Natural Languages Are *Not* Generative Systems

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1. Begged Questions about Generative Grammars

A renowned logician (Priest, 2017: 5) remarked: 'In philosophy, all interesting claims are contentious.' One might assume that a parallel situation would hold in linguistics. But a central theme of this study is that, on the contrary, although repeated on too many occasions (by too many) to be enumerated, fundamental linguistic assumptions which should be contentious have for many decades instead gone largely unchallenged. But since even massive repetition of assumptions obviously does nothing to support their truth, the actual situation represents a danger of widespread uncritical acceptance of falsehoods. That is, repetition of dogmas has, I suggest, filled an intellectual space which should be occupied by reasoned debate about alternatives. These remarks reference the underlying ideas of the so-called generative grammar movement.

That more than sixty-year-old framework for the study of natural languages (NLs) has been, and, amazingly, continues to be, driven by the work of its founder, Noam Chomsky. It has, of course, vastly expanded beyond Chomsky's personal contributions through the work of masses of people in many countries over the intervening years. The movement is dominant in work on the foundations of NL and in syntactic studies and is quite influential in other areas as well. It appears to be widely assumed by many that generative grammar ideas represent the epitome of current linguistic understanding.

Since the technical notion of generative grammar (see just below) is central to the movement, the contentious title of this article could then well seem simply deranged. But evidence supporting the thesis is easily found and much of it has been staring linguists in the face ever since there were such things as linguists.[1]

While multiple adherents of the generative movement have directed their research at syntactic, semantic, pragmatic, and phonological aspects of NLs, Chomsky's own work has concentrated on syntax.[2] Indeed, since the 1968 publication of *The Sound Pattern of English*, his jointly written phonological opus with Morris Halle, he has had little to say about phonology and has never had much to say about semantics or pragmatics. The present work is centrally concerned with his syntactic ideas.

No remarks better characterize the fundamental thinking originally underlying the ideas of generative grammar than (1) and (2):

(1) Chomsky 1956: 114

> The first step in the linguistic analysis of a language is to provide a finite system of representation for its sentences. We shall assume that this step has been carried out, and we shall deal with languages only in phonemic or alphabetic transcription. By a language, then, we shall mean a set (finite or infinite) of sentences, each of finite length, all constructed from a finite alphabet of symbols.

(2) Chomsky 1959: 137

> A language is a collection of sentences of finite length all constructed from a finite alphabet (or, where our concern is limited to syntax, a finite vocabulary) of symbols. Since any language L in which we are likely to be interested is an infinite set, we can investigate the structure of L only through the study of the finite devices (grammars) *which are capable of enumerating its sentences*. (emphasis mine: PMP)

While the third sentence in (1) and the first in (2) define a term *language*, that English word has many (other) senses. To avoid equivocation, I take these statements to define a specific technical term, *Z-language*. As a mere definition, the relevant remarks have as such no factual implications that is, make no testable assertions.

However, the second sentence in (2) expresses two extraordinary factual claims. First, it asserts that the collection of sentences of an arbitrary NL_x, hence of English, is a recursively enumerable set.[3] Second, the presence therein of the word *only* entails that the characterization of an infinite set *necessitates* a system which enumerates its sentences. I return to this *clear falsehood* in section 16.

During the period of the publication of (1) and (2) Chomsky explicitly spelled out his view of the relation between NLs and Z-languages:

(3) Chomsky 1957: 13

> I will consider a language to be a set (finite or infinite) of sentences, each finite in length and constructed out of a finite set of elements. *All natural languages in their spoken and written forms are languages in this sense, since each natural language has a finite number of phonemes (or letters in its alphabet) and each sentence is representable as a finite sequence of these phonemes (or letters).* (emphasis mine: PMP)

The highlighted, nondefinitional part of (3) amounts to the factual assertion that every NL is a Z-language.

That claim was further explicated as in (4):

(4) Chomsky 1959: 138

a. We learn nothing about a natural language from the fact that its sentences can be effectively displayed, i.e., that they constitute a recursively enumerable set.

b. The weakest condition that can significantly be placed on grammars is that sF be included in the class of general, unrestricted Turing machines.[4]

Remark (4a) makes clear that during the early developmental period of generative grammar Chomsky took it as self-evident that the collection of sentences of any NL formed a nonfinite recursively enumerable set.

For him, this claim did not need to be argued or supported and so, unsurprisingly, was not. Given that, the claim that such collections had to be representable by some variety of Turing machine followed, since such devices can characterize any denumerable collection. The reason that one supposedly learned nothing from the fact that NL grammars lay within the set of unrestricted Turing machines is that such a conclusion was taken to be guaranteed by the recursively enumerability of NLs. It was not pointed out that there are ways of characterizing infinite collections, recursively enumerable or not, that are distinct from equivalents of Turing machines. In effect then, at the earliest period of the generative grammar movement it was taken for granted that NL grammars had to be what came to be called in linguistics *generative grammars*.

Complementary characterizations of that notion are given in (5):

(5) a. Levelt 2008:1

From a mathematical point of view, grammars are FORMAL SYSTEMS, like Turing machines, computer programs, prepositional [sic] logic, theories of inference, neural nets, and so forth. Formal systems characteristically transform a certain

INPUT into a particular OUTPUT by means of completely explicit, mechanically applicable rules. Input and output are strings of symbols taken from a particular alphabet or VOCABULARY. For a formal grammar the input is an abstract START SYMBOL; the output is a string of 'words' which constitutes a 'sentence' of the formal 'language'. Therefore a grammar may be considered as a GENERATIVE system; this feature is often emphasized by the use of the term GENERATIVE GRAMMAR.

b. Pullum 2020

> I use the term 'generative grammar' here in the narrow sense developed by Chomsky in the middle 1950s. In this narrow sense, generative grammars are nondetermninistic random construction procedures interpreted as definitions of sets of strings or other algebraic objects such as trees. A generative grammar consists of (i) a set of one or more relevant objects that is given initially, and (ii) a set of operations for constructing new objects from those that are already available. A system of this sort defines a certain set of objects if and only if every object in the set could in principle be constructed from the initially given strings using the operations of the grammar and only objects in the set can be constructed from the initially given strings using the operations of the grammar.

The 1950s era assumptions in (1)-(4) underlie the entire intellectual edifice of the generative syntax movement. Since they were accompanied neither by supporting arguments nor any references to such, it was not argued during the developmental period of generative grammar, still less demonstrated, that NLs are Z-languages. Hence it was not

argued that the correct grammars of NLs *could* be generative grammars, still less that they *had to be* such. Because, as gone over in detail below, if the collection of sentences of NL_y fails to represent a Z-language, no generative grammar can specify the membership of NL_y.

Unquestionably then, Chomsky's 1950s developmental work on generative grammar entirely begged both of the following critical theoretical linguistic questions:

(6) a. Is it demonstrable that NLs are Z-languages, which, if the case, would at least render *possible* their having generative grammars?

b. Are generative grammars the *only* means to characterize nonfinite collections? Within the question begging internal to Chomsky's conceptual scheme, the basic open question was just what *type* of generative grammar was the proper one for NL description. The contrast with philosophy alluded to in Priest, 2017 is striking.

2. The Unending Maintenance of the Question-Begging

One might assume that in the sixty five years plus passed since the formulation of (3), the massive intellectual lacuna created by the lack of factual support for the Z-language assumption during generative grammar's foundational period must have subsequently been filled. But this is not at all the case. The movement in general turns out to have never extricated itself from the question-begging attending its birth.

Accomplishing that would have required extensive support for the soundness of the substantive points made in (1)-(4) and the provision of strong evidence supporting those assumptions against logically possible alternatives. It would obviously have been necessary to argue explicitly for the view that the conditions defining Z-languages hold for English, the most extensively studied target of generative work.

Instead though, what one finds, specifically in Chomsky's own truly extraordinarily numerous subsequent relevant writings and those of his coauthors and close followers, is quite different. It amounts to just astoundingly many repetitions in various guises of the same Z-language defining/generative grammar necessity assumptions. These are repeatedly advanced (in general, less precisely than in the 1950s) without argument and with no recognition of the existence of any alternative. Justification of that historical assertion is provided, for instance, by consultation of e.g. Berwick and Chomsky 2011: 30, Berwick and Chomsky 2016: 98-101, Chomsky, 1995b:14-15, 2000a: 98, 2004: 106-107, 2005: 12-19, 2006: x, 2007a: 6, 2007b: 15, 2008: 135-137, 2014: 7, Chomsky and Lasnik 1995: 14-15, Everaert, Huybregts, Chomsky, Berwick, and Bolhius 2015: 2, Hauser, Chomsky and Fitch 2002: 1571. This long list is nonetheless very far from exhaustive.

To lend explicitness to the claim that the fundamental question-begging assumptions of the beginning of the generative grammar movement have never been abandoned, there follow randomly chosen quotes from the work of Chomsky and collaborators over the last quarter century. I annotate each telegraphically in italics.

(7) Chomsky 1995a: 154-155

> Another standard assumption is that a language consists of two components: a lexicon and a computational system. The lexicon specifies the items that enter into the computational system, with their idiosyncratic properties. The computational system uses these elements to generate derivations and SDs. The derivation of a particular linguistic expression, then, involves a choice of items from the lexicon

and a computation that constructs the pair of interface representations. So far we are within the domain of virtual conceptual necessity, …

Grammars are generative, as a function of some kind of necessity. Generation initiates with a lexicon.

(8) Chomsky 1995a: 207-208

The simplest such operation takes a pair of syntactic objects (SOi , SOj) and replaces them by a new combined syntactic object SOij . Call this operation Merge. We will return to its properties, merely noting here that the operations Select and Merge, or some close counterparts, are necessary components of any theory of natural language.

Unsupported talk of the necessity of a generative view.

(9) Chomsky 1995b: 3

One such operation is necessary on conceptual grounds alone: an operation that forms larger units out of those already constructed; call it Merge.

The currently favored generative device (Merge) must be part of NL grammars because of some kind of unspecified necessity.

(10) Chomsky 2000b: 120

The I-language consists of a computational procedure and a lexicon. The lexicon is a collection of items, each a complex of properties (called features) such as the property bilabial stop or artifact. The computational procedure selects items from the lexicon and forms an expression a more complex of array of such features.

Grammars are generative and initiate with selection from a lexicon.

(11) Chomsky 2007a: 6

> In addition to Merge applicable without bounds, UG must at least provide atomic elements, lexical items LI, each a structured array of properties (features) to which Merge and other operations apply to form expressions.

Same as (10).

(12) Chomsky 2008: 138

> As has long been recognized, the most elementary property of language—and an unusual one in the biological world—is that it is a system of discrete infinity consisting of hierarchically organized objects. The simplest such system is based on an operation that takes n syntactic objects (SOs) already formed, and constructs from them a new SO. Call the operation Merge. Unbounded Merge or some equivalent (or more complex variant) is unavoidable in a system of hierarchic discrete infinity, so we can assume that it ‘‘comes free,’’ in the present context.

Unsupported claim of necessity for a generative procedure based solely on the supposed discrete infinity of NLs.

(13) Chomsky 2014: 7

> A finitary computational procedure P will have buried in it in some form an operation – call it Merge – that takes objects already constructed and forms from them a new object, beginning with a set of atomic objects (which may have internal structure). To first approximation, we can take the atomic objects to be lexical items drawn from the lexicon, though this is not an innocent move.

A finite lexicon is taken as the sole basis for a generative mechanism.

(14) Everaert, Huybregts, Chomsky, Berwick, and Bolhius 2015: 2

> Merge is a (dyadic) operation that takes two syntactic objects, call them X and Y, and constructs from them a single new syntactic object, call it Z. X, Y can be building blocks that are drawn from the lexicon or previously constructed objects.

Same as (11) and (13).

(15) Berwick and Chomsky 2016: 98-101

> Every computational system has embedded within it somewhere an operation that applies to two objects X and Y already formed, and constructs from them a new object Z. Call this operation Merge… We can think of the computational process as operating like this. There is a workspace, which has access to the lexicon of atomic elements and contains any new object that is constructed. To carry a computation forward, an element X is selected from the workspace, and then a second element Y is selected. X and Y can be two distinct elements in the workspace, as when *read* and *books* are merged to form the syntactic object underlying the phrase *read books*. (12)

Begs question as to whether grammars are generative. Same lexicon idea as (11, (13) and (14).

(16) Chomsky 2020a:

> Jespersen's "notion of structure in the mind" is I-language: a finite generative system that Determines an unbounded array of hierarchically structured expressions of thought, what we can call "the Basic Property of Language." The Basic Property holds as a matter of fact, and requires a computational operation…"
>
> It follows that there is really no alternative to the Principles and Parameters (P&P)

approach that crystallized a decade later, though it took some time for this to be recognized. We therefore take Merge (X,Y) = {X,Y}, where X and Y are either lexical items or syntactic objects in WS, already generated.

Begs question as to generative nature of grammars; claims without argument a specific generative view is necessary ('there is really no alternative').

(17) Chomsky 2020b

> The answer is that language is based on the simplest computational operation—namely Merge, which yields no linear order.

Same as (7).

(18) Chomsky, 2021: 14

> I-language is a computational system. Any such system has primitive elements and computational procedures to form new elements. In our case, the primitives constitute the lexicon (LEX), atoms of computation for I-language…

Begs question as to whether grammars are generative. Same lexicon idea as (11), (13) and (14).

The claims just cited or presented show that the technical assumptions seen in the 1950s remarks in (1)-(4) are effectively maintained to the present day in the later and most recent work of Chomsky and his close supporters. These statements show that despite the time lapse and the publication of massively many generative works, the assumptions

defining the generative grammar view continue a tradition of being stated without argument, as if they represented a kind of revealed truth.

The maintenance of the question-begging of the 1950s is not obscured by differences in terminology, e.g. that the earlier *generative* tends more recently to be replaced by *computational* and that there have developed differing assumptions of *which* generative devices are advocated. There is, of course, also the more recent extreme emphasis on a 'biolinguistic' approach, not found in the works from which (1)-(4) are drawn. This is largely orthogonal to the technical issues in question here. But see Postal 2009, 2012.

The key is that as in the 1950s, generative work continues to insist without argument that NL grammars *must* be generative devices and that the generative devices have as terminal symbol basis a finite set of elements, the lexicon, and an associated character set and nothing outside of that. Section 5 addresses the notion of lexicon and its role in generative grammars in detail.

3. The Logic of Testing the Z-language Hypothesis

Consider the following remarks also made during the advocacy period of (1)-(4):

(19) Chomsky 1956: 116

> No matter how we ultimately decide to construct linguistic theory, we shall surely require that the grammar of any language be finite. It follows that only a countable set of grammars is made available by any linguistic theory; hence that uncountably many languages, in our general sense, are literally not describable in terms of the conception of linguistic structure provided by any particular theory.

The first conclusion to be drawn from (19) is that the lexicon, which, as the quotes in (1)-(3) and (7)-(18) indicate, has always been taken by Chomsky to be a necessary feature of any NL Z-language and any generative grammar characterizing it, must be finite. Call this view about NLs the *Finite Lexicon Hypothesis* (FLH). I explicate this claim in what follows.

Statement (19) also reveals Chomsky's awareness at the beginning of his generative grammar work that there were language-like systems that could not be characterized (generated) by generative grammars. This idea became a commonplace of formal language theory:

(20) Levelt 2008: 7-8

> Furthermore, there are languages which are not even recursively enumerable. That is, there are languages for which we cannot even effectively list the sentences of the language.

Chomsky went on to add:

(21) Chomsky 1956: 3

> Given a proposed theory of linguistic structure, then, it is always appropriate to ask the following question:
>
> [(3] Are there interesting languages that are simply outside the range of description of the proposed type?
>
> In particular we shall ask whether English is such a language. *If it is, then the proposed conception of linguistic structure must be judged inadequate*. (emphasis mine: PMP)

But despite these appropriate and entirely reasonable statements, the question of whether the sentences of NLs in general and English in particular were effectively listable was not raised in early generative grammar work, which simply advanced the dogmatic assertions in (1)-(4). And as (7)-(18) indicate, in the work of Chomsky and those he strongly influences, the issue is still ignored six decades later. So, amazingly, the generative grammar movement in general has never applied what I take to be the unchallengeable logic of Chomsky's (21) to its own fundamental assumptions.

The goal of the present study is then just to apply that logic to the questions begged in (1)-(4) and subsequent statements like those referenced in section 2. Specifically, I raise the question in Chomsky's [3] of (21), but focused more broadly than his remarks. The latter were limited by the unargued assumption that NLs were Z-languages, which, would have at least guaranteed the possibility they could have generative grammars. But in no way would that state of affairs have rendered appeal to such grammars necessary. The current focus is to consider the factual question of whether NLs, English in particular, are Z-languages. This amounts to expanding the denotation of the phrase 'description of the proposed type' in (21) to question the existence of any type of generative grammar capable of characterizing the full class of English sentences.

4. Sentences, Types and Tokens

4.1 Fundamentals

I assume that the fundamental elements in the characterization of NLs are objects called *sentences*. As discussed in Katz 1981, 1984, 1996, 1998, 2004, Katz and Postal 1991. Postal 2003a, 2004a, 2009, 2012, 2018, sentences are abstract objects, more precisely, sets,

quite complex sets with other sets as components. NLs can then be taken to be classes of such sentence sets. It follows from their set-theoretic character that neither sentences nor NLs are elements of the *physical* universe. This claim encompasses the view that NL sentences have no temporal or spatial coordinates, have no causes, have no mass, and cannot cause anything. With respect to these properties, sentences are like other abstract objects, integers, propositions, symphonies, etc. And the same nonphysical nature inheres in the sentence classes which make up NLs. In all these respects, NL sentences differ radically from physical things like fur, chairs, brains, noises, etc.

The claim that NL sentences and NLs are abstract objects is, of course, quite controversial. For instance, the following clearly takes NLs to be part of the natural world:

(22) Chomsky 1983: 156-157

> In contrast, a mentally represented grammar and UG are real objects, part of the physical world, where we understand mental states and representations to be physically encoded in some manner. Statements about particular grammars or about UG are true or false statements about steady states attained or the initial state (assumed fixed f or the species), each of which is a definite real-world object, situated in space-time and entering into causal relations.

Taken seriously, approach (22) would require sentences to be some kind of physical things. But that view has never been able to specify the supposed physical characteristics of sentences, consistent with the abstract object view, which entails that there are no such properties. Even more compellingly, actual work in the framework claiming NL is

biological, hence physical, nonetheless systematically takes sentences to be set-theoretical, as noted especially in Postal 2012.

While the implicit rejection in (22) of the abstract object view of NLs is clear, it is, notably in no way argued for. On the contrary, the abstract view of NLs and their component sentences has been extensively supported, especially in the works in (23):

(23) Katz 1981, 1984, 1996, 1998, 2004, Langendoen and Postal 1984, chapter 6, Katz and Postal 1991, Levine 2018, Nefdt 2018, Postal 2003b, 2004b: chapter 6, 2009, 2012, 2018.

It might be objected that the idea of NLs as nonphysical objects clashes with the very term *natural* language. But there is no real incongruity in this usage. Abstract NLs are nonetheless reasonably called natural because *knowledge of them* systematically arises in the members of human communities as is massively discussed in the literature on first language learning. *How* that knowledge arises is another matter, not at issue here.[5]

Knowledge of NLs, being psychological, can plausibly be argued to be part of the physical universe, hence something natural. But whatever it is, knowledge of NLs is distinct from NLs and hence its ontological status cannot determine that of NLs themselves.

I cannot attempt to review the argumentation in the works in (23) in detail here. But one can simply convince oneself of the reality of the distinction between abstract sentences and physical things which represent or code them, that is, pronunciations, inscriptions, gestures, etc., by considering four properties I will call *multiplicity*, *order*, *destructibility* and *finiteness*.

The first refers to the fact that an utterance or inscription representing some sentence can be repeated without limit in principle, as an inscription in (24) appears three times:

(24) Squirrels don't often play tennis.

Squirrels don't often play tennis.

Squirrels don't often play tennis.

Beavers frequently play squash.

These repetitions are not sentence repetitions since only one English sentence underlies the first three inscriptions in (24). Displays of repetitions like that in (24) are nothing original and are easily found in philosophical writings; see e.g. Pitt 2018: 13.

By order, I refer to the fact that the first three inscriptions in (24) precede the last inscription in the written list. But there is no sense in which the sentence inscribed three times in (24) precedes the sentence inscribed once there. NLs are unordered collections of sentences.

Destructibility can be illustrated as follows. Write on a piece of paper an inscription of the second positive integer, call it II, and another inscription, call it V = *This sentence cannot be destroyed*. Then (following all applicable fire safety regulations) burn the paper. The inscriptions II and V will evidently be destroyed. What effect does that have on the second positive integer and the sentence related to V? Clearly, none. What shows that among other things is that for all a reader knows, I may have actually carried out the incendiary experiment above. But it is hardly in doubt that both the second positive integer and the sentence in question nonetheless still exist. The impossibility of destroying integers

and sentences follows from their abstract nature. Not being elements of the physical world, abstract objects cannot be affected by physical events, that is, are not subject to cause and effect.

Diversity refers to the fact that the sentence inscribed three times in (24) can also obviously be realized by pronunciations, which have vastly different properties than inscriptions. This shows that *identifying* sentences with physical things like inscriptions, gestures or pronunciations can only lead to incoherence. These remarks ignore the possibility touched on below that one might claim with some support that orthographic systems define distinct NLs from their corresponding pronunciation analogs.

Finally, finiteness references the fact that masses of sentences (in fact, almost all) must fail to ever have specific physical codings, as in effect previously observed:

(25) Bromberger 1992: 193

> The first difficulty concerns types that have no tokens. Linguistic theory is not limited to types that have tokens. It is concerned with all the linguistic types, including those that will never have any tokens. It admits no essential distinction between exemplified and unexemplified types.

Evidently, physical things like pronunciations and inscriptions can only exist via physical world actions, those which cause their existence. Accepting that an NL K is an infinite collection of sentences, to associate each of K's sentences with one or more pronunciations, inscriptions or gesture sequences would require infinitely many physical world actions. Considering that the relevant actions are principally vocal tract movements, various forms

of writing and human nonvocal gestures, human limitations determine that only a relatively tiny subset of K's infinite membership can ever be physically signalled.[6]

Those like the author of (22) who take NLs to be part of the physical world must in general take sentences to be some kind of mental/brain features rather than human-external things like pronunciations and inscriptions. But one can also in no sense identify sentences with mental elements. This is shown by the fact that they also manifest the properties of multiplicity, destructibility and finiteness, which cannot coherently be assigned to NL sentences.

4.2 Philosophical Concepts

The use in (25) of the terms *type* and *token* introduces the fact that modern philosophy of language has developed the concepts underlying this terminology. These are used to cover relations like those discussed in section 4.1 between abstract sentences and the distinct physical things involved in speech, gesture and writing which in some sense represent or signal them.

This notion complex was apparently first introduced by Charles S. Peirce (see e.g. Wetzel 2009 xi; Szabo 1999 150 n. 11) and has led to a significant philosophical literature. This conceptual framework distinguishes *types*, taken to be abstract objects, and *tokens* generally taken to be concrete things, objects part of the natural world. The notion is described from a linguistic perspective as in:

(26) Wetzel 2006

> So for example consider the number of words in the Gertrude Stein line from her poem *Sacred Emily* on the page in front of the reader's eyes:

Rose is a rose is a rose is a rose.

In one sense of 'word' we may count three different words; in another sense we may count ten different words. C. S. Peirce 1931-58, sec. 4.537) called words in the first sense "types" and words in the second sense "tokens". Types are generally said to be abstract and unique; tokens are concrete particulars, composed of ink, pixels of light (or the suitably circumscribed lack thereof) on a computer screen, electronic strings of dots and dashes, smoke signals, hand signals, sound waves, etc.

A clear nonlinguistic instance of the type/token distinction is provided by cartons of liquid in a refrigerated compartment of a market, all assumed to contain milk. Such milk portions are tokens of the type [MILK]. As here, when the discursive focus is on types, I may write inscriptions denoting them in caps inside square brackets. Moreover, I will in the same contexts, if relevant, place symbols denoting tokens in < > brackets. Evidently, like any other abstract object, the type [MILK] is neither in any of the cartons nor anywhere else.

One notices in the milk case that the reality determining that a physical thing < x> is a token of the type [MILK] is *inherent*; it depends only on the intrinsic physical characteristics of the sample and the defining physical properties of [MILK]. No coding or conventions are relevant. For a revealing discussion of the role of physical types in natural science, see Pitt 2018.

One might assume that it is possible to take any type [Z] to be defined by a set of properties $\{p_1 \ldots p_n\}$ such that the qualification for a physical thing <x> to be a token of [Z] is to manifest all of $\{p_1, \ldots p_n\}$. For instance to qualify as a token of the type [MILK] a

substance sample <x> would merely need to have the defining properties of substances produced by the mammary glands of a female mammal. One can ignore barbarisms like *almond milk*, which define partial homonyms. That is, almond milk is not milk.

This description would allow a liquid sample to be an instance of [MILK] even if artificially produced by a machine as long as it manifested the defining properties of the products of female mammary glands. But the idea that the type/token concept complex can be reduced to the property set satisfaction idea above is controversial. It was explicitly rejected in Wetzel 2009 61-62 on the basis of an argument about the role of the type/token idea in the characterization of NLs. See section 5.4 for a rejection of her argument.

Further linguistic perspectives on the type/token contrast are seen in:

(27) Wetzel 2009: xi

> Peirce (1931–58, vol. 4, p. 423) illustrated the type–token distinction by means of the definite article: there is only one word type 'the', but there are likely to be about twenty tokens of it on this page. Not all tokens are inscriptions; some are sounds, whispered or shouted, and some are smoke signals. And some, as David Kaplan (1990) pointed out, are empty space (e.g., in a piece of cardboard after letters have been cut out of it).[7] The type 'the' is neither written ink nor spoken sound. In fact, it is no physical object at all; it is an abstract object.

(28) Quine 1974 [1987: 216-217]

> ES IST DER GEIST DER SICH DEN KORPER BAUT: such is the nine word inscription on a Harvard museum. The count is nine because we count *der* both times; we are counting concrete physical objects, nine in a row. When on the other

hand statistics are compiled regarding students' vocabularies, a firm line is drawn at repetitions; no cheating. Such are two contrasting senses in which we use the word *word*. A word in the second sense is not a physical object, not a dribble of ink or an incision in granite, but an abstract object. In this second sense of the word *word* it is not two words *der* that turn up in the inscription, but one word *der* that gets inscribed twice. Words in the first sense have come to be called tokens; words in the second sense are called types.

A particularly clear and detailed statement about types and tokens is found in:

(29) Hugly and Sayward 1981: 186

What is to be said about *being a token of* which relates a concrete object (the token) to an abstract object (the expression)? [8]

First, it does not just relate these two items; one has to at least add the language as a third item. But this isn't enough. Note that it is only because of Morse Code that objects made up of dots and dashes are taken as expressions of English. A perceptible particular is a token of an expression of language L only relative to some tokening. Being a token of is a 4-place relation between perceptible particular, expression, language and stokening system.

It is at least convenient to assume that NL grammars have two distinct components; one, the *Core*, includes their syntax, morphology, lexicon and semantics. The other, the *Expression system*, contains abstract mechanisms whose function is to provide the

structures cores specify with connections to the physical world. These are what Hugly and Sayward call tokening systems. Expression systems permit NLs to serve as devices for communication, which the objects described by cores alone cannot.

The tokens of linguistic objects alluded to so far are physical things *external to human organisms*. However, plausibly there exist mind-internal representations of some sentences and their parts. But any view which takes human beings to be concrete physical objects must take these mind-internal things to be sentence tokens not sentences. The existence of such tokens represents the tiny morsel of truth in claims like (22) above,

But a difficulty in discussing mind/brain internal tokens is that it is not known what the physical properties defining the types of such tokens are, whereas for human body external sound tokens, orthographic tokens, gestural tokens, etc. the nature of the token instances is less mysterious. But in any case, it remains crucial to avoid confusing sentences, which are abstract objects occurring neither in the external world nor in the universe of mental/brain elements, with either mental token types or actual mental tokens

Granting that (some) NL sentences can have token representations in the minds/brains of NL speakers, such representations cannot permit communication with others barring apparently unavailable mind-reading. That renders use of NL sentences for communication impossible unless mental tokens of NL sentences are somehow connected to physical things perceptually available to others. It is the function of expression systems to facilitate this connection.

There are different types of known expression system, the fundamental one evidently being that which links core elements to the output of vocal tract bevhavior, that

is, to pronunciations. This clearly has biological primacy in humans. But there also exist the expression systems of the deaf utilizing nonvocal tract gestures and, obviously, writing systems. But I see no reason to believe that anything in NL cores limits their associated expression systems to one of these three. For instance, it is easy to *imagine* alien creatures having NLs with human-like cores but an expression system based, for example, on emitting and perceiving different types of light. It will be argued in section 10 below that English in fact has certain expressions which make use of light. Other possibilities could also exist.

My view then is that while there is an inherent *biological* connection between the cores of known NLs and human sound-producing vocal tract gestures, there is no inherent *logical* connection. I take the existence of the gesture expression systems of the NLs of the deaf and orthographical expression systems to justify that conclusion.

Distinguishing cores from expression systems reveals that the existence of orthographies alongside pronunciation expressions raises a theoretical question. Under common understandings, writing systems are not considered parts of NLs but rather mostly as parasitic auxiliary systems. But if expression systems in general are parts of NLs, then the combination of a $core_x$ with an orthographic system would define a distinct NL from the combination of a $core_x$ with a pronunciation system.

While I will not be able to address such matters seriously, I note that the sections which follow document masses of English expressions which can *only* be tokened graphically or pictorially. It is argued that these expressions are English sentences. That

conclusion is incompatible with the idea that only a pronunciation expression system can provide tokens of English sentences.

There is a partial analogy between NLs and computers; for either to function, there needs to be a fixed connection between abstract structures, Core elements in the former case, computer programs in the latter, and physical things. Programs by themselves are useless; they become valuable tools when they are implemented in hardware. This implementation involves a complex translation of abstract program elements into specific physical elements and behaviors of computer hardware. Computer implementations then permit the physical behaviors of a computer to be interpreted in highly reliable ways as carrying out abstract functions, e.g. arithmetic. Just as such implementations permit computers to function for real world tasks, the linking of NL core structures to physical things, that is, to pronunciations, inscriptions or gestures, permits NL sentences to function as means of communication with others. They accomplish this by making available physically perceivable objects linked in systematic ways to core defined aspects of particular NL sentences.

4.3 Type/Token Issues

Remarks like those of Wetzel, Quine, and Hugly and Sayward clearly make critical enlightening distinctions between linguistic entities including words and sentences, and quite different sorts of elements such as inscriptions, pronunciations and gestures. These are no doubt fundamental to understanding what NL sentences are (abstract objects) and what they are not (physical things). While the distinctions in (25)-(28) are a commonplace

of philosophy of language discussions, the distinction unfortunately seems to play almost no role in most linguistics, as already noted:

(30) Bromberger 1999: 188

> One perhaps strange but nevertheless good reason for holding this is that linguists seldom if ever mention tokens, or more precisely, habitually conflate mention of tokens with mention of types.

But notwithstanding the evident virtues in accounts like (25)-(28), use of the type/token terminology to discuss the relation between physical concreta and NL sentences and their components is not without problematic issues. I see at least three.

First, the notions are subject to some lack of clarity. As indicated earlier, in cases like that involving milk, what is called the type/token relation is intrinsic…it is something specifiable by the physical sciences. The relation between a portion of milk and [MILK] is such that no milk sample can fail to fall under [MILK]. No conventions or coding are involved. But as all of (25)-(28) illustrate, the relation between so-called types and tokens in NL discussions is not characterized by an intrinsic property. This point was noted in:

(31) Wetzel 2006 section 6

> If it is not already clear from the foregoing, it should be noted that a physical object that is a token of a type is not one *intrinsically*—merely by being a certain sequence of shaped ink marks, say.

Rather the relevant relations involve a kind of coding: exactly the tokening systems of Hugly and Sayward.

In other terms, linguistic entities do not inherently yield the physical mode of their tokens, which are determined by certain conventions. This is an aspect of the long understood insight that the relation between sound and meaning in NLs is largely arbitrary ('largely' because of the so-called sound symbolism phenomenon). Hence:

(32) Monaghan, Shillcock, Christiansen and Kirby 2014

> One of the central 'design features' of human language is that the relationship between the sound of a word and its meaning is arbitrary.

These considerations might reasonably lead to the conclusion that the relations mentioned in (25)-(28) between physical things and linguistic elements are not properly described by the same conceptual framework as that between e.g. a milk sample and the type [MILK]. I do not find this conclusion implausible but must ignore this issue in what follows.

Second, it can be argued that standard discussions of the type/token relation do not analyze the facts of NL deeply enough. For example, Quine in (28) above talks about the inscription *der* being a token of a certain German word, a definite article. And of course, there is regular talk about inscriptions being tokens of whole sentences. But such discussions ignore what one can call the segmental linkages involved in the sort of relations Quine invoked. The orthographical representation of the German word *der* is not a single entity but a sequence of three letters. Each letter is, I suggest, a type, defined by partial shape specifications.[9] So when dealing with a so-called token of an orthographical inscription of the word *der*, one is actually talking about a sequence of tokens, each member

of the sequence a token of the corresponding member of the sequence of letters d, e, r. Parallel remarks would surely hold for tokens of the pronunciation and gesture types.

But if this is the case, it is just not true that an inscription like *der* is in a simple one to one token/type relation to a German word. It seems as if the relation between individual tokens (which are physical things) of the letters and the word is mediated by the sequence of letter types, which represent the spelling of the word. I have not studied this matter sufficiently to say much more about it and I will ignore the segmentation issue in what follows. But doing so could possibly have undesirable consequences somewhere.

A second issue about token/type relations involves the fact that terms like *inscription*, *pronunciation* and *gesture* are ambiguous. Each can refer to a physical type or to a particular instantiation of that type. So, for instance, when it said that that some English word is spelled *dogs*, the assertion involves the type usage of *dogs*. But suppose I point to a particular piece of paper on which is written the following:

(33) Dogs are....

And I then say:

(34) The first element is written in green ink.

I have then referred to a specific physical thing the philosophical tradition would call a token.

The ambiguity of forms like *inscription*, etc., extends to those like *article*, *book*, *mark*, *page*, etc. To facilitate the following discussion, I will mark the type reading of terms like *inscription*, *pronunciation*, *page*, *book*, etc. with a subscripted capitol T.

To see the relevance of the type/token distinction here, consider:

(35) A long *sentence* that is on the first page of my book is on the second page of her book.

A first observation is that (35) has a sensible reading. A second is that at first glance the relevant reading might seem to conflict with previous talk about types and tokens. It *appears* that (35) talks about a sentence, taken above to be an abstract object, saying it occurs on two different pages. But since *page* is ambiguous over token/type readings, one must ask whether a set-theoretial abstract object like a sentence can appear on a page taken in either sense.

On the token sense, impossibility is obvious. Ignoring cases involving time points, a single concrete thing cannot be in two distinct places, hence not on two distinct physical pages in different books. This shows clearly that anti-abstract object views of NLs such as the following are untenable and amount simply to confusing sentences with sentence tokens:

(36) Devitt 2008: 249

> According to my 'linguistic conception' a grammar explains the nature of linguistic expressions. These expressions are concrete entities external to the mind, exemplified by the very words on this page.

That is, the price of view (36) is that the sentence underlying (35) must, falsely, be taken to have a single incoherent reading.

For the type reading of *page*, things are less clear but I still think it is impossible for a sentence to appear on a page. The $page_T$ reading seems to reference an abstract two dimensional space. Such a space can contain zero (defining a blank page) or more $mark_T$s. $Mark_T$s are abstract objects specifying the physical conditions required to be a particular

symbol token. Since an abstract space is an abstract object, it is then not immediately excluded that a sentence, also an abstract object, could appear on it. But that is arguably also impossible.

The reason is that sentences are a specific kind of abstract object, a complex set composed inter alia of various other sets of syntactic and semantic elements and perhaps expressional elements. These are distinct from mark_{T}s. If this reasoning is correct, a sentence cannot appear on a page because a sentence is not a mark_{T} or a composition of mark_{T}s.

Other types of abstract object also cannot appear on page_{T}s. For instance, integers are a kind of abstract individual, rather than some kind of type. In particular they are not mark_{T}s. Thus integers also cannot appear on pages_{T}.

But the sensible reading of (35) equally does not talk about physical pages, so it cannot express the position of sentence tokens. That is, the coherent meaning covers any physical copy of both books. But if the sensible reading of (35) is neither about a sentence nor about its tokens, what is it about?

To answer, at the initial level of analysis, I take (35) to be represented as:

(37) A long *sentence* ~~inscription~~$_{\text{T}}$ that is on the first page~~$_{\text{T}}$~~ of my book~~$_{\text{T}}$~~ is on the second page~~$_{\text{T}}$~~ of her book~~$_{\text{T}}$~~.

This rightly indicates that (35) deals neither with sentences nor tokens. Rather it is about inscription types, these defining the shapes which can be valid parts of inscriptions. To impose that, there are two choices. First, one can take the word *sentence* to be ambiguous, having in particular at least one reading distinct from the complex set one alluded to at the

beginning of this section. This would be a reading denoting sentence inscription types. The alternative, illustrated in (37), which I suggest, rejects taking the English word *sentence* to have an inscription meaning. It adopts instead a syntactic approach to the real inscription meaning. This takes such examples to involve a phonologically null variant of a form denoting inscription types.

The considerations just advanced determine that (35) represents a sentence whose meaning specifies that a certain inscription type which occurs on the first $page_T$ of my $book_T$ also occurs on the second $page_T$ of her $book_T$. This is tenable because saying that an inscription type appears on a $page_T$ makes sense, given the two dimensional space account of page types. Moreover, I think it is clear that talking about inscription types being on pages is quite common.

Thus a statement like (38) will not in general raise any semantics related eyebrows and is in fact true, as confirmed by looking at (28) above.

(38) Quine's remark 'Words in the first sense have come to be called tokens.' occurs on page 217 of Quine 1987.

This is only sensible if the expression sequence in single quotes denotes an inscription type. It cannot be taken to denote a token since it is not about a specific physical page in a particular physical book. Anyone who has a copy of Quine 1987 can verify the truth of (38), which would be impossible if it were about a specific sequence of physical elements. I conclude that far from threatening the type/token distinction, interesting cases like (35) rather illustrate its importance.

What emerges from the previous discussion is that many usages of consituents containing the word *sentence* actually denote inscription types. In fact, it well may be that most uses at least in linguistics are of this sort. A typical example like (39) surely has this sense:

(39) Consider the following sentence: beavers build dams.

This statement talks about the relative positions on a page of the expressions *following sentence* and *beavers build dams*, indicating that the former precedes. But the abstract sentence inscribed as *beavers build dams* isn't on a page and doesn't precede anything. Therefore, a sensible reading would seem to have to adopt an analysis in which *the following sentence* denotes an inscription, an analysis yielded by a treatment parallel to (37).

A relevant question is whether examples partially parallel to (35) have readings in which *sentence* and *page* have token readings:

(40) A long *sentence* that is on the first page of my book got stained with purple ink.

This seems to be well-formed semantically. If so, an analysis partially parallel to that in (37) with a covert form denoting inscription tokens rather than inscription types would be motivated:

(41) A long *sentence* ~~token~~ on the first page of my book got stained with purple ink.

In such a case, both *page* and *book* would have token, that is, physical, rather than inscription type readings.

5. The Notions *Lexicon* and *Typability*

5.1 Basics

As seen in sections 1 and 2, fundamental to the ideas of generative grammar is that NLs are based on a finite lexicon/vocabulary. What this somewhat unclear claim must mean in generative terms needs explication. Informally, it is generally taken to say no more that each NL is based on a finite set of morphemic and multimorphemic lexical items. One can take a lexical item to be a grammatical element which is mentioned in a grammar of an NL and ultimately mapped to a representation in a token defining system of that NL. That is, for spoken varieties NL there is a mapping into a phonetic representation, in a sign language into a gesture representation and in an alphabetic orthography into a representation of letters. I refer to such mappings with variants of *spell*/*spelled/spelling*. Thus among all grammatical elements mentioned in a grammar, lexical items, e.g. *garage*, differ from non-lexical items, e.g. the category Verb, in being assigned a spelling. Put differently, the question 'how does one pronounce/spell *garage'* makes sense while 'how does one pronounce/spell the category Verb' does not.

The question then arises as to how this view interacts with Chomsky's statements in (1) and (2) about a finite alphabet of phonemes/letters. Clearly, the notion vocabulary in the broadest sense needs to encompass beyond a set of lexical items (including, for simplicity, so-called grammatical morphemes under that rubric) also an alphabet of *characters*, phonemes, letters, gestures, one of whose principal function is to spell lexical items.

One can then theoretically distinguish two aspects of NL lexicons. I will say that each lexicon, $LEX(NL_x)$, consists of the pair of collections $ITEM_x$ and $CHAR_x$. The former is a list of morphemes and more complex lexical items. $CHAR_x$ is a set of alphabetic

elements, phonological, gestural or graphic. Each entry in $ITEM_x$ is spelled exclusively with items in $CHAR_x$. Since the FLH, basic to the generative grammar movement, requires that $LEX(NL_x)$ be finite, it follows that the generative view requires both $ITEM_x$ and $CHAR_x$ to be finites sets. The notion of Z-language embedded in the generative grammar movement from the outset must therefore satisfy the FLH.

5.2 Lexical Change

There is though a potential obscurity about the idea of a finite lexicon needing clarification. Fifty years ago, one would have found no instances in English discourse of the expressions:

(42) *blog*, *brexit, facebook, google, iphone, internet*

Here is an excellent informal description of the phenomenon alluded to:

(43) Pullum and Scholz 2005: 493

> In a natural language the lexicon continuously changes, not just on an intergenerational time scale (in the sense that children do not learn exactly the same words as those their parents learned), but week by week and day by day. New brand and model names are introduced; novel personal names are given; technical terms are devised; new artifacts are dubbed; onomatopoeic terms are made up on the fly; words are borrowed from other languages; noises are imitated and used as words; and in dozens of other ways the word stock of a natural language is constantly under modification. The lexicon of a natural language is open and indefinitely extensible.

But I have a significant disagreement with the conceptualization of what is well described in (43). The authors take the phenomena cited to represent changes internal to a

single NL. But as discussed in the works listed in (23), I regard an NL as a collection of sentences, a set-theoretical object, hence an abstract object. Therefore, the notion of NL changes is incoherent. Collections are defined by their members in the sense that collections with distinct memberships are distinct collections:

(44) Halmos 1960: 2

> The most basic property of belonging is its relation to equality, which can be formulated as follows.
>
> **Axiom of extension**. Two sets are equal if and only if they have the same elements.

With greater pretentiousness and less clarity: a set is determined by its extension. The alternative view to that adopted by Pullum and Scholz is that the phenomena at issue, that is, the historic introduction of novel expressions, represent instances of *language change.* But in the current context this term is misleading, since abstract objects cannot change. Hence so-called language change cannot be NL change.

What can and do change are the *knowledge systems* of people, knowledge being psychological hence distinct from collections of sentences known. Over time then, the particular NLs for which knowledge is shared (in significant part by communities) differ from those whose knowledge was previously shared by related people in related places. This conclusion is obscured by the fact that there are enormously more NLs (considered as collections of sentences) than there are NL names like *English*, *Japanese*, etc. See Kayne 2016, who persuasively calculates the number of NLs (spoken and as yet not spoken) as on the order of 10^{30}.

To illustrate, the following sentences appeared in British media and thus are certainly 'English' in the ordinary sense:

(45) a. The committee are now hearing from young people's representatives on how to combat negative body image #youthselect

https://twitter.com/YourUKParl

b. 'It's a cheap shot!' Diane Abbott lambasted live on BBC for rubbishing May's Brexit speech.

http://www.express.co.uk/news/uk/857766/brexit-news-diane-abbott-bbc-latest-may-speech-eu-theresa-may-delay-brussels-europe

c. Boris's call to 'let the British lion roar' gets the conference hall to its feet as a volley of speeches banishes Brexit glumbucketry, writes QUENTIN LETTS

http://www.dailymail.co.uk/home/index.html

d. The teenagers, all girls, were in a car that collided with an articulated lorry at about 12.30pm in Tishomingo, about 100 miles (161km) southwest of Oklahoma City.

https://news.sky.com/story/six-teenage-girls-die-in-collision-between-car-and-lorry-in-oklahoma-12573061

But none of these are actual American English sentences. Example (45a) shows plural agreement with a group noun where American English requires singular agreement; (45b) involves an unknown verb *rubbish*; (45c) manifests a noun *glumbucketry* nonexistant in

American English, while (45d) uses the British noun *lorry*, an equivalent of the actual American word *truck*.

So use of *English* as an NL name is a practical way of speaking about a mass of distinct NLs which, however, share a very great deal of structure, particularly, syntactic structure, but which can differ even massively in vocabulary and pronunciation. There are many available documentations of the multitude of differences between American and British English; see e.g. Davies, 2005. Another way of saying this is that terms like *English* roughly denote a collection of sentence sets which intersect with respect to masses of sentences but which fail to intersect for endlessly many others.

This view is relevant to the current investigation as follows. It means that the sort of phenomena cited by Pullum and Scholz are as such irrelevant to the question of whether the FLH holds. To fairly ask whether there are instances of NL sentences which are not based on finite lexicons, one must avoid reference to all instances of language change, because from a theoretical linguistic point of view, language change yields knowledge of distinct NLs not accretions to the vocabulary of an earlier known NL. The fact that each relevant language change represents an extremely tiny modification in relation to the original NL no doubt contributes to the idea that there is a single modified NL. From a practical point of view, the latter theoretically erroneous view is nonetheless the normal, entirely justified perspective.

5.3 Typability

Recall from (3) the following claim:

(46) each natural language has a finite number of phonemes (or letters in its alphabet) and each sentence is representable as a finite sequence of these phonemes (or letters). [10]

Assertion (46) is a key element in the claim that NLs are Z-languages, hence, a crucial basis for the claim that NLs can (still less must) have generative grammars.

The claim was given a graphic, easily graspable formulation due to Hockett, 1966: 196-197; see Postal, 2004b, chapter 6 for extensive discussion. Given (46), there would exist for each NL_x what can be called an *abstract typewriter*, $T(NL_x)$. $T(NL_x)$ is a finite collection of elements, call them *keys*, which can be considered abstract representatives of a typewriter keyboard. It is required that there be a bijection between the set of abstract keys and $CHAR_x$ such that each key is labelled with one $CHAR_x$ member and nothing else. It follows that the cardinality of $CHAR_x$ determines that of $T(NL_x)$. The 'key/typewriter' metaphor can be taken to indicate that invoking ('clicking on') one of the keys represents an abstract 'action' which generates in an abstract space the character on the activated key. In effect, $T(NL_x)$ is a computer program, whose executions in the case of NL_x yield strings of symbols from $CHAR_x$. If a $T(NL_x)$ were to exist, it would be possible to implement it in a piece of hardware, analogous to the way computer programs are implemented in physical computers.

If NLs were rightly characterizable as in the definition of Z-language, every sentence of NL_x would be a finite object associated with a finite phoneme/letter/gesture string, each of the latter being drawn from a finite list, $CHAR_x$. Hence the superficial form of each NL_x sentence could, via a finite number of key activations, in principle be typed on

$T(NL_x)$. Any such action sequences for NL_x would yield a finite sequence of elements from $CHAR_x$. I will say that any sentence of NL_x whose superficial form can be typed on such an abstract typewriter $T(NL_x)$ is *typable* (by $T(NL_x)$) and that NL_x as a whole is typable (by $T(NL_x)$) if and only if *every* sentence of NL_x is typable (by $T(NL_x)$.

In what follows I will usually omit the crucial *by* $T(NL_x)$ specification with respect to claims that an expression or set of expressions is or is not typable. But the notion must always be understood to assume a fixed $T(NL_x)$ hence a fixed set of keys, hence a fixed, finite set of characters available for representing expressions.

Of course, referring back to the discussion in section 4 of types and tokens, the concept typability should in precise terms be taken to reference inscriptions for orthographic cases rather than sentences. This is consistent with the metaphorical extension of the idea of typewriter.

Evidently, characterizing NLs in terms of an abstract typewriter is unrealistic in one minor way relating to the distinction drawn above between the collections ITEM and CHAR. Sentences are not in generative grammar terms taken to involve the *direct* generation of sequences of phonemes/letters from a finite alphabet. Rather, of course, it is posited that there is a syntax whose output involves structured sequences of elements from ITEM.[11] Then, since each such element has (inter alia) a representation as a (necessarily finite) sequence of phonemes/gestures/letters, the syntax will derivatively generate a sequence of characters. But since the alphabetic expression of each lexical item must be typable, lexical item existence evidently does not conflict with the fact that generative grammars are inherently limited to generating typable collections.

Put differently, the existence of lexical items and their role in generative grammars, in effect builds typability into a requirement that each member of ITEM have a typable representation, that is, a typable spelling. The generation of structures yielding sequences of lexical items as one feature of sentences cannot then fail to yield typable outputs. Actually, there is a minor gap in this reasoning. It assumes that the complex mapping from lexical items to an executable representation whose execution yields actual physical tokens does not interfere with typability. In other words, it assumes that the morphophonology of lexical items cannot introduce nontypability.

Given that, since in Z-language terms the lexicon and each of its elements is finite, and typability is a finite property, the maximally superficial representation of each NL_x sentence will be a finite object containing nothing but elements of $CHAR_x$. In effect, that is just what Chomsky's (3) says.

The relation between typability and generative grammars is further clarifiable via consideration of the notions *terminal/nonterminal symbol*. These are standardly introduced in the context of formalizing the notion of generative grammar, as in:

(48) Levelt 2008: 3-4

> The terminal vocabulary V_T is the set of terminal elements with which the sentences of a language may be constructed. Elements of V_T will be denoted by lower case letters from the beginning of the Latin Alphabet. We write $a \in V_T$ or *a in* V_T when a belongs to the terminal vocabulary.
>
> The nonterminal vocabulary V_N consists of elements which are only used in the derivation of a sentence; they never occur as such in the sentences of the language.

Elements of V_N are indicated by upper case Latin letters and are called variables or category symbols. V_N and V_T are disjoint: their intersection, $V_N \cap V_T$, is empty. Together V_N and V_T form the vocabulary V of the grammar, thus $V = V_N \cup V_T$.

The idea then is that a generative grammar G will have a subvocabulary, $V_{T,}$ such that every sentence of NL_x output by G will consist syntactically of a finite sequence of the elements V_T of G. Since each element of V_T can be taken to be a lexical item, it follows that the output of G is a set of sequences of V_T and since each member of V_T is typable, each sentence generated by G is typable. It then follows that NL_x is a Z-language.

Critically, one can posit a distinct notion of 'terminal vocabulary', one conceived not from the perspective of a grammar, but from that of the collection of all sentences of some NL_x. So call the lexical and grammatical elements found in the sentences of NL_x *occurrence terminals*. (O_Ts). For instance, for the English sentence in (49a), the O_Ts are those in (49b):

(49) a. Some doctors claim to be endowed with superior powers.

b. Some, doctor, plural, claim, to, be, endow, ed, with, superior, power

The element plural occurs twice. This notion of O_T is independent of theoretical specifications about grammars. The membership of the relevant class for any NL is a matter of fact. I take $O_T(NL_x)$ to denote the totality of the O_Ts in the complete collection of sentences of NL_x.

The formal characterization of generative grammars then entails (50):

(50) The Generative Grammar Condition

There exists a generative grammar $G(NL_x)$ only if the collection V_T of $G(NL_x)$ is identical to the collection $O_T(NL_x)$ and there is a $T(NL_x)$ such that every member of $O_T(NL_x)$ is typable by $T(NL_x)$.

Condition (50) holds because every member of $O_T(NL_x)$ has to be mentioned somewhere in $G(NL_x)$. Take a particular element M of $O_T(NL_x)$. And let $G_\$$ be a generative grammar putatively generating NL_x. If M is not mentioned in $G_\$$, the latter will fail to specify that there is at least one member of $V_N(NL_x)$ which ancestrally maps to M. Hence no sentence of NL_x containing M could be generated by $G_\$$ and $G_\$$ could not in fact be a grammar of NL_x.

In line with these considerations, Chomsky, 1965: 68 gave the rules in:

(51) a. M → *may*

b. N → *sincerity*

c. N → *boy*

d. V → *frighten*

Of interest in (51) are not the rules themselves but the illustration that for generative grammar G to generate a sentence containing a particular item M in its output, M must be mentioned in G.

These conclusions determine that regardless of how many typable sentences an NL_x has, if it has any untypable sentences, it has no generative grammar. This fact together with the FLH permits testing the logic of Chomsky's claim (3) against the nature of English by inquiring whether English has untypable sentences, instances of sentences containing elements of O_T(English) which are not members of the V_T of any putative *generative*

grammar of English. Only by carrying out such an inquiry could the question-begging assuming some necessity in the requirement that NL grammars be generative seen to have infected the foundations of generative grammar be shown to have been harmless for linguistics or, on the contrary, be revealed to have been a massive mistake.

5.4 A Note on Orthographies

From the present point of view, one very positive feature of statements (1) and (3) above is their inclusion of orthographical representations in the discussion of NLs. Surely no one fails to understand the monumental role which the invention of writing systems has played in human cultural evolution. However, arguably the creation of such devices has been of only limited interest to theoretical linguists and has not been seen as having revealed anything much about NLs. But there is at least one fundamental conclusion about NLs to be drawn from the development of orthographies.

Arguably, humans have a built-in system for creating sound wave tokens of sentences. Traditional grammatical descriptions normally provide considerable information about the phonetic properties of these tokens. See e.g. Riegel, Pellat and Rioul 1994: 39-40 for a description of French phonetics. But despite the biological connection between NL sentences and the production of sound wave tokens, the invention of orthographies, which provide relatively durable visual tokens of sentences, indicates that NLs do not inherently determine their token formation medium or the nature of the latter, beyond a certain necessity to provide representations of digital sentence structures. That conclusion is of course strengthened by the now nearly universally recognized existence of the gesture tokened sentences of the NLs of the deaf; see section 7.

Suppose there are creatures from some other galaxy whose physical structure permits their bodies to emit light of different intensities, colors, etc. I find it evident that such creatures could utilize NLs whose expressions would involve visual tokens in the form of light variations. Current technology may well permit construction of devices which could also accomplish that. And, as discussed in section 10, there is good reason to think that English and other NLs also permit some sentences containing parts whose tokens involve the light spectrum.

The importance of these considerations for the current study is this. While token systems are arguably logically independent of the rest of NL structure, it is possible for one token system to permit the tokening of certain sentences of a given NL which another would not. And, as seen below, exactly this is the case with orthographies, token systems whose elements are, I claim, defined by shapes.

One might think that this claim about shapes would not be controversial. The material nature of marks involved in an orthography is clearly irrelevant. Thus one can write a Roman Z on paper with a black lead pencil or with a green ink marker, write it on a wall with yellow spray paint, carve it in a rock, write it in the sky with whatever stuff skywriters use, etc. And currently, one can write a Z on electronic screens with patterns of light. From a linguistic point of view, these differences are irrelevant (which is why in most cases, one hardly notices the physical medium).

Nonetheless, the idea that shapes define letters in alphabetic orthographies *is* controversial and is denied in the following:

(52) Wetzel 2009: 61

> Sensitive to this consideration, those who favor the spelling theory are likely to add that letter types are just *shapes* (or classes of similarly shaped objects) and hence that words are shapes too. Of course, as an addendum to the spelling theory, this view is subject to all the objections that the latter faces. What, for example, is a *shape*? With good reason Quine (1961c, pp. 73–74) classifies shapes as abstract objects. But it is subject to an additional objection. The spelling theory by itself would at least classify Braille tokens of the word 'cat' together with signed tokens of it and Morse Code tokens, since they all have the same spelling; but the shape theory could not classify them together. Worse, the shape theory would not even classify all printed tokens of the letter 'A' together. Tokens of radically different fonts are *not* similar in shape (in anything like the Euclidean sense). Witness the differently shaped tokens of 'A', shown in figure 3.1, a short while in the library uncovered.

Wetzel supports her rejection of the shape view with an impressive diagram showing a massive variety of shapes of what she takes to be the letter 'A':

(53) Wetzel 2009: 62


Aa Aa Aa

Given the diagram, her argument continues:

(54) Wetzel 2009: 61-62

> This illustration should kill enthusiasm for the shape theory, but presenting these ideas publicly has taught me that the shape theory dies hard. Let me take another stab at it. Suppose that someone still wants to insist that all *he* means by a letter *is* a very particular shape—as in 'vee-shaped', 'ess- shaped', 'ell-shaped'. Then either: (i) he also wants to insist that all the tokens of 'A' just illustrated are similarly shaped, in which case he is employing some esoteric notion of 'similarly shaped' not based on Euclidean geometry—not even based on topology—and it is incumbent upon him to spell out what it is.

I regard Wetzel's argument against a shape view of letters as challenging but not convincing. Focusing on her diagram, I make it out to contain thirty five letter shapes. Of these, I make out nine of them *not* to represent the intended letter. I think that would be clearer if each appeared in a separate view, which would eliminate the possible suggestive distortion involved in placing them in a supposed list of forms of a unique letter. No matter.

The real weakness of Wetzel's diagram-based criticism of the shape idea is that she ignores the possibility of subtypes. The idea of an alphabet involves a fixed number of letters, which are ordered. Thus we know that whatever defines 'a' it is the first letter of the English orthographic system. But that system has distinct subtypes, most basically that between printed and handwritten styles. Both systems distinguish upper and lower case letters. Thus there is no reason that there should be unique shape analyses of upper and lower case printed characters, or upper and lower case script characters. So once these divisions are made, and they are hardly innovative, there are not twenty six letters with defined shapes but at least one hundred and four.

This analysis into subtypes can be diagrammed as follows for an arbitrary letter type:

(55) The English alphabet consists of twenty six principle letters, each with four variants:

letter n

script letter n printed letter n

capital script letter n lower case script letter n capital printed letter n lower case printed letter n

It is at best only the four lowest level elements in the letter tree which need to receive shape definitions. I think this analysis already accounts for much of the variation in (53).

Some of the rest may well involve historical change of the shape definitions. But much of the variation is, I suggest, simply artistic distortion of standard shape definitions. It seems impossible to me that anyone would use many of the shapes in Wetzel's diagrams to actually compose serious text, either hand written or printed. Wetzel rightly raises the

issue of fonts. I cannot say anything much about these. But my guess is that the developers of fixed fonts add precise variations within the limits of the more basic shape definitions of printed letters of both types. Similar questions arise about bold and italic characters.

The bottom line is that I assume that the idea that orthographic elements are in general defined by shapes has not been refuted, although questions certainly remain.

The key point for present purposes, documented below, is that there are endlessly many sentences having visual tokens which do not have acoustic ones. These will be for the most part untypable sentences. But collections of sentences which have untypable members are not Z-languages, hence have no generative grammars.

Part II Theoretically Ignored Sentences

6 Evaluating the Finite Lexicon Hypothesis

6.1 Goals

This section documents data challenging a defining element of generative grammar assumptions, the Finite Lexicon Hypothesis (FLH), discussed in section 5.4. Recall the remark in that section about Chomsky's view on the relevance of orthographic elements to generative grammar ideas:

(56) From the present point of view, one very positive feature of statements (1) and (3) above is their inclusion of orthographical representations in the discussion of NLs.

This and following sections build on my acceptance of the view that tokening systems involving orthographical elements are as relevant to grammatical theorizing as those based on speech production or gestures. Moreover, it will be argued that orthographic representations are only a special case of a still more general class of planar shape based

tokens which are properly confronted with the FLH. I will call this more general class *two dimensional tokens*. For instance, as will be illustrated, although such are not parts of orthographies, a picture of a geometric figure or a mountain lion can be a two dimensional NL token.

Relevant facts to be considered involve what I will call *alexical constituents*. By alexical constituents of NL_z, I refer to those containing at least one O_T which is not a member of ITEM(NL_z). The term originated in:

(57) Postal 2004b: 192

> The first distinction is that between constituents of NL_x that are, as (1a) requires, wholly based on forms mentioned in the grammar of NL_x. I will call these *lexically pure constituents*. So, in (48) the subject constituent is lexically pure, but the object constituent, the verbal phrase constituent that contains it, the whole clause, and so forth, are not. Call them *alexical constituents*.

The item referred to as (48) was the following, where the sequence in single quotes represents neither a lexical item nor a sequence of such:

(58) The newly arrived alien shouted ‘vlaatu worrada smekto’ at the mailbox.

One can define subtypes of alexical constituents. A key distinction is that between typable and untypable alexical constituents. The sequence *vlaatu worrada smekto* in (58) is alexical but obviously typable since I typed it with no special characters. That is, its component characters can be taken to derive from the same standard finite list of orthographic English characters as any common lexical item. An obvious implication is that an expression can be alexical without being untypable.

6.2 Theoretical Considerations

I begin by adopting a somewhat abstract theoretical perspective about two dimensional visible tokens. Consider the following remarks:

(59) Hopcroft and Ullman 1969: 1

> An alphabet or vocabulary is any finite set of symbols. Although a noncountably infinite number of symbols exists, we shall consider only a countably infinite subset from which all finite sets will be drawn. This subset will include digits, the Latin and Greek letters both upper and lower case (possibly with combinations of subscripts, superscripts, underscores, etc.), and special symbols such as #, ¢, and so on. Any countable number of additional symbols that the reader finds convenient may be added. Some examples of Alphabets are the Latin Alphabet, {A, B, C,..., Z}, the Greek Alphabet, {α, β, γ,…, ω}, and the binary Alphabet, {0, 1}.

Each member of UCHAR is in essence a nonnull set of shapes, that is, lines/curves, in a two dimensional space. Henceforth I will just speak of lines, taking curves to be a subtype. It would often be more precise to speak of (line) segments rather than lines, where segments are lines with two end points. But I will avoid that distinction. Each line is just a geometrical type. The members of UCHAR are not even required to be connected (see e.g. English lower case *i*, the numeral *11*, etc.). I hedge by saying *in essence* because orientation in the plane is also relevant. As normally understood, letters require specification of two planar dimensions, specifically:

(60) a. While their shapes are identical, *b* is a distinct character from *d* because of differing *horizontal* orientations;

b. T is a distinct character from ⊥ despite their identical shapes because of differing *vertical* orientations.

What follows ignores the orientation parameters.

Each line is a sequence of an infinite number of points, whose cardinality is of the order of the real numbers; see Davis and Hersh, 1981: 224.

The following is a proof of the key assumption underlying the claim that the membership of UCHAR is uncountably infinite, namely, that there are an infinite number of lines in a plane:

(61) Theorem

A *plane* contains an *infinite number* of *distinct lines.*

Proof

A *plane* contains an *infinite number of points*.

Not all these *points* are *collinear*.

Let A, B and C be *points* in a *plane* P.

From *Propositions of Incidence: Line in Plane*, any two of these *points* determine a *line*.

Consider the *lines* AB, AC and BC, all of which are *distinct*.

Let X be one of *infinite number* of points on BC which is not B or C.

Then AX is a *line* in P which is *distinct* from both AB and AC.

As there is an *infinite number* of points on BC there are an *infinite number* of *lines* incident to A and BC.

All these *lines* are in P.

Hence the result.

https://proofwiki.org/wiki/Plane_contains_Infinite_Number_of_Lines

Given that the number of points in the plane is of the cardinality of the reals and each point is the endpoint of some line, it follows that the infinite number of lines proved in (61) to exist are also of that cardinality. Since any nonnull set of such lines defines a character, the cardinality of the overall set of characters = UCHAR is also that of the reals, an of course nonrecursively enumerable set.

The question is how this notion of character relates to attested or more generally in principle attestable orthographies. Are there general principles limiting any such orthography to a tiny subset of the total collection of characters? It is intuitively clear that any orthography will be at least limited to a finite set of characters. Moreover, David E. Johnson has pointed out that there is a more profound argument for orthographic finiteness than mere intuition. He refers to Richeson 2010, which indicates that Turing 1937 offered a topological proof that *every orthography is finite*.

Turing remarked:

(62) Turing 1937

> If we were to allow an infinity of symbols, then there would be symbols differing to *an* arbitrarily small extent. The effect of this restriction of the number of

> symbols is not very serious. It is always possible to use sequences of symbols in the place of single symbols. Thus an Arabic numeral such as 17 or 999999999999999 is normally treated as a single symbol. Similarly in any European language words are treated as single symbols (Chinese, however, attempts to have an enumerable infinity of symbols). The differences from our point of view between the single and compound symbols is that the compound symbols, if they are too lengthy, cannot be observed at one glance. This is in accordance with experience. We cannot tell at a glance whether 9999999999999999 and 999999999999999 are the same.

Turing assumed a more restricted and realistic notion of orthography than that specified so far, which merely invoked a set of characters. Turing required beyond that *discernability*. That is, each character in an orthography must be recognizable by some device, whether human, nonhuman or mechanical as distinct from any other. The theorem is then that any orthography in that sense can only have a finite number of characters. This follows since it is shown that no device of any sort animate or mechanical can discern the difference between arbitrary pairs of an infinite set of characters. Moreover, since the purpose of alphabets is to provide inscriptional tokens for NL sentences, such tokens being physical things, evidently, to be feasible in the physical world, the number must not only be finite but reasonably small.

Given Turing's theorem, what is the relevance to the possibility of generative grammars of the statement in (59) that there are uncountably many characters? The

answer involves the interaction of two factors. First, although each orthography will be finite and small, the source of the characters building an orthography is the uncountably numerous UCHAR. This leaves open whether any *theoretical* principle limits the particular finite set of characters in a specific orthography. I return to this issue; see the remarks about the possibility of a universal character set preceding (90) and its discussion below.

But certainly properties of human perception and pragmatic considerations will limit the class of characters found in attestable orthographies. For example, characters with multiple numbers of lines (e.g. twenty, fifty, one hundred, ...) connected or disconected will surely not be found. Just so sets of characters differentiated only by *numbers* of lines would surely burden perceptions intolerably. So e.g. a set of say twenty five characters of the forms schematized in (63) seems to me inconceivable as an actual orthography.

(63) |, ||, |||, ||||, |||||, ...

This would probably follow from the sort of discernability considerations raised in Turing 1937.

However, I take these human limitation facts to have no bearing on the nature of NLs, particularly, none on the question of whether NLs (English in particular) are Z-languages. That is, it seems unjustifiable to claim that there are NL principles which determine that some shapes or combinations of shapes are in principle unsuitable as

elements of an orthography. An argument to the contrary would have to describe such principles or at least argue for their existence.

Now, since every orthography will involve a finite set of characters, that is, a finite number of sets of finite shapes, each element of any orthography can be listed. Hence if the lexicon of NL_x as far as a written expression system is concerned, involves only items spelled with elements of its orthography, it would seem at first that the properties of NL_x's orthography cannot represent any threat to the FLH. They could therefore present no threat to the possibility of a generative grammar of NL_x. But this initially valid reasoning involves a massive gap which, I will argue, yields in fact multiple deadly objections to the FLH, hence in reality deadly objections to the claim that NL_x has a generative grammar.

6.3 Some Names

I will begin gradually to indicate how orthographic cases can challenge the FLH. ITEM(English) no doubt includes *cholera*, *dread*, *sneeze*, *vain*, *zoo*, *Barbara, Frank*, etc. So these forms will occur in English sentences and will be part of O_T(English). The question though is whether every element of O_T(English) is a representative of an element in ITEM(English), so that the FLH holds.

To begin, focus on the trivial fact about NLs that multitudes of their sentences contain names. Chomsky's statement entailing that English is a Z-language, specifically, the key FLH requirement of the foundation of the generative grammar movement, requires inter alia that every name found in every English sentence, that is, every English name O_T, is listed in ITEM(English).

To test this entailment, here are some place names from the Ivory Coast:

(64)) Abengourou, Adzopé, Biankouma, Katiola, Marahoué, Odienné. Tiagba.

All of these names have, of course, phonological instances as well as written ones such as those listed here. What is important is that each form in (59) can occur in unremarkable *English* expressions such as:

(65) a. Kim has never visited Marahoué, which is (a place) in the Ivory Coast.

b. I don't know how far Adzopé is from Tiagba.

I carefully just used the term *expression* rather than *sentence* to refer to (65a,b). There are two possibilities:

(66) a. The expressions (65a,b) are representations of English sentences.

b. The expressions (65a,b) are not representations of English sentences.

Claim (66a) assumes that the expressions (65a, b) represent must be characterized by a correct English grammar just as much as sentences all of whose O_Ts realize lexical items. I will tentatively take (66a) to be true and will make a parallel assumption about further alexical constituent-containing examples *until* section 13. There I consider in detail, and argue against, the general view yielding (66b), which I will call the *Sentencehood Rejection Defense*. Given that, examples like (66a, b) illustrate further what is meant by alexical constituents.

Further, consider names of people. Some person names, e.g. those like *Mary* and *Jones*, can unproblematically be taken to be elements of a fixed ITEM(English). But (67) lists some recent MIT linguistics graduate student names:

(67) Itai Bassi, Ido Benjabi, Fulang Chen, Omri Doron, Danfeng Wu

Despite their exotic (from an English speaker point of view) status, each of these can form parts of seemingly unproblematic English expressions, e.g.:

(68) Ido Benbaji has studied linguistics at MIT.

Thus foreign names in general are problematic for generative assumptions, specifically for the FLH.

Still, the foreign names in (64) and (67), are not so foreign in the sense that they can all be typed mostly with standard English characters, needing only an extra acute accent in a few cases. It might be difficult to accept that such cases really threaten the FLH because it does not seem unreasonable that an accomodation of the relevant data could be achieved by a modest and entirely finite expansion of $CHAR_{English}$ to include one or more accented letters not normally thought of as part of English orthography.

6.4 Beyond Names

But such a defense of the FLH idea is entirely unrealistic. To see that, one can turn to some different examples like:

(69) I don't speak the Tigrinya language, whose name in its alphabet is written ትግርኛ.

Although (69) is a fine English expression, it contains characters drawn from the alphabet associated with an East African NL.[12] Significantly, the presence of those characters in (69) is unavoidable in defining the relevant expression in the sense that there is no reasonable way to express the proposition that (69) does without using the Tigrinya representation. Replacement of the last element(s) by any other sequence of characters would turn a truth into a falsehood.

Is there is any plausibility to the idea that the Tigrinya characters in (69) are part of $CHAR_{English}$? The a priori lack of seriousness of such an idea follows from the fact that nothing in particular determined the choice of Tigrinya characters for choosing sentences like (69), as shown immediately by parallel facts from Japanese orthographies:

(70) a. I don't speak the Japanese language, whose name in kanji is written 日本語.

b. I don't speak the Japanese language, whose name in hiragana is written にほんご

c. マクドナルド is the Japanese translation of "McDonald's".

Were it possible to take (69) to show that the characters of the Tigrinya alphabet are, as a matter of hitherto unnoticed fact, part of $CHAR_{English}$, parity of reasoning about (70a,b) would show that both sets of Japanese orthographic characters would also have to be part of that set.[13]

Just so the English expression in (71) shows that Arabic letters would also have to be claimed to be elements of $CHAR_{English}$.

(71) An example of this is the use of: أولا and the use of خلال فترة ما قبل لاانتخابات.
https://www.actfl.org/resources/actfl-proficiency-guidelines-2012/arabic/%D8%A7%D9%84%D9%83%D8%AA%D8%A7%D8%A8%D8%A9/arabic-writing-examples

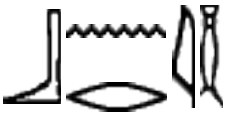
Moreover, here are three naturally occurring English cases which incorporate Egyptian hieroglyphic elements:

(72) Ignoring the vowels, you could now spell freight like this:

or **F-R-T**

https://www.neferchichi.com/hieroglyphic-writing

(73) In Middle Egyptian, one can write:



– *bnrj* (written *b*+*n*+*r*+*i*, with determinative)

which is fully read as bnr, the j not being pronounced but retained in order to keep a written connection with the ancient word (in the same fashion as the English language words through, knife, or victuals, which are no longer pronounced the way they are written.)

https://infogalactic.com/info/Egyptian_hieroglyphs

(74) The word has a young-person determinative symbol:

– which is the determinative indicating babies and children;

https://infogalactic.com/info/Egyptian_hieroglyphs

To give a further sense of the extreme unreality of the idea that a fixed finite $CHAR_{English}$ can be part of a generative grammar of English capable of generating every

sentence, one can note the existence of evidently exotic click consonants from Southern African NLs described in:

(75) Wikepedia

> The Khoesan families (Tuu, Kx'a and Khoe) all have at least four click types, {ǀ ǁ ǃ ǂ} or variants thereof. A few have five, with bilabial {ʘ} or retroflex {ǃǃ}. Hadza and Sandawe have three, {ǀ ǁ ǃ}. Yeyi is the only Bantu language with four, {ǀ ǁ ǃ ǂ}, while Xhosa and Zulu have three, {ǀ ǁ ǃ}, and most Bantu languages with clicks have fewer than that.

https://en.wikipedia.org/wiki/Click_consonant

Evidently, such consonant characters defined initially in terms of human vocal apparatus actions have also led to orthographic representations, based on unique symbolizations.

Consider from Collins and Chebanne 2017: 50 representations of two sentences involving click consontants from the Khoisan NL Kuasi, spoken in Botswana.

(76) a.

ɟìní	ŋǁúì	è	kè	kâ̂ĩ
bee	fat	SBJ	REC	delicious

'The honey was delicious.'

b.

ɬʔâå̂ è khīī
wind SBJ cold
'The wind is cold.'

Here the symbol ǁ in (76a) is a so-called lateral click, while ǂ in (76b) is a palatal click.

The key fact is that the Kuasi sentences inscribed in cases like (76a,b) can be parts of *English* sentences. Abbreviating the example in (76b) as U for simplicity, one would be:

(77) U is the way to say 'The wind is cold' in Kuasi.

The motivated generalization is that any sentence from any NL containing any click consonant can appear as part of an English sentence, meaning that such foreign forms have a role in defining sentencehood for English. But in generative terms that means minimally that every click consonant would have to be regarded as a member of $CHAR_{English}$.

So it turns out that generative ideas apparently lead to the conclusion that inter alia all of the characters of Tigrinya, Japanese, Arabic, Egyptian hieroglyphic, and click language alphabets would have to be claimed to be elements of $CHAR_{English}$. But the choice of characters from these NLs to illustrate the point was random. Consequently, the conclusion is that any character from any orthography can appear in English sentence orthographic representations. So the real generalization is that in generative terms every foreign character would have to be regarded as a member of $CHAR_{English}$.

But even that would not suffice. A final way to highlight that a finite expansion of $CHAR_{English}$ could not allow the description of sentences like (69)-(74) and (75)-(77) in a way compatible with the FLH, would be the following. Invent some new orthography and show that its elements can also be parts of inscriptions of thereby untypable English sentences. One need not bother with the first part of such an exercise because those involved in developing the Klingon ‘language’ originating in the script for the Star Wars

television series have already done it. See e.g.: https://en.wikipedia.org/wiki/Klingon_language. Some of the characters in the system they displayed are seen in:

(78)

b		/b/
ch		/t͡ʃ/
D		/ɖ/

These can of course appear in inscriptions of English sentences, such as:

(79) The Klingon letter for D is  and not  .

The possibility of novel orthographic elements like those in (79) in the representations of English sentences indicates further that characters beyond $CHAR_{English}$ can form English O_{TS}. This means that no fixed finite $CHAR_{English}$ in anything like the usually assumed sense can contain every character which could appear in the inscriptions of English sentences. This appears to represent the grave threat to the FLH and hence to the possibility of generative grammars forseen earlier. But before considering this conclusion in greater detail, I will turn to a distinct class of cases.

6.5 Sentences from Foreign NL Descriptions

Alexical English sentences should be well-known to essentially every linguist using English as a descriptive medium since relevant examples are a commonplace of linguistic works written in English about distinct NLs. To illustrate the point, there follow some randomly chosen examples from works on respectively Afrikaans, Hungarian, Mohawk (Northeastern North America), Arabic and El Fogaha Berber (Libya) and Polish.

(80) Africans: Oosthuizen 1998: 61

> An interesting syntactic property of Afrikaans is the use of the so-called double negative in sentences which express a negative proposition by means of a negation word like *geen* ('no', 'none', 'not (any)'); *geeneen* ('no one'); *geensins* ('by no means', 'in no way'); *g'n* ('never', 'not'); *nerens* ('nowhere'); *nie* ('not'); *niemand* ('nobody'); *niks* ('nothing'); *nooil* ('never').

(81) Hungarian: Szabolcsi 2002: 11

> Examples like (33)-(34) might seem to suggest that it is the choice of a negative quantifier (*sohasem* 'never', *senki se* 'no one') as opposed to the negative particle *nem* that permits the narrow scoping of disjunction.

(82) Mohawk: Baker 1996: 62

> Again, there is an interaction between the indefinite NP *úhka* and the particle *yah* 'not'.

(83) Arabic: Almansour 2010: 195

> From the truth of xaradʒat qabla ʔajji ʃaxsʕ in aaxarin „She left before anybody else,“ we can infer that she actually left before anybody else.

(84) Lofagaha Berber: Lafkioui and Brugnatelli. 2020: 7

> In the context of injunctions, *(ĕ)nk* can be replaced by the preverbal negator *bâk*, which is necessarily followed by a verbal form that takes the 2 [nd]person of the aorist, singular (5a) or plural (5b).

(85) Polish: Błaszczak 1999, section 2

> In (20), the *-kolwiek* pronoun is contrastively stressed and followed up by a 'correction phrase' introduced by *tylko/lecz* ('but'). In this usage *-kolwiek* pronouns are similar to *byle* pronouns as indicated in (21) below.

And, ironically, here is an example from Chomsky's 1951 master's thesis on Hebrew, published as:

(86) Hebrew: Chomsky 1979: 71, n. 23á

> In addition, the following transformation sometimes holds:
>
> - --→ + in env. [# [tY$_1$ a … C$_3$]]---, C3 =/ Y3
> - giving such forms as "tikatávna", "teládna", " hodá'na"
> - MR30.5

Strengthening the point, as observed in Postal, 2004b: 187, Chomsky 1988 contains more than two hundred examples with embedded Spanish forms, including:

(87) Spanish: Chomsky 1988: 86

> Let us first take the case in which the clitic attaches to *afeitar*, forming *afeitarse*.

Remarkably then, Chomsky need only have looked at his own 1951 master's thesis or Chomsky 1988 to see that his claims like (7) above (see (88)) were at best gravely threatened, even by expressions he had himself constructed.

Clearly, the Afrikaans forms *geen*, *geeneen,* g*eensins*, nerens, *nie*, *niemand*, *niks*, *nooil*, the Hungarian elements *sohasem*, *senki* and *nem,* the Hebrew forms *tikatávna*, *teládna,* hodá', the Arabic forms *ʔajji, ʃaxsʕ* etc., the Mohawk forms *úhka* and *yah*, the Arabic forms *ʔajji* and *ʃaxsʕ,* the Berber form *bâk, the Polish* form *-kolwiek* and Spanish *afeitar* are not English lexical items. But linguists could hardly deny the English sentencehood of (80)-(87). To do that would in effect assert that much of the English literature on foreign NLs somehow fails to involve English sentence representations. This would leave it entirely mysterious what such elements would represent. I return to these questions in section 13.

Moreover, note that the first sentence inscribed in the previous paragraph is impeccable English although containing all the foreign forms from the eight NLs mentioned in (80)-(87). By *impeccable* here, I mean that outside of an attempt to defend the FLH, I do not believe it would occur to anyone to deny that that expression is an English sentence. One could find innumerable similar cases from the linguistic literature on the world's NLs. In fact, linguists writing in English about a foreign NL probably would have to expend some effort to avoid writing sentences like these. 6 Of course, one should constantly bear in mind that what are displayed in e.g. (80)-(87) are inscriptional representations of the relevant sentences, not the sentences themselves.

7 Implications

7.1 The Tempting Conclusion

At his point, it is appropriate to begin to assess the theoretical implications of the material in sections 6.2-6.5. The perhaps seemingly self-evident conclusion would be that the cited name and foreign NL examples like (65a,b), (68), (69), (70a,b,c), (71)-(74), (77), (79) and (80)-87) show that:

(88) a, English has sentences some of whose O_Ts are not part of ITEM(English), that is, has sentences *containing alexical constituents*.

b. Moreover, many of these alexical constituents are untypable with respect to anything like the character set that could reasonably be taken to define $CHAR_{English}$, e.g. those like the click consonant containing forms or those with Klingon letters.

These conclusions minimally challenge the idea in statements like Chomsky's (7) above, repeated here:

(89) Another standard assumption is that a language consists of two components: a lexicon and a computational system. The lexicon specifies the items that enter into the computational system, with their idiosyncratic properties. The computational system uses these elements to generate derivations and SDs. The derivation of a particular linguistic expression, then, involves a choice of items from the lexicon and a computation that constructs the pair of interface representations. So far we are within the domain of virtual conceptual necessity,

…

Since this statement, essentially the FLH, asserts that every NL derivation begins with lexical items, it entails, in apparent conflict with the data in sections 6.2 -6.5, that every O_T(English) is a realization of an English lexical item, that is, a realization of elements from a finite list part of English grammar.

Simply on the basis of the limited cases cited so far, one already legitimately suspects that generative grammar assumptions have been based on an unjustified, since unargued, truncation of the range of NL (in particular, English) sentences. These data already reveal seemingly many untypable alexical constituents, thus a radical incompatibility with a basic feature of generative grammars. The existence of such will be greatly strengthened in what follows.

One might then conclude that the data of 6.2 and 6.3 show that V_T(English) is not identical to O_T(English), that thereby the FLH is false, hence that English is not a Z-language, is not typable and that therefore it has no generative grammar.

7.2 Possible Defenses

But before entertaining such a very strong and radical conclusion, it is worth lingering over what might seem, even in the face of seemingly untypable alexical sentences like various of those cited above, possible ways to avoid rejecting the idea that NL grammars are generative systems.

First, focusing on the foreign name cases, it could be suggested that when a speaker encounters examples containing names like those in (64) and (67), the relevant names become part of that speaker's English lexicon. But this would be a rather transparent confusion of a finite lexicon with an unbounded process of what would be purely

hypothetical language change, irrelevant to the point, as discussed in section 5.2. It is of modest interest that even Microsoft Word knows the difference between elements like the names in (64) and (67) and actual English lexical elements, as it marks the former as unknown forms.

No doubt for *some* speakers the encounter with *some* foreign names does indeed yield an expansion of their personal lexicon, hence, technically, new knowledge of an NL trivially different from that known before the encounter with the novel foreign names.[14] However, for innumerable sentences, such hypothetical lexicon extensions would have no reality whatever. For instance, a few minutes after seeing them, I had completely forgotten the Ivory Coast place names in (64). But one hardly wants to conclude that the nature of some NL depends on fortuitous indvidual memory.

Even more seriously, while one could, I suppose, consider it remotely conceivable to maintain that as a general rule contact with foreign names immediately yields linguistic modifications of the NL one knows, the analogous claim about cases like (80)-(85) lacks any plausibility whatever. Linguists only encounter and cite a tiny percentage of all the lexical entities in any NL_x under description. There will thus be untold others from NL_x which could also be cited in English sentences but which cannot be said to have affected a researcher's English. Moreoever, even if some researcher has learned a lot of words from NL_x, that obviously has no influence on the hundreds of millions of other speakers of English. Thus the idea that the data of 6.2-6.5 could be kept consistent with the FLH via a language change assumption cannot be correct.

So far then, nothing seems to interfere with the conclusion that there is no finite $CHAR_{English}$, making it impossible for English to be a Z-language, hence impossible for there to be a T(English). Thus there could be no generative grammar of English.

To avoid this conclusion, there is what might seem a possible radical step. Rather than taking the kind of data cited in sections 6.2-6.5 to falsify the FLH, one might suggest the following. The idea of an isolated $CHAR_{English}$ was a mistake and in fact there is a *universal* orthographic character set containing all the characters of any orthography. Call this U-OCHAR. If so, the conceptual line between e.g. English characters and foreign characters would not exist. For every NLx, U-OCHAR would be the $CHAR_x$ [15]

Several things should be said about the U-OCHAR idea. First, a priori, the notion that every character possible in any NL or NL orthography must, via incorporation of U-OCHAR, be specified as part of English grammar and orthographical definitions has zero plausibility. Focus for example on click consonants. Clearly English speakers differentiate parts of English sentences like the click-containing representations in (76a,b) from ordinary representations. Click consonants, whether pronounced or orthographically represented as in (76a,b), are clearly recognized as foreign elements. In particular, ordinary literate English speakers would have great difficulty even hearing the differences between different clicks and would further have no idea what the orthographic click symbolizations {| ‖ ! ǂ} stand for.

Generalizing, it is untenable to imagine that U-OCHAR could be part of the grammars or orthographies of English, Tigrinya, Japanese, Arabic, Egyptian, Klingon, Berber, as well as every other NL past present and future having or even potentially

having an orthography. An obvious point showing this is that many such NLs and their orthographies have been learned by billions of people. But it would be absurd to imagine inter alia that previous to the discovery of click consonants or the development of Klingon, literate English speakers had learned orthographic shapes like e.g. those in (76) or (79).

There is in fact no experiential ground at all for the idea that either the phonetic or orthographic representations of click consonants and other foreign symbols are in any sense part of systems defining English grammar or orthography.

But, second, there are much more serious objections to any appeal to U-OCHAR than its sheer remoteness from linguistic reality. To be of any relevance to defending the FLH and hence the ideas of generative grammar, U-OCHAR would have to be finitely characterizable. Either:

(90) a. U-OCHAR would just be a finite list of characters; or:

b. There would have to be a recursive enumeration of U-OCHAR's nonfinite membership, that is, a finite specification of the infinite character set defining it.

Neither of these ideas seems remotely sustainable.

First, given that UCHAR contains a nonenumerably infinite number of characters, it remains unproven that U-OCHAR could be finite even given the discernability facts related to Turing's theorem. But even were it arguable that it is finite, it would just be a finite subset of UCHAR. What principle is supposed to subset the latter *in the relevant way*?

Second, to see the a priori unlikelihood of the idea of such a subsetting principle, imagine a time period before click consonants were known to the linguistic world. To believe one could construct a universal list of characters including such elements, one would have to believe the following: there is some principle which linguists could have specified before click consonants were known which would have nonetheless correctly included both their phonetic and orthographic representations in U-OCHAR.

The same issues confront (90b). In that case, it would not be a matter of constructing a finite list. Rather, needed would be an appropriate Turing machine generating some recursively enumerable set of characters suitable for covering inter alia every example of the types in sections 6.2-6.5. While I cannot prove there is no such Turing machine, the burden of proof of showing there is falls on anyone appealing to such an entity.[16] Nonetheless, the viability of the FLH and hence of the possibility of generative grammars of NLs like English would nonetheless minimally hang on the validity of one of (90a, b). That follows, since nothing else could guarantee that the necessary condition on generative grammars stated earlier in (50) would hold:

(91) The Generative Grammar Condition

> There exists a generative grammar $G(NL_x)$ only if the collection V_T of $G(NL_x)$ is identical to the collection $O_T(NL_x)$ and there is a $T(NL_x)$ such that every $O_T(NL_x)$ is typable by $T(NL_x)$.

And evidently (91) can only be satisfied if V_T is a finite list of elements each of whose spellings involves characters meeting one of the conditions in (90).

But, crucially, the a priori implausibility of (90a) and the current formal indeterminacy of the existence of a device like that in (90b) turns out to be ultimately irrelevant to the viability of generative grammars. That follows because the discussion so far has focused only on orthographic cases. But there are large bodies of data of several types distinct from orthographic matters which also attack that viability. These include two dimensional inscriptions of NL sentences of *nonorthographic* types, gesture cases and acoustic ones. For these, any analog of the finite list alluded to in (90a) or the Turing machine needed for (90b) is out of the question, as will be shown in the following sections.

Despite having insightfully seen the relation between NL characterization and typability, Hockett 1966 did not advance to the conclusion that there are NLs, specifically, English, which are untypable. On the contrary, he asserted:

(92) Hockett 1966: 182

> Our assumption is, then, that if one has the right keyboard one can type, not just *almost* anything one wishes in a given language, but *any* sentence of that language.

But that orthographic data alone strongly indicates that there is no such 'right keyboard' for English in particular is just what section 6 and the earlier subsections of this section have argued. [17]

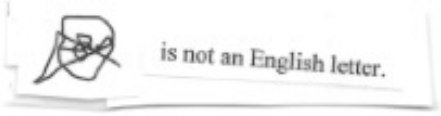
7.3 Nonorthographic Untypable Two Dimensional Visible Alexical Constituents

Return to the issue of the possible recursive enumerability of a subset of all characters defining possible characters for any NL orthography. Suppose among the higher order infinitude of all characters there *were*, as in (90b), such a recursive enumeration of a relevant subset of UCHAR. Call the resulting hypothetical enumerable

character subset Q. Then let the complement set of Q among UCHAR be Q^c; the latter will contain the overwhelming mass of characters.

It turns out that the English sentence positions in cases like (65a,b), (68), (69), (70a,b,c), (71)-(74), (77), (79) and (80)-87) which clearly permit character occurrences from nonEnglish orthographies, also arguably permit arbitrary members of Q^c. This can be indicated as follows. Consider a random member of Q^c say that in (92a,b,c). The resulting English expressions have no less an acceptable quality than those like (65a,b), (68), (69), (70a,b,c), (71)-(74), (77), (79) and (80)-87).

(93)a.


is not an English letter.

b.

The shape  is not a letter in any known alphabet.

c.

. No known alphabet contains 

Of course, I have offered no proof that the element in (93a,b,c) is not a member of a recursively enumerable collection defining the possible elements of character sets for the orthographies of NLs. But that is an impossible task without having in hand a relevant, so far unknown recursive specification. And as already indicated, a supporter claiming such exists faces the task of displaying it or at least of providing arguments that there is such a thing. The problem for such a view is that it seems evident that the nonorthgoraphic shape in (93a,b,c) could be replaced by any random scribble.

That the class of untypable visible planar constituents possible in English extends far beyond orthographic inscriptions is illustrated by the different type of case in (94):

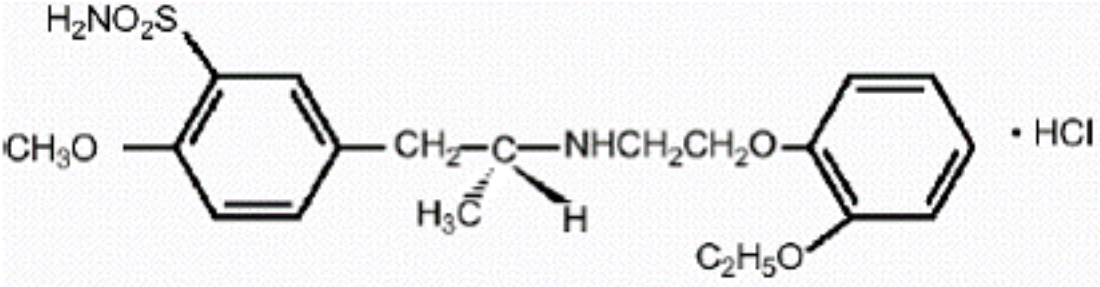
(94).

The mysterious one-sided shape  is called a möbius strip.

Again, the choice of the particular topological shape in (94) was entirely arbitrary. The möbius strip shape could be replaced by any other without, I claim, in any way affecting the English quality of the result.

While examples (93a,b,c) and (94) represent striking illustrations of untypable nonorthographic alexical sentences, there are numerous *natural text* sentences some of whose O_{TS}' characterizability by any enumerable character set seems hopeless. For example:

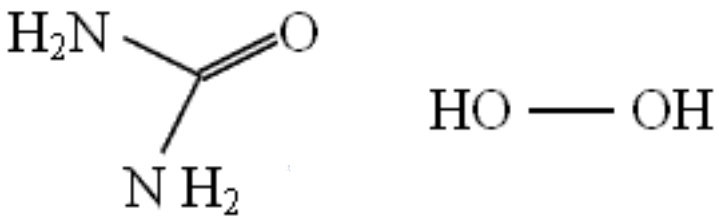
(95) a. The empirical formula of tamsulosin hydrochloride is C20H28N2O5S • HCl. The molecular weight of tamsulosin hydrochloride is 444.98. Its structural formula is:



https://www.accessdata.fda.gov/drugsatfda_docs/label/2009/020579s025lbl.pdf

and:

b. Carbamide peroxide, ($CH_4N_2O.H_2O_2$), is a chemical that contains hydrogen peroxide and urea – an organic compound. Its structural formula is:



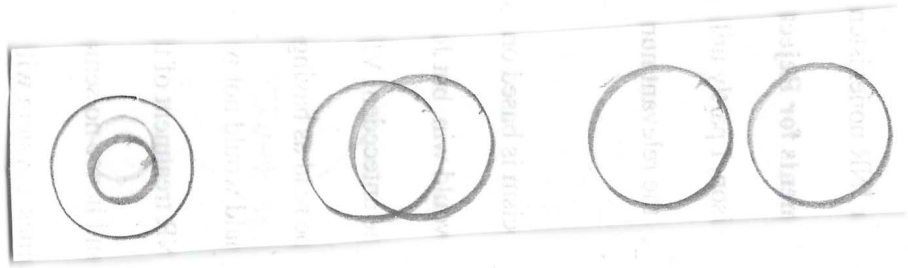
https://ec.europa.eu/health/scientific_committees/opinions_layman/glossary/abc/carbamide-peroxide.htm

The key here is that while the diagrams in (95a, b) contain particular line and line organization shapes, nothing in English determines those. They could be replaced by any random geometrical patterns. That would no doubt yield chemical nonsense but would not alter the linguistic status of the result.

See also:

(96) Shin 2002: 27

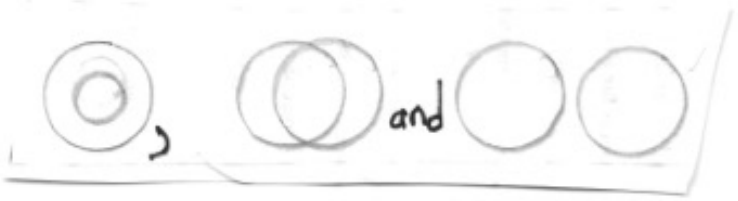
The following diagrams represent subset, intersection, and disjoint relations between two sets, respectively:



In this example the three circle combinations are clearly integrated into the sentence and represent semantically the elements linked to the coordinated. *subset, intersection, and disjoint relations*.

Moreover, there are related sentences where the syntactic need for the circle combinations is manifest, eg.:

(97) In this work,


and

represent subset, intersection, and disjoint relations respectively.

The key point is that nothing about English grammar determines that the graphic elements in (96) and (97) have the circular shapes that they do. Any triple of shapes with similar properties would yield fine sentences, e.g. one with a square inside a square, two overlapping triangles and a pair of unconnected pentagons.

Another class of untypable alexical expressions dependent on shape is provided by elements commonly marked on professionally delivered packages called *barcodes*:

(98) A **barcode**, consisting of **bars** and spaces, is a machine-readable representation of numerals and characters. ... These are **barcodes**. A **barcode** consists of **bars** and spaces of varying width that can be read with an optical **barcode** scanner.

https://www.denso-wave.com/en/adcd/fundamental/barcode/barcode/index.html

And barcodes can be part of English sentences, such as:

(99) a. The barcode on my recently delivered package of 9mm ammunition is

b. The barcode 

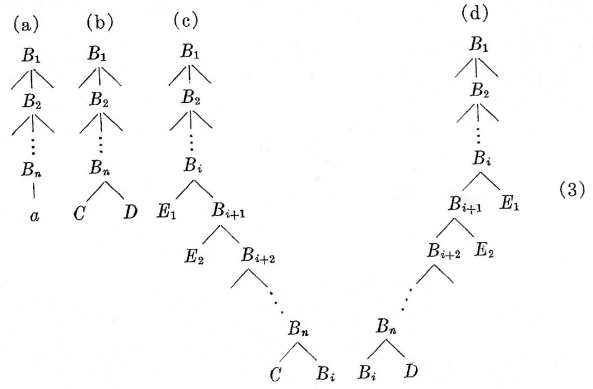
on my recently delivered package was almost covered by tape.

Barcodes consist essentially of sequences of lines of various thicknesses and to some extent of various lengths. There is no nonarbitrary way to specify the longest barcode, although in practice each barcode (token) will be reasonably short (parallel to the situation with NL sentences). Hence barcodes are untypable alexical constituents.

Ironically, there are even examples of shape based nonorthographic untypable alexical components in the Chomsky works cited at the outset of this study, those defining the foundations of the generative grammar movement, for instance:

(100) Chomsky 1959: 153

Since G is regular and non-s.c., we have to consider only the following configurations:



(3)

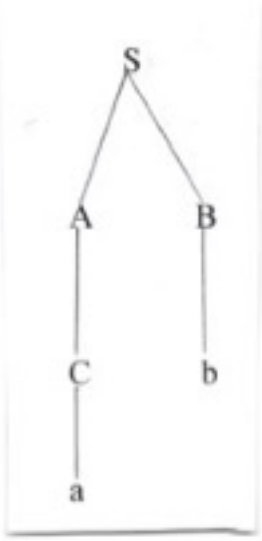
where at most two of the branches proceeding from a given node are non-null; in case (b), no node dominated by B_n is labeled $B_i (i \leqq n)$; and in each case, $B_1 = S$.

A key point about (100) is that while the nature of its diagrammatic subpart is obviously determined by the substance and logic of Chomsky's discussion, nothing in English determines any aspect of it. One could replace the diagram with any image whatever, yielding nonsense in most cases but violating no English grammatical principle. For instance, one could replace each line in (100) originating at a subscripted capital B with a circle and each dotted line ending with subscripted capital B with an image of a möbius strip. The sentence represented by that altered diagram would no more violate a principle of English than the original does. This is true because such diagrams represent untypable alexical constituents whose internal form is not subject to NL constraints.

See also:

(101) a.Chomsky 1959: 140

We can represent D diagrammatically in the form


S
A
B
C
b
a

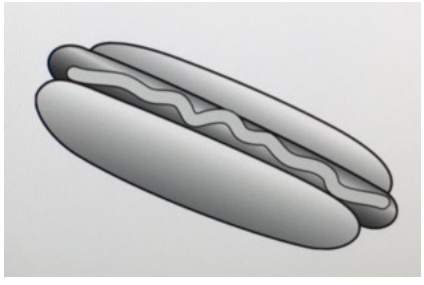
b. *That we can represent D diagrammatically in the form has not been proven.

Expression (101a) cannot represent a sentence unless the diagrammatic elements are parts of it since (101b) shows that *We can represent D diagrammatically in the form* alone is clearly ungrammatical:

Remarkably then, in the period where Chomsky insisted on the Z-language nature of NLs, he himself nonetheless wrote inscriptions like (100) and (101a), evidently without reflecting on their conflict with his claims. This is one piece of evidence that reasonable sized untypable alexical sentence constituents are entirely natural, so much so that they can still escape notice after their inscriptions are constructed by an author who has in effect denied they exist. The relevant lack of self-directed curiosity is, as far as I know, maintained in his following work, which also fails to address cases like (101a).

Even examples like (100 and (101) hardly begin to illustrate the scope of untypable alexical sentences based on combinations of orthographical representations and other shapes independent of any finite character set. This is exemplied by the natural text example in (102), cited in Postal, 2004b:186:

(102) Cullicover 1999: 28

˜ Conversely, the fact that *hotdog* means 

is not predictable from ‘hot’, ‘dog’ or the combination.”

Clearly, nothing limits such cases to images of hot dogs. The evidently nondenumerable class of all such untypable alexical sentences arguably includes expressions containing any arbitrary image whatever. For example:

(103) Conversely, the fact that *mountain lion* means.

is not predictable from ‘mountain’, ‘lion’ or the combination.

Whatever one's view about the possibility of a recursive enumeration of all orthographic characters, it is clearly out of the question to imagine such a device capable of enumerating every possible image. That conclusion is reinforced by the fact that relevant images can be colored. But clearly nothing in English determines the color of such images and the color

spectrum contains an infinity of different values; see section 10. But the cases cited show that English inscriptions can unproblematically incorporate arbitrary images.

I claimed earlier in connection with orthographies that some tokening systems permitted the tokening of sentences which others did not. The picture cases in (102) and (103) are perfect examples of English sentences tokenable in graphic media but not in the standard speech one.

Pictorial cases like (102) and (103) reveal starkly the irrelevance of the issue of whether there is a universal character set for orthographic elements or whether there is a recursively enumerable set of such. For certainly the nonfinite character of the set of all pictures as well as the impossibility of recursively enumerating that set is hardly in doubt. Thus once one moves beyond the case of orthographic representations, the fact that the necessary condition for a generative grammar given earlier in (50) and repeated here cannot be met is beyond question:

(104) The Generative Grammar Condition

> There exists a generative grammar $G(NL_x)$ only if the collection V_T of $G(NL_x)$ is identical to the collection $O_T(NL_x)$ and there is a $T(NL_x)$ such that every member of $O_T(NL_x)$ is typable by $T(NL_x)$.

The conclusion follows since each member of V_T English must be spelled in terms of $CHAR_{English}$. But examples cited in this subsection indicate how unattainable that condition is for any V_T of an English grammar attempting to cover every O_T possible in English sentences.

It should be pointed out that the essence of the point made by the preceding cases in this section was already long ago briefly observed for Hungarian: [18]

(105) Kálmán and Prószéky 1985, p. 31

> Fickó és Mackó, two figures in a Hungarian children's review whose names never appear in writing, drawings are used instead, even within sentences. Since Hungarian children are not supposed to have any linguistic formation in the linguistic sense about these drawings, the question arises how they are able to interpret the sentences containing them, if the grammar they use makes crucial use of lexical categories. The paper claims that such phenomena are not at all exceptional in the use of natural languages.

I take this passage to clearly indicate that Hungarian allows untypable alexical constituents in sentences, specifically, where the relevant constituents are drawings.

8 Gesture Characters

8.1 Gesture NLs

I doubt that any current linguists deny that the multiple and varied signed systems of the deaf found across world communities represent NLs. Thus:

(106) Lillo-Martin 2021: 372

> Sign languages have moved into mainstream generative linguistics as languages that should be consulted when universal concepts of language are considered. These are characterized by the property that their signing systems provide sentences with human body gesture tokens independent of the human articulatory apparatus.

This is of relevance to the current study, as follows. It *might* make sense to say that there is a universal phonetic system, rendering it plausible that a universal phonemic inventory could underlie all NLs with a spoken token system. On the contrary though, one finds:

(107) Pierrehumbert 1990: 389

> Such results indicate that the idea of a universal eventory of phonetic/phonemic ` characters cannot be taken as given.

But in any event, for signed NLs, the analog of a universal, enumerable CHAR set is anything but plausible because the signs of such NLs are not even geometrically planar (like standard orthographic representations; see the following section) but multidimensional and dynamic. This is illustrated by the following remarks about the gestures in American Sign Language (ASL):

(108) Neidle 2000: 27

> Morphemes are distinguished by differences in handshape, hand orientation, movement, and the location relative to the signer's body at which the morpheme is articulated. Thus, particular handshapes, orientations, movements, and locations are the equivalent of phonemes. ASL phonemes are coarticulated in the production of a given morpheme. Each of these parameters of the sign can be altered to yield (potentially) a new sign with a different meaning.

Key in this account is that the parameters of possible signs include handshape, facial movements, orientations, hand movements and locations. Given the multiple dimensions

and body parts involved plus the dynamic character of some, it seems almost impossible that all signs *across all gesture NLs* could be specified by a finite set of gestural characters.

The following remarks about linguistically relevant gestures reinforce the point:

(109) Abner, Cooperrider and Goldin-Meadow 2015:

> A fundamental difference between speech and gesture is that their representational formats are different and, as a result, the two modalities are suited to expressing different kinds of information: speech is categorical and discrete, *whereas gesture is gradient and analog*. Speech is thus not well-equipped to encode visuo-spatial information, whereas gesture seems to be designed for this task. For example, when a speaker utters *the box is near the table*, he or she has encoded in speech two objects (box and table) and a relation between them (near). However, the co-speech gesture produced along with this utterance is likely to encode fine-grained information about the objects (the size of the box and the height of the table) and their relation (how far apart the two are and how they are arranged) that does not appear in speech. (emphasis mine: PMP)

Strong doubts on the possibility of a discrete universal account of gestures were expressed some time ago, as follows:

(110) Postal 2004b: 183

> Rather, under the assumption that there are analogs of direct speech constituents in nonspoken NLs, there would have to be as well a recursive enumeration of a gestural equivalent of discrete phonetic segments for every physical gesture that

could underlie the performance of any nonspoken NL. Far from being plausible, this seems chimerical. That it is might well be implicit in the claim cited in Perlmutter 1986: 523 that pertains to signing:

(25) Whitney 1875/1979.

> Among their manifold capacities, they are able to make gestures, of infinite variety, all of which are reported by the vibrations of the luminous ether to a certain apprehending organ, the eye, both of the maker and of others.

In any event, anyone claiming that there is a recursive enumeration of the gestures capable of serving as parts of performances of all signed NLs bears the heavy (and to my knowledge never assumed) burden of supporting such an idea.

Given these considerations, it seems nearly inevitable that gesture-based NLs are extensively characterized by constituents which cannot meet the typability condition. They would thus not be Z-languages, and could hence not have generative grammars.

8.2 Mixed Expressions

The implications from gesture-based contituents in NLs are much broader than the domain of the NLs of the deaf. Because even NLs like English, whose standard central constructions do not involve gesture tokens but spoken or orthographic ones, permit sentences incorporating gestural elements. Here are two:

(111) The ASL word for ‘thank you’ is  .

(112)  is the ASL expression for ‘I love you”.

Of course, in these cases the graphic representations are just stand-ins for the actual gestural constituent tokens which would be seen with living ASL users or on videos of such. Thus the general untypable character of ASL leaks into English. In fact, I can see nothing which suggests that there is any ASL expression which cannot be part of an appropriate English sentence. This fact renders English equally untypable, and hence beyond characterization by any *generative* grammar. There is no reason to doubt that gesture elements of other deaf NLs could equally be part of English sentences.

Moreover, Postal, 2004b cited a number of English examples involving included gestures independent of gesture NLs, including:

(113) Postal 2004b: 164, 188

a. The deaf person went __ yesterday.

b. The deaf person made the gesture __ in the living room.

c. When the cop told her to leave, Sheila gave him the finger (twice).

d. When the cop told her to leave, Sheila went __ (twice).

e. In. the NL of the deaf of Gwambamamba, the gesture __ means 'why not?'

f. In America, the gesture __ means 'screw you'.

In these cases the blanks stand in for actual gestures which are independent of ASL. The existence of English sentences like those tokened in (113a,d) illustrates, for example, that the position immediately following an occurrence of the verb *go* (with its gesture meaning) provides English with an endless number of alexical gestural constituents. In these cases the blanks stand in for actual gestures which are independent of ASL. The existence of English sentences like those represented in (113a,d) illustrates, for example, that the position immediately following an occurrence of the verb *go* (with its gesture meaning) provides English with an endless number of alexical gestural constituents. In all these cases, an entirely acceptable result appears when the dashed position is performed with an actual gesture sequence.

8.3 Iconic Constituents

While I am mostly unfamiliar with it, a rich literature has grown up around iconic aspects of NL sentences. Brief skimming suggests that this literature documents a wide variety of

sentences lacking any possibility of being reduced to the Z-language format. See for instance Schlenker 2018 and many references therein.

The latter's abstract observes:

(114) Schlenker 2018: 877

> We argue that the status of iconic enrichments is constrained by two parameters: ±*internal*, ±*separate_time_slot*. If an enrichment is effected by the internal modification of an expression *(+internal*) – e.g. by lengthening the word *loooong* in English, or the sign GROW in ASL – it can have any semantic status and can in particular be at-issue. If an enrichment is an external addition to an expression *(- internal*) – as is the case of co-speech gestures in English – it does not make an at- issue , but it may have the status of a presupposition or of a supplement. If an enrichment has a separate time slot *(+separate_time_slot*), it may not be trivial (= presupposed), and must thus be at-issue or supplemental. The generalization is assessed on the basis of vocal iconicity in spoken language, iconic modulations in sign language, co-speech/co-sign as well as postspeech/post-sign gestures and facial expressions in spoken and sign language, and also gestures that fully replace words in spoken language.

The key notion then is iconic enrichment, which refers to modifications of, or enhancements of, the tokens of NL sentences by physical gestures related in some way to the meanings of noniconic elements of sentences. Schlenker offers the following iconicity typology:

(115) Schlenker 2018: 879

> We call an iconic enrichment external if it can be eliminated without affecting the integrity of the sign it modifies, and (therefore) the acceptability of the resulting sentence. An iconic enrichment is internal if this is not the case. At this point, we will leave the distinction on this intuitive level, although it should be formalized in future research. The key is that enrichments that are effected by adding to an expression an optional element in a different modality certainly count as external—as is the case for co-speech gestures. By contrast, modulations of a sign or word, obtained for instance by lengthening part of it, should certainly count as internal enrichments.
>
> Examples are found in:

(116) Schlenker 2018: 880

> (1) Notational conventions: Spoken language
>
> a. A gesture that co-occurs with a spoken word (= a co-speech gesture) is written in capital letters or as a picture (or both) *preceding* the expression it modifies (which will be boldfaced, and enclosed in square brackets if it contains several words).
>
> Examples: John SLAP **punished** his son.

John SLAP_  **punished** his son.

John  **punished** his son.

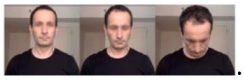
Such examples clearly illustrate the integration of iconic gestures into specific English sentence tokens, instantiating English sentences which are beyond representation in Z-language terms.

Among a variety of iconic enrichment examples Schlenker gives, particularly clear cases of the integration of iconic elements into English sentences is provided by cases where iconic elements replace rather than accompany other constituents. So:

(117) Schlenker 2018: 882

> A remarkable use of 'internal encrichment' pertains to cases in which the iconic element cannot be separated from an expression it modifies because it fully replaces some words - and is ineliminable because it fulfills a grammatical function (see Slama-Casacu 1976, Clark 1996, Fricke 2008, Ladewig 2011). We use the term 'pro-speech gesture' for such cases, as the gesture fully replaces a spoken expression.

Among the examples Schlenker gives of this phenomenon in his notation is:

(118) In two minutes, our Chair will DOZE-OFF_  .

=> in two minutes, our Chair will fall asleep

This representation indicates that the sentence consists of the first six words followed by an image of three pictures of a man, the first image showing him awake, the second starting to lower his head and the final one with head down indicating he is asleeep. The

capitalized *DOZE OFF* indicates that the images have the same meaning as those words when they are present. In other terms, in this sentence, the complex three element image serves as the main verb following the auxiliary *will*. Such sentences are evidently not typable with respect to any $CHAR_{ENGLISH}$ and thus could not be part of the output of any generative grammar of English.

Notable is that at no point does Schlenker 2018 express any doubt as to whether the iconic examples he discusses represent bona fide English sentences.

9 Alexical Constituents with Acoustic Tokens

9.1 Harris's Insight

The arguments in previous sections that English in particular is untypable were based on non-English characters forming English sentences, gestural expressions including those from NLs used by the deaf, sentences with iconic elements and shape forms including orthographical ones. Some might have a sense that such bases for an argument against generative grammars are in some way illegitimate because of the view that NLs are essentially spoken. But in an age of internet searches for linguistic data, such a view would be hard to take seriously. Since such searches yield almost entirely nonacoustic exemplars of sentences, denial of the linguistic relevance of written forms would undermine the use of internet supplied data. Would any serious linguist be willing to go there?

While I thus regard the potential position rejecting written exemplars of sentences as usable data against the idea that NL gramamrs are generative as indefensible, it is ultimately irrelevant to the present argument that English has no generative grammar. That

follows since there is vast evidence of untypable alexical O_T parts of English sentences that have spoken, that is, acoustic tokens.

In fact, more than a half century ago, one could have read:

(119) Harris 1968: 11, n. 11

> The latter is due to the fact that there are sentences which contain sound sequences that are not words. *Any sound* (my emphasis: PMP) can be the subject of a sentence of the form X is a sound, X is his name, X_1 and X_2 are different sounds...etc. The set of objects that occupies the positions of X here, and so the set of sentences of the above forms, is not discretely differentiated...and not necessarily denumerable.

Essentially, Harris here noted the existence of phonetically tokened sentences (e.g. of English) some of whose elements involved components not part of any fixed $CHAR_x$, for instance, such as those in the last component of:

(120) Karen yelled u!a‡ep. (see (75) for the click characters involved).

These observations already indicated that English was not a Z-language and hence had no generative grammar. Harris evidently considered the matter so obvious and hence indisputable that he relegated its recognition to a footnote. Despite that, the subsequent generative work of Chomsky and his supporters has up to the present seemingly entirely ignored Harris's account.[19] For instance, as noted in Postal 2004b: 180-181, Chomsky 1981, 1986a, 1986b, 1988, 1995a, 2000b fail to reference Harris's remarks. And to the best of my knowledge, none of Chomsky's very many relevant post 2000 works confront them either.

The above said, I believe there is at least a *possible* technical confusion in Harris's remark in (119) to the effect that certain *sentences* contain sound sequences. As stressed earlier, I regard sentences as abstract objects, sets, hence objects with no location in time or space. The expression *sound sequences* can however be understood as denoting physical events. So the question is whether Harris's remarks referenced sentences or sentence tokens.

Postal 2004b tried to deal with the task of rendering sentences like (120) consistent with the abstract object status of sentences by claiming that:

(121) Postal 2004b: 192-194

> The only answer I see is that an alexical, unregimented constituent C must represent a set whose elements include *the physical tokens that make up individual performances of C*.

But this entirely confused view loses sight of the fact that performances (tokens) of direct speech constituents are unique, that is, have specific time/space coordinates. This clashes with the fact that direct speech sentences like e.g. (120) are *repeatable*. Were the post *yelled* part of (120) represented by a set containing an actual performance, that is, a token, the sentence could not have distinct performances.

Beyond repeatability, the conclusion that relevant sentences cannot involve actual sound events is supported by discourses such as:

(122) a. Karen yelled u!a‡ep and Bob later also yelled u!a‡ep.

b. Karen yelled u!a‡ep and Bob later uttered the same sound.

Under a view that cases like (122a, b) involved sentences with actual performances as parts, the propositions they express would have to be false. But that is not the case and neither proposition's truth value is determined by the linguistic structure of the examples of (122).

What follows, I suggest, is that the alexical elements in direct speech cases like (120) and (122) are sound *types*, abstract objects instantiated by particular tokens. This view, which owes its origin to David E. Johnson, is elaborated in section 11. In such terms, the sentence tokened in (122a) contains two occurrences of the same sound type, while any token of it will contain two distinct tokens of that same type. This rightly allows for the sameness invoked in (122b) to yield a factually tenable claim about two distinct tokens.

It is thus correct, I believe, to say that the grammatical object of *uttered* in the first conjunct of the phonically tokened version of (122a) is a sequence of sound types, not a sound sequence. Acoustic tokens of the same type will be physically similar up to some contextual standard, taking account of context conditions, different personal articulatory structures, etc

Therefore, I think one should interpret Harris's insightful remark as equivocal on the meaning of *sound sequence*. A defensible reading for that expression in (119) is one which refers not to physical events but to the sound types those physical events instantiate. The types are abstract objects whose tokens are physical events. See section 11 below for further discussion of the physical type character of untypable alexical constituents with acoustic tokens.

The result, I claim, is that once the type/token distinction about sound sequences is clarified, Harris's remark was an insightful statement of one aspect of the truth that English is not a Z-language, hence is a system that has no generative grammar.

9.2 Further Support for Harris's Insight

The issue raised by Harris was taken up at length in Postal, 2004b: 6.4. There is no need to cover that ground in detail again. But a few items are worth citing:

(123) Postal, 2004b:184

> For instance, (28a) might be a schema of descriptions of the noise made by a person afflicted with serious snoring, while (28b) might schematize the description of the noise associated with a tornado:
>
> (28) a. He goes __.
>
> b. It gives off a roar like __.
>
> The relevance of such cases is that even though the material schematized by the blanks in (28) involves performance via the creation of sound waves, there is, evidently, no reason at all to imagine that the full range of such performances is coded by anything like a universal phonetic alphabet. That is, there is no reason to believe that, for example, the class of examples illustrated in (29) that purport to indicate bump-induced car noises is a priori specifiable in a linguistic way:
>
> (29) Pullum and Scholz 2001: 17
>
> My car goes 'ehhrgh' when I go over a bump.
>
> The discussion continued:

(124) Postal, 2004b: 185

This position is consistent with the observation of Kathol and Levine, 1993: 210, note 7:

> Thus inarticulate cries, imitations of animal or industrial noises, indeed anything producible by the human vocal tract can appear within the fronted quotation.

Moreover, it was further claimed that there was reason to assume that schemas of the form of his (28) and (the quoted part of) (29) could equally well represent NL sentences where:

(125) Postal, 2004b: 185

> the blanks or quoted material are performed even without human vocal apparatus, for example, by clapping, or utilizing an arbitrary mechanical means of producing sounds, orchestras, guitars, machines guns, or whatnot. That is, I suggest that while it is certainly proper to perform (29) by making a vocal noise after the word *goes*, it is just as proper to perform it by playing a recording of actual car noises in that position and just before one pronounces *when I go over a bump*.

In all such cases the alexical acoustically tokened O_{TS}s constitute untypable constituents unrepresentable via membership in any finite $CHAR_{English}$.

9.3 Pullum and Scholz's Claim of Ontological Diversity

In apparent conflict with my view that NL sentences are abstract objects, one finds the following, which, relevant to the current section, invokes pronunciation facts:

(126) Pullum and Scholz 1997: 30-41

> sHeterogenism asserts that the referents of the theoretical terms of a single generative linguistic theory are ontologically diverse. We believe that this view has some initial plausibility. *Languages are structured connections between sound and meaning*. At the phonetic end, no linguistic theory can adequately describe human languages without a predicate 'nasal' being involved. And statements containing the predicate 'nasal' are satisfied by concrete (and mind-independent) objects; specifically, the relevant objects here are velums (a segment is nasal if and only if the velum is lowered during its production so that the velic port to the nasal cavity is opened). (emphasis mine: PMP)

The claim appears to be then that NL sentences are composed of both abstract elements and concrete ones, e.g. things denoted by *nasal*, hence the ontological diversity alluded to. This obviously conflicts with the view expressed in section 4 above and references therein that NLs are homogenously abstract.

View (126) has a certain initial plausibility, some of which lies, I suspect, in the highlighted statement, which is a commonly accepted view, seen also in:

(127) Chomsky, Gallego and Ott 2019: 231

> A traditional characterization of language, going back to Aristotle, defines it as "sound with meaning."

And no doubt there is more than a grain of truth in the relevant claims.

That said, I think they are irreparably flawed, basically because they do not take into account the distinction between physical types, which, as repeated earlier, are abstract objects, and physical world instantiations of those types.

Immediately, one should be suspicious of the idea that NLs literally connect sound with meaning. Meanings are surely nonphysical elements of sentences. But sounds only exist in the physical world because of actions, their causes. In the case relevant to the aspect of NLs Pullum and Scholz dealt with, these are movements of the human vocal apparatus. Take the example:

(128) The extraterrestrial's noodles had been imported from Jupiter.

I just produced a vocal token of the relevant sentence represented by the orthographic token in (128). Plausibly that was the first time this sentence has ever been provided with a speech token. And that pronunciation indeed involved a nasal element, as described in (126). But it is impossible to view the relevant movements and the noise they produced as part of the sentence. The sentence existed before I pronounced it, exists subsequently and out of the infinite collection of English sentences having words with nasal elements, most of them have never been pronounced and never can be on length grounds alone. That is, as Bromberger's (25) in section 4.1 noted, there are sentences which will never have associated tokens. In fact most sentences fall into that category.

What then is the connection between NL sentences and articulatory movements and the actual sounds those movements produce. A coherent view is that phonetic representations are types, in effect, instructions to the speech apparatus. There then exist in human beings some kind of physical representations of such types, as computers contain some kind of physical representations of program elements and their functioning.

Given the physical structure of the speech apparatus, these implemented instructions *when executed* on speech occasions create physical instantiations, that is,

utterances, some of which will manifest the properties caused by the velum positioning Pullum and Scholz mention. Under this interpretation, what NLs provide for sentences are connections between meanings and speech apparatus instruction types. The latter, when executed, yield the physical noises Pullum and Scholz invoke. But in no sense are those noises parts of sentences, hence they cannot be parts of NLs under the view that NLs are collections of sentences.

In short, the passage in (126) permits the same sort of equivocation over the type/token distinction discussed in connection with Harris's remark in (119). In both cases, one achieves a coherent account of the facts by granting that NLs link some sentences to real world concrete elments like nasal elements, but only via the production of tokens. Moreover, the relation between real NL sentence abstract elements and such tokens is not direct. Since phonetic representations seem to have to be taken as vocal action instruction types, the physical types which actual sounds are tokens of are not parts of sentences.

Bottom line: no valid conclusion about the existence of nonabstract elements in NL sentences can be drawn from the remarks in (126).

10 Colors

Beyond shapes, certain English sentences are in a sense capable of incorporating colors, a claim made more theoretically precise below. What is meant is illustrated by expressions like (129a,b):

(129) a. The color ▮ is denoted by the English term *green*.

b. ▮ is the color that Mary likes best.

I see no way to treat the sentences represented by such inscriptions other than as containing untypable alexical O_Ts, each of whose tokens is a colored portion of the surface containing the tokens of the lexical elements of such cases. While the colored surfaces in (129a, b) are green, the patterns in (129), would clearly permit any color marked surfaces whatever in the color positions.

How many such color possibilities would that make? A physicist put it this way:

(130) Christopher S. Baird. (Quora)

> There are an infinite number of physically different wavelengths of light in the visible spectrum. Furthermore, there are an infinite number of different ways to mix these spectral colors in order to get mixed colors. Humans can only differentiate at most 10 million different colors.

This means that the class of distinct O_Ts realized as color marks which English grammar allows in patterns like those represented by (129a,b) is not recursively enumerable. Since there is no finite character set which could represent the relevant O_Ts, the O_Ts tokened by colored portions in sentence tokens like (129a,b) represent an infinite collection of untypable alexical constituents.

I stress that this negative conclusion about cases like (129a,b) leaves unspecified the nature of the sentence elements tokened by colored portions of sentence tokens. I return in section 11 to a more general version of this issue, raising parallel questions about other types of untypable alexical elements including those whose tokens are graphic, pictorial, acoustic, etc.

To support claims that English cases like (129a, b) document the possibility in NLs of sentences with untypable alexical constituents whose tokens are colored surfaces, I have been able to determine that cases parallel to (129a,b) exist in other NLs of various language families:

(131) German

Die Farbe ▮ wird mit dem englischen Begriff green bezeichnet.

The color ▮ with the English. Expression denoted

'The color ▮ is denoted by the English expression 'green''

(132). Hungarian

a. A ▮ az a szín, mit a magyar *zöld* szó jelöl.

the ▮ that the color which-acc the Hungarian *zöld* word denotes

'▮ is the color which the Hungarian word *zöld* denotes'

b. A ▮ színt a magyar *zöld* szó jelöli.

the ▮ color-acc the Hungarian *zöld* word denotes(object agreement)

'The Hungarian word *zöld* denotes the color ▮'

(133) Japanese

▮ to. iu iro wa midori to iu hyouki saremasu

post-P call color topic green post-P call term express do-pass

"The color ▮ is expressed by 'midori'"

(134) Polish

Kolor ▮ określa się polskim terminem *zielony*.

The color ▮ denoted by Polish term green

'The color  is denoted by the Polish term *green*'

Thus the color cases are hardly an English idiosyncracy and are evidently a phenomenon characteristic of at least a diverse range of NLs. [20]

The general conclusion then is that English permits an endless array of sentences some of whose OTs, whether performed by graphic, gestural, acoustic, color, etc. tokens, lie beyond any possibility of being represented by any finite lexical system. Simply put, the color cases also show strikingly that English does not obey the FLH and that there are an uncountable number of untypable alexical cases. This reinforces the conclusion that the Generative Grammar Condition in (91) cannot be satisfied, determining that English has no generative grammar.

11 The Abstract Structure of Untypable Alexical Constituents

I have claimed that various cases involving alexical constituents conflict irreparably with the dominant view that NLs, specifically English, are Z-languages. This justifies the conclusion that English and other NLs with comparable sentences have no generative grammars. But those claims, no matter how well founded, leave open a critical issue. This is the question of how untypable alexical constituents are represented as parts of sentences. Ordinary constituents are structures built of linguistic items in fixed linguistic relations, that is, built of lexical items, grammatical categories, grammatical features, etc. But untypable alexical constituents cannot be *fully* formed of linguistic elements. I explicate the motivation for the modifier *fully* in what follows.

Rather, the essential insight as to the nature of untypable alexical constituents is due to David E. Johnson. His personal communication of December 9, 2011 proposed that

each (untypable) alexical constituent is a physical type, an abstract entity defined by strictly nonlinguistic properties, in the case of alexical constituents with spoken tokens, characterized by the relevant physical science, acoustics. See the discussion of types and tokens in section 4. These types define the nature of the physical elements which serve as tokens of the untypable alexical constituents.

Johnson illustrated with an example of the form:

(135) Jack whistled $.

where in a token of (135) $ would be realized by an instance of the produced sound middle C (C4), which has a fundamental frequency of roughly 262 Hz. Compare this view of (135) with the example:

(136) Jack whistled middle c.

Whereas the sentence represented by example (135) contains an untypable constituent which is the characterization of a sound type, middle C, the sentence tokened by (136) does not *contain* a physical type. Rather, it contains the lexically analyzable typable expression *middle C*, which *denotes* the sound type middle C.

While Johnson's fundamental idea about untypable alexical constituents was illustrated with an acoustic case, the fundamental idea generalizes to all the alexical constituent examples illustrated earlier, those based on shapes, gestures, colors, etc. For each variety, there will be a specific physical type component of the relevant sentences. In the case of an alexical constituent whose tokens are orthographical or pictorial, the relevant

constituent will be a shape type (possibly a colored shape type). In pure color examples like (129a,b), the relevant types will specify wavelengths of light (for humanly tokenable cases, light in the humanly visible spectrum). For gesture consituents or iconic ones, the untypable elements will define the relevant physical gestures. Since all such types are abstract objects, taking them to be parts of certain sentence structures is perfectly compatible ontologically with the general view that NL sentences are abstract objects.

To clarify these claims about sentences having physical types as constituents, I will illustrate with two untypable alexical cases cited previously. Turn first to:

(137) I don't speak the Tigrinya language, whose name in its alphabet is written ትግርኛ.

Following Johnson's insight, my claim has been that the last constituent in the overall abstract object which is the sentence represented in (137) is a physical type, more plausibly, a sequence of physical types defining each of the Tigrinya letters. The relevant types would characterize the graphic shape seen in the overall token of that constituent. One must of course avoid the confusion of taking the sentence itself to contain something with the shape seen in (137)

The clear difference between the types defining the Tigrinya expression and the tokens of such types appearing on pages or screens is that the tokens, being physical things, exist in space and time and can be destroyed, while the types are abstract objects. Hence they have no physical world properties at all. The types can have instantiations via distinct tokens, hence in different places. For instance, the token read at the end of (137a) is distinct from that at the beginning of:

(138) ትግርኛ is a Tigrinya name.

But they instantiate the same sequence of letter types.

Next, consider:

(139) The color  is denoted by the English term *green*.

No matter what media type is accessed to read this document, what a reader will see is a physical object of some kind including a subportion which has the color green. This object is a graphical token of an English sentence. That sentence contains nine common words which raise no special problems for the current work. But it also has to contain something which is the untypable alexical element part of the subject DP, the part whose correspondent in any tokening of that sentence is the green blotch. That 'something' is a physical type specifying some position on the light spectrum.

For all of the physical types relevant to the discussion of untypable alexical constituents, their tokens will occur as parts of physical things which manifest features irrelevant to defining them as the appropriate tokens. This state of affairs is not different from that of ordinary spoken tokens of typable sentences. For instance, in general the absolute loudness of an utterance is irrelevant to the features which determine that its parts are tokens of particular linguistic elements. In the case of (139), irrelevant factors of the color token are transparent, namely, the size and shape of the blotch. Specification of these would not be part of the particular type defining the third constituent in (139). That would rightly allow the colored marks to be any shape or any size whatever. It is of course inevitable that any paper or screen token of the color type have a shape. But that has no linguistic significance just as e.g. those aspects of the acoustic signal of a spoken sentence which at least partly reveal e.g. a person's identity have none.

I said at the beginning of this section that untypable alexical constituents 'cannot be *fully* formed of linguistic elements'. The reason for the hedge was that plausibly just as it is necessary to assign lexical constituents to grammarical categories, it will be equally necessary to so categorize particular physical type components of NL sentences. This follows from the need to control their distribution. Consider:

(140) a. Jane shouted $. (where as in (135) above, in a token of (140a) $ would be realized by an instance of the produced sound middle C (C4), which has a fundamental frequency of roughly 262 Hz)

b. Jane painted the wall .

c. *Jane shouted .

d. *Jane painted the wall $.

Here (140a, b) are evidently grammatical, while (140c, d) are clearly ill-formed.

This suggest that sound types can form or help form the objects of the verb *shout* but cannot form the post-object phrase of the verb *paint*, while color types can form or help form the post-object phrase of *paint* but not the object of *shout*. A way to characterize such facts is to recognize grammatical categories COLOR and SOUND and to require that color type specifications be components of the former, sound type specifications components of the latter. The claim that the relevant types have no linguistic structure would then be a characterization only of their *internal* nature.

To capture the facts in (140), it would then be possible to say that the verb *shout* requires an object phrase whose denotations are acoustic objects, while the verb *paint* allows no such constituent as its post-object phrase but does allow one whose denotations

are colored objects. These semantic specifications would cover as well fully lexical cases like (141), which parallel (140):

(141) a. Jane shouted middle C.

b. Jane painted the wall green.

c. *Jane shouted green.

d. *Jane painted the wall middle C.

That is, here like $ in (140), the phrase *middle C* in (141a) denotes acoustic objects, while like ▮ in (140b) the phrase *green* in (141b) denotes colored objects. But the sources of the denotational parallels are different. The lexical phrases have the types of denotations they do because of arbitrary lexical specifications. The physical types have theirs inherently. Thus it is logically possible that the English form *green* might have denoted blue objects but it is not logically possible that the type green denote anything but green objects.

There are obviously a multitude of unexplored questions about the distsributional features of the type constituents which (help) form larger untypable constituents. But such matters are beyond the scope of this study. The latter's goal is only to indicate the insurmountable problems untypable alexical constituents provide for the foundational ideas of the generative grammar movement.

12 Jackendoff's Missed 1984 Opportunity

With a modest change, Jackendoff 1984 could and should, I claim, have become one of the most important and cited papers of modern linguistics. That is true because it documented an English construction revealing some of the same general characteristics as those previously considered in this work (and in Postal, 2004b: chapter 6). The construction in

question involves an unbounded class of expressions based on a characteristic type of DP which Jackendoff illustrated with the list in (142)-(150):

(142) a. the phrase *the phrase*

b. the word/verb *run*

c. the prefix *un*

d. the construction *N of NP*

e. the sentence *Will you marry me*

f. the sequence *up a*

g. the sound p^h

h. the syllable *pa*

(143) a. the letter *A*

b. the number *14*

c. the note E^b

(144) a. the song *Entzweiflung*

b. the play/opera/novel/movie *Death in Venice*

c. the poem *Trees*

d. the painting *Seated Woman*

(145) a. the element engoopium

b, the compound engoopium sulfate

c. the material polyacrynilate

(146). a. the actor John Gielgud

b. the artist/poet William Blake

c. the pianist/composer Johannes Brahms

(147) the name Harry

(148) the color red

(149) a. the noise ***** [*rasberry*, *imitation of a goat, etc.*]

b. the pattern *da-dum da-dum da-dum*

(150) the symbol $

He claimed:

(151) Jackendoff 1984: 25

> The construction consists of a definite article and a noun followed without pause by an expression *E* which can be quite varied in character. [21]

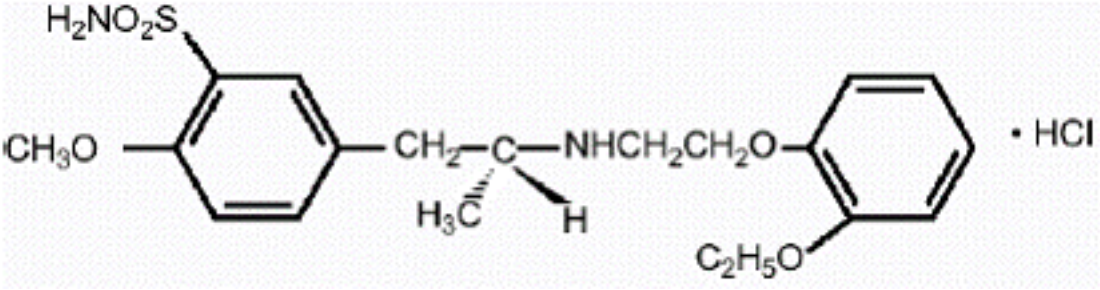
While only (142g), (143c), (145a,b,c) and (149a) really raise questions of alexicality and typability, Jackendoff rightly grasped that the English context he called *E* permitted any element whatever:

(152) Jackendoff 1984: 26

> On the other hand, there are no inherent syntactic constraints on *E*: it need not be a syntactic constituent - as in (1) [142]; nor even an expression of English - as in (3) [144]. In fact, if the construction is uttered, *E* need not be expressible in standard orthography (as I have tried to suggest in (8a) [149]); while if the construction is written, *E* need not have a pronunciation, as in (9) [150]. Hence, like the complements of verbs such as *say* and *go* (in the sense 'make a noise'), *E* is a constituent whose interior is unconstrained by normal rules of syntax and phonology.

To support Jackendoff's claim, one notes that every type of untypable alexical constituent cited earlier can be an instance of *E,* e.g.:

(153) a. the structural formula



b. the color

More precisely, a particular *E* position can contain anything which satisfies the selectional requirements of the preceding NP. So:

(154) a.*the formula

b.*the sound ትግርኛ

But while Jackendoff seems to have well understood the essential nature of *E,* he unfortunately did not grasp the inability of generative devices to characterize the phenomenon, claiming:

(155) Jackendoff 1984: 26

> We will assume, therefore, that the phrase structure rule responsible for introducing *E* violates the normal theory of syntactic categories by permitting a totally free expression.

But, as is confirmable by consultation of (5a,b) of section 1 above, the concept of 'totally free expression' cannot be represented by any generative operation, each of which maps a specific structure to another specific structure. There thus are, and can be, no phrase

structure rules or any other generative devices capable of permitting a 'totally free expression'.

The unfortunate conclusion then is that while Jackendoff 1984 clearly discovered the existence of a class of English sentences containing untypable alexical constituents, he was unable to take the logical step of concluding that consequently English has no generative grammar.

Nonetheless, he did rightly defend the theoretical relevance of his discovery of the *E* phenomenon against the dismissive and largely substanceless comment of a reader:

(156) Jackendoff 1984: 36

> One reader has remarked that these constructions "lie at the edge of linguistic structure-in my judgment, just at the point where linguistic structure slides off into chaos," and that "we would presumably not want to use them to throw light on the core of linguistic theory." My conclusion, however, is quite the opposite. The only 'chaos' in these constructions lies in the appearance of the free expression *E*, and the judgments seem to me no more delicate or unreliable than in contemporary discussions of 'core' matters such as control.

I find Jackendoff's remarks here to be entirely sound and the reader's use of vague and undefined terms like 'chaos' and 'edge of linguistic structure' should, in my opinion, never have appeared in a referee report.

13 Denial of the Sentencehood of Alexical Sentences

Since the discussion of (61) above I have assumed that all the alexical English expressions I have documented are sentences of English, hence of an NL, thereby undermining any

claim that NLs as such are generative systems. The most direct way for a defender of the generative character of NLs to deal with the undeniable existence of expressions containing untypable alexical constituents would be to simply reject the claim that the expressions containing them are sentences, thereby denying that such expressions are actual elements of NLs. This hypothetical position is that dubbed above the *Sentencehood Rejection Defense.*

But there are solid reasons to reject such a defense of generative grammars. First, untypable alexical constituents like that in (153) occur as parts of natural texts, even, as seen in (100) and (101), in natural texts produced by the original developer of generative grammar. My experience when questioning people about them is that there is never much doubt that they are NL sentences, specifically, English sentences, even when they contain foreign expressions. This claim is supported by several instances of examples from the philosophical literature on quotation cited below; see (192). Moreover, as discussed in section 10, I was able to obtain judgments that expressions containing color types were grammatical sentences from speakers of four NLs other than English. And the remarks in (105) above indicate that some untypable expressions are sentences of Hungarian. Moreover, as noted in section 8.3, Schlenker 2018 clearly regarded the untypable iconic expressions he dealt with as English sentences.

Suppose though it were claimed that the untypable alexical expressions I have cited are semisentences, fragments of partial English sentences with foreign or erroneous parts. This would ignore though their noticeable sharp difference from real semisentences, e.g. those

containing mistakes made by nonnative speakers or natives engaging in deliberate distortions for comic or other purposes. Consider for example:

(157) *Dog want eat much meat.

This perfectly understandable English expression is though clearly ungrammatical. A characteristic of such cases is that natives know how to repair them. In this case, principles for accomplishing that would be:

(158) a. Add an article before the common noun *Dog*;

b. Since the subject *Dog* is third person and presumably singular, the verb must be the third person singular *wants*.

c. Since the combination of *want(s)* with following predicational material requires an infinitive, an infinitival complementizer *to* is hence needed after *want(s)*.

d. object position *much* is a negative polarity item and nothing in (157) licenses such. Replace it with a non-negative polarity equivalent, e.g. *lots of.*

But, as a survey of the alexical expressions of the types previously cited shows, no notion of correction for alexical O_{TS} is applicable. Take e.g (159):

(159) 

was the barcode on my recently delivered package.

What makes this an (untypable) alexical expression is its *actual barcode image component*, which is not a mistake and cannot be corrected. The highlighted phrase of course must denote an image type, not a physical image token. The particular type is a necessary element; replacement of it by anything else cannot yield an improvement but rather just a different expression. The same point holds for all the color examples in section 10.

Moreover, the alexical O_T in (159) is solidly integrated into English syntax. To illustrate that while rendering presentation less onerous, I symbolize the barcode image with the symbol @ and the chemical formula in (95a) by &. Then one notes that alongside (159) all of the following are equally fine English expressions:

(160) a @ appears to have been the barcode on her package rather than some chemical formula &.

b. @, Jane believes to be the barcode on my package.

c. @ is believed to be the barcode on my package.

d. @ or other barcodes and & or other formulas were suspected of having been copied.

e. All of @ was copied by the thief.

f. @ was in its entirety painted over by the mischievous child.

g. Karen copied $@_1$ but Roberta did not copy it_1 or the formula &.

h. Karen copied not @ but &.

i. The first machine misread @ but the second one didn't.

j. Sandra described to Louise in detail both @ and &.

Example (160a) shows that @ can be the raised phrase in the subject raising construction. (160b) shows that @ can be a topicalized constituent. (160c) shows that @ can be passivized. (160d) shows that @ can be disjoined with a DP. (160e) shows that @ can be the object of a preposition in the partitive phrase of a universal quantification structure. (160f) and (160g) show that @ can be the antecedent under different kinds of anaphoric relation to the pronouns *its* and *it*. (160h) shows that @ can be one element of a contrastive negation structure. Example (160i) indicates that alexical constituents participate in the identity principles regulating VP ellipsis. That is, the barcode O_T serves as an element which some form of identity condition must reference in the VP ellipsis structure. So the ellipsis site is only understood as referencing that particular barcode. Finally, (160 j) shows that the relevant alexical O_Ts can be subconstituents of so-called Heavy Shift cases.

Moreover, the case that the full grammaticality of expressions containing untypable alexical constituents cannot be rationally denied is stronger than the considerations just gone over. Accept *for argument* to the contrary that, English-like expressions containing untypable alexical constituents with the properties illustrated in (160a-j) are *not* elements of the NL English. Call such expressions *pseudo-(English) sentences*. And call the collection of all the English-like expressions containing untypable alexical constituents *pseudo-English*.

The question then is what linguistic purpose could be served by a denial that pseudo-English expressions are in fact English expressions. Such a denial obviously could not make the relevant expressions vanish. Moreover, they function in ways entirely parallel to uncontroversial English sentences. That is, tokens of reasonably short ones are produced,

understood, etc., seen to be acceptable or not, recognized as paraphrases of others, etc.,

Moreover, as noted in Postal, 2004b: 182 such elements permit the expressions of meanings, some of which would otherwise not be inexpressible. Here is one otherwise only roughly characgerizable with long explicit descriptions of the forms of the relevantTigrinya letters.

(161) ትግርኛ is a piece of Tigrinya orthography and the first constituent of this expression is not formed of English lexical elements.

The proposition expressed by the second conjunct of (161) is true. But if the foreign orthography were not part of the structure of the expression tokened in (161), it would be false. Semantically then, inscription (161) behaves exactly like an inscripition of an uncontroversial sentence:

(162) *That* is a piece of Tigrinya orthography and the first constituent of this expression is not formed of English lexical elements.

The only difference is that where (161) is true, (162) is false.

There is thus exactly as much need for a descriptive and theoretical account of pseudo-English as there is for what is ordinarily taken as English. It follows that the claim that pseudo-English is distinct from English has as its major consequence the need for two descriptive accounts and two theories, not only for the English domain, but for every NL allowing analogs of English pseudo-sentences. But the idea that English and pseudo-English represent distinct phenomena is untenable. For as hinted at by (160a-j), every syntactic specification for English will be needed for pseudo-English. That follows inter

alia from the fact that pseudo-English expressions can be conjoined with ‘pure’ English expressions.

This is illustrated in e.g.:

(163) a. @ appears on my just delivered package and communism is a constant threat.

b. @ appears on my just delivered package and Betty seems to be tired.

c. @ appears on my just delivered package and Bob is believed to have been arrested.

That is, *any* English declarative clause could occur as a conjunct part of pseudo-sentences like (163a,b,c). And one can as well form analogs of conjoined cases for other sentence types, questions, commands, etc., as in:

(164) Don’t cover over @ and don’t take the contents out of the box.

But this means that the entire grammar of English would need to be part of a grammar of pseudo-English.

This point was in effect touched on earlier in connection with (165).

(165) In this work,

represent subset, intersection, and disjoint relations between respectively.

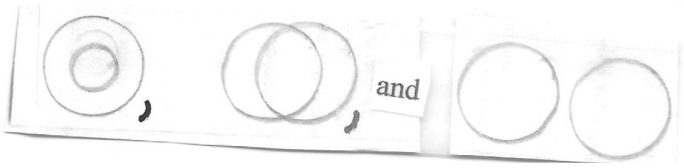
Relevant is that the pseudo sentence (165) has the relevant properties of the non-pseudo sentence:

(166) In this work, A, B, and C represent subset, intersection, and disjoint relations between two sets, respectively:

In both cases, the semantic requirements on *respectively* require three elements in the appropriate position. Thus were a grammar of pseudo-English distinct from that of English, both would have to incorporate the same numerical matching condition.

The point is even clearer with the pair:

(167) a. In this work, A, B and C represent subset, intersection, and disjoint relations between sets.

b. In this work, 

represent subset, intersection, and disjoint relations between sets.

In (167a) *A, B, and C* functions as the subject of the verb *represent*, whose nonsingular form is determined by it. In (167b) this function is filled by the conjoined untypable alexical diagrammatic elements.

At this point, one sees that the *Sentencehood Rejection Defense* creates an artificial need to recognize an alternate universe of supposedly non-NL structures manifesting however all of the features of ordinary exclusively lexicon-based English structures. This assumptively distinct system just exhibits as well nondenumerably many untypable alexical constituent containing sentences. Put differently, starting without unargued a priori assumptions about the need for *generative* grammars, grammatical theorizing would never

have a reason to treat pseudo sentences as other than sentences. Phrasing matters in this way shows that denial that pseudo sentences are sentences amounts essentially to an assault on Okham's Razor.

I conclude that the Sentencehood Rejection Hypothesis offers no actual defense of a denial of the sentencehood of alexical sentences and provides no support for the idea that the grammars of NLs are generative devices. Fundamentally, the only reason to question the sentencehood of alexical sentences is the never justified dogma introduced in Chomsky's early works cited in section 1 and proclaimed innumerable times since. The dogma assumes, merely on the assumption that NLs are (denumerably) infinite collections, that their grammars have to be generative devices. Such a view could never have been justified for two reasons. First, as argued here, the existence of untypable alexical sentences shows it is false. Second, as is clear from formal studies and touched on in section16, below Cantor's foundational work on set theory shows that it is groundless to suggest that the infinite size of a collection necessitates its description via a generative grammar.

14 Infinitude and Expressibility

The claim that NL collections are infinite is well-founded, although, as argued for example in Langendoen and Postal, 1984: 30-35, and in Pullum, and Scholz, 2001, 2010: 495-499, various popular arguments to that conclusion are unsound. I believe though that there are sound arguments for the conclusion, including those in Katz 1966: 122; see the discussion in Langendoen and Postal, 1984: 3.3. These embody reasoning which accepts the following basic insight:

(168) Chomsky 1957: 23-24

> In general, the assumption that languages are infinite is made in order to simplify the description of these languages.

The logic of this claim is explicated in Tiede and Stout, 2010: section 4.3. But acceptance of the view that NLs are infinite collections in no way entails acceptance of Chomsky's multiply repeated claim seen in (12), (16) and (169a,b) that infinitude is the key characteristic property of NLs.

(169) a. Chomsky 2008:137

> As has long been recognized, *the most elementary property of language*—and an unusual one in the biological world—is that it is a system of discrete infinity consisting of hierarchically organized objects. (emphasis mine: PMP)

b. Chomsky 2020b: 17

> To recapitulate briefly, of the many different ways one can approach language, we've focused on one particular one, what's been called the generative enterprise, which is concerned with *what's been called the basic property of language, namely that each language constructs in the mind an infinite array of structured expressions* ... (emphasis mine: PMP)

Such claims of the centrality of the infinitude of the collection of sentences represent a major misconception, whose misguided character was long ago revealed by remarks of Katz 1978.

Without challenging the reality of the infinitude property, he pointed out that this feature hardly comes to grips with what makes NLs distinctive:

(170) Katz, 1978

> Unboundedness is a consequence of a system having recursive structure, and since such structure can be exceedingly simple, exceedingly simple systems, too simple to be a natural language, are unbounded. An automaton that just enumerates strings of *a*'s of any length qualifies as unbounded. [22]

While the unbounded collection of strings of *a*'s represents an infnite set, it is evidently one utterly unlike any NL. One clear characteristic of such a system is its massive limitation of *expressability*. Informally, this notion is a measure of the ability to encode a diversity of propositions, commands, questions, exclamations, etc. That is, expressability is a measure of the variety of things the sentences of an NL can say. Unless it is claimed that the item *a* in (170) is infinitely ambiguous (having at least nominal, predicational and quantificational meanings), the collection Katz sketched is unable express the multitude of propositions, questions, commands, exclamations, etc. actual NL sentence collections can.

Rather than seeing infinitude as the fundamental characteristic of NLs, Katz's more realistic suggestion was that their core property is their massive expressability. The question of expressability is a common topic in the philosophy of language, especially in connection with the liar paradox:

(171) Simmons 1993: ix

> The problem is this: is a natural language like English universal in the sense that it can say everything there is to say? Or are there concepts beyond the reach of English, rendering it expressively incomplete? In particular, we can ask whether English is semantically universal; whether, that is, it can express every semantic concept.

Katz advocated the extremely controversial possibility that NLs are what he called *effable*, that is, able to express *every* proposition. Barring appeal to infinitely ambiguous lexical items, that axiom would entail that any NL for which it holds is infinite. As Katz, 2004: 95 noted, the effability position was earlier expressed by the eminent logician Alfred Tarski:

(172) Tarski 1956: 164

> A characteristic feature of colloquial language…is its universality. It would not be in harmony with the spirit of this language if in some other language a word occurred which could not be translated into it; it could be claimed that 'if we can speak meaningfully about anything at all, we can also speak about it in colloquial language.

Nonethelesss, the universality of the effability claim receives a simple, initially *apparently* devastating refutation such as:

(173) Pullum 2019a: 56

> Consider Pirahã. Spoken by a hunter-gatherer people who do no counting and build no permanent dwellings, this language has no terminology for numbers, money, colors, art, or architecture (Everett 2005). It what serious sense could one claim to be able to translate into Pirahã the statement that before renting out the house we should get an estimate for repainting the dining room walls in turquoise between the dado rail and the crown molding?

Certainly, Pullum's Pirahã example refutes the idea that that the version of Pirahã *with its current vocabulary* can express every proposition, specifically, every

proposition expressable in English. But this is really an uninteresting conception of the idea. It would also suggest that the version of English before English speakers borrowed e.g. the Japanse term *satori* was not effable. And could one in say 1927 have translated *Babe Ruth hit a long home run today* into Mandarin without lexical borrowing or innovation?

The question, which becomes precisely expressable in a model-theoretic view of grammars, is whether there are grammatical principles which *even with borrowing of or creation of the appropriate vocabulary* would preclude forming the needed grammatical sentences. This seems to be the significant question about effability. Since I don't know that Pirahã or any other NL is so constituted, I regard it as premature to dismiss Katz's ideas about effability.

The effability question arises most prominently in the literature on the liar paradox; see e.g. Armour-Garb and Woodridge 2003, Azzouni, 2003. Discussion of such matters is well beyond the bounds of the current work.

The central role of expressability is strengthened by noting actual infinite subsets of English, e.g. that characterized by the Kleene * notation in (174), studied in Postal 2003a, 2004b: 177.

(174) my (father+s)* + father + die + ed

The relevant collection of expressions characterized in (174) is clearly infinite but that set can hardly be confused with an NL. It can only express propositions about a speaker's direct line of paternal ancestors. It can express no proposition about maternal ancestors or dinosaurs, or soccer, or socialism, etc. It permits the formulation of no questions, no

commands, no exclamations, no performatives. For practical purposes, a restriction of English sentences to say a maximal length of one hundred words surely provides most of the expressability needed for everyday life, while in contrast the infinite system schematized in (174) is useless for most purposes.

And, of course, the recognition of the existence of untypable sentences interacts powerfully with the view that expressability is the essential feature of NLs. As made clear by a multitude of earlier examples, there are endless propositions expressable via untypable alexical constituents not expressable via sentences restricted to lexical constituents. In short, if, contrary to reality, NLs were restricted the way generative dogma has assumed, they would be impoverished systems incapable of expressing endlessly many ideas which actual NLs can express. It is particularly ironic, as the examples of section 6.5 illustrate, that discourse by linguists about NLs and their elements is notably dependent on sentences built in part from untypable alexical constituents.

15 Grammars Compatible with Untypable Alexical Constituents

From the point of view of the generative position criticized in this work, the clear existence of untypable alexical sentences represents an insurmountable theoretical and descriptive problem. But that intellectual condundrum is an artifact of the unargued dogma represented by Chomsky's (1)-(4) of section 1. It is not a paradox or a genuine linguistic difficulty.

Jackendoff put his finger nicely on the issue raised by alexical constituents in talking about them as 'totally free expressions':

(175) Jackendoff 1984: 26

> We will assume, therefore, that the phrase structure rule responsible for introducing *E* violates the normal theory of syntactic categories by permitting a totally free expression.

What is needed is for grammars to be able to allow constituent types whose members are subject to no *internal* constraints whatever, permitting in relevant cases as many members as there are real numbers. The reason for the highlighted *internal* is addressed presently. As discussed in section 12, the notion of free expression is unrepresentable in any *generative* grammar.

So the key question is what kind of grammars can permit this idea to play the needed role. My view is that the proper answer is the conception of grammars as *model-theoretic systems*. The model-theoretic view of grammars has been explicated at length in a linguistics literature now dating back more than four decades. Relevant works include those in (176):

(176) Johnson and Postal, 1980, Langendoen and Postal, 1984, Keller 1993, Postal, 2003a, 2004b: chapter 6, 2010, Pullum, 2007, 2013, 2020, Pullum and Scholz. 1997, 2001, 2003a. 2005, Rogers, 1996, 1997, 1998, 1999, 2003 and many references therein.

The basic idea of the model-theoretic view is that NL grammars are finite axiom systems, formulas in some specified formalism (no doubt, with at least the power of some second order logic), which are interpreted as statements. That is, each principle can be assigned truth values and the (un)grammaticality of structures is determined by model-theoretic satisfaction, via an interpretive principle of informally the form:

(177) A structure S is grammatical with respect to a grammar G = axioms $\{a_1 \ldots . a_n\}$, that is, is an element of the NL defined by G, if and only if S satisfies every member of G.

This principle would be a basic element of general linguistic theory.

Such an approach to defining collections is essentially standard in formal studies of all kinds; see e.g. Stoll 1963: chapter 5, Partee, ter Meulen and Wall 1993: chapter 5. The technical apparatus it appeals to is largely provided independently by logic and mathematics, especially by model theory. This contrasts with the situation for generative views with their rich appeal to often baroque, linguistics-specific mechanisms.

The relation between a model-theoretic view of NL grammars and logical studies is very clearly and informatively spelled out in Pullum and Scholz 2001. Much further of relevance to these matters is found in Pullum 2019b. As these authors have pointed out, modern logic has two different approaches, one semantic, one syntactic. The former appeals to model theory and satisfaction, the latter to proof theory. Earlier remarks about the question-begging involved in Chomsky's claims that NL grammars had to be generative (that is, proof-theoretic) devices can be restated as follows. Chomsky chose to base his conceptions of NL grammars on proof-theoretic ideas rather than model-theoretic ones. Moreover, as shown, he did this without offering any argument for his decisions. Worse, he in effect tried to justify his ungrounded decision by appealing to a nonexistent notion of necessity, falsely claimed to require a proof-theoretic view merely on the basis of the assumption that NLs are infinite systems.

Critically, as such, the view that model-theoretic grammars are the correct way to characterize NLs is mostly neutral about the nature of linguistic structure. All grammatical

questions about e.g. passives, relative clauses, parasitic gaps, coordination, morphology, etc. must be resolved by substantive research and arguments in model-theoretic terms just as in any other framework. Model-theoretic ideas are not a magic way of solving linguistic problems in general. But achieving consistency with the existence of untypable alexical constituents is a key area where the superiority of model-theoretical ideas over generative ones is inexaggerable.

It is not possible to consider here the details of model-theoretic grammar. The reader is referred to the literature cited in (176). But it does need some clarification why, unlike any generative view, the model-theoretic conception of grammars is not refuted by untypable alexical expressions. That holds because in such terms, an arbitrary expression E is ungrammatical with respect to a model-theoretic grammar G only when there is some condition in G which E fails to satisfy, that is, when there is an a_i in G which is false for E. Thus all that is required for a model-theoretic grammar to allow a particular untypable alexical constituent in position P is for the grammar to contain no statement which imposes conditions on P which E does not satisfy. In aphorism form, for a model-theoretic grammar, grammaticality is the null hypothesis.

In terms of the brief discussion of color and sound grammatical categories in section 11, the relevant idea would be that these categories allow as constituents any type specification of the relevant category, e.g. any color type for COLOR, any sound type for SOUND. In the case of COLOR, this would be achieved by a general statement that for X to be a subconstituent, it is required that X be a physical type defining a portion of the light spectrum. The fact that there are, as noted earlier, an infinite number of such specifications,

is then entirely irrelevant for the form of a grammar since these need not be specified in the system.

It is a noteworthy historical oddity that in at one point at the beginning of generative grammar work Chomsky described grammars in a way in fact inconsistent with generative assumptions although compatible with the model-theoretic view. And parallel remarks that grammars were theories were later repeated:

(178) a, Chomsky 1956: 2

> The grammar of a language can be viewed as a theory of the structure of this language. Any scientific theory is based on a certain finite set of observations and, by establishing general laws stated in terms of certain hypothetical constructs, attempts to account for these observations, to show how they are interrelated, and to predict an indefinite number of new phenomena…Similarly a grammar is based on a finite number of observed sentences (the linguist's corpus) and it "projects" this set to an infinite set of grammatical sentences by establishing general "laws" framed in terms of such hypothetical constructs as the particular phonemes, words, phrases, and so on, of the language under analysis.

b. Chomsky 1961: 7-8

> A grammar, in the sense described above, is essentially a theory of the sentences of a language; it specifies this set (or generates it, to use a technical term which has become familiar in this connection) and assigns to each generated sentence a structural description.

c. Chomsky 2006: xi

> For the study of language, a natural conclusion seemed to be that the I- language attained has roughly the character of a scientific theory: an integrated system of rules and principles from which the expressions of the language can be derived.

In asserting that grammars are theories, these passages adopt unheralded the model-theoretic view, since a theory is a set of statements. A generative grammar on the contrary is essentially a set of operations, phrase structure rules, transformations, merge, whatever. The right analogy for such grammars would be computer programs or proof systems, which are in no sense theories. Claim (178b, c) avoid outright inconsistency only via the hedges *essentially, roughly*.

To achieve something with the status of a theory based on a generative grammar, one would have to refer to a metagrammar level. A theory would only arise via the claim that some particular generative grammar is the adequate grammar of some NL. But such a theory would be of little use, since it contains no components which can be individually tested against any data. One can conclude that early in his development of generative grammar, Chomsky was confused about the logic of grammatical investigation and confused grammars as theories with the various generative devices he actually worked on and advocated. And this confusion appears to have continued well into the 21st century.

The preceding is not meant to say that alexical constituents do not raise important never worked out issues about grammatical structure. One potential problem arises from the fact that such constituents are not recursively enumerable and are arguably of the order of the reals. Consider for instance, the definition of the graph-theoretic trees common to most views of linguistic structure. Such definitions assume a set of primitive nonterminal nodes,

with each constituent ultimately corresponding to one such dominating node (the root of its subtree structure). It might seem to follow that a formalism for linguistic structures consistent with untypable alexical constituents would need to incorporate a nonterminal node class at least equivalent in size to the real numbers.

But one can, rather, consider the type specifications differentiating the endless number of colors as terminal elements dominated by the node COLOR. There would indeed be a set of nodes whose cardinality is that of the reals, but all of these would be terminal nodes. Or, possibly, the terminal nodes could actually be real numbers, with the type specifications functioning as their labels. Tokens of these terminals would then be objects whose color satisfies the relevant type specification.

What cannot be avoided, however, is that the a model-theoretical grammar would have to represent a nonrecursively enumerable set of elements capable of being O_Ts. But that is inherent in the reality of the existence of untypable alexical elements and represents in distinct terms the impossibility of a generative grammar of cases like those involving structures whose denotations would be e.g. color blotch tokens.

A second issue about model-theoretic grammars and alexical constituents relates to Jackendoff's idea of ‘totally free constituents’. It can be seen that this is a minor exaggeration by considering for example a word like *articulate*. I believe this has at least two meanings. One, call it the *token meaning*, references the physical aspects of a piece of speech. A second, call it the *concept meaning*, references the meaning of an expression of which a piece of speech is a token. These two meanings are seen in:

(179) Jerome articulated something loud/stupid.

What is asserted by (179) to be loud is a noise, while what is asserted to be stupid is an idea.

Similarly, consider *scribble*. This too has both token and concept meanings:

(180) Jerome scribbled something yellow/stupid on the wall.

Limiting attention then to token meanings, consider:

(181) a. Jerome articulated something loud/%.

b. Jerome scribbled something rectangular/$.

If % stands for a sound type and $ stands for a shape type, both (181a, b) make sense. Compare then:

(182) a. Jerome articulated something rectangular/$.

b. Jerome scribbled something loud/%.

Such examples raise the issue of *selectional restrictions*. A priori one would like to say that *articulate* (on the token meaning) requires an object which denotes sounds, while *scribble* (on its token meaning) requires an object which denotes things with planar shapes. To capture in these terms the relevant generalizations over both the lexical and alexical object cases, it would be necessary to say the physical type of the sound case denotes an acoustic object, while that of the shape case denotes objects with a planar shape.

A related more familiar type of case is seen in:

(183) That woman is named Helen.

While one is usually told that a name like *Helen* denotes persons, that cannot be the case for that form in (183). Clearly, such cases are ambiguous, depending on whether the name is taken to be phonological or orthographic. In either case, the internal structure of the name

is a sequence of physical types, acoustic types in the former case, shape types in the latter. In a model, the acoustic types denote objects having certain sound properties, while the shape types denote objects having certain planar configurations.

This discussion suggests that alexical constituents considered as physical types may be subject to external constraints, in particular, to selectional restrictions defining sensible meanings. Thus the claimed 'total freedom' manifested by such constituents only refers to the fact that nothing linguistic limits their *internal* nature.

These remarks about the formulation of model-theoretic grammars in a way consistent with untypable alexical constituents are of course extremely sketchy and will here have to remain that way. Readers seeking more detail about model-theoretic grammars should consult the literature listed in (176). The goal of this study is only to argue the irremediable incompatibility of generative grammars with such constituents, contrasted with the straightforward compatibility possible for model-theoretic systems.

Part III Implications

16 Conclusion

As argued in some detail in Part II, a wide variety of alexical constituents of both the typable and untypable subtypes exist, specifically in English sentences. Nonetheless, for going on seventy years, driven inter alia by the incredible repetitiveness of Chomsky's extremely influential massive output, the generative grammar movement has maintained a conflicting view of NLs. Within that framework, it is *implicitly* claimed falsely that there are no alexical sentences, particularly, are no untypable alexical sentences. This claim is

made indirectly by the the logical combination of the inherent nature of generative grammars and the FLH, clearly enunciated in:

(184) Chomsky 1995a: 206

> Another natural condition is that *outputs consist of nothing more than arrangements of lexical features.* (Emphasis mine: PMP)

This assumption is by no means an idiosyncracy of Chomsky's, as illustrated in:

(185) Aoun, Choueiri and Hornstein 2001: 400

> It is universally assumed that the atoms manipulated by the computational system come from the lexicon.

The FLH obviously limits O_TS to a finite set. Therefore, a generative grammar must explicitly mention any element which is an O_T in any sentence putatively generated by that grammar. But, as documented in Part II, English, certain other well-known NLs and no doubt at least many others permit endlessly many untypable sentences containing a variety of untypable alexical constituent types, acoustic, orthographic, pictorial, gestural, color, etc. These yield a nondenumerably infinite class of O_T-containing sentences whose O_TS are not lexical. The existence of such sentences reveals that no NL embodying them is a recursively enumerable set, thus rendering (184) and (185) false and guaranteeing that no NL containing such sentences, including, as was documented, English, has a generative grammar.

The result just cited is entirely independent of the claims in Langendoen and Postal 1984. That work presented an argument that English had no generative grammar based on the claimed properties of coordination in NLs like English; see also Langendoen 2010 and

to appear. That discussion appealed only to sentences with pure lexical constituents. While independent of each other, the present argument based on untypable alexical constituents and that in Langendoen and Postal 1984 do though both yield the conclusion that English in particular has no generative grammar.

While there exist innumerable assertions on Chomsky's part (many of which I have cited or referenced) and others that NLs not only have generative grammars but that some kind of necessity requires that conclusion, more than four decades ago he nevertheless remarked as follows:

(186) Chomsky 1980: 122–123

> I mentioned that it might turn out that grammars do not generate languages at all. Given the epiphenomenal nature of the notion 'language,' this would not be a particularly disturbing discovery. It would mean that the real systems that are mentally represented do not happen to specify recursively enumerable languages.

Chomsky gave no clue as to what it might mean for a *generative* grammar to fail to generate a language. The remark leaves entirely unclear what he then could take grammars to yield as outputs. Moreover, he offered no explication of his claim that NLs are epiphenomenal. Nor did he present any argument that that concept characterizes NLs. Claim (186) is simply another instance of fundamental question-begging.

To show that his remarks about epiphenomena had some basis, Chomsky would have needed to show that concepts like the following have some relevance to NLs:

(187) https://en.wikipedia.org/wiki/Epiphenomenon

> In *philosophy of mind*, *epiphenomenalism* is the view that *mental* phenomena are epiphenomena in that they can be caused by physical phenomena, but cannot cause physical phenomena. In strong epiphenomenalism, epiphenomena that are mental phenomena can *only* be caused by physical phenomena, not by other mental phenomena. In weak epiphenomenalism, epiphenomena that are mental phenomena can be caused by both physical phenomena and other mental phenomena, but mental phenomena cannot be the cause of any physical phenomenon.

Given the arguably abstract object nature of NL sentences and NLs, the required task seems to me to be unachievable in principle.

Of course, I agree with the view that that *mentally real systems* cannot generate recursively enumerable languages because being physical things, like computers, physical brain activities cannot generate anything in the technical sense of *generate*. That follows since in linguistics *generate* is a term of art from formal studies relating abstractions. And whatever mental activities produce would be physical not absstract.

One observes further that the negative remarks in (186) fail to give any idea of what Chomsky did take to be the yield of 'real' systems. In sensible terms, keeping abstract and physical (mental) objects distinct, were a generative grammar G of any kind to fail to generate an NL_x, that is, fail to generate certain sentences of NL_x, that would simply determine that G is not a grammar of NL_x. The defensive conceptual failures in (186) permit one to justly question their seriousness.

But in any event, this admission amounts to another piece of incoherence internal to Chomsky's longstanding theoretical views. In particular, (186) is clearly inconsistent with claims like e.g. (2), and (4). Claiming that what a grammar specifies might not be a recursively enumerable collection accepts, contra (4b), that NLs might not fall within the systems characterizable by Turing machines. Further, (186) is evidently inconsistent with the implications of a host of post-1980 claims, like those cited in section 2.

Given that (186) has mostly been ignored within the generative grammar movement, the conclusion that NLs like English have no generative gramamars might well strike many readers as bizarre. To that, two responses are relevant First, the reaction exists, I suggest, only because the conclusion is incompatible with a massive literature promulgated over decades sampled in section 2. This literature has claimed not only that NLs have generative grammars but that some type of necessity demands that conclusion. But no serious argument for such claims has ever been provided and it is clear that none can be, as argued above.

The reason for that conclusion is that the only ground discernable for the idea that generative grammars for NLs are a necessity is the conclusion that NLs are infinite. But even accepting that as a true premiss does nothing to justify the claim. That follows from the fact, now a truism in modern formal work, that there are endless infinite collections which are not recursively enumerable (that is, which cannot be put in one-to-one correspondence with the class of integers) and which hence have no generative grammars.

The point is explicated by the following passage, in which *N* denotes the set of natural numbers and $\aleph_0$ denotes its cardinality.

(188) Partee, ter Meulen and Wall 1993: 62

> At one time it was supposed that there were no sets with cardinality greater than $\aleph_0$, but Georg Cantor (1845-1918), the mathematician who developed a large part of the theory of sets, proved that for any set A, the power set of A always has greater cardinality than A. Thus the power set of N will have cardinality greater than N.

This means of course that there is no generative grammar of the power set of N

The present work then leads to the conclusion that the generative grammar theoretical belief system is based on two extreme falsehoods. The first is the unsupportable necessity claim about generative grammars. The second involves a remarkable history of mass research blindness. That is, the generative view has been promoted under a never justified and as shown in sections 6-10 unjustifiable truncation of a gigantic portion of linguistic reality. To my knowledge none of the hundreds/perhaps thousands of works proclaiming the generative view have seriously addressed the problem raised by (untypable) alexical sentences. This should be massively embarrassing for linguistic defenders of the generative grammar thesis for at least four reasons.

First, the failure to take alexical sentences into account had to overlook the multitude of *linguistic* works whose content included such sentences, works like those cited in section 6.5. These include, as was documented earlier, examples by originator of the generative grammar movement, including (100) and (101a). A few minutes of reflection on some untypable sentences used by linguists in linguistic articles should not have failed to raise doubts in the minds of those proclaiming the generative nature of grammars about claims that NLs like English can be characterized in generative terms.

Second, essentially all of the alexical counterevidence in earlier sections to the claim that NL grammars are generative devices was drawn not from remote, exotic NLs, e.g. those spoken only in the Amazon jungle, the Australian outback, West Africa or Central Asia, but from English, the most intensively studied NL within the generative movement.

Third, as already indicated, there is a body of linguistic work dating to at least 1968 which directly displayed untypable alexical sentences and used such data to attack the idea that NL grammars could be generative devices. But that work is ignored, specifically in the literature cited in section 2.

Fourth, while alexical sentences have been largely ignored in mainstream linguistics, there are indications that they have been at least marginally noticed in the philosophy of language literature, particularly, in that concerned with quotation. For example:

(189) Quine 1940 [1981]: 26

> Quotation is the more graphic and convenient method, but it has a certain anomalous feature which calls for special caution: from the standpoint of logical analysis each whole quotation must be regarded as a single word or sign, whose parts count for no more than serifs or syllables. *A quotation is not a description, but a hieroglyph; it designates its object not by describing it in terms of other objects, but by picturing it.* The meaning of the whole does not depend upon the meanings of the constituent words. The personal name buried within the first word of the statement:

(11) ‘Cicero’ has six letters.

e.g., is logically no more germane to the statement than is the verb ‘let’ which is buried within the last word. (emphasis mine: PMP)

Critical here is that Quine claimed that quotations were hieroglyphs, pictures. In current terms, he then noticed that at least some quotations did not really represent linguistic structures but rather graphical types. Specifically, he noticed in effect that the O_T parts of quotations were not representative of lexical elements.

Quine could have made the point from his (11) even more strongly if he had used a quotation of a foreign form, as in:

(190) ‘Le Maghreb’ is a French term denoting North Africa (excluding Egypt).

Here there is no inclination on the part of an English speaker to believe that the object shaped *Le Maghreb* is a token of an English lexical expression or combination of such. But Quine’s idea covers it perfectly. Occurring before the English word *is* is then a visual token of a French expression, something which as part of an English sentence has no internal *linguistic* structure.

While Quine did not utilize foreign expressions in his account of quote cases like (189), he did in the following partially strange passage:

(191) Quine 1953: 135:

(10) ‘Die Schnee ist weiss’ is true-in-German if and only if Die Schnee is Weiss.

The quotation at the beginning of (10) is indeed a good English word, constituting a name of a German statement; but the rest of (10) is a meaningless jumble of languages.

Quine's comment makes more sense if one replaces his odd usage of the term *word* for the quoted sequence in his (10) by *constituent*. But the term *English* in (191) is highly misleading as it suggests wrongly that the representation in question has become part of English. But in fact any orthographic token from any NL could occur there. That is, *Die Schnee ist weiss* is not an English word

So explicated, despite its innacuracies, Quine's remark then amounts to a recognition that an English sentence can have subparts not formed on the basis of an English lexicon, that is, can contain alexical constituents. The version of *Die Schnee ist Weiss* occurring before *is* in his (10) is not an expression having anything to do with ITEM(English). In his earlier terminology it is, rather, a picture of a token of a German sentence.

In short, at least as early as the beginning of the generative doctrine, Quine had essentially recognized the existence of alexical constituents and saw that they had a pictorial physical type nature rather one representing linguistic structure. Implicitly at least, Quine had then long ago arguably recognized that Chomsky's claim in e.g. (89) was a fundamental distortion of linguistic reality.

Some more recent philosophical work on quotation also recognizes the existence of alexical constituents as parts of English sentences:

(192) a. Cappelen and Lepore 2007: 6-7

For example, the string (1.11) appears to have as one of its constituents (i.e. 'snøman'), an item that is not itself a part of the English lexicon.

1.11. 'Snøman' isn't a word in English; it's a word of Norwegian.

This is particularly interesting *since (1.11) is a true grammatical sentence of English*. The problem for compositional meaning theories, then, is this: if some quotable items are not themselves a part of English, and if they are in some sense components of well-formed English sentences that contain them, how then can such grammatical English sentences be built up out of a finite set of meaningful elements of English? If there's no such finite set, then how can a finite theory determine the semantic content of all English sentences out of the semantic contents of their constituents? (emphasis mine: PMP)

b. Cappelen and McKeever 2019:

Quotation can be used to introduce novel words, symbols and alphabets; *it is not limited to the extant lexicon of any one language*. Both (10) and (11) are true English sentences:

(10)'Φ' is not a part of any English expression.

(11)'☙' is not an expression in any natural language.

(Emphasis mine: PMP)

In (192a) the authors unequivocally recognize that the Norwegian word *snøman* can form a part of English sentences. In (192b), the authors assume that the Greek letter Phi in their (10) is not an element of $CHAR_{English}$ but can still appear as part of English sentences, that is, can appear as an alexical constituent. Similarly, the pre-*is* form in their (11) was clearly intended to be an arbitrary planar form, again an element foreign to $CHAR_{English}$. One notes that the authors are categoric that their (10) and (11) are English sentences in spite of their

alexical character. The highlighted portion of (192b) is in effect an explicit rejection of the FLH, constituative of the doctrine that NLs are generative systems.

Evidently then, the philosophy of language literature contains citations showing one aspect of the artificiality of the claims that all NL sentence O_{TS}s are drawn from a finite lexicon. And some of these date back decades.

Postal 2004, chapter 6 described a selection of facts involving untypable alexical constituents in terms of the concept *openness*, defined in several ways, including:

(193) Postal 2004: 178

a. An NL is *closed* if and only if there exists some finite list of all the minimal forms of every sentence of NL.

b. An NL is *open* if and only if it is *not* closed.

It should be clear that *minimal forms* in (193a) is equivalent to the earlier term *output terminals* (O_{TS}). Given that equivalence, what was argued in Postal 2004 and above is that NLs, specifically English, are open. That is equivalent to saying that the FLH does not hold and that infinitely many English sentences have untypable alexical parts. Consequently, English has no generative grammar.

It should then be rather depressing for linguists that while this conclusion and the facts underlying it remain essentially unrecognized in linguistics, philosophers like those cited in (192) have basically grasped the problem so that (192) in effects states that English is open.

17 Salvage

Several facts about linguistics over roughly the last seven decades need to be confronted. First, as requires little stress, during that period the assumptions of the generative grammar movement and its claims that NL grammars not only are but must be generative devices have achieved emormous, even dominant, influence in much of linguistics. Second, as argued at length in Part II, a vast body of data shows that any NL parallel to English in permitting alexical sentences, especially untypable alexical sentences, can have no generative grammar. Third, within the overall assumptions of the generative movement, a huge body of research has been carried about by multiple people on multiple NLs in a range of distinct and evolved variants of generative ideas.

The combination of the second and third facts cited in the previous paragraph inevitably raises the question of the fate of the existant research results carried out under generative assumptions. Certainly, one must avoid the facile conclusion that the impossibility of generative grammars of NLs like English shows that the body of descriptive and theoretical work done within the generative grammar framework is thereby uniformly mistaken and subject to dismissal. Nothing like such a conclusion could be justified.

The valid conclusion, I believe, is that a great deal (but certainly not all) of the conclusions of the generative work which has been done can be salvaged. The criterion for a tenable salvage will be the possibility of successfully *translating* claimed results into a nongenerative framework, one capable of accounting for (untypable) alexical sentences. As discussed in section 15, there is good reason to believe that some variant of the model-

theoretic conception of grammars is the appropriate framework within which to seek such adequate translations.

Of course, each body of putative results develolped and promulgated in generative terms will have to be evaluated individually to determine to what extent it can be maintained in nongenerative terms. But it is easy to cite a variety of cases which should be unproblematic. For instance, discoveries about the role of *locality conditions* on central reflexive elements like that in (193) (194) owe nothing to the particular assumptions about the generative nature of grammars.

(194) a. Marilyn criticized herself.

b. Marilyn wondered why she/*herself had been unsuccessful.

In the same anphora domain, the strong crossover generalization has never been successfuly argued to depend on ideas specific to technical generative ideas; see Postal, 2004b: chapter 7.

In a distinct area, conditions on the relations between so-called licensers and negative polarity items, which at least in NLs like English seem to appeal in part of conditions like c-command, can certainly be stated without reference to generative ideas.

No doubt the most widely appealed to descriptive ideas in generative terms involve the notion of (transformational) *movement*, reinterpreted in minimalist terms as internal merge. Such ideas have been applied in detail to a huge variety of phenomena from passivization, left-extractions, subject raisings, verb raisings, NEG raisings, etc. This work has led to important discoveries, e.g. the existence of island constraints Ross 1967 [1986]), the existence and properties of negative polarity items, the existence of the strong crossover

effect, the role of invisible resumptive pronouns Obenauer 1984, 1985, 1986, Cinque 1990, Postal 1998 among many others.

But there is ground to deny that the relevant constructions support the ideas of generative grammar, still less its supposed necessity. Multitudes of such facts have been described in nonmovement terms in a number of distinct frameworks, including Generalized Phrase Structure Grammar (Gazdar 1981, Gazdar, Klein, Pullum and Sag 1985), Head Driven Phrase Structure Grammar (Sag 2010, Sag, Wasow and Bender. 2003), Lexical Functional Grammar (Bresnan, 1982, Dalrymple 2001, 2006), Arc Pair Grammar (Johnson and Postal, 1980; Postal, 2010) to name only some, work going back many decades. And there is considerable argument that various nonmovement treatments are superior. Hence while it is then obviously important to reconstruct movement/merge generative ideas in nongenerative terms, there is no reason to doubt that whatever is factually sustainable in previous generative oriented work in this domain can be successfully translated into model-theoretic terms.

On the contrary, inevitably, any claimed results which inherently depend on generative assumptions, e.g. ideas about rule ordering, cycles, particular generative devices like Merge, etc. and, obviously, anything related to the idea of fixed lexicons have as such no hope of being retainable in nongenerative terms.

The present study is not the place where salvage issues can be considered in any detail. It suffices to stress that once the impossibility of generative grammars is recognized, there will be no alternative to serious investigation of salvage questions.

18 The Sociology of the Mistake

The following questions about the sociology of linguistics over the period from the beginning of the generative grammar movement to the present seem inevitable. How was it possible for the striking theoretical incompatibility with linguistic reality documented in earlier sections to be central to the generative grammar thesis to have maintained itself for more than six decades? And how does it manage to continue? How have so many in linguistics quietly accepted an unargued view incompatible with masses of available data, even data found in the earliest works on generative grammar, as shown above in (100) and (101a)? This question is especially pertinent since, as stressed at the outset, the idea that NLs have generative grammars was originally introduced without argument as part of a program of question-begging which, as was shown, has never ended.

Some insight into this initially paradoxical situation is, I suggest, provided by the useful French term *doxa*, apparently of Greek origin. It is characterized as in:

(195) https://en.wikipedia.org/wiki/Doxa

> Pierre Bourdieu, in his Outline of a Theory of Practice (1972), used the term doxa to denote a society's taken-for-granted, unquestioned truths. In comparison, opinion is the sphere of that which may be openly contested and discussed. The doxa, in Bourdieu's view, is the experience by which "the natural and social world appears as self-evident." It encompasses what falls within the limits of the thinkable and the sayable ("the universe of possible discourse"); that which "goes without saying because it comes without saying."

I find that the persistant doctrine introduced in the 1950s that NL grammars had to be generative devices fits perfectly under the concept doxa described in (195). Chomsky was

able to create, expand and play the leading role in maintaining a movement in which the ideas of generative grammar became 'taken-for-granted, unquestioned truths', became something which 'goes without saying because it comes without saying'.

The same idea was expressed by George Orwell (of course, he was talking about political orthodoxy):

(196) Orwell 1945 [1972]

> At any given moment there is an orthodoxy, a body of ideas which it is assumed that all right thinking people will accept without question.

https://www.nytimes.com/1972/10/08/archives/the-freedom-of-the-press-orwell.html

That is, what took place in the development of the generative grammar movement was a large scale, amazingly successful process of indoctrination. Students of Chomsky and others influenced by his early ideas were exposed to the dogmas in (1)-(4) and not told that they involved both obvious falsehoods and fundamental question-begging. Then these people matured, many became teachers themselves and transmitted the received ideas to their students and others they influenced, and so on. Chomsky's considerable post-1965 access to the popular media (due in significant part to his political activities) strengthened this process as his ideas reached many people unequipped to consider the soundness of his assumptions.

There is little doubt that a crucial element in the maintenance of the factually unsupportable doctrine underlying generative grammar was the multiply repeated, never justified and entirely false claim that some kind of necessity requires that NL accounts be generative.

Another way to state the doxa in question is that Chomsky has for more than sixty years been remarkably successful in accomplishing within linguistics what he himself (Herman and Chomsky, 2002) called *manufacturing consent* (seen as a propagandistic process). One notes the truly massive repetition of the false necessity claim, intensive repetition being a key and characteristic propaganda mechanism.

Probably nothing could show as clearly the persuasive success which Chomsky has achieved in instilling in so many the untenable underlying assumptions of generative grammar as the introductory remarks to Chomsky, 2020, which inform the reader:

(197) Friedin 2020

> without such an operation [Merge], language wouldn't exist – that is,
>
> this is the simplest operation for language to exist at all."

The grandiose claim that the existence of a collection of objects could depend on some particular system recursively enumerating it makes no sense. View (197) implies, for instance, that nonrecursively enumerable infinite collections cannot exist at all, an absurdity in the face of Cantor's results, modern set theory, etc. Further, it ignores the fact that truly recursively enumerable infinite collections can be generated by distinct formalisms. For instance, for a one symbol alphabet containing X, the infinite Kleene* collection of Xs, that is, the set of all sequences of Xs of length zero or more, can be generated by both phrase structure rules and Merge.

These considerations aside, since, as has been shown, English has no generative grammar, taking Friedin's claim seriously would entail, implausibly, that English does not

exist. Friedin's remarks are a revealing indication of the extraordinary strength of the psychological grip which the generative grammar doxa has successfully led to.

For many, the claim that the ideas of generative grammar represent in effect an untenable mythology might well seem offensively dismissive. Relevantly though, viable intellectual structures can of course be defended against criticisms. But several considerations relating to defenses of generative grammar stand out.

First, as has been indicated, the appearance of *linguistic* work revealing the existence of untypable alexical constituents is not recent; some of it goes back at least to Harris, 1968, some of it to Jackendoff, 1984, and there is extensive discussion in Postal, 2004b: chapter 6. And there are no doubt other linguistic documentations which I can't cite due to ignorance, as in the remarks about Hungarian in (105) above. Despite this, there appears to be no work in the mainstream generative tradition which even attempts to take the relevant facts into account. What one has seen instead is unfounded claims like those in (7)-(18).

Further, as already mentioned, the idea of a model-theoretic approach to NL grammars appeared more than forty years ago and has generated an extensive literature, some of it specifically critical of the relative inadequacies of generative approaches. Nonetheless, again, the mainstream generative tradition has ignored this work and made no attempt to show the superiority or even the relative adequacy of generative conceptions of grammars.

In this connection, the following remarks are a propos:

(198) Priest 2006: 284

> If one attacks a view that constitutes an entrenched orthodoxy, it would be naïve to expect the orthodox simply to agree—just like that. Strategically, if it can be made to work, the best response to a heresy is to ignore it.

And as far as dealing with untypable alexical constituents and model-theoretic views of grammar go, the generative orthodoxy has reacted just as Priest described. Today, in 2023, I am not aware of a single work which attempts to show either how generative grammars can be made compatible with untypable alexical constituents or to argue why the generative conception of grammars is not inferior to a model-theoretic one, not to mention simply untenable.

These twin failures are exactly what one might expect from defenders of a view which, from its outset, was based on question begging and false invocations of never justified types of necessity, e.g. as in (7), (8), (9), (11) and (12) above. The lack of defenses at issue supports the conclusion that none is possible and that the originator and principal exponent of the generative grammar view is aware that none is possible.

Notes

****This work owes a truly enormous debt to David E. Johnson. His comments on issues relevant to this study provided in a multitude of e-mails over more than ten years have led to improvements at many points and would in many respects justify recognition of coauthorship. Section 8 owes a great deal to his input. Even more significantly, his fundamental insight as to the nature of the structures called *untypable alexical constituents* below is arguably the central substantive concept of this work. It is discussed in section 11 below.

I am also indebted to David Pitt for many helpful correspondences about types and tokens and to Stefan Dyla and Adam Przepiórkowski for helpful comments and corrections, especially with respect to Polish data.

These recognitions notwithstanding, no one else is in any way responsible for any mistatements, flaws or errors in this study, which could only be the entire responsibility of the author.

1 One aspect of the present work's title is misleading. The material bearing on its claim is drawn overwhelmingly from English. So a more prudent statement of what is intended is that no NL sharing the properties documented for English is a generative system.

2 Nonetheless, arguably most of Chomsky's linguistic output, especially, since say 1980, is concerned less with the syntactic analysis of bodies of NL sentences than with what could be called foundational issues. So:

(i) Seuren 1998: 252

> Most of Chomsky's work in theoretical linguistics deals with metatheoretical questions.

(ii) Seuren 1998: 252, n. 27

> The paucity of Chomsky's actual grammatical analyses and descriptions is surprising for someone who has written so much on linguistics.

But these judgments have no bearing on current concerns.

3 For current purposes the irrelevance of differences between the multiple distinct varieties of English can safely be assumed.

4 Chomsky's symbol F in (4b) denotes the 'class F of functions from which grammars for particular languages may be drawn.'

5 However, the question of how knowledge of NLs develops in children is to a significant extent poorly defined because the notion 'knowledge of NL' also is. Answering it would require a solid understanding of the nature of NLs and the grammatical systems which characterize them. Each conception of grammatical structures and the grammatical systems specifying them raises distinct problems for any learning mechanism hypotheses.

Claims that much of the basis of learning is innate do not change the picture, since everything depends on the nature of such a putative innate system. In a valid indirect sense then, to study the nature of NL sentences and the grammars that can characterize relevant classes of them is a necessary foundational component of the study of NL learning.

6 Moreover, innumerable perfectly processable sentences will never be represented in any way because they represent claims, questions, commands, etc. whose meanings are too absurd to motivate their use, even if they are compact enough to be in principle performable. For example:

(i) Megajaws, the first left-handed hitting alligator to be named the American League's most valuable player, grew up on Jupiter and attended Yale College, majoring in reptile rights theory.

For other, similar sentences where the word *alligator* is replaced by one denoting some other arbitrarily chosen animal type one can be pretty sure that vanishingly few if any will ever be pronounced or written.

7 I reject the view that the token in Kaplan's example is empty space. Rather, I believe the token in such cases is represented by a part of the relevant material having the planar shape. In Kaplan's example the token is a subregion of the cardboard containing the relevant letter-shaped hole. If the token were the hole, sequentially cutting away the cardboard until none is left could not destroy the token but clearly it would.

8 While common, taking tokens to be exclusively physical is not universal in the philosophical literature. For instance, Pitt 2018 e.g. p. 12 text, p. 12 n. 8, makes clear that for him tokens can be abstract objects related to other abstract objects which are types. But in what follows, I assume that in the case of NLs, relevant tokens will be limited to physical things.

9 Most orthographies depend on the shapes of marks on a largely planar surface. But Braille, a system of writing for the blind, differs:

> (i) B**raille**, universally accepted system of writing used by and for blind persons and consisting of a code of 63 characters, each made up of one to six raised dots arranged in a six-position matrix or cell. These Braille characters are embossed in lines on paper and read by passing the fingers lightly over the manuscript.

https://www.britannica.com/topic/Braille-writing-system

To simplify the discussion without theoretical loss, I will ignore Braille in discussions of orthographies which follow.

10 Despite (22), Chomsky of course made clear that the notion of an NL sentence as merely one or more string of characters was an extreme artifact. That is, such a string structure is only the most superficial aspect of the complex set-theoretical nature of NL sentences. But

for his purposes and the present ones, this does not really matter. For it is uncontroversial that the structure of each sentence *includes* a string of minimal syntactic elements.

11 One can imagine a linguistic system in which every sentence is composed of a sequence of phonemes/letters with no organization into ordinary lexical items. Such a system would contrast with NLs in providing no effective way to assign meanings to sentence parts. For instance, without organization of the sequences *bin, din, fin, gin, kin, pin, sin, tin, win* into separate entities, no meanings could be assigned to the parts of these sequences. That is, somewhere in a grammar e.g. *fin* has to be treated as a unit with specific semantic properties not derivable from those of its component phonological elements. As illustrated, these also occur in other forms with entirely distinct meanings.

12 Tigrinya is a member of the Ethiopic branch of Semitic languages spoken mainly in the Tigre region of Ethiopia, and in Central Eritrea. In 2007 it had about 4.4 million speakers.

13 Many thanks to David E. Johnson for the Japanese data.

14 In the terms sketched earlier, this would mean that a person hearing a foreign name would come to know a slightly different NL containing that name in its lexicon where the previously known NL did not.

15 A related view is arguably implicit in the view of Chomsky and Halle, 1968: 5, that there is a universal (digital) phonetic system of phonetic representation. Since phonemes have a phonetic interpretation, plausibly there would be no more phonemes across NLs than there are phonetic items.

However, such an assumption is strongly called into question in work like:

(i) Pierrehumbert 1990

Such results indicate that it will not be possible to identify a universal inventory of phonetic segments.

16 Of course, if there were such a thing, one would have to alter the requirement of typability for generative grammars. It would then be necessary to have a 'dynamic' keyboard such that at any point the output of the Turing machine is allowed to provide the symbol on a key. This is not worth worrying about in the absence of an actual device of the sort at issue.

17 Despite Hockett's failure to draw the correct conclusion from his typability insight, his account was nonetheless greatly superior to that of mainstream generative thinking on the topic. That is, he did not beg the question of the recursive enumerability of NLs and thereby their capability of being characterized by generative grammars.

18 I am indebted to Anna Szabolcsi for providing the link to this work.

19 This is especially remarkable given the close historical relations between Chomsky and Harris, the latter having been inter alia one of Chomsky's University of Pennsylvania teachers, his doctoral thesis advisor and the source of many of his earlier transformational grammar ideas.

20 I am greatly indebted to Christina Behme for the German example, to Anna Szabolcsi for the Hungarian examples, to Rie Johnson for the Japanese example and to Stefan Dyla for the Polish example.

21 Jackendoff's characterization should have referred to a phrasal category NP rather than Noun, as shown by:

(i) the interesting Klingon letter 

21 This quote is from a prepublished version and may contain irrelevant deviations from the published text.

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