اللسانيات الحديثة والبحث عن أنموذج علمي

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الملخص

يدور موضوع هذه الدراسة حول أثر العلوم الطبيعية الأكثر تقدّماً على التنظير اللغوي. لقد ظلّت دراسة اللغة لقرون طويلة تحت عباءة الفلسفة، لكن بعد أن وصلت العلوم الطبيعية، لا سيّما الفيزياء، إلى مرحلة من النضج المنهجي، بدأت اللسانيات، بوصفها العلم المختص بدراسة ظاهرة اللغة، في محاولة الانضمام إلى تلك العلوم، وهي محاولة لم تكن سهلة على الإطلاق على الرغم من الجهود التي قام بها العديد من اللسانيين من مختلف المدارس الفكرية على طريق الوصول إلى ما يُمكن أن نطلق عليه «علْمَوَة البحث اللساني». تهدف هذه الدراسة إلى تقييم المحاولات التي قام بها ثلاثة من كبار اللسانيين في ردم الهوة بين علم اللغة والعلوم الطبيعية الأكثر تقدّما، مُحاجّاً أنّ كلّاً من دو سوسير وبلومفيلد وتشومسكي اشترك في غاية واحدة، وهي استخدام المقاربة الاستنباطية- الأولية (الأكسيومية) في دراسة ظاهرة اللغة، وأنّ تلك الغاية لا تخلو من معضلات تعود إلى طبيعة موضوع الدراسة (أي اللغة). تنقل الدراسة بعد ذلك إلى تسليط الضوء على بعض المحاولات الحديثة في التعامل مع لسانيات تشومسكي بوصفها علما يقف على قدم المساواة مع الفيزياء النظرية؛ إذ يلفت الانتباه إلى ما تنطوي عليه تلك المحاولات من مبالغة، وذلك من خلال تبيان بعض الفروقات الجوهرية بين النظرية اللغوية والنظرية الفيزيائية.

الكلمات المفتاحية: المقاربة الاستنباطية-الأكسيومية، الأنموذج العلمي، لسانيات تشومسكي، الفيزياء.

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Modern Linguistics and the Quest for a Scientific Model

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Abstract

This paper concerns the impact of the more developed sciences on linguistic theorising. For many centuries, the study of language remained in the orbit of philosophy, and it was not until other disciplines, most notably the physical sciences, had reached a relatively advanced stage that linguistics, as the science of language, began to affiliate itself with the growing 'scientific club.' Seeking membership of this club was certainly not an easy task, and enormous efforts have subsequently been made by eminent scholars, embarking from different points to achieve what might be called the 'scientisation of the study of language.' Focusing on the work of three well-known authors in modern linguistics, the paper purports to assess their attempt at bridging the gap between linguistics and the more developed sciences. It argues that Saussure, Bloomfield, and Chomsky share the same desire of implementing an axiomatic-deductive approach to the study of language, and that such a desire is problematic due to the very nature of the object of inquiry, namely, language. Next, the paper turns its focus on more recent attempts to elevate Chomskyan linguistics to the status of theoretical physics. By outlining some of the key differences between linguistic theory and physical theory, the paper draws attention to the danger of promoting Chomskyan linguistics as a mature natural science.

Keywords: **Axiomatic-deductive approach; Scientific model; Chomskyan linguistics; Physics.**

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1. Introduction

The study of language has been pursued by grammarians and philosophers for many thousands of years, but the year 1786, in which William Jones, the distinguished English philologist, read his celebrated paper to the Royal Asiatic Society in Calcutta, is taken to mark the inauguration of the science of modern linguistics. According to the British linguist and historian of linguistics Robert Henry Robins, in that paper, the English philologist established the historical relationship of Sanskrit with Latin, Greek, and the Germanic languages, and he adds that the comparison of Sanskrit with the European languages marked the first phase in the systematic expansion of comparative and historical studies in linguistics, thereby providing Europeans with a rich source of linguistic knowledge embedded in the writings of Indian grammarians (134-136). In the nineteenth century, the expansion of referent material and the development of method "went on side by side, with constant reciprocal influence" (Pedersen 13)[(1)]. Pedersen maintains that while the creation of a linguistic method can be seen as a reaction to the accumulated knowledge, this method also amplified the material available for study (12).

Up to the late nineteenth century, however, language studies remained in the orbit of philosophy, and it was not until other disciplines, most notably the physical sciences, had reached a relatively advanced stage that linguistics, as the science of language, began to affiliate itself with the growing 'scientific club.' Seeking membership of this club was certainly not an easy task, and enormous efforts have subsequently been made by eminent scholars embarking from different points to achieve what might be called the 'scientisation of the study of language.'

The present paper discusses and evaluates some of the early attempts at the *scientisation* of the study of language by focusing on three examples where well-known linguists try to *imitate* the scientific 'style' of the exact sciences. A *weak* version of this imitation can be found in Saussure where we witness this desire of designing a *système de géométrie* for language, although he had never claimed to have achieved such an ambitious plan for linguistics (Simone 240). In Bloomfield's behaviorist psychology, however, we find a *strong* version according to which there are in fact "a set of postulates for linguistics as a science" (Bloomfield, *Postulates for Linguistics* 153). If we wish to consider the status of mainstream linguistics, we can even encounter the *strongest* version of this imitation embedded in the Chomskyan school, where doing linguistics *à la Chomsky* is taken to be already an instance of a natural science (cf., for instance, Uriagareka 1998; Boeckx and Piattelli-Palmarini 2005; Boeckx and Hornstein 2010). We shall see that Saussure, Bloomfield, and Chomsky, have all shared the same desire of implementing an axiomatic-deductive approach to the study of language, and one of the two aims of this paper is to expose the limitations of such a desire. The other

aim is to highlight the danger of overselling linguistics as manifested in pretentious proclamations to the effect that Chomskyan linguistics should be regarded not only as a science that is comparable to the natural sciences, such as physics or biology, but as itself a natural science.

The paper is structured as follows. Section 2 has a preparatory character. It offers some initial comments on the achievements of physical science, highlighting the significance of the Euclidean axiomatisation of geometry as a scientific model. Section 3 examines some of the efforts to import the Euclidian method to the field of linguistics. I argue that not only did such efforts bring confusion to linguistic theory, but they also proved to be difficult to achieve; the reason behind this difficulty, as I suggest, may lie in the intrinsic nature of language itself. In Section 4, I highlight and criticise the tendency within the Chomskyan camp to elevate their own brand of generative grammar to the status of the natural sciences. Finally, a general conclusion, summarising the results of this paper, is offered.

2. Deductivism as a Method and Physics as a Model

The enormous success of the natural sciences is hardly questionable among scholars in all fields of science. This success is associated with certain features which prevail among disciplines, such as physics and to lesser degree biology [(2)]. Among these features are the extensive use of mathematical models, exposition of logical and systematic rigour, construction of highly sophisticated experiments, and, perhaps most notably, accurate and unambiguous display of predictive power. The scientific work of men like Newton, Darwin, Mendel, Einstein and Bohr, just to mention a few from a large list of well-known scientists, is largely responsible for this established reputation for which the natural sciences are often accredited. Given this state of affairs, it is hardly surprising to witness other fields of inquiry taking physics or biology as their scientific model.

Let us first try to establish the nature of this 'scientific model' being imitated by scientists outside the domain of the exact sciences. The essence of this 'scientific model' does not originate in physics nor biology, but in geometry, and the success of any field of inquiry to attaining this model is determined by (i) the extent to which this field can make use of mathematical tools, and (ii) the discovery of *material* truths derived from an *abstract* deductive system. Accordingly, if physics is taking the lead in exhibiting this scientific model, the reason for this must lie in the ability of physicists to show that the mathematical models they use correspond to reality. To capture this relationship between mathematics and physics, we may offer a 'linguistic metaphor' and suggest the following: if mathematics is the *syntax* of nature, physics would be its *semantics*. In other words, a mathematician may establish the logical truth of an abstract world, but it is for a physicist to interpret this world, i.e., to locate it in space and state its factual

properties. To consider 'God as a mathematician' is to assume a correlation between pure mathematics and the material world, and it is here where physics proves itself. It is also here where the scientific search for a set of underlying principles becomes meaningful.

Perhaps the clearest example of the establishment of a correlation between a purely formal system and the world of experience is found in Euclid's *Elements*, in which physical space is shown to have a logical foundation. Indeed, Euclid furnished the logical basis for what is now known as Euclidean geometry. Starting with a small number of axioms and postulates, Euclid was able to demonstrate the known theorems at his time. To be sure, in Euclid's work, no new theorems were discovered, but rather the possibility of a logical system for geometry was exhibited (Cohen and Nagel 168). One can regard Euclid's work as an extension of the earlier logico-deductive method, where new knowledge is derived from old through syllogisms, but this extension is by no means without its merits. In fact, the genuine epistemological value of this axiomatic-deductive method can be appreciated if we take into account its far-reaching consequences on, and fruitful applications in, many other fields of inquiry. Thus, the advances in mathematics and physical sciences amply confirm the importance of the role of deduction in these fields. Moreover, the development of a scientific field is measured, among other things, by the extent to which this field exhibits a coherent formal system.

As to the field of linguistics, the desire to formalise and ultimately scientise it has led linguists to adopt an axiomatic-deductive approach to the study of language. It is necessary here to emphasise the difference between *formalisation* and *scientisation*; it is one thing to assign a logical structure to the object of inquiry, and quite another to take a step further and assign a physical reality to this logical structure. There may be several mathematical models for an abstract universe, but a consistent physical theory will have to establish the exclusion of all but one of these. Similarly, there may be several formalisms for the description of a given language, but a linguistic theory is lacking unless it makes the claim that a specific formalism *actually* corresponds to this language. It is here where the dilemma of linguistics arises, and where the distinctive nature of its subject matter becomes evident. For language seems to involve both the abstract and the concrete, i.e. the mental and the physical. If the natural sciences proved to be successful, it is partly due to the fact that the line between the metaphysical domain and the physical one is unmistakably discernible in these disciplines, and hence the necessary and continuous move from one domain to another, whether for capturing generalisations or suggesting predictions, is attainable [(3)].

We now turn to discuss some of the early examples of imitating the scientific 'style' of the exact sciences.

3. Imitating a Scientific Model

As early as 1891, Saussure puts forward an approach to language analogous to Euclid's approach to geometry:

> [L]a linguistique générale m'apparaît comme un système de géométrie. On arrive à des théorèmes qu'il faut démontrer.
>
> [General linguistics appears to me as a system of geometry. One arrives at something like theorems that it is necessary to demonstrate.] (Godel, quoted in Simone 239)

We may be tempted to equate the term 'theorems' in the passage just cited with 'sentences,' although some have argued that Saussure's linguistic analysis concerned words rather than sentences (for instance, Bloomfield, *Review of Saussure*, 317-319). However, be that as it may, the passage, as Simone maintains, clearly suggests "a demand for *axiomatization* and the idea of providing linguistics with protocols capable of leading to formally appropriate *demonstrations*" (240). If we choose to stretch the analogy between linguistics and geometry a little further along these lines, we ought to seek an answer to the following question: If physical space is the object of Euclidean geometry, what is the object of linguistics? A very straightforward answer would be 'language,' but what *is* language? In his *Cours*, Saussure fails to give a consistent answer to this question, for he admits and denies at the same time the psychological nature of language (Seuren 147)[4]. In any case, his distinction between *langue* and *parole* seems to assign an *immaterial* reality to the former, and this should suffice to demonstrate that linguistics *á la Saussure* does not belong to the empirical sciences. As will become clear by the end of this discussion, unless we put forward a definite ontological definition for 'language,' the assertion that linguistics is a natural science remains baseless.

Unlike Saussure, Bloomfield attempts to explicitly offer an axiomatic-deductive approach to language. Following the example of A. P. Weiss, who in 1925 proposed a 'set of postulates for psychology,' and equipped with John Young's (1879–1932) *Lectures on the Fundamental Concepts of Algebra and Geometry*, Bloomfield, in his *Postulates for Linguistics*, writes the following:

> The method of postulates (that is, assumptions or axioms) and definitions is fully adequate to mathematics; as for other sciences, the more complex their subject-matter, the less amenable are they to this method, since, under it, every descriptive or historical fact becomes the subject of a new postulate. Nevertheless, the postulational method can further the study of language, because it forces us to state explicitly whatever we assume, to define our terms, and to decide what things may

exist independently and what things are interdependent (153).

Thus, although Bloomfield seems to acknowledge the difficulty of applying what he calls "the postulational method" to the study of human language, he nevertheless asserts the usefulness of this method to delimit the primary assumptions, to specify the definitions of the terms employed, and to make a clear distinction between what can be regarded as a self-evident statement (i.e., axiom) and what can be seen as a derived proposition (i.e. theorem). However, the suggestion that X may be useful for Y does not necessarily imply that the former is applicable to the latter. To be sure, not only is the set of postulates proposed by Bloomfield vaguely stated, but it also lacks the necessary formal status, typically achieved via symbolisation, by which ambiguity is removed and preciseness is obtained. For instance, consider the following Bloomfieldean assumption:

> Assumption: within certain communities, successive utterances are alike or partly alike (196).

The adjective 'certain' in the above assumption is by definition vague, and the same can be said about the adverb 'partly.' Given this lack of preciseness in stating the general assumptions, it would be fair to cast doubt on the significance of the derived theorems, let alone their *raison d'être*. Hence, in his *Language*, Bloomfield asserts that "Bill John hit" does not belong to the set of English forms "because our language does not arrange these constituents in this order" (163). This is hardly an explanation, indeed.

It is certainly not without reason that some notable logicians had already realised how difficult it was to formalise a natural language. Thus, the German logician, Rudolf Carnap, following Hilbert's work on metamathematics and focusing solely on the description of formal languages, writes in his *The logical Syntax of Language* that

> in consequence of the idiosyncrasies and logically imperfect structure of the natural world-languages (such as German or Latin), the statement of their formal rules of formation and transformation would be so complicated that it would be hardly feasible in practice […]. Owing to the deficiencies of the world-languages, the logical structure of a language of this kind will not be developed (2, quoted in Tomalin 90).

As Tomalin maintains, Bloomfield was certainly aware of the so-called 'foundations crisis' in the field of mathematics, and his bilingualism enabled him to have direct access to German texts in logic and mathematics (97-98). Yet, strangely enough, he firmly believed that only the linguist could resolve the foundation crisis of mathematics (Tomalin 97) [(5)]. Moreover, he takes it for granted that the methodology and results of linguistics are similar to those of the natural sciences. In *Language*, Bloomfield asserts that

> [t]he methods and results of linguistics, in spite of their modest scope, resemble those of natural science, the domain in which science has been most successful. It is only a prospect, but not hopelessly remote, that the study of language may help us toward the understanding and control of human events (509).

These remarks, apart from their overambitious nature, seem to either underestimate the methods and results of the natural sciences or overestimate the methods and results of linguistics [(6)]. At any rate, they certainly constitute a genuine misjudgement. By employing a deductive method to describe language, linguistics does not automatically rise to the level of mathematics, and regarding the categories of stimulus and response as pure physical entities does not *convert* the linguist to a natural scientist. What Bloomfield and other behaviourists fail to see is that physical elements are not sufficient to describe linguistic phenomena, for language involves the mental as well as the physical. Moreover, and as we shall argue in the next section, there are substantial differences between linguistics and the natural sciences, and the assumption that they are similar with respect to their methods and results is simply unfounded.

In the late fifties, linguistic behaviourism fades away and the Chomskyan school becomes dominant. Although this change in theoretical orientation is viewed by many scholars as significant or even 'revolutionary,' two aspects at least remain the same as in previous decades. First, the axiomatic-deductive method continues to be present in linguistic theorising. Second, and as we shall see in the next section, not only does the alleged resemblance between linguistics and the natural sciences continue, but it is also intensified.

In *Syntactic Structures*, the central aim of linguistic theory is specified by the assertion according to which a theory of language L should "separate the *grammatical* sequences which are the sentences of L from the *ungrammatical* sequences which are not sentences of L, and to study the structure of the grammatical sequences" (Chomsky 13). Some advocates of Chomskyan linguistics considered this aim of linguistic theory to be one of "finding the right axioms," that is, of specifying "a set of axioms from which it was possible to derive all and only the valid inferences" (Boeckx and Hornstein 119-120). In fact, in his *Three Models for the Description of Language* Chomsky himself considered his model of grammar analogous to a logical system with its sets of axioms and rules of inferences (117). Moreover, in Chomsky's *The Logical Structure of Syntactic Theory*, the notion of 'sentence' is considered "playing the role of the single axiom" (729). As I have argued at length elsewhere, if this is the role of 'sentence' in the model of grammar, then the suggestion that the aim of linguistic theory is to find the right axioms would be absurd, "for there is only one axiom and it is known beforehand" (Al-Mutairi 9). In fact, the very search for the 'right' axioms "can only be meaningful insofar as an axiom has a propositional content," and the initial string representing the only axiom in Chomsky's model of grammar has no such a content (Al-Mutairi 8-9).

Of course, as a matter of analogy, there is no harm in viewing grammar as an axiomatic formal system, even when a fully fledged generative grammar remains an unfulfilled ambition. But there is more to grammar than just formalism. For instance, in *Language in a Psychological Setting*, Chomsky makes clear that his model of grammar describes "a system represented in the mind/brain, ultimately in physical mechanisms that are now largely unknown" (37). Since these mechanisms remain "largely unknown," Chomsky is among those linguists who distrust experimental studies of the human brain and have no option other than the reliance on the intuition of native speakers in order to empirically verify their theoretical results(7). If this is the case, then tenuous and naïve assertions such as the following remain pointless:

> generative grammar is turning into a natural science already, because of what it is now, not because of what it might one day turn into. (Piatelli-Palmarini, foreword to Uriagareka ix)

This statement is one of many that reflect a tendency among some of the proponents of Chomsky's work to oversell their way of doing linguistics, and this is the topic to which we now turn.

4. Overselling Linguistics

Physics is an extremely successful science, and success often arouses envy in those who would – but cannot – claim credit for it. Thus, it is no news that many non-physicists are afflicted with physics envy. But envy sometimes has a positive side-effect, for it may encourage imitation of what is being envied. It is therefore hardly surprising that physics offers the rest of the scientific landscape a model to imitate. However, for reasons that have been mentioned in Section 3, such an imitation is no trivial matter for a young science such as linguistics, and it is failure to realise this fact that has led some linguists to do more harm to their discipline than good. Indeed, and as we shall shortly see, their insistence on non-trivial connections between the principles of language and the laws of physics can only succeed in damaging the reputation of their framework rather than in improving its popularity(8).

Physics enviers within the Chomsky camp are a minority, to be sure, but they are a very loud minority – one who is able to spread its propagandistic rhetoric through popularising books, articles, lectures, workshops, and social media. Their marketing strategy has certain features: for example, it contains various citations from the works of prominent scientists, especially physicists of great reputation; it seeks to establish a comparison between the basic tenets of Chomskyan linguistics and some empirical findings or general practices in the core sciences; and often it ends with the suggestion that there are genuine analogies between the two sides of the comparison. The

following examples express some of the pretentious proclamations one finds in the literature.

As already quoted at the end of the previous section, in his forward to Uriagareka, Piattelli-Palmarini asserts with full confidence that Chomskyan linguistics "is turning into a natural science already, because of what it is now, not because of what it might one day turn into," and Fukui argues for the existence of "rather unexpected fundamental connections…between the principles of language and the laws governing the inorganic world" (51). Following in the footsteps of the latter, Uriagareka's *Rhyme and Reason* is a sizeable monograph which invokes such diverse notions as Fibonacci numbers, DNA, Einstein's famous equation, and so forth, and in which the author introduces what he calls the 'entropy condition' on syntactic derivations and maintains that this condition "is comparable to the Second Law of Thermodynamics" (869). In their article entitled "Exquisite Connections: Some Remarks on the Evolution of Linguistic Theory," Freidin and Vergnaud's provide numerous citations from the works of prominent scientists, and the following is my comment on their interpretations of these citations:

> After reading Freidin and Vergnaud's interpretations of these citations, one is led to wonder whether some [linguists] have actually inherited from Einstein his search for a unified theory, from Dirac his mathematical methods, and from Feynman his sense of the glory of science. This is because the name of Einstein is invoked, *inter alia*, to make the point that [the latest version of Chomsky's theorising] may turn out to be premature "in much the same way that Einstein's search for a unified field theory was premature" (650, n. 21). Dirac's authority is cited in the claim that "the recent developments within [Chomskyan framework] must be viewed… as Dirac's mathematical procedure (method) at work within linguistics" (647). As for Feynman, he is presented as someone who would have endorsed both the methodology and substance of [the latest version of Chomskyan linguistics], someone whose view on Fermat's principle of least time, according to the authors (651), "extends to all economy considerations developed in the natural sciences" – including, one gathers, linguistics (Al-Mutairi 194, n. 6).

If the reader does not find these proclamations amusing, then he or she might try to have a look at Krivochen's paper whose title includes the grandiose expression 'Quantum Linguistics.' Similarly, Piattelli-Palmarini and Vitiello entitle their paper "Quantum Field Theory and the Linguistic Minimalist Program: a remarkable isomorphism," in which they claim that the central computational operation in Chomskyan linguistics is "a bit like Feynman's sum of all histories, before amplitudes give the wave function" (6). As I have argued elsewhere, such examples as the above, through their heavy reliance on metaphysical ideals which are no longer acceptable in modern physics, offer "nothing more than vague analogies which furthermore reflect serious misconceptions

of some scientific concepts…often inflecting linguistic theorising with mysticism and unnecessarily exposing it to contempt and ridicule" (Al-Mutairi 141). Indeed, when contrasted with the results of the hard sciences, such examples would fit well with the Arabic proverb according to which one hears the clappering of the mill, but one sees no flour.

But what makes such claims difficult to defend? This is not the place to launch a comprehensive comparison between physical theory and linguistic theory, and I shall limit myself here to pointing to some features that illustrate some differences between the two, with the caveat that reference to linguistic theory in this context is limited to the one championed by Chomsky and his followers. The aim of the following discussion is merely to show why it is difficult to substantiate the claim that Chomskyan linguistics is comparable to physics.

If we ask a physicist what is actually done when the pressure of a gas is measured, for instance, reference may be made to a simple laboratory procedure involving mercury levels. Accordingly, the physicist compares two readings of mercury levels in closed and open tubes, identifies the difference between the two readings with a numerical value *h*, and states that the pressure of the gas under investigation satisfies the mathematical equation *P* gas = *P* atmosphere ± *h*. Thus, the outcome of the laboratory operation involving the subtraction or addition of two values is referred to simply as *P*, for pressure, and the number obtained by this mathematical operation is assigned to this symbol. However, the physicist also knows that, alongside the procedure relying on mercury levels, there are other laboratory procedures, such as the use of an aneroid barometer or a Bourdon pressure gauge, which can be used to measure pressure. Therefore, instead of restricting the symbol *P* to the outcome of a single laboratory operation, the physicist does "not hesitate to use such operations as a means of assigning numbers to the symbol *P*" (Lindsay and Margenau 13). The important point to emphasise here is epistemological; physically interpreted symbols, unlike purely mathematical ones, are not deprived of material content. Hence, while a mathematician is only concerned with whether or not a conclusion follows from a set of initial premises, a physicist is also concerned with this conclusion as having empirical content that can be investigated experimentally. It is here where the powerful tools of the symbolic method are clearly manifested, for not only does this method provide physical statements with preciseness and economy of expression, but it is also responsible for the genuine *predictive power* that has so much characterised the field of physics.

This is, in essence, what is involved in providing an appropriate physical interpretation for an abstract symbol. But such an interpretation of abstract symbols is neither here nor there when it comes to symbolisation in Chomskyan linguistics. Consider for instance the following two symbolic statements:

(i) $P \cdot V = K$

(ii) $VP \rightarrow V\ (NP)\ (PP)$

A comparison between (i) and (ii) reveals the following facts. First, (i) is a genuine mathematical equation, constructed in terms of physical symbols whose numerical values can be experimentally determined, and as such it refers to an experimental law known as 'Boyle's law.' On the other hand, (ii) is not mathematical but, rather, structural; it is constructed in terms of conventional linguistic symbols (VP = Verbal Phrase; V = Verb; and so on), and refers to a grammatical rule based on observation and belongs to what are known as 'phrase structure rules.' Second, (i), as an equation, can yield precise numerical values once initial conditions are determined, whereas (ii) involves some optional constituents within its 'compositional recipe.' Third, although (i) can be regarded as a mathematical theorem embedded in a logical system called 'physical theory,' its truth is independent of the fate of any theory[9]. (ii), however, is 'constructed' in a theory of grammar, is dependent on this theory, and is supposed to 'generate theorems,' although it seems dubious that mere substitution of linguistic symbols by other linguistic symbols or lexical items can be regarded as equivalent, in the mathematical sense, to the logical procedure of deducing theorems.

In the previous section, we saw how Bloomfield was eager to bridge the gap between linguistics and physics. Likewise Chomsky aspired to the same goal:

> Any scientific theory is based on a finite number of observations, and it seeks to relate the observed phenomena and to predict new phenomena by constructing general laws in terms of hypothetical constructs, such as (in physics, for example) "mass" and "electron". Similarly, a grammar of English is based on a finite corpus of utterances (observations), and it will contain certain grammatical rules (laws) stated in terms of the particular phonemes, phrases, etc., of English (hypothetical constructs). These rules express structural relations among the sentences of the corpus and the indefinite number of sentences generated by the grammar beyond the corpus (predictions). Our problem is to develop and clarify the criteria for selecting the correct grammar for each language, that is, the correct theory of this language (49).

The reader may have noticed that not only does this passage contain serious misconceptions concerning the meaning of physical theory, it also claims a legitimate association between linguistics and physics in terms of theory construction. To be sure, Chomsky's reference to 'general laws' is used in a rather, vague way, for we are not sure whether it refers to the *principles* of a theory, or to the *empirical laws* which can be deduced from these principles. At any rate, 'empirical laws' may as well be called

'general laws,' but they have no resemblance to grammatical rules, and they certainly need not be "constructed" by the relevant theory as Chomsky seems to suggest in the passage above. Boyle's Law, for example, is an empirical one discovered and confirmed by a laboratory experiment long before the existence of the theory from which it was later derived, namely the kinetic theory of gases(10).

There is also a certain degree of vagueness in the claim that the concepts of 'mass' and 'electron' are 'hypothetical constructs.' It is true that a 'theoretical term' has its meaning within the theory from which it originates and that the use of this term in a different theoretical context may alter the original meaning of the term. For instance, the term 'electron' does not have the same interpretation "in pre-quantum theories of the electronic constitution of matter, in the Bohr theory, and in post-Bohr theories" (Nagel 88). However, referring to the terms 'electron' and 'mass' as 'hypothetical constructs' does not mean that these terms, like linguistic ones are deprived of empirical content or engagement with experimental procedures. On the contrary, 'mass,' 'electron,' and the like are theoretical terms that form part of coherent theories part of the aim of which is to suggest experiments by which such terms, or their assumed properties, can be measured. Millikan's oil-drop experiment, for instance, was suggested by a theory that assumed the existence of imperceptible particles named 'electrons,' and it was successful in assigning a definite number to the physical symbol *e*, that is, the elementary charge of an electron (Nagel 87-88). As to the term 'mass,' although it has been given different interpretations by various theories, the physical symbol corresponding to it, *m*, can be calculated by using the experimental law $f = m \cdot a$, which itself is derived from the general principles of Newtonian mechanics. By contrast, no theoretical linguistic terms, let alone linguistic rules, can be empirically grounded in this sense. Thus, the alleged analogy between linguistic theory and physical theory is simply unfounded; it merely offers a simple and unsupported correlation between theoretical constituents. To be credible, not only does the passage cited above need to specify exactly in what sense linguistic theory is similar to physical theory, but it should also explain how theoretical linguistic terms are to be physically interpreted. But this requires knowledge of the physical basis of language and, as indicated in the previous section, Chomsky himself admits that such a basis is 'largely unknown'.

Finally, and before concluding this paper, I will end the present discussion by considering how the term 'prediction' is conceived in the passage under consideration. According to what Chomsky says here, *prediction* in linguistics takes place when grammatical "rules express structural relations among the indefinite number of sentences generated by the grammar beyond the corpus." How similar is this definition of prediction to its counterpart in physics? To answer this question in an appropriate way, let us first observe some of the conditions that a scientific prediction must satisfy. First, a scientific prediction must be *useful*; that is, it must genuinely enrich our scientific knowledge of the world.

Thus, to assert that the sun will rise the next morning is a useless prediction, even though there may be a tiny possibility that it never does. Second, given that a scientific prediction is generally based on observation, whether direct or indirect, and given that scientific observation must be carried out and abstract theories stated in prescribed fashions, it follows that a scientific prediction ought to be *precise* in terms of its content. Finally, a scientific prediction must be *testable*, for without this requirement, there will be no way of distinguishing between a scientific prediction and mere speculation.

Having set out some of the general conditions for scientific prediction, we now ask to what extent *linguistic* prediction, as defined in the passage cited above, satisfies these requirements. First, it is not clear to me how *useful* it might be that our description of a limited number of data may be generalised to encompass a larger domain. It is certainly useful as far as descriptive adequacy is concerned, but I must admit that I fail to see the impact of this on the enrichment of our scientific knowledge about language. In this respect, a linguistic prediction may confirm what a linguist had previously thought about language, but it is unlikely that it would alter our entire conception of language. In physics, however, not only may a scientific prediction lead to enhanced accuracy in description, but it may also transform our entire conception of the world. Second, linguistic predictions in Chomskyan linguistics, just as the linguistic observations on which they are based, are *qualitative* in nature, and thus they lack the high degree of precision that often characterises physical predictions. Third, there is evidence to believe that predictions sometimes are not taken seriously in Chomskyan linguistics, even by those who make them; Hubert Haider condemns such an irresponsible attitude and gives a very telling example from the literature where a generalisation with considerable predictive power was not only abandoned, but was also blatantly violated (4). Finally, the abundance of speculations in linguistics, and linked scientific disputes may be attributed to the lack of a common methodological mechanism in which scientific predictions can be converted into scientific 'facts.' By observing the way in which some linguists from different theoretical schools gather their evidence to support their preferred theory, or their counterevidence to refute rival theories, I am uncomfortably reminded of the long-lasting disputes between rival religious sects, in which evidence and counterevidence are all based on different interpretations of the same "Holy Text".

5. Conclusion

The aim of this paper has been twofold: (i) to present and evaluate some of the early attempts at the *scientisation* of the study of language; and (ii) to highlight the danger of underestimating the methodological differences between Chomskyian linguistics and theoretical physics. To achieve the first aim, we have focused on Saussure, Bloomfield and Chomsky, and tried to show some of the difficulties in their shared desire to adopt

a 'scientific style' to the study of language. In particular, we have indicated some of the confusion created by the attempt to implement an axiomatic-deductive approach to linguistics. As to the second aim, our approach has been gradual; we first have identified certain aspects of the early tendency among well-known linguists to bridge the gap between modern linguistics and the exact sciences, and we then have proceeded to illustrate the intensification of such a tendency by proponents of Chomskyan linguistics. I have argued that their attempt to elevate their work to the status of theoretical physics is abortive, and does more harm to their field than good

Notes

(1) However, according to George J. Metcalf, the Swedish scholar Andreas Jager anticipated William Jones with respect to "the modern concept of the Indo-European family" (251).

(2) Some philosophers of science went so far as to assert that the term *science* itself became gradually and exclusively associated with physics and biology during the first decades of the nineteenth century (for instance, Hayek 13).

(3) This remark needs further clarification. Put simply, the capturing of generalizations involves abstracting from the world of experience, i.e., the inference is from the material world to the pure world of mathematics. The suggestion of scientific predictions is a consequence of an abstract theoretical system and, thus, the inference here is the reverse of the previous one.

(4) However, we must acknowledge, as Seuren rightfully does, the fact that "we do not have [Saussure's] own text but only a text distilled from lecture notes" (156).

(5) In fact, as Tomalin confirms, Bloomfield went on to write a manuscript of 300 pages, titled "The Science of Language", but the publication of this work was blocked by the mathematician Haskell Curry, who identified some mathematical errors (96).

(6) As will be seen in the next section, similar but more explicit remarks have been made by Chomsky in his *Syntactic Structures*.

(7) For instance, in his *New Horizons in the Study of Language and Mind*, Chomsky refers to findings from the brain sciences as "something of a curiosity" (117). As to linguistic intuition, it is well to remember its circular character on which observation and verification of linguistic statements are based. This fact can easily be seen in the double role played by linguistic data, where we start with intuitive knowledge to induce generalizations, and then use the same sort of knowledge to test the consequences of these generalizations.

(8) See, among others, the following: Fukui; Uriagereka (1998); Freidin and Vergnaud (2001); Epstein and Seely (2002); Boeckx and Piattelli-Palmarini (2005); Boeckx and Hornstein (2010). For criticism, see, for example: Lappin *et al.* (2000); Lappin *et al.* (2001); and Al-Mutairi (2014).

(9) In fact, the truth of an experimental law may not even be dependent on the fate of its "parent," or indeed, any other theory (cf. Nagel 88).

(10) See previous footnote.

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