1 *Introduction*

Linguistics is an old subject, and since 1957 it has been a great one.[1] In that year *Syntactic Structures* was published, initiating officially what we would now call "Chomskyan linguistics." The enormous and successive stimuli to the discipline due to Chomsky's work over the past fifty years have significantly changed the landscape of linguistics, and its vast influence is palpable in the mainstream of linguistic thinking and research. The most recent book-length manifestation of these developments is *The Minimalist Program* (Chomsky 1995a).

The Minimalist Program (henceforth, MP) can be characterized from a number of perspectives which give it an interesting, and potentially far-reaching, interdisciplinary character. It can be considered simply as a linguistic framework involving a substantial revision of many of the technical assumptions and theoretical proposals which have been developed within the Chomskyan paradigm prior to the early 1990s. It can also be viewed as an extension and reconstruction of the biolinguistic approach to language which was initiated by Chomsky (1955, 1965) and Lenneberg (1967), an approach which views language as a biological capacity rooted in evolution.[2] Moreover, from ontological and methodological perspectives, the MP embraces a "naturalistic" approach to language as a "mental organ" of the brain, an approach based on the assumption that the mind is part of the natural world and, as such, it should be studied in the same way as any other aspect of nature (cf., for instance, Chomsky 2000a: 75).

These perspectives are closely related in that the substantial revision of pre-minimalist assumptions and theories is committed to the goal of achieving a principled explanation of linguistic phenomena, an explanation that is intended to go beyond the sphere of influence of genetic endowment to general principles which relate not just to language, but to general cognition or to the natural world as a whole. The standard for this explanation is set by the central thesis of the MP, the so-called Strong Minimalist Thesis (SMT), which suggests that language is "well designed" to satisfy certain legibility conditions for its interaction with other cognitive systems (cf. Chomsky 2001: 2).

In fact, proponents of the minimalist program believe that there is even more to the SMT than just setting a standard for true explanation in linguistics. It has been argued, for instance, that if this thesis is on the right track, one should expect a number of positive consequences, not just for linguistics, but for science in general. Two of these stand out. One concerns the study of the evolution of language, and the other relates to the prospects of unification in science. As to the former, Chomsky (2007b: 2–3) argues that "the less attributed to genetic information . . . for determining the development of an organism, the more feasible the study of its evolution." Similarly, though in a somewhat different context, Hauser *et al*. (2002) and Fitch *et al*. (2005) suggest that if most of the properties of language can be found in species other than humans, then a comparative empirical approach to the evolution of language becomes more feasible. In regard to the prospects of unification in science, some minimalists believe that if language turns out to indeed be "well-designed" or "optimal" in the sense of the SMT, that is, if aspects of the general principles that determine the "design" of language can be regarded as direct consequences of the workings of the laws of physics, then this outcome should be celebrated as a step towards this goal (cf., for instance, Boeckx and Piattelli-Palmarini 2005).

Thus, if the SMT turns out to be correct, it will have implications not only for the conduct of linguistic analysis itself, but also for our understanding of the place of language in the world. In fact, and as I hope to show in this book, different, but no less significant, implications will follow if the SMT turns out to be false in specific respects; minimalism promises to yield significant implications whether its central claim turns out to be true or false, and this, I take it, is the definition of a good research program. From such perspectives, it is hard to see how any linguist can fail to be interested in it.

The core questions that this interest raises, and that this book seeks to answer, are the following: (1) what is the nature of the transition to Minimalism? (2) How should the SMT be interpreted? (3) How plausible is the SMT from an evolutionary perspective? (4) To what extent does the SMT provide an appropriate standard for true explanation of linguistic phenomena? (5) Are there, as some minimalists would have us believe, genuine connections between the principles of language and the laws of physics? (6) Is the "bio" in "biolinguistics" really significant or does it merely reflect an implicit belief that the scientific merit of linguistics is proportional to the strength of its relation with the more advanced sciences?

In attempting to answer question (1), I have found it necessary to first take a broad view of the general development of Chomskyan linguistics, with the primary aim of clarifying some of the misconceptions that have been

expressed by (ironically enough) some well-known popularisers of Chomsky's work. For only when these misconceptions are dispelled will we be in a better position to understand the nature of the shift to minimalism. This shift, as I argue in this book, is neither a matter of taking account of methodological considerations, as some advocates of the MP seem to believe, nor is it as dramatic and unexpected as some critics have suggested. By examining the defining features of the pre-minimalistic conception of language, and by identifying their fate in the context of the MP, I seek to demonstrate that the shift to minimalism is merely one of emphasis among the factors that govern the nature of the language faculty.

The answer to question (2) calls for an exploration of the nature and content of the SMT, and this is one of the two main tasks that this book undertakes. I argue that Chomsky's work over the past fifteen years suggests three different formulations of the SMT, some of which seem to be incompatible with his own views on language. I also show that by making clear the differences between the three formulations of the SMT, and by submitting the phrase "virtual conceptual necessity" to critical analysis and examination, it is possible to avoid much of the confusion surrounding its interpretation. Each of the three formulations of the SMT will be discussed in turn, and after pointing out the shortcomings of the first two, I argue that the last formulation provides the most transparent reflection of the content of the thesis. This content involves two distinct claims and the evaluation of each of these constitutes the other main task of the book.

The first claim is an ontological one. It asserts that universal grammar contains nothing beyond the combinatorial operation Merge; i.e. the genetic component of the language faculty is confined to this recursive operation. This is what I will call the merge-only hypothesis, and to evaluate it is to evaluate the SMT from an evolutionary perspective and thereby provide an answer to question (3). Before this can be done, however, it is necessary to contrast Chomsky's work with his contributions to Hauser *et al*. (2002) and Fitch *et al*. (2005). For it is my contention that a careful analysis of the similarities and differences between Chomsky's linguistic and interdisciplinary discourses should caution us against an assumption that is widespread in the literature, namely that the notion of "recursion" as employed by Hauser *et al*. (2002) is identical to "merge" in the minimalist vocabulary. Through such an analysis I develop a conceptual and empirical assessment of the merge-only hypothesis, and I clarify its relation to the recursion-only hypothesis of Hauser *et al*., concluding that the two hypotheses are not equivalent and have different empirical content. I also argue that not only are there conceptual and empirical difficulties surrounding the merge-only hypothesis, but that there is also an

uncomfortable ambiguity in Chomsky's position regarding the ontological status of merge, an ambiguity that is not easy to resolve.

The second claim which the SMT involves is epistemological. As mentioned above, this minimalist thesis is intended to set a standard for true explanation of linguistic phenomena, and through its (implicit) connection to the notion of "physical law" it promises a better understanding of the place of language in the world. This brings to the fore questions (4) and (5): does the SMT offer a principled explanation of linguistic phenomena? Are there non-trivial connections between the principles of language and the laws of physics? As will be seen through this book, my own answer to both questions is negative, and while I suggest a way to ameliorate certain aspects of minimalist explanation, I make it clear that some of the attempts which have been made to ground optimal computation in physical law do more harm to the MP than good. I also consider the explanatory status of the kind of physics which some minimalists take to be germane to the MP, and I demonstrate that it is no longer acceptable in modern physics.

Of course, it is one thing to say that there is little empirical support for the deduction of optimal computation from physical "neatness" and another to say that such a deduction is untenable in principle. Indeed, an attitude of "let's wait and see" is sometimes expressed by advocates of the biolinguistic approach to language in defence of their speculations on the connections between linguistics and physics (see, among others, Freidin and Vergnaud 2001; Uriagereka 2002). In fact, Chomsky himself expresses this same attitude in his criticism of Fodorian functionalism, the philosophical doctrine that asserts, among other things, that the level of abstraction at which our explanatory theories of the mental are made is principled. He suggests that this level of abstraction should be conceived of as a "temporary convenience" which may not resist further examination at a more fundamental level, say that of neurology (Chomsky in Cela-Conde and Marty 1998). Clearly, this optimism on the prospects of unifying cognitive science with brain science underlies Chomsky's biolinguistics and its quest for a principled explanation in linguistics. But is this unification really necessary for linguistic theory or does it merely reflect Chomsky's (2000a: 77) belief that "the place to look for answers is where they are likely to be found: in the hard sciences"? This is another way of expressing the remaining question on the list above: is the "bio" in "biolinguistics" really significant or does it merely reflect an implicit belief that the scientific merit of linguistics is proportional to the strength of its relation with the more advanced sciences? As a necessary step on the way towards an answer to this question, I assess the explanatory status of optimal computation in the

context of the philosophy of mind. By bringing Chomsky's naturalism face-to-face with Fodorian functionalism I seek to pin down some tensions that arise between the two. I argue that some of these have significant implications for the explanatory role of optimal computation in particular, and for the status of the biolinguistic approach to language in general, leading to a revised version of minimalism in which optimal computation plays its familiar role but is now regarded as primitive rather than triggering a search for a deeper level of explanation.

In short, this book explores Chomsky's biolinguistics in general and its fundamental thesis in particular. I seek to shed some light on the content of the SMT and evaluate it from a number of perspectives. In this endeavour, I identify gaps in current minimalist theorizing and, whenever possible, I search for ways to fill such gaps.

Unlike many who are excited by the prospects opened up by taking minimalism seriously, I adopt an open-minded view on its tenets and their formulation; I do not hesitate to be critical when criticism is necessary, especially when unsubstantiated claims are apt to lead either to erroneous conclusions or pretentious proclamations. To use the words of Whitehead (1997 [1925]: 18): "If science is not to degenerate into a medley of *ad hoc* hypotheses, it must become philosophical and must enter upon a thorough criticism of its own foundations." Indeed, given the fact that minimalism involves a variety of theoretical issues from a wide range of scientific as well as philosophical inquiries, this book is in a sense philosophical in that it encourages a critical examination of the very foundations of the MP and its relation to other fields of inquiry.

2 *The minimalist program*

2.1 Introduction

This chapter takes a broad view of the minimalist program (MP), providing background for the chapters that follow. It has five main sections. Section 2.2 concerns the historical development of the generative program from its inception in the early 1950s to the emergence of minimalism in the 1990s. It follows the structure of the useful review of Boeckx and Hornstein (2010), while maintaining that this review is misleading in important respects. Section 2.3 is an attempt to uncover the nature of the shift to minimalism and to explain how this program differs from its predecessors. A description of how this shift affected the theoretical role of universal grammar (UG) is given in Section 2.4, while in Section 2.5 an illustration of the impact of minimalism on the question of the design of language is presented. Finally, Section 2.6 asks a simple question, "Why minimalism?", and attempts to provide a tentative answer to it. This last section also prepares the ground for the discussion of the strong minimalist thesis in the next chapter.

2.2 Chomskyan linguistics: refutation of some misconceptions

When asked whether the history of his work on linguistics is misconceived, Chomsky (p.c.) replied by saying that "[t]he history of [generative grammar] is hopelessly misconceived, sometimes ludicrously so," and he referred, as an example, to overtly hostile critics such as Boden (2006).[1] However, as the present section purports to show, there seems to be no reason to believe that certified members of the Chomskyan school are immune from historical misconceptions, albeit of a different nature to those displayed by Boden. A case in point is Boeckx and Hornstein's (2010) goal-directed approach to the development of Chomsky's work on linguistic theory.

The authors (henceforth B&H) advocate a three-period distinction in connection with the generative enterprise. They attribute to each historical period

its own theoretical goal, core text(s), and related field of inquiry. The first period is called the *combinatoric stage*, the primary goal of which is discovering "the right axioms." Its core text is Chomsky (1957), and its related fields of inquiry are engineering and logic. The second period is the *cognitive stage*, where the chief aim is solving the problem of how language is acquired, i.e. so-called Plato's problem (Chomsky 1986). The core texts are Chomsky (1965) and Chomsky (1981), and the related field is biology. Finally, the third period is the *minimalist stage*, concerned with finding the *best* solution to Plato's problem. Chomsky (1995a) is its core text, and physics is its related field of study.

2.2.1 The combinatoric stage

As observed, B&H relate the early period of Chomsky's linguistic theory to the fields of engineering and logic. It is not clear how Chomsky's work on linguistic theory bears on engineering, and since B&H do not provide even a hint as to how this might be the case, I shall not seek to evaluate this claim. The case of logic as a field of inquiry, however, is different, for here we are given an explicit analogy between generative grammars and logical systems, and we should therefore be able to assess the proposal that Chomsky's early work on syntactic theory can be seen as related to work in logic.

To begin with, there is no reason to deny that early work on generative grammar was influenced, to a certain extent, by modern logic. For instance, Chomsky's "rules of formation" and "rules of transformation" are two expressions which were adopted from Carnap (1937), and Chomsky (1965: 9) himself acknowledges the apparent similarity between his phrase structure rules and Post's (1943) production rules. Moreover, it is perfectly legitimate to draw a tentative analogy between early generative grammar and logical systems, where the notions "initial string," "rewriting rule," and "grammaticality" in a generative grammar might be associated with their respective counterparts "axiom," "inference rule," and "theoremhood" in a logical system.[2] Indeed, in his description of a phrase structure grammar of the form [Σ, F], where Σ denotes the set of initial strings and F represents the set of rewriting rules of the form $X \rightarrow Y$, Chomsky (1956: 117) considers a derivation in such a grammar as "roughly analogous to a proof, with Σ taken as the axiom system and F as the rules of inference." However, we should be careful not to stretch the analogy too far. B&H (p. 120) appear to do this when they identify the goal of linguistic theory in early generative grammar as "finding the right axioms." In particular, the authors claim that this alleged goal of linguistic theory parallels that of theories in logic – "to find a set of axioms from which it was possible to derive

all and only the valid inferences" (p. 119). The analogy is far from convincing, however. To see why, let us examine briefly the notion of "axiom" and how it might be related to early linguistic theory.

There are at least two issues to consider when speaking about axioms. First, given a formal deductive system, the axioms of the system represent a *starting point* from which certain statements or theorems can be derived by rules of inference. It is by virtue of this property that the tentative analogy made earlier between phrase structure grammars and logical systems may be justified, for the string S in a phrase structure grammar is considered as the starting point from which all subsequent strings are derived by formation rules. To give a simple example, a phrase structure grammar G can be formally defined as a quadruple {N, Σ, S, P}, where N, Σ are two finite and disjoint sets of non-terminal and terminal symbols, respectively, S ∈ N, and P is a finite set of production rules of the form X → Y, where X and Y are strings of symbols from N ∪ Σ.[3] Without going into all the details of the grammar, it should be clear how the sentence in (1) can be derived using such a grammar from the start symbol S by repeated applications of the rules in (2) as shown in (3):

(1) The postman rang the bell.

(2) Rule 1: S → NP + VP
Rule 2: NP → D + N
Rule 3: VP → V + NP
Rule 4: D → the
Rule 5: N → postman, bell, etc.
Rule 6: V → rang, saw, etc.

(3)

S	
NP + VP	[by rule 1]
D + N + VP	[by rule 2]
D + N + V + NP	[by rule 3]
the + N + V + NP	[by rule 4]
the + postman + V + NP	[by rule 5]
the + postman + rang + NP	[by rule 6]
the + postman + rang + D + N	[by rule 2]
the + postman + rang + the + N	[by rule 4]
the + postman + rang + the + bell	[by rule 5]

As should be clear from this example, the initial string S represents the point from which the derivation of the sentence in (1) begins, and in this sense S may be said to be comparable to axioms in a logical calculus. However, there is more to axioms than just initiating a set of derivations, which brings us to the second important property of this logical notion, namely that an axiom is standardly

viewed as expressing a *proposition* that has, or can be assigned, a *truth value*. It is by virtue of this property that axioms in logic differ from initial strings in phrase structure grammars. Notice that this is a non-trivial distinction, for the notion of "finding the right axioms" can only be meaningful insofar as an axiom has a propositional content. Thus, given an axiomatic system and a domain of objects, it is reasonable to inquire as to whether the chosen axioms are true of these objects and whether they provide a basis for deriving *any* true proposition in the domain. These inquiries about the truth of axioms are neither here nor there when it comes to the derivation in (3), and this is because the initial strings are simply not propositions. Thus, it makes no sense to ask whether the initial string "S" is true. Consequently, and contrary to what B&H believe, there never was a notion analogous to "finding the right axioms" in generative grammar, nor could there have been.

As already noted, Chomsky (1956) draws a tentative analogy between his theory of generative grammar and proof theory, an analogy also raised in Chomsky (1955: 729) when he says: "A derivation is roughly analogous to a proof, with Sentence playing the role of the single axiom, and the conversions corresponding roughly to rules of inference" (underlining in original). Thus if S is considered to be "the single axiom" as is the case in (3) above, then it would be absurd to suggest, as B&H do, that the goal of linguistic theory is to "find the right axioms," for there is only one axiom and it is known beforehand. In short, "finding the right axioms" was never an issue for Chomsky.

B&H identify the aim of Chomsky's early work with an alleged computational goal. They say:

> The primary aim is computational or combinatoric [footnote omitted]. The problem is framed by two observations. First, the set of well-formed sentences of a natural language is infinite. Second, natural language sentences naturally partition into two sets: the well-formed and the ill-formed. Given this partition into two infinite sets the grammarian's goal is to characterize them by *finding a set of rules (a grammar) that will generate all the well-formed sentences and not generate any ill-formed ones*. If successful, such grammars would constitute comprehensive theories of language comparable to the kinds of theories that chemists and biologists construct in their respective areas (this sentiment is especially made explicit in Lees' 1957 review of *Syntactic Structures*). (B&H, p. 116, my italics)

Setting aside this unwarranted movement from "finding the right axioms" to "finding the right rules," which may be taken as indicative of more confusion on

the part of the authors, it is important to remember that Chomsky (1955, 1957) was well aware of the fact that two or more sets of rules (i.e. grammars) may be compatible with whatever data are available, and it was precisely because of this that he introduced the notion of "evaluation measure" as a special case of relating particular grammars to the general theory of linguistic structure. Thus the task facing the linguist cannot be merely computational, for it is not limited to finding an adequate grammar. Rather, the task facing the linguist is understood to be ultimately explanatory. This is what Chomsky (1955: 11) calls "the problem of justification," that is, "the problem of choosing among the vast number of different grammars, each giving a different structure, and all meeting ... external criteria."

More importantly, and contrary to what B&H assert in the passage above, the goal of generating all and only the grammatical sentences was merely a *descriptive* one, and meeting it in no way leads to "comprehensive theories of language," at least not in Chomsky's sense.[4] Since B&H cite Lees' famous review of Chomsky (1957) favorably, it is instructive to note that in that review the generation of all and only grammatical sentences is held to be a descriptive requirement, for Lees (1957: 382) maintains that a grammar "must permit us to generate automatically all and only the grammatical sentences of the language, else it could not be called a description at all." Now, it is clear that B&H's views on the early period of Chomskyan linguistics involve at least one problematic implication. For if the primary goal of linguistic theory were essentially computational, in the sense of generating all and only the grammatical sentences of a language, and if this goal amounts to an adequate description of the object of inquiry as Lees seems to suggest, it follows that the primary goal of Chomsky's *Syntactic Structures*, a text which, no doubt, B&H regard as revolutionary (and rightly so), was merely descriptive in nature. But nothing can be further from the truth. For the requirement of separating grammatical sequences from ungrammatical ones constitutes only a first step towards what Chomsky was trying to achieve in the mid-fifties, namely an explanation for the linguistic intuition of native speakers. In fact, B&H do not seem to appreciate the role of cognition in the early writings of Chomsky, for otherwise they would hardly have divided Chomsky's pre-minimalist conjectures into combinatoric and cognitive stages. To show that this is indeed the case, let us now turn to their second stage.

2.2.2 The cognitive stage

The alleged transition from a combinatoric stage to a cognitive stage is described by B&H as a shift "from finding the right axioms ... to solving