Synoptic Introduction

Nicholas Allott[4], Terje Lohndal[1,2] and Georges Rey[3]

[1]NTNU Norwegian University of Science and Technology
[2]UiT The Arctic University of Norway
[3]University of Maryland
[4]University of Oslo

Noam Chomsky is justly famous for his revolutionary contributions to linguistics, psychology and philosophy. He is presently in his 92nd year, and we thought it high time to provide an overview of the major achievements of his now more than sixty-year-old research program and its prospects for the future. This is particularly pressing in the light of persistent rumors, encouraged by a number of authors[1], that his program has proven bankrupt, "completely wrong" and has been replaced by various sorts of proposals in general statistical learning and "functionalist/constructionist" linguistic theories (which we return to below).

We think these rumors are seriously mistaken. To be sure, the theory has evolved, displaying the kinds of complexities, revisions and increasing depth typical of any ongoing science. However, Chomsky's ideas and those of others working in his "generativist" framework are at the center of much of the most successful current work on the grammar of human language, and his work has been influential across many other areas of linguistics, including research on processing, language acquisition, language diversity and semantics. His program is one of the most important in the history of linguistics, and it has profound and enduring significance for psychology and philosophy, and indeed for our understanding of human nature generally.

This volume brings together views of Chomsky's legacy from the perspectives of many of his program's foremost practitioners, as well as some of his critics, in the many specific areas his work has influenced, including syntax, semantics, pragmatics, psycholinguistics and language acquisition, as well as philosophy of language, mind and science. It is divided into sections that address the main aspects of his work, each of which we will briefly summarize in this introduction.

Chomsky is, of course, also famous for his political writings. It is important to stress that these bear no direct connection to his linguistics, and lack of space here ruled out an entire section that would begin to do them justice. But we have at the end included one excellent and unusual discussion by Joshua Cohen and Joel Rogers of some of the enlightenment ideas that seem to inform both the politics and the linguistics.

All the chapters here are intended to be accessible to people not expert in the topics of the papers. All should be readable by linguists, philosophers, psychologists, and the general public interested in the present status of Chomsky's work in the many areas we have mentioned. Therefore they do not presuppose extensive technical knowledge of linguistics, although since the papers are short, some do get more technical towards the end.

1. Historical Development of Linguistics

A key feature of Chomsky's work on grammar, present from the beginning, is its concern to explain how on the basis of exposure to a finite set of utterances we come to be able to produce and understand a potential infinity of sentences we've never encountered (Chomsky 1955, 61; 1957, 15). Note the obvious but (when you think about it) remarkable fact that most sentences anyone encounters they have never heard before, and that the potential infinity is systematic, allowing some clauses and other constituents to be nested indefinitely, as for example in *This is the cat that chased the mouse that…. lived in the house that Jack built* but not *Cat Jack mouse the in is lived house chased*.

In his (1955) and (1957), where he developed an explicit and rigorous framework for analyzing the syntactic structure of human languages generally, Chomsky proposed that the potential infinity of sentences should be accounted for by the system of rules being "recursive" i.e. they can take their own output as input, thus building up structures of arbitrary complexity. In this framework, sentences are not just words that are linearly ordered, but instead, have abstract hierarchical structure[2]. He postulated two types of rules: "phrase structure" rules that construct (or "generate") the underlying structures, and transformational rules which operate on the structures thus generated and (inter alia) explain relations between sentences with related meanings: e.g. between the declarative *Eagles can fly* and the related polar interrogative *Can eagles fly?*[3]

Chomsky (1957) illustrated the need to postulate hierarchical structure and transformations that operate on it with a ground-breaking analysis of the English auxiliary system. Consider how English polar interrogatives are formed.[4] The auxiliary *can* in *Eagles can fly* "moves" to the beginning of the sentence, yielding *Can eagles fly?* English is strict about polar interrogatives starting with an auxiliary. When the declarative doesn't have one – e.g. *Eagles fly* – the "dummy" auxiliary *do* is inserted to satisfy the rule, so the interrogative here is *Do eagles fly?*

But what about more complex sentences with embedded clauses, such as *Eagles that fly swim,* where *Eagles that fly* is the subject? The related interrogative is *Do eagles that fly swim?* And even if you've never read this sentence before, you know (after a moment's thought, perhaps) that it is a question about whether a certain type of eagle (the flying type) swims and it *cannot* be understood as a question about whether swimming eagles fly. That is, the question auxiliary, *do*, is somehow connected to the verb *swim*, not the verb *fly.* If a sentence is just a list of words, this is hard to explain. Why should *do* be connected to the verb *swim*, which is further away than *fly*?

If we see sentences as hierarchical structures, then the answer is obvious. The structure of *Eagles that fly swim* is:

(1) [[Eagles [that fly]] swim]

That is, the sentence is made up of a subject [*Eagles that fly*] combined with a verb [*swim*], and the subject also has internal structure: it is made up of the noun *eagles* followed by a relative clause [*that fly*]. And then the rule for making a polar interrogative is just that the auxiliary *do* can only question the *main* verb in the clause (here *swim*), not a verb embedded in the subject like *fly*. In somewhat intuitive terms, we can say that *fly* is too deeply embedded to be 'visible' to the rule that forms the interrogative. Equally, we can say that

despite the misleading appearance given by linear order, *swim* is actually "closer" to the auxiliary, because the kind of closeness that matters is closeness *in the hierarchical structure*, and *swim* is at the top level, easy to access for a rule that operates on the declarative as a whole structure.

Thus, an adequate theory of English polar interrogatives has to postulate that sentences have hierarchical structure and that syntactic rules are sensitive to this structure (i.e. they are "structure-dependent"). There's nothing special about English or auxiliaries, though. In effect, all the work done by Chomsky and other generativists on syntax of many languages rests on these assumptions, and its continued, cumulative success has by now made it clear that all human languages have hierarchical structure and structure-dependent grammatical rules.

Chomsky's interest in the formal aspects of grammars led him to organize formal grammars themselves into a hierarchy, today known as either the Chomsky hierarchy or the Chomsky-Schützenberger hierarchy (Chomsky & Schützenberger 1963). Tim Hunter's chapter provides an extensive introduction to this hierarchy and also discusses its application to human languages, a central research objective in formal linguistics ever since Chomsky's fundamental work on this topic.

However, Chomsky himself quite quickly turned away from this purely formal interest, and from around 1960 he began to pursue in print what he always regarded as the more fundamental questions concerning the human ability to acquire and use language, which he proposed was due to a faculty of "Universal Grammar" (UG).[5] UG is the name for whatever innate mechanisms humans are born with which are specific to language ability and which enable them to acquire language. What they acquire includes an internal grammar (their "I-language" in the current terminology) that is characterized in terms of the kind of recursive rule system mentioned above, thus explaining the ability of a finite brain to produce and understand a potential infinity of novel sentences.

One kind of striking phenomenon that can serve as a useful introduction to Chomsky's psychological theories in this regard are what he sometimes calls "fine thoughts," or what we will call "WhyNots." These are strings of words that native speakers of a language find unacceptable, even though they can pretty readily guess what someone could mean by them: They would seem to express "perfectly fine thoughts" (cf. Chomsky 1962, 531; 2013a, 41; 2015, 98). Innumerable examples can be found in the literature, but one particular sort is interesting because it appears to be indisputably universal, i.e., true of all human languages.[6]

Consider the perfectly reasonable English sentence that a child might hear, *Mommy and Daddy will feed Fido.* Now, someone unsure of hearing this sentence could ask the "echo" questions, *Mommy and Daddy will feed* ***who****?* or *Mommy and* ***who*** *will feed Fido?*, and in any language like English that moves interrogative (or *wh*-) words, they could also ask the first one by asking, *Who will Mommy and Daddy feed?* But, curiously, in no language in which the interrogative could be moved, could they ask the second one by: **Who will Mommy and feed Fido?* Indeed, in no language can one extract an interrogative from a conjunction.[7]

The question for linguistics is: *Why not?* Surely no one ever teaches a child such a rule. Nor does such a rule seem to be merely a tacit convention, since alternatives to it never occur. Indeed, it's extremely unlikely that the child ever hears or tries to produce such a sentence. It's hard to resist the suggestion that Chomsky pursued on the basis of this and innumerable

similar phenomena that human children are somehow innately constrained to form some but not others of a potential infinity of strings of words. And Chomsky's main proposal at this stage was that these constraints could and should be capturable by formal and explicit theories of grammatical structure of the sort he had studied earlier, but which are in some way or another the result of innate features of the human brain.

The chapters included in this section are as follows. Artemis Alexiadou and Terje Lohndal provide an answer for two questions about generative grammar: Where are we now? And how did we get there? They explain how the Principles and Parameters approach emerged from early Phrase Structure grammars of the 1950's and 1960's. They also set out the underlying ideas leading to Government and Binding Theory and later to the current Minimalist Program, alongside identifying some prominent contemporary areas of research.

Lisa Lai-Sheng Cheng and James Griffiths consider some enduring discoveries that the Chomskyan program of research has contributed, focusing on empirically supported assertions relating to non-local dependencies and the explanatory role of gaps or empty categories. The generalizations they discuss are cross-linguistically robust, which also means that they serve as useful diagnostic tools.

As already mentioned, Hunter's chapter is an introduction to the Chomsky hierarchy, and a review of recent discussions of it. He focuses on the key intuitions from this highly mathematical work and how they can be applied to theoretical linguistics. Notably, Hunter argues that the lasting contributions of the Chomsky hierarchy are more significant than previous assessments would suggest.

Chomsky has mostly worked on syntax, but in a ground-breaking study of the sound patterns of English, Chomsky & Morris Halle (1968) launched a new framework for phonology construed as the study of the mental representations of speech sounds, which, like those of syntax, also turn out to have complex structure. This book was enormously influential and led to a great deal of cross-linguistic work based on the general approach Chomsky and Halle developed. In their chapter, Charles Reiss and Veno Volenec argue that, notwithstanding its status as a landmark in phonology, some of its most important implications have been neglected by the field, and remain to be exploited.

In the last chapter in this section, Lila Gleitman offers a personal and historical perspective on how Chomsky's work engages with and fits into cognitive science more generally, in particular in experimental work on language acquisition. She explains how her initial prejudice in favor of non-nativism – i.e., that children learn the vast bulk of their linguistic knowledge from the input they receive – was challenged at every stage by her experimental findings.

2. Contemporary Issues in Syntax

Over the past 70 years, since the work that led up to his (1951) MA thesis on Hebrew[8], Chomsky has developed and revised his ideas, sometimes radically, often in reaction to work that emerged in the large community of linguists working within the generative framework. As Alexiadou and Lohndal's chapter makes clear, the differences from one period to another may be quite substantial, yet the core questions that are being addressed are often rather similar. Each new path attracted new students and scholars, but some scholars also decided to

stick to the previous path (cf. Sells 1985). As such, the new ideas have also led to a rather dynamic community, and sometimes controversy as to what is the best way forward.

Often, the theory has been developed based on a small set of data (e.g., so-called "expletive" constructions in English such as *There were many students in her class/It is raining today,* where the *There* and *It* are semantically vacuous), but then the theory makes numerous predictions about other areas of the grammar that can then be tested and, as a result, the theory is often revised. This is just normal science, in which theories are frequently revised and sometimes replaced as new evidence is considered and greater depth achieved.

Some opponents of Chomsky have criticized him for being too focused on English, or for not caring enough about the coverage of data from the thousands of the world's languages. Apart from his master's thesis on Hebrew, it is fair to say that Chomsky has not personally worked on a large number of languages. However, generativists have pursued comparative syntax across languages from many different families from Amharic to Zoque – including both spoken and sign languages (see e.g., Lasnik & Lohndal 2013, Allott and Rey 2017). This work was one of the considerations that led directly to the "Principles and Parameters" approach, which proposes that UG is a combination of fixed principles and variable parameters — e.g., whether a verb precedes its direct object or *vice versa* — which are set during language acquisition on the basis of what the child hears. In fact, as Mark Baker's chapter makes clear, Chomsky's work has contributed significantly to the study of linguistic diversity.

Of course, the languages of the world at least superficially appear to vary widely. Appreciating the cross-linguistic evidence, using it to triangulate on UG, and to show how, despite the diversity of superficial appearances, all these languages plausibly do respect UG, requires careful analyses of the expressions in these languages — just as appreciating the underlying unities in any domain requires analyses beyond surface appearances (as in biology, chemistry, physics – who would have thought that ice and steam are the same substance?).

The present section covers multiple topics that all relate to contemporary issues in syntax. David Adger's chapter deals with the nature of hierarchical relations, in particular the computational procedure needed to generate such relations. In contemporary parlance, this operation is called Merge, and it has become a hallmark of the Program, partly also because of Chomsky's suggestion that Merge may be one of the evolutionary novelties that enabled humans to develop language. Adger is concerned with what kind of computing device this is, and among others, he discusses the relationship between the abstract specification of a function and procedures to compute it.

Adger's chapter also prepares the ground for Peter Svenonius' chapter, which discusses Merge and syntactic features, collectively described as "the engine of syntax." Minimalism has pursued Chomsky's (1995b) proposal that the grammatical operations themselves are very simple, but that they operate on lexical items (e.g., morphemes, such as words and suffixes) that may have a range of individual features that are the basis of a complex grammar. A great deal of research has been devoted to determining the class of these possible features across human languages, their character (are they binary or multivalent, for example), and the relationships and possible interdependences between them. Svenonius provides an overview of some ways in which this pursuit has been carried out, focusing in

particular on the operations not only of Merge, but also "Agree," which governs the interaction between different kinds of features.

As we've mentioned, language variation has always been important to Chomsky's program, leading to the emergence of the Principles and Parameters theory in the late 1970s. Baker's chapter discusses the importance of linguistic diversity in Chomsky's work, as described above. Baker divides Chomsky's career into three different phases, using three influential books as representatives of each phase.

Michelle Sheehan's chapter probes the issue further in discussing Chomsky's influence on the modelling of linguistic variation, in particular work that has suggested some kind of parametric approach to language variation. Originally, this approach assumed that linguistic variation was pretty much like a "switchboard" where the task of acquiring syntax was confined to determining the correct setting for each property listed on the switchboard. This model has undergone substantial changes, which Sheehan discusses alongside objections to the very concept of parameters.

As Cheng and Griffiths' chapter in section I made clear, one of the enduring discoveries of the Chomskyan research program is the restrictions it proposed on non-local dependencies, such as those involved in *Wh*-movement, as in the case of barring the movement of *wh*-words out of a conjunction (see related examples (a)-(c) in fn. 4). Gereon Müller's chapter discusses these in great detail and provides an overview of the various ways in which these have been accounted for.

Chomsky's own work has mostly focused on synchronic grammatical analyses. However, his work has also inspired work on historical change mainly in the area of syntax, in particular through the realization that much language change happens through language acquisition. Elly van Gelderen's chapter provides an overview of this development, including his most recent work on labelling.

Another area where Chomsky's thinking has inspired a great deal of work is the area of second language acquisition. Roumyana Slabakova's chapter demonstrates how this has happened, in particular by showcasing how work on second language acquisition has embraced theoretical developments in syntax, and how it has sometimes informed those developments as well. In recent years, work on multilingual speakers more generally has burgeoned. This research has tried to unravel the nature of mental representations in speakers who master multiple languages. The chapter by Tanja Kupisch, Sergio Miguel Pereira Soares, Eloi Puig-Mayenco and Jason Rothman puts this recent development in context and explains its importance.

3. Comparisons with Other Frameworks

There are, of course, many ways in which grammar can be studied. Chomsky's methodology has been remarkably influential and successful, but it is important to compare it with other perspectives. For reasons of space, we obviously could not do justice to the many perspectives in the larger field of linguistics. We have chosen comparisons with three prominent approaches to syntax: "non-derivational," but broadly generative approaches, general statistical learning, and usage-based approaches.

A hallmark of Chomskyan approaches has always been that they are what is called "derivational," that is, that they assume that non-local dependencies are created by what is typically called movement (e.g., in *What did you eat for breakfast?*, *what* has moved from its original position as the object of the verb *eat*). However, in the late 1970's, non-derivational approaches started to emerge, where rules of grammar are stated as constraints that apply to representations, i.e. ruling that they are allowed (well-formed) or barred (ill-formed). Such approaches are often called "declarative" (sometimes "representational") as they do not have a procedural component – the grammar is not characterized in terms of derivational steps.[9] However, they share with Chomsky the goal of providing explicit and structured accounts of a well-formed expression in a given language and for any language. The chapter by Peter Sells discusses three different declarative frameworks and shows in detail how they are compatible with Chomsky's early work, and then outlines their design features, and provides examples of grammatical analyses within such frameworks.

Another approach that is often assumed to be incompatible with Chomsky's approach is statistical learning in its many different guises (as we noted at the beginning of this introduction). Lisa Pearl's chapter argues that this is too simplistic, and that statistical learning can both complement UG and help refine our models of its contents. Her focus is in particular on how statistical modeling provides a better understanding of how learners navigate the hypothesis space they are faced with, and she argues that within an approach that remains generative, statistical learning might even replace UG as an explanation for at least certain properties of the adult grammar and how they are acquired.

The last chapter in this section, written by Frederick Newmeyer, scrutinizes differences between Chomsky's linguistics and what can broadly be labeled "usage-based linguistics". The latter is an umbrella term for a variety of approaches that share the commitment to study the *use* of language as opposed to focusing on the underlying computational systems of syntax that enable such use. This includes 'constructionist' work that sees the basic units of language as grammatical constructions (e.g. active and passive) and the 'functionalist' perspective that the use of language (primarily in communication) is a major influence on grammar. Comparing Chomsky's work to the shared commitments of usage-based linguistics is complicated by the fact that Chomsky has rarely engaged with published work in this tradition. However, Newmeyer solves this problem by selecting what he takes to be the most important issues separating the two traditions and carefully outlining the positions that they have taken on those issues.

4. Processing and Acquisition

There is no doubt that Chomsky was a core member of the group that started what is often called "the cognitive revolution" (Miller 2003), which he spearheaded with his critique of B.F. Skinner (Chomsky 1959). His work ensured that linguistic competence was viewed as part of cognition and, together with developments in psychology and philosophy, that mental computations over representations came to be seen as a legitimate and fertile area of research. In this section, we consider his legacy in two areas that we have labeled "processing" and "acquisition."

The chapter by Dave Kush and Brian Dillon explores how Chomsky's work has influenced research on one area of linguistic performance, namely sentence processing or "parsing." In particular, they carefully demonstrate with examples how grammatical theory is relevant to

such research: specifically, how the theory makes predictions about the behavior of the parser.

Work on parsing and linguistic perception focusses on real time processing of language, connecting syntax with psycholinguistics. A more recent development is research into the neurolinguistic underpinnings of language, which is the topic of Emiliano Zaccarella and Patrick C. Trettenbrein's chapter. In particular, they are concerned with the neural signatures of the core components of grammar as put forward in much of Chomsky's work: Universal principles of grammar, constituency, recursion, and Merge. The identification of such signatures supports Chomsky's claim that language is a biological system and that his work has significant implications for the study of the neuroscience of language.

Ever since Chomsky (1959), but in particular with Chomsky (1965), language acquisition has been a vital concern when developing theories that can model humans' linguistic abilities. This in part arises from his conception of language as being essentially a biological phenomenon, where facts about growth and development are often essential to the characterization of its structure: a full theory of the structure of the eye needs to include an account of how it grows. Thus, for Chomsky, a central goal of linguistic theory has been what he calls "explanatory adequacy," i.e., it must at least account for the possibility of language acquisition. And here a core argument has always been that children are born with the relevant constraints that determine the "hypothesis space" for acquiring the grammatical rules in a given language, what has traditionally been referred to as UG. In their chapter, Stephen Crain and Rosalind Thornton provide many examples of children's acquisition of restrictions on co-reference that demonstrate the necessity of UG for any explanatory account of child language development.

Another area where Chomsky's ideas about innateness have been important is the linguistics of the spontaneous sign languages of the deaf. Diane Lillo-Martin's chapter provides an overview of research on sign language grammar that has been inspired by Chomsky, focusing particularly on what that grammar can tell us about the innateness of linguistic abilities and cognitive modularity more generally.

The last area that this section surveys is work done on atypical acquisition. This encompasses two different types of cases: Instances where there is no essential input during the early stages of acquisition, and instances where the stimulus is rich but insufficient due to some disorder. In the chapter by Neil Smith and Ianthi Tsimpli, these cases are discussed in detail from the point of view of the influence of Chomsky's work. Smith and Tsimpli show that they provide invaluable evidence about the language faculty and its distinctness from and interaction with other aspects of human cognition.

5. Semantics, Pragmatics and Philosophy of Language

Chomsky's work on grammar sees language as a bridge between sound and meaning, and has always aimed to explain certain facts about linguistic meaning. "Meaning," of course, is a controversial and polysemous term, and the different entries in this section address some of the very different concerns to which it is attached.

One issue that has always been central to generative grammar is why certain readings of sentences are and others are not possible for certain sentences. For example, why can *The*

man called the woman from Montana mean *The man called the woman, who was from Montana*, and *The man called, from Montana, the woman*, but not *The man, who was from Montana, called the woman*? And why are superficially very similar sentences understood so differently (*John is easy to please* entails *It is easy to please John*, but *John is eager to please* does not entail **It is eager to please John*)? Equally, why do certain distinct strings have related or identical meanings (as with an active sentence and the related passive, for example)? Chomsky and other generativists provide answers in terms of underlying hierarchical sentence structures and constraints which explain both which structures can be generated and transformed, and how their constituents relate to each other: that is, by providing a syntactic theory. It is in this respect that generative syntax can be said to be essentially concerned with meaning.

Chomsky has, however, always opposed the widely-held functionalist view of language according to which the purpose of language is communication, and the associated methodology that seeks to explain syntactic facts –which kinds of configurations of linguistic items are possible– in terms of semantic function, i.e., what they are used for. (Such views are discussed in Newmeyer's chapter in section 3.) Chomsky's view is that if language has any purpose at all, it is the expression of thought. He notes that many, indeed the vast majority of grammatical sentences are hardly usable, because they are too long – e.g. example (2), or hard to parse (3), or combine words that are syntactically but not semantically compatible (4), for example:

(2) John and Mary and […+ two million conjuncts…] went to the party.
(3) Mice cats dogs chase bite squeak.
(4) Colorless green ideas sleep furiously.

Chomsky is also skeptical about much work in linguistic semantics, in particular formal truth-conditional semantics – at least if it is taken in full metaphysical seriousness, involving commitments to extralinguistic objects, as it often is in contemporary philosophy of language – since it treats word-meanings as denotational (e.g. *water* denotes H_2O, and *London* denotes the city of that name) and sentence meanings as involving *truth* conditions. Influenced on this point by the later Wittgenstein, JL Austin and Peter Strawson among others, he argues that it is language *users* who *refer*, not the words themselves considered in abstraction from use. Sentences should not be seen as contributing to meaningful propositions that are true or false by themselves independently of usage, but rather constraints on the thoughts that they can be used to express (when used literally).

Notwithstanding these influences from ordinary language philosophers, and Chomsky's rejection of formal semantics, his conception of grammar as a system of computations over representations has been influenced by the formal, "analytic" tradition in the philosophy of language exemplified by the work of Frege, Russell and the early Wittgenstein, as John Collins discusses in the initial article of this section. Of course, for Chomsky the formal system is intended as a description of a particular aspect of cognition, the language faculty. Collins argues that it is a significant achievement of Chomsky's to propose that "language is its own thing, an object of interest regardless of its poor design relative to the ends to which formal systems are developed," and to show how an explicit theory of that object can be provided.

Paul Pietroski's chapter explains in some detail the centrality to generative grammar of accounting for different readings in terms of underlying structures (discussed above). He also

sets out some of the currents in modern philosophy of language that Chomsky opposes, in particular the truth-conditional, referential conception of linguistic meaning found in the work of Donald Davidson and David Lewis, and Hilary Putnam's semantic externalism. He explains Chomsky's challenges to these views and shows how they point the way to an alternative, internalist conception of meaning.

In his chapter, Michael Glanzberg explores the influence that Chomsky has had on natural language semantics. He explains the extent and the specific targets of Chomsky's skepticism about semantics and the related issue of whether syntax is in some important sense 'autonomous' of semantics. He notes that much of the leading research on truth-conditional semantics is generativist and indebted to Chomsky's methodology in syntax. But he goes on to explain Chomsky's reasons for skepticism about the foundations of such work, which seems to him to be committed to the existence of referents of words such as *foible* and *average family*, as when we talk about "the foibles of the average family". Chomsky's point is not that it's impossible to devise workarounds for such problems, but that they suggest that, as we've already noted, the mechanisms of language in abstraction from its use don't involve *reference*, so linguistic semantics should be recast. Glanzberg also discusses what Chomsky sees as a more productive line of enquiry: the study of features within the I-language which both have syntactic effects and encode aspects of meaning. Chomsky's suggestions here have helped to foster the now thriving field of lexical semantics.[10]

As mentioned above, Chomsky's view is that truth and reference are not properties of linguistic expressions but of speech acts performed by language users. He has also stressed what he calls "the creative aspect of language use": the ability to produce and understand sentences in ways that are appropriate to circumstances but not determined by them, an ability that is in part explained by the generative, recursive nature of human language which enables us to produce and parse an indefinite number of novel sentences. So he might be thought sympathetic to the study of communication and utterance meaning in context: linguistic pragmatics. Indeed, in the context of his skepticism about truth-conditional linguistic semantics, he says that "[i]t is possible that natural language has only syntax and pragmatics" (Chomsky 1995a, 26). But he is also skeptical about the prospects for pragmatic theory. Nicholas Allott and Deirdre Wilson's chapter examines his reasons and argues that they do not rule out systematic work. On the contrary, they claim, Chomsky's work provides a blueprint for the study of mental systems in terms of an explicit theory of their proprietary principles, and they argue that work in theoretical and experimental pragmatics implements these recommendations in investigating the system that generates interpretations for overt communicative acts.

6. Cognitive Science and Philosophy of Mind

Chomsky has often said that what really underlay his interest in linguistics was his desire to understand the mind more generally, and he early on presented his views as a resuscitation of early modern "Rationalist" views of the mind that had been rejected by the 18th and then 20th Century "Empiricists." Very roughly: According to Rationalists such as Descartes and Leibniz, crucial parts of our knowledge, for example, logic and mathematics, were "innate" and could be known "a priori," justifiable without any essential appeal to experience. Empiricists, particularly the "Logical Positivists," who flourished first in Europe and then in America from about 1935 through 1960, regarded such claims as virtually mystical, and argued that the only view of knowledge compatible with the striking successes of natural

science was that it was wholly based upon experience – or, in the case of logic and mathematics, on the social conventions of language; and language was known by reinforced responses to stimuli, along lines studied by the Behaviorists such as Watson and Skinner.

Chomsky (1975) explained that the notions of innateness, UG and explanatory adequacy were in the "immediate background" of his work in the 1950s (cf. fn 5), but they didn't explicitly emerge until his now famous (1959) critique of Skinner's (1957) presentation of a Behaviorist conception of language learning. From then on, particularly in his (1965, 1966, and 1968/2006), Chomsky championed specifically the Rationalist's appeal to innate ideas as a basis of knowledge, particularly of grammar (interestingly, he seldom, if ever discusses *a priori* knowledge, and certainly never claims that the principles of grammar are knowable *a priori*; and so that topic is not addressed in this volume). This resuscitation of innate ideas has been tremendously influential not only in linguistics, but in research on infant cognition (e.g., Spelke, 2003), knowledge of arithmetic (e.g., Carey, 2009), the folk theory of mind (e.g., Apperly, 2010) and moral thought (Mikhail, 2011).

In section 6, Georges Rey explores the philosophical issues surrounding Chomsky's nativism, and Stephen Crain, Iain Giblin and Rosalind Thornton set out some of the extensive empirical evidence for it. Central to that evidence is what has come to be called the "poverty of the stimulus" argument: The stimuli presented to small children acquiring language are simply far too impoverished to account for the grammatical competence they acquire in only a few years, a problem Chomsky calls "Plato's problem," assimilating it to the problem Plato raised in his *Meno* about how someone untutored could come to appreciate geometry. Again, consider the "WhyNots" mentioned above: What empirical basis could lead apparently all children not to ask questions like **Who will Mommy and feed Fido*?: It is hard to see an alternative to an account that posits some kind of innate state that constrains them from moving a question word from a conjunction, or, more specifically, from acquiring an internal grammar that would permit it.

A further question, of course, is how a brain with such innate knowledge could possibly have evolved, an issue that Chomsky began to address in detail the 1990s as one of the motivations for the Minimalist program. In the present volume, Anne Reboul discusses Chomsky's views on language evolution, noting that he has long held that the language faculty is a biological endowment, but that it probably arose suddenly and that the core principles of language show no signs of selection pressure. In work in recent decades he has proposed that the sudden transition was the arrival of Merge, allowing for the production of hierarchical structures, initially used only in thought, but later externalized in speech. Reboul argues that work on evolution of language (and thought) also needs to account for the fact that human concepts, perhaps uniquely, are 'decoupled' from external stimuli and so seem to be innately constrained along the lines of a Chomskyan theory.

Behaviorists such as Skinner and (more forcefully) the influential philosophers Nelson Goodman and Willard van Orman Quine were not only skeptical of the Rationalist's appeal to innate ideas; they were even more skeptical of what they called "the idea idea" itself, and thought serious science should avoid traditional appeals to internal ("private"?) mental states and properties of the sort that were presumed in Rationalist accounts that Chomsky seemed to want to revive (but see John Collins and Rey's contribution for complexities here). They were particularly dismissive of the explanatory utility of talk of so-called "propositional attitudes," or talk that typically involves mental verbs, such as "believes," "prefers" that take a "proposition" or "that…" or "to…" clause as a direct object; thus, one believes *that it is*

raining and prefers *to not get wet* –i.e., *that one not get wet* which is ordinarily supposed to explain someone's avoiding the rain.

All such talk involves a curious property that Franz Brentano (1874/1995) had called "intentionality," or the "directedness" or "aboutness" of such attitudes on things real and often unreal, such as beliefs about Zeus and ghosts. Particularly for Chomskyans and other cognitive scientists, it would appear that the almost ubiquitous term "representation" is intentional in this way: Representations are always "of" something, which can be real or non-existent as in the case of illusory triangles and unuttered words and sentences. But what determines what a representation is "of"?

What has been particularly worrisome about this and other issues regarding intentionality is that Brentano plausibly argued that it was not "reducible" to a physical phenomenon (after all, how can a physical phenomenon involve a relation to something that doesn't exist?), and many have tried, but no one has yet quite succeeded in proving him wrong. In an influential discussion, Quine (1960/2013:221) claimed these failures revealed "the baselessness of the intentional idiom and the emptiness of a science of intention".

Now, one might have thought that Chomsky's resuscitation of innate ideas and appeals to "mental" processes had given the lie to Quine's view. However, beginning in the 1990s, Chomsky himself begins to defend similar claims: "We can be reasonably confident that "mentalistic talk" will find no place in attempts to describe and explain the world." (Chomsky 1996, 74-7) Indeed:

> [I]ntentional phenomena relate to people and what they do as viewed from the standpoint of human interests and unreflective thought, and thus will not (so viewed) fall within naturalistic theory, which seeks to set such factors aside. (Chomsky 2000, 22–3; see also p. 132)

But this seems incompatible with the many apparently intentionalistic appeals to the "representation" and "knowledge" of grammar that seem ubiquitous in Chomsky's other writings (and, indeed, in most cognitive science generally). How is Chomsky in this regard different from Quine? In their entry, Collins and Rey try to sort this issue out.

The problem of intentionality is only one of many "mind-body" problems that philosophers have traditionally addressed. Others are, of course, that of the peculiar "privacy" of subjective experience of "qualitative" phenomena (or "qualia"), such as the smell of roses or the feeling of pain, which it's hard to imagine an account of merely our bodies satisfactorily explaining. Chomsky has been surprisingly dismissive of these problems as well, claiming that, since Newton's theory of gravitation refuted Cartesian mechanics, we have no coherent notion of "body" with which we can even state such problems.[11] In his entry, Joseph Levine discusses what he thinks is really driving contemporary discussions of mind and body, arguing that they can be and often are pursued quite independently of Descartes' and any specific notion of body.

7. Methodological and Other Explanatory Issues

Part and parcel of Chomsky's rejection of the Positivism and empiricism that at least

ideologically dominated much of philosophy and science up until about 1960 is his insistence on what he calls "the Galilean method," which he argues is responsible for the success of our most serious sciences, such as chemistry, biology and physics. There are several issues often included under this term: for example, an insistence on mathematical formulations; a belief in the ultimate "simplicity" of nature; and the central role of idealization in successful explanations. To keep the topic manageable, we (the editors) have prepared an entry that focuses on the last topic, idealization, alone, since that is what seems to us to be most important to Chomsky's work (the other topics are less essential and far more controversial; see Boeckx 2006 for discussion).

Crucial to Chomsky's work is the idealization he initially distinguished in terms of linguistic "competence," which he thought was the only theoretically tractable component of the far too many things responsible for linguistic "performance," or actual speech production. In order to avoid an excessively behavioral conception some associated with "competence," he eventually replaced this talk by an even more idealized conception of an "I(nternal, intensional)-language," or a specific computational system of grammar that is one of a panoply of systems (e.g., of reasoning and decision making) responsible for what people think of as "language." This is contrasted with what he calls "E(xternal, extensional)-languages," such as "English," "French" or "Mandarin," the complexities of which Chomsky thinks we need to abstract away from in characterizing the underlying system. Chomsky reasonably claims that this sort of idealization is precisely what Galileo and Newton engaged in when they provided laws not of the complex motion of leaves in the wind, or clouds in a storm, but of objects falling in a vacuum, or of one point mass orbiting around another in empty space. We defend Chomsky's conception against the charges that it is non-empirical, leading to "unfalsifiable" theories, and ignores too many actual linguistic phenomena.

In fact, idealizations have been pursued in different ways by different proponents of a Chomskyan approach. As we have just noted, Chomsky himself has argued that systematic investigation of our linguistic abilities requires abstracting away from the interaction of the numerous systems presumably involved in performance, in order to narrow the focus to the competence embodied in the I-language. He also assumes that there are other faculties or mental "organs," and therefore recommends the same general methodology in investigating other aspects of cognition, such as the infant's ideas of objects in space and time, our number sense, and moral "grammar" (see references in section 6 above). In their chapter, Nicholas Allott and Neil Smith set out Chomsky's conception of such "competence" or "analytic" modules (as they have also been called) and their relation to processing, discussing three ways that it has been understood. But they also explore Jerry Fodor's *different* idealization which he introduced with his influential notion of encapsulated "modules." This was inspired by Chomsky's notion of faculties, but, unlike them, Fodor's modules concern specific *processing* systems: in the case of language the system responsible for how speech is perceptually understood. Allott and Smith provide an overview of evidence for modularity from dissociation data, where selective impairment of one ability leaves another ability intact, concluding that there is evidence both for Fodorian modularity of input systems, and for a central Chomskyan language faculty.

A related concern about Chomskyan linguistics has to do with its heavy reliance on speakers' "intuitions," or verdicts about the acceptability and interpretation of sentences or phrases presented to them in books or lectures, as in queries about WhyNots. These don't seem like the experimentally controlled data with which serious science is normally concerned. Indeed, such intuitions can seem more like the armchair speculations of traditional philosophers that

have been the object of much recent skepticism. In his entry, Steven Gross reviews much of the recent discussion of this topic, discussing the similarities and differences between such linguistic judgments and the kinds of judgments about visual appearances on which vision theorists routinely rely.

Chomsky's interest in idealization leads him to be skeptical about theories of insufficiently idealized domains, not only of "E-languages" and speech production, but of human behavior in general. To a first approximation, issues that might be amenable to an idealized explanation in terms of an underlying competence system he regards as "problems"; issues that involve massive interaction effects between systems such as the decision making of agents, he regards as "mysteries," unamenable to scientific understanding. In his entry in this section, Collins calls attention to problems with the distinction as Chomsky draws it.

Many have wondered how someone so concerned with abstract idealizations of the sort Chomsky seeks in linguistics could also be as deeply concerned with such concrete and enormously complex phenomena as the kind of human behavior involved in politics. Part of Chomsky's view here is that political research is precisely *not* particularly theoretical, but involves simply paying closer attention to the mass of information about actual events of states and individuals in the world that, he argues, standard discussions in the public media often systematically ignore (Chomsky refers to the failure of people to learn the facts about present political realities as "Orwell's Problem." Whereas "Plato's Problem" is how people can learn so much given the exiguousness of experience, Orwell's is: how can people know so little, given the actual accessibility of political information). Joshua Cohen and Joel Rogers examined this issue at length in their (1991) article from which their present entry has been excerpted, and they bring to light some of the background assumptions of Rationalism and the Enlightenment generally that have informed both Chomsky's linguistics and his political discussions.

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[1] See, for example, Cowie (1999), Pullum & Scholz (2002), Everett (2012), Evans and Levinson (2009), Tomasello (2003), Evans (2014), Chater, Clark, Goldsmith & Perfors (2015), and Christiansen & Chater (2017).

[2] The focus on hierarchical structure and the generative ability of the grammar were a radical break with the work of Chomsky's mentor, Zellig Harris (see biographical sketch), and all the other linguists of the era. Harris' work in the 1950s also made use of transformations, but these were different formally and in the (descriptive, not explanatory) role that they were intended to play. (See Collins 2008, 66–7; Newmeyer 1986, 4–6).

[3] Declaratives are sentences of the type whose default use is making statements; interrogatives are of the type dedicated to asking questions. A polar (or *yes/no*) interrogative is one inviting a "yes/no" response (in contrast to *wh*-interrogatives which are formed with *wh*-words such as *who, what, where, which* – see below for examples of these).

[4] For expository purposes, we illustrate the point using somewhat different examples from Chomsky 1955 and 1957 (cf. Chomsky 2013b, 651–2) and the theory as we set it out here (very informally) is closer to work from the 1960s. For a more rigorous presentation of the analyses in Chomsky 1957, including evidence for structure dependence, see Lasnik et al. 2000, especially chapter 1.

[5] On this 'cognitive turn' see Collins (2008, ch. 4) and Chomsky (1975), where Chomsky says that questions of cognition were in the "immediate background" in his work in the 1950s, but he thought it "too audacious" to set them out. (See also below.) The *locus classicus* for the cognitive conception is Chomsky's influential *Aspects of the Theory of Syntax* (1965).

[6] It's important to see that the universals of UG need not be manifested in every language. UG apparently provides options and constraints. Not every language makes use of every option, and thus some of the constraints may not be visible in that language. For example, the constraint barring *wh*-movement out of conjoined constituents (as in the example that follows) would not be visible in a language that lacks *wh*-words or conjunction.

[7] Stars in front of a sentence indicate ungrammaticality. Some other WhyNots that invite a similar conclusion:

a. *Who did stories of scare Mary?
b. *Who did Susan ask why Sam was waiting for __?
(cf. *Susan asked why Sam was waiting for Bill.*)
c. *Who do you wanna laugh? (cf. *I want Bill to laugh*)
d. *I want a book you've in the car. (vs. *you have*)
e. *I know I should go home, but I don't want *(to) (i.e., one needs "*to*")

f. *He hopes John will win (where *he = John).*

[8] Chomsky's master's thesis was an expanded version of his 1949 undergraduate honors essay, 'Morphophonemics of modern Hebrew'. (On this early work see Newmeyer 1996, ch. 2.)

[9] It is crucial to note that the issue here concerns the *characterization* of the grammar, with no commitment to whether or not "derivational steps" are realized in the brain in real time.

[10] On the complex history of lexical semantics, with brief commentary on Chomsky's influence, see Pustejovsky 2016.

[11] One mind/body problem that Chomsky does take seriously is the traditional problem of "free will," which many have thought is incompatible with the kind of "deterministic" theories that the natural sciences pursue. However, he (2010) regards this issue as not really a "problem" that can be addressed scientifically, but a "mystery" that will likely remain beyond possible human understanding. This view is sometimes associated with his views about the impossibility of a theory of speech "performance," but it is importantly independent of it: performance may simply be a massive interaction effect, unamenable to theory, involving no mysterious "free will" at all. Cf. below and Collins' chapter on "Problems and Mysteries".