untersuchungen
Recherches Linguistiques à Potsdam

Edited by
Herausgegeben von
Edité par

Peter Kosta
Gerda Haßler
Teodora Radeva-Bork
Lilia Schürcks
Nadine Thielemann

Christina Behme

Evaluating Cartesian Linguistics

From Historical Antecedents to Computational Modeling

PETER LANG
EDITION

Chapter 1: Introduction

Cartesian Linguistics, originally published with the purpose of deepening "our understanding of the nature of language and the mental processes and structures that underlies its use and acquisition" (Chomsky, 1966, p. ix), has generated controversy from the time it was first released in 1966 to its recent 3rd edition in 2009. On the one hand it has been praised exuberantly as "an intellectual tour de force… an unprecedented and – so far – unequalled linguistic-philosophical study of linguistic creativity and the nature of the mind" (McGilvray, 2009, p. 1). On the other hand it has been severely criticized: "Chomsky's version of the history of linguistics… is fundamentally false from beginning to end – because the scholarship is poor, because the texts have not been read, because the arguments have not been understood…" (Aarsleff, 1971, p. 584). In this book I will evaluate the arguments of both sides.

I will use *Cartesian Linguistics* as a framework for an inquiry into the linguistic work of Noam Chomsky. Chomsky's work has been tremendously influential, and a comprehensive evaluation of it would exceed the scope of a single book. I will focus on several key aspects here: (i) the historic connection of *Cartesian Linguistics* to previous linguistic theorizing, (ii) the development of Chomsky's own theorizing, (iii) the empirical work addressing the problem of language acquisition, and (iv) the problem of computational modeling of language learning. Each of these themes will be dealt with in one chapter.

Broadly speaking, there are two philosophical positions regarding language acquisition. Either all our linguistic knowledge comes directly (perception) or indirectly (inference, induction) from sense experience (empiricism), or at least some of our linguistic knowledge is innate rationalism). Similarly, in psychology, empiricism (sometimes called the 'blank slate' or *tabula rasa* view) holds that virtually everything is learned through interaction with the environment, and nativism is the view that certain skills or abilities are hard wired into the brain at birth. Currently no one holds either the pure empiricist or pure rationalist view, and I will introduce more nuanced positions as I discuss proponents of either tradition.

Chomsky has defended throughout his career a rationalist/nativist view of language acquisition and language use. He has claimed that this view can be traced

back to important linguistic, philosophical, and scientific precursors. According to Chomsky these have been largely neglected:

> Modern linguistics, however, has self-consciously dissociated itself from traditional linguistic theory and has attempted to construct a theory of language in an entirely new and independent way. The contributions to linguistic theory of an earlier European tradition have in general been of little interest to professional linguists, who have occupied themselves with quite different topics within an intellectual framework that is not receptive to the problems that gave rise to earlier linguistic study or the insights that it achieved; and these contributions are by now largely unknown or regarded with unconcealed contempt. (Chomsky, 1966, p. 1)

These remarks were written in 1966 but are repeated, without comment, in 2002 and 2009. I will show that while they may have had some justification in the 1960s, they are not applicable to contemporary linguistics. When dealing with the historic antecedents I will focus on two distinct but closely interrelated aspects. First, I give a brief account of Chomsky's original proposals as expressed in the 1966 edition of *Cartesian Linguistics*. Second, I show how the term 'Cartesian Linguistics' has been used by Chomsky and some of his close followers over the last five decades to argue for the superiority of their linguistic theorizing.

Chomsky (1966) claims that some of the allegedly neglected insights have been those of René Descartes. I will give a detailed account of the role 'innate ideas' and 'poverty of the stimulus' arguments (both prominent elements in support of contemporary nativist/rationalist positions) played in Descartes' writings. It will become evident that insofar as Descartes concerned himself specifically with linguistic theory, his insights are equally compatible with the theories of contemporary nativists and empiricists. Furthermore, a close reading of Descartes' own work makes it dubious that Chomsky's work can be traced back to a coherent rationalist tradition of which Descartes was one important founder.

My discussion of Descartes' writings focuses on issues that are specifically important to Chomsky's linguistic theories. Chomsky holds that Descartes' commitment to innate ideas foreshadows his own postulation of an innate domain specific language acquisition device (LAD). Focusing on three fundamental claims of Chomsky that (i) language is species specific, (ii) language is domain-specific, and (iii) language depends on innate knowledge, I will provide textual evidence supporting the conclusion that, while Descartes believed that language is species specific, he was committed neither to the view that language is domain specific nor to the view that language acquisition depends on innate knowledge in a sense that is compatible with Chomsky's use of these terms. Further, I will show that

Chomsky misunderstands important arguments for Descartes' belief that animals could not acquire language.

Descartes' writings demonstrate that he believed that language is species specific. Virtually all humans acquire language and use it regardless of a wide range of differences in their age, health, and intelligence. On the other hand, no animal has cognitive abilities that would allow the use of language. The fact that language is species specific could be explained in two different ways. The first scenario is that only humans have a domain specific language faculty. In this case it would be possible that an animal that had implanted an artificial language faculty would behave in ways that are indistinguishable from a human being. In the second scenario language is an indicator of general intelligence (thought and reason in Descartes' terminology). In this case it would not be possible to 'construct' an artificial language faculty that is independent of 'general intelligence'. I will provide evidence for my claim that Descartes was committed to the second scenario.

When Descartes discusses the differences between animals and humans he stresses repeatedly that very little reason is needed to use language. This could indicate he believed, like Chomsky, that humans have a domain specific language faculty that is independent of 'general intelligence'. I will show that the purpose of Descartes' comparative examples is to show that the most fundamental difference between humans and animals is that only humans have a mind. Language requires a rational mind, and, according to Descartes, animals lack such a mind (Gunderson, 1964; Miel, 1969). Having a rational mind does not entail having domain-specific mental faculties. In fact it is well established that for Descartes minds are indivisible: "we cannot understand a mind except as being indivisible… we cannot conceive of half a mind" (CSM II, p. 9) and that the essence of mind is thought. I will show that these strong commitments prevent Descartes from holding that language is domain-specific. Seemingly, Chomsky does not understand this commitment of Descartes (e.g., Chomsky, 1975b, 2010b). For Chomsky, animals have some form of 'general intelligence'. But they do not acquire language because they lack a domain-specific language faculty. This is an inportant difference in the views of Descartes and Chomsky.

Next, I discuss textual evidence supporting a possibly surprising view about Descartes' commitments regarding language acquisition. He states that language "can be acquired without any process of reasoning… [based] on experience alone" (CSM, II, p. 403), that we learn language by connecting words with their meanings and remembering later upon encountering words which things they signify and vice versa (CSMK, III, p. 307) at a time when our thoughts are 'confused' and based of 'misconceptions'. Of course, the language we acquire under such

circumstances is not a perfect tool for the correct expression of our thoughts. But while engagement with philosophical or scientific work requires that we employ new ways of thinking, Descartes does not suggest that our language needs to be changed. Descartes also does not hold that language acquisition is a mechanical process of brain maturation in accordance with 'deterministic physical principles', as Chomsky (2010b) incorrectly suggests.

After establishing these points about language acquisition I will show that my reading of Descartes is compatible with his theory of innate ideas. Discussing the frequently cited passages in *Comments on a Certain Broadsheet* (CSM I, p. 304), where Descartes asserts that all ideas are innate, I show that a careful reading of the context reveals that Descartes' main goal here was to refute the scholastic account of sense perception. On this interpretation what is innate is not the content of sensory ideas but the faculty of sense perception. This interpretation allows for a coherent Cartesian account of language acquisition, and suggests that the role that Cartesian innate ideas play for language acquisition is very different from the role innate knowledge plays for Chomskyan accounts. For these reasons I suggest that, from a perspective of 'the history of ideas', it is quite misleading to call Chomsky's approach to linguistics Cartesian. I discuss some of the reasons Chomsky provides for interpreting Descartes in a very unconventional "hybrid" way and suggest that this does not reflect any genuine Cartesian commitments.

In the next chapters I connect the historic antecedents of *Cartesian Linguistics* to contemporary debates in linguistics, philosophy of language, and developmental psychology. Today virtually all researchers agree that extreme rationalism/nativism (all knowledge is innate) is as implausible as extreme empiricism (nothing is innate). Thus, recently the debate concerns mainly how much of our knowledge extends beyond our sense experience. Empiricist and rationalist researchers inquire about the character of the interaction with our linguistic environment, and the nature of the mechanisms that allow us to acquire linguistic knowledge. As we learn more about the structure of the human brain and the learning mechanisms available to children, we can develop more tools to (i) clarify boundaries between innate and acquired linguistic knowledge, and (ii) evaluate how pre-linguistic infants can extract information from their environment. Furthermore, research in linguistics has provided new insights regarding the status of core issues such as types of grammars, recursion, and the role of linguistic intuitions and empirical testing. Recently, computational models of language acquisition have provided additional means for testing different hypotheses. The information gained from these different sources has important implications for subsequent philosophical theorizing.

In chapter 3 I provide an overview of the evolution of Chomsky's theorizing during the past six decades. My inquiry focuses on the work of Chomsky and his closest followers and I will use the term 'Chomskyan' only to refer to this restricted group, not to the much larger community of linguists that have been influenced by Chomsky in some way but departed in important points from the views he defends. I chose this focus because Chomsky has been such an influential figure, and is widely considered as instrumental to the cognitive revolution of the 1950s even by those who disagree with his views (e.g., Sampson, 1980; Katz, 1981, 1996; Seuren, 1998; Boden 2006). Linguists, cognitive scientists, and philosophers continue to look to him for inspiration. I provide comprehensive evidence for my conclusion that this trust in Chomsky's intellectual leadership is no longer justified.

My main focus is on the claim that Chomsky's work has situated linguistics firmly within the natural sciences and provided a better understanding of language acquisition and language use (McGilvray, 2009, 2012). I discuss how the core claims of Chomskyan theorizing have changed over time, and show how this affected his attitude towards 'traditional scientific practice'. I introduce several criticisms of Chomsky's work, concerning methodological and conceptual issues, and show that Chomsky has failed to address them satisfactorily. Further, I evaluate the contributions that Chomsky's work made to our understanding of how children learn language. Chomsky's definition of what language is, and thus what children acquire when they learn language, has changed considerably. I argue that these changes have not led to a better understanding of language acquisition.

I give a detailed account of the evolution of Chomsky's linguistic theories. Early in his linguistic career Chomsky focused on syntax and grammar (e.g., Chomsky 1951, 1956, 1957, 1959, 1965a,b, 1966, 1968). Some important contributions of Chomsky's early work were the proposals that (i) human languages have syntactic universals, (ii) a grammar defines the class of grammatical sentences, and (iii) the universals define a range of possible grammars (and by implication rule out any logically-possible grammar not contained within that range). Chomsky claimed that human languages cannot be generated by simple constituency grammars alone, and proposed that an additional series of transformational rules is needed to generate all grammatical sentences of human languages. This early work contributed to clarifying important conceptual issues, provided a scientific framework for linguistics, and had an impact that reached far beyond linguistics. I discuss some of these early contributions and show how they were relevant to Chomsky's theories of language acquisition.

During the following decades Chomsky "has overturned and replaced his own established systems with startling frequency" (Smith, 1999, p. 1). I discuss some of

the milestones of these conceptual changes. In the 1960s Chomsky proposed that the true subject of linguistic inquiry should be the "deep structure" of language. He suggested that this deep structure is the same for all human languages and only indirectly reflected in the 'surface structures' of languages such as English. Chomsky suggested that a set of transformational rules converts deep structures to surface structures. Over the next two decades the complexity of the proposed rules increased continually. An important conceptual "innovation" of the 1980s was the introduction of the competence and performance distinction and the E- and I-language distinction. Chomsky insisted that the object of linguistic study should be the physical parts of biological brains that constitute language (I-language), and he suggested that the focus of non-Chomskyan linguists on E-language is misguided. He held now that E-language is an arbitrary, artificial construct "that is understood independently of the properties of the mind/brain" (Chomsky, 1986a, p. 29), and the study of E-language will not reveal anything interesting about the nature of language.

In the 1990s a sweeping reconceptualization greatly reduced the complexity of Chomskyan system and eliminated deep structure. The resulting Minimalist Program is based on the assumption that syntax is a computational system that provides the optimal solution to the problem of relating sound and meaning. This proposal has been severely criticized, even by theorists closely associated with Chomsky's earlier work (e.g., Culicover, 1999; Jackendoff, 2011; Jackendoff & Culicover, 2005; Newmeyer, 2008). I show that these critics are justified.

If we conceive of language as well-defined part of the physical brain, then the brain should be the main object of linguistic study. However, Chomsky's own research has not contributed directly to locating language in the human brain. Further, because Chomsky continues to perceive of empiricist linguistics as behaviourist dogmatism he essentially ignores the results of these researchers. Critics have suggested that this attitude leads to a "time wasting rediscovery of facts or principles that had long been common knowledge outside the Chomskyan camp" (Sampson, 1980, p. 160).

Further, the conceptual move from 'language' defined as set of sentences or expressions to 'language' as part of human brains is problematic. Essentially, this move has never been fully completed, and Chomsky continues to treat language as both: as sets of sentences and as biological object (e.g., Chomsky 1986a, 1995, 2000a,b, 2007b, 2012). This inconsistent treatment blurs the distinction between the object of linguistic study (sentences of a language and their logical relations), and the object of physiological/neurological study (brain structures involved in generating the sentences linguists can

analyze). Chomsky's conflation of the physical tokens of sentences with the non-physical types of sentences results in the untenable view that languages are both finite (as parts of human brains) and infinite (as grammatical strings of words). It may seem that on a charitable interpretation this dilemma dissolves, if we consider the language faculty as a biological part of the brain that produces a (potentially infinite) set of linguistic expressions. I show that this interpretation raises different problems for Chomsky's account, and suggest that his view rests on a metaphysically incoherent foundation.

While some important details of Chomsky's theories have changed over the years, he has remained consistent in his core assumptions about language acquisition. He continues to use Poverty of the Stimulus Arguments as a crucial component of support for his postulation of an innate domain specific language acquisition device (LAD). This LAD supposedly is a largely genetically determined part of our biological endowment. I provide a detailed account of Chomsky's definitions of the language faculty and show that Chomsky still needs to provide a coherent hypothesis that could be experimentally confirmed or falsified.

My literature review reveals that the nature of the LAD is still shrouded in mystery. This may seem surprising because for Chomskyans the LAD can "provide an implicit definition of the notion 'human language'" (Allen & van Buren, 1971, p. 14), and a lot of conceptual work has gone into explaining and re-explaining it. According to Chomsky his ideas regarding the study of the LAD "crystallized into a distinctive approach to the topic by 1980. In the years since many specific variants have been developed and explored" (Chomsky, 1995, p. 13). However, the frequent re-evaluations of earlier variants and wholesale reconceptualizations of previous theories have resulted so frequently in "substantially different conceptions of the mechanisms of language" (Ibid., p. 219), that it has become increasingly difficult to evaluate Chomsky's theoretical commitments at a given point in time. To date Chomsky's work has not provided an unambiguous hypothesis that can be empirically tested.

Other main concepts of Chomsky's work remain ill defined. I discuss the example of 'innateness' and show that (i) Chomsky's own work has not contributed to clarifying this important concept, and (ii) his use of the term 'innate' is inconsistent and has frequently misled his followers and his critics alike. Specifically Chomsky's repeated claims that he has never defended an innateness hypothesis are misleading and should be replaced by clear statements of the current hypothesis. This would allow to evaluate whether or not this hypothesis is viable.

Chomsky's commitment to accounting for empirical data has seemingly waned. More precisely, he and some of his followers have become more selective regarding the subset of empirical data they consider to be acceptable for linguistic theorizing. His wholesale dismissal of data gathered by researchers outside his own school is never explained based on studies that have exhibited problematic methods or produced unrepeatable results. In this context I discuss a particularly troublesome aspect of Chomskyan science: the many imprecise formulations and contradictory statements that have allowed him to escape criticism. I suggest that Chomsky needs to provide a clear account of his position and of his contributions to linguistics. Until such an account is provided, it is not possible to evaluate whether his contributions have been substantial.

In chapters 4 and 5 I discuss work of experimental and computational language acquisition researchers and show that they are paying close attention to the conditions under which children acquire language. Specific aspects of language acquisition (e.g., word segmentation, acquisition of grammatical categories, past-tense formation, auxiliary fronting in question formation, etc.) are under intense empirical investigation. Researchers work with young children and attempt to develop computational models that simulate the performance of children. This 'empiricist work' is the focus of the second part of this book. Chapter 4 introduces the results of some of the work that has been completed by developmental psychologists, and chapter 5 focuses on computational models of language acquisition that are informed by results obtained from the work with children.

Chapter 4 focusses mainly on the first steps of language acquisition that have been largely neglected by Chomsky's research. Children need to master many cognitive skills in order to acquire and use language. Several of these skills need to be in place long before children begin producing the grammatically complex utterances that are often the focus of Chomsky's work. One of these skills is the ability to produce the sounds of their native language and to combine them into words and eventually into grammatically correct sentences. It takes a considerable amount of learning before children can reliably produce recognizable words. These learning processes occur over several months and set the stage for later learning. Yet, they are virtually neglected in the Chomskyan approach.

Further, I highlight some of the abilities that the young language learner has to acquire before she can produce her first meaningful sentences. I discuss in some detail the stages that precede the production of single and multi-word utterances. In the first months of life the infant goes through a phase of vocalization during which she identifies, acquires, and practices the sounds that are common in her language. This babbling stage lasts several months. Around the first birthday,

most infants speak their first meaningful words, and they gradually expand their productive vocabulary. Empirical research has shown that the initial pace of vocabulary learning (from birth to 18 months) is very modest. It has been suggested that during this time children acquire and practice many cognitive abilities. An infant needs to be able to *see* object boundaries before she can form the hypothesis that ostensive definitions apply to whole objects. She needs to be able to *perceive* similarities and differences between objects before she can categorize them. Further, she needs to be able to resolve the conflict between the mutual exclusivity assumption (one name for one object, e.g. 'dog' for the family pet) and the need for taxonomic categorization (e.g. 'dog' for any dog-like object). Children acquire and practice these abilities over an extended time period. Gradually they learn to categorize the world and to understand how words refer to objects, actions, and properties. One hypothesis suggests that once the child has acquired this knowledge, she can slot with ease new words into existing categories (Deacon, 1997). According to this view, general learning mechanisms could account for language acquisition, and an LAD would not be needed.

The fast acquisition of vocabulary and syntax after the second birthday (vocabulary spurt) is frequently used as supporting evidence for the existence of language-specific learning mechanisms that mature at genetically predetermined times (e.g., Chomsky, 1975a, 1985; Lightfoot, 1989; Pinker, 1994; Smith, 1999). I discuss recent work that offers an alternative account for the vocabulary spurt. On this view the vocabulary spurt is an inevitable result of the infant's immersion in words of varying difficulty, not evidence for the existence of an innate language faculty that is shared by all members of the human species. Further, empirical work has shown that not all children go through a well-defined vocabulary spurt. And in cases where a vocabulary spurt occurs its timing varies widely between individual children. These findings suggest that the vocabulary spurt should not be considered as evidence for genetically predetermined stages of language acquisition.

Another empirical observation that seemingly supports Chomsky's Poverty of the Stimulus Argument is that certain data (or linguistic constructions such as wh-fronting) appear to be so infrequent in the input that they are virtually inaccessible to the child. This raises the question of whether or not the use of such constructions requires innate knowledge. In recent years researchers have begun to analyze the frequency of some crucial constructions in the input (Sampson, 2002). Considering that not all children are exposed to the same data input, it is important to analyze large samples of data from different backgrounds. Eventually this will provide the data to evaluate *appropriately*

the competing hypotheses (data-driven learning vs. learning driven by innate knowledge).

Another important issue is explaining the alleged absence of certain kinds of mistakes in children's speech, even though one would expect those mistakes to occur (Chomsky, 1985, 1988). It has been suggested that language comprehension precedes language production and that children do receive feedback when they make comprehension mistakes (overview in Johansson, 2005). I suggest that more data are needed to rule out the possibility that children have learned facts about language, that help them to avoid these kinds of mistakes, at earlier stages of the language acquisition process. In this context it is also important to analyze the mistakes that children *do* make and the kinds of utterances they *fail to produce*, especially in the very early stages of language acquisition. Furthermore, I discuss the controversial issue of negative evidence (explicit correction of mistakes) in the language input. Chomsky (1977) claims that negative evidence is virtually unavailable. However, recennt research shows that different forms of negative evidence are available. Further, it has been shown that negative evidence is not *necessary* for learning to take place (e.g., Smeeton et al., 2005). Thus, the issue of negative evidence appears to be less clear than implied by Chomsky (1977), and further empirical research is needed to determine whether (and to what degree) negative evidence is required for language learning.

The empirical evidence discussed in chapter 4 does not provide strong support for Chomskyan nativism/rationalism. Detailed analysis of the information that is contained in the language input and re-evaluation of the power of general-purpose learning mechanisms suggest that a domain specific LAD may not be *necessary* for language acquisition. But these findings do not rule out that a domain specific LAD exists. As long as Chomskyans do not provide a specific innateness hypothesis that makes testable predictions, empirical research can neither confirm nor disconfirm that a Chomskyan LAD exists.

Computational models of language acquisition provide two independent ways to challenge the Chomskyan dictum that language acquisition is domain specific and depends on innate knowledge. First, if it can be shown that mechanisms that clearly are not involved in human language acquisition can achieve human-like performance, then this proves that the mechanism postulated by Chomsky is not necessary for language acquisition. Second, if 'general-purpose' connectionist and/or other computational models succeed in simulating language acquisition, then it cannot be ruled out that general-pupose mechanisms *are* used in human language acquisition.

In chapter 5 I discuss some of this work and show that some computational language acquisition researchers are attempting to simulate the conditions under which children acquire language. Many computational language acquisition researchers use as input samples of child-directed speech that has been collected by developmental psychologists. The CHILDES database (MacWhinney, 1985) in particular provides a rich resource for computational modeling. Many researchers use samples from this database as input for their models. Further, several computational models have successfully simulated the performance of language-learning children not only in respect to their successes but also in respect to limitations (e.g., processing of higher order recursion). Further, I show that many current computational models directly incorporate insights from previous models and from experiments performed with children. I suggest that researchers have shown the potential to provide a model of language learning that does not depend on domain specific mechanisms. However, currently implemented models only simulate small parts of the language-learning task and can, at best, provide evidence that some limited aspects of language learning can be accomplished by non-domain-specific mechanisms. Whether or not the same would hold true for the learning of a complete language 'from scratch' remains to be seen.

The complexity of language has led several authors to conclude that it is implausible that distributional information of patterns within language could play a significant role in the acquisition of syntactic categories (Chomsky, 1975d; Crain 1991; Crain & Pietroski, 2002, McGilvray, 2005). However, it has been demonstrated that a considerable amount of information concerning syntactic categories can be obtained from stochastic information. Natural languages contain rich statistical information and children have powerful learning mechanisms to access this information. The ability to track items based on their perceptual properties allows infants to categorize their natural environment long before they have access to the meaning of words. Recent computational models simulate how children might master the first steps of language acquisition. I discuss examples of models that succeed in word-segmentation and acquisition of grammatical categories.

Researchers have used computational models to simulate many aspects of the performance of language-learning children. However, even fully successful simulation would not entail that human children acquire language using the same mechanisms. Thus, the computational work cannot disprove the LAD hypothesis. But it can refute the claim that the language input is too impoverished to allow for a data driven general-purpose language learning mechanism. I provide an overview of recent studies that show how simple recurrent networks (SRN's) and other

computational devices can access and use the multiple statistical cues contained in natural languages.

Many aspects of language acquisition have been simulated successfully. Recent work has shown that (i) simple computational models can achieve high accuracy in the word-segmentation task based on positive evidence alone, (ii) correct auxiliary fronting (AUX) in polar interrogatives can be acquired based on indirect statistical information contained in child-directed speech, (iii) "natural" and/or "grammatical" languages are easier to learn than "unnatural" and/or "ungrammatical" languages, (iv) postulating specific mechanisms for rule-based abstraction is not necessary to account for the acquisition of complex grammatical and orthographic rules.

When SRNs and other computational models are able to acquire statistical "knowledge" of the input based on positive examples alone, then it seems to be at least imaginable that children can pick up this information as well. Whether or not children rely on similar mechanisms as SRNs remains a point of debate (for some critical suggestions see Marcus, 1999; Marcus & Brent, 2003). But the success of computational models relying on these mechanisms casts some doubt on the claim that *only* an innate, domain-specific mechanism can underwrite human language acquisition.

In the final chapter I summarize the key findings of the previous chapters and provide recommendations for future research. Specifically, my research in casts doubt on Chomsky's claim that his work can be traced back to a single 'rationalist' Cartesian tradition. This is an important finding for the accurate discussion of the history of ideas. But it is only of marginal importance for the contemporary linguistic debates. Whether or not Chomsky's views can be confirmed by empirical research remains to be seen. However, in spite of repeated theoretical reformulations (e.g., Chomsky 1980, 1986b, 1995, 2002, 2005) of these views over the past decades, it seems doubtful that Chomsky's "theories have made considerable progress" (McGilvray, 2009, p. 19), if progress is defined in terms of making better empirically testable predictions. Chomsky's work has not clarified the subject of linguistic inquiry, and we still await unambiguous definitions of essential concepts relevant to linguistic research (e.g., 'innate', 'Universal Grammar' 'Language Acquisition Device'). Chomsky's "theory of a biophysically based organic system" (Chomsky, 2010a, p. 20) remains so vague that it cannot be confirmed or disconfirmed experimentally. Thus, a main task for future work is to make good on the promises of the 1980s and provide "a principled theory of UG" (Chomsky, 1986b, p. 10) that is descriptively and explanatorily adequate and "accounts for the fact that

knowledge of language is acquired on the basis of the evidence available" (Ibid.). Given the vast literature that has been created by Chomskyans, it is essential that they take stock and provide a accurate overview of the views that have been rejected and the views that are currently held. No such overview has been completed to date.

Regarding the empirical work discussed in chapters 4 and 5, several important tasks remain to be solved. Language acquisition studies can help to cast some doubt on the necessity of domain-specific learning mechanisms and Universal Grammar. But, we still know little about the brain-mechanisms that allow children to acquire language. Direct research on human subjects is complicated for a variety of reasons. First, ethical considerations prohibit direct input studies under strictly controlled experimental conditions. Therefore, researchers have to rely on participants who bring an unknown amount of learned knowledge to the experiment, and they "never know for certain what the child has and has not heard [before]" (Tomasello, 2000, p. 215). It remains to be seen whether it will be possible to develop methodologies that can distinguish between previously learned and innate knowledge. Second, existing empirical studies tend to focus on very narrow questions. This results in a wealth of empirical data that seem to suggest that certain aspects of language learning can be accomplished by data-driven general-purpose learning mechanisms. But even showing that all of the 'individual pieces' of language competence can be acquired in this way, does not rule out that a domain-specific mechanism is required to combine and coordinate such complex learning. This is one important question to be examined in future research. Finally, given the tremendous quantity of input available to young children, it would take a substantial amount of time to collect representative samples of even small parts of the actual input. Tomasello cautions that "if we do not know what children have and have not heard, adult like production and comprehension of language is not diagnostic of the underlying processes involved" (Tomasello, 2000, p. 216). Representative input samples will be needed to evaluate adequately the poverty or richness of the input.

Overall, it is essential to strive for conceptual clarity that provides a solid foundation for multidisciplinary research that compares language to more general cognitive capacities in humans and animals. As philosophers we can contribute to this important conceptual work. To do this effectively we need to communicate with researchers who work on the different aspects of language acquisition. Their results need to inform our theorizing. A detailed analysis and evaluation of the problems encountered by Chomskyan linguistics can provide valuable insights

for future theorizing. Such analysis can help to eliminate incorrect assumptions and to question conclusions drawn from them. Such a process is quite Cartesian in spirit: "…[a man] should resolve once and for all to remove from his imagination all traces of the imperfect ideas which have been engraved there up until that time. Then he should begin in earnest to form new ideas, applying all the strength of his intellect" (CSM II, p. 406).