RULES OF GRAMMAR

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1 'Rules' in the everyday sense

The past six decades – broadly, the period dominated by generative grammar – has seen hundreds of articles and books with titles suggesting that the notion 'rule' is a thoroughly familiar one in linguistics, and that linguists deal with rules all the time. Anyone familiar with post-1960 linguistics will recall seeing titles like these:[1]

'On the notion 'rule of grammar' ' (1961)
Some Syntactic Rules in Mohawk (1962)
'Global rules' (1970)
'Evidence for transderivational rules' (1972)
'Evidence that indirect object movement is a structure-preserving rule' (1972)
'Verb agreement as a rule of English' (1972)
'Zero-output rules' (1973)
'The base rules for prepositional phrases' (1973)
Rule Ordering in Syntax (1974)
'Conditions on rules of grammar' (1976)
Rules and Representations (1980)
Extraction Rules in Icelandic (1980)
'A landing site theory of movement rules' (1982)
Words and Rules (1999)
Architectures, Rules, and Preferences (2008)

But the strange fact is that none of the uses made of the term 'rule' in generative grammar seem to denote anything like rules in the everyday sense. Rules as we ordinarily conceive of them can be followed or ignored; they can be obeyed or disobeyed; they can be respected or flouted; they can be waived or enforced. This is at root because in all cases they define CORRECTNESS within the terms of some moral, social, legal, conventional, or other such system.

Rules differ from scientific laws. It makes no sense to talk of following, obeying, respecting, or waiving the laws of physics. And rules also differ from descriptive generalizations: it makes no sense to talk of complying with a summary of the present state of the traffic on I-95, or waiving the anatomy of the duck-billed platypus, or violating a chemical analysis of a sample of canal water. Human beings can conform to rules or violate them, normally at will. (I grant that a person might

[1] The dates given in parentheses are merely intended to locate these well-known works by decade; I will not supply bibliographical details for each of them in the reference list. A bibliography of modern linguistic works talking about rules would take up much more space than I have here.

sometimes become so habituated to obeying a rule as to find it next to impossible to behave in ways that flout it, but that is not the usual state of affairs, and the compulsion experience by such a victim of habit does not constitute or define the rule.)

Rules as we are familiar with them in everyday life arise in numerous contexts:

- clubs and societies (‘Gentlemen must wear ties and jackets in the Cosmopolitan Club members’ dining room’);
- rights and prohibitions in condominium and office buildings (‘Smoking is not permitted anywhere in the building or the courtyard’);
- games (‘The bishop moves diagonally’);
- competitions (‘Employees of Kelloggs or its affiliated companies are not eligible’);
- table etiquette (‘The fork goes on the left of the place setting, the knife on the right’);
- parliamentary procedure and order in meetings (‘Each member has a vote and each vote is weighted equally’; ‘A motion to rescind, repeal or annul or amend something previously adopted requires a two-thirds vote, a majority with previous notice, or a majority of the entire membership’; see Robert 2011);
- driving on public roads (‘The speed limit is 25 mph in all residential areas’; ‘Stop’; ‘Right lane must turn right’);
- public behavior (‘No Parking’; ‘Do not wedge this door open’; ‘Wait behind yellow line until called’);
- manuscript submission (‘Abstracts must fit on one side of letter-size paper in 12-point type with one-inch margins’);
- order of arithmetical operations (‘Operations are applied working from the left in a formula with mixed division and multiplication, so ‘$6 \div 2 \times 3$’ means ‘$(6 \div 2) \times 3$’ = $3 \times 3 = 9$, not ‘$6 \div (2 \times 3)$’ = $6 \div 6 = 1$’);
- interpretion of legal statutes (‘In the absence of a contrary indication, the singular includes the plural, and vice versa’; see Scalia and Garner 2012, 129–131’).

And grammar, of course, is one of the most obvious domains in which rules are (or used to be) standardly invoked. Every traditional grammar and every prescriptive usage manual deals in rules. A few attested examples:

- ‘Assumptive adjective-words precede their head-words’ (Sweet 1898, p. 7)
- ‘Modern English generally has the normal order subject + verb’ (Sweet 1898, p. 13)
- ‘Preposition-groups normally follow their head-words ... But preposition-groups often take emphatic front-position ... *of fuel they had plenty*’ (Sweet 1898, p. 26)
- ‘The number and person of a Finite verb depend upon the *number* and *person* of its Subject’ [Nesfield 1900, §66 p. 55]
- ‘Do not join independent sentences with a comma.’ [Strunk And White, 2000, p. 5]
- ‘Do not use small caps for roman numerals.’ [*The Economist Style Guide* 2003, p. 7]
- ‘It is a sound rule that *that* should be dispensed with whenever this can be done without loss of clarity or dignity.’ [Gowers 2014, p. 216]
- ‘When a proper name is used as an adjective, it isn’t a possessive and therefore doesn’t take an apostrophe. Hence “the Cubs [not *Cubs’*] game is at 1:00 today.” [Garner 2022, p. 855]

I have deliberately chosen a diverse array of examples to illustrate the point that rules expressed in English can be stated in a variety of grammatical forms: they may be declarative or imperative in clause type; they may be given in active or passive voice; they may use the simple present tense or contain modal auxiliaries; they may be in the second person, third person, or possibly even first person ('We do not allow members to bring more than one guest'). But what links them all is the notion of providing guidance about what's right: their intent is to tell you what is correct or compliant and what is not. That is, they have NORMATIVE force.

2 'Normative' and 'prescriptive'

For my purposes it is regrettable that there is a hundred-year-old tradition in linguistics of equating the terms NORMATIVE and PRESCRIPTIVE. References to 'normative grammars' in sources from Bloomfield (1930) to Tieken-Boon van Ostade (2017) almost always mean prescriptive grammars of the authority-dispensing type, which are so often polluted by bossiness or snobbery.

The tradition may have started in the 19th or even the 18th century, but one early use of the term 'normative grammar' was in the work of Hanns Oertel (1901). He treats 'normative' as synonymous with 'didactic,' and contrasts the didactic enterprise with what scientific linguists do. 'Normative or didactic grammar sets up a certain standard as correct,' he says (p. 87), and he proceeds from there to discuss the matter of defining a standard variety of a language that can be taught to those who speak non-standard dialects of it. He is very clearly referencing 18th and 19th-century efforts to 'improve' the speech of non-standard dialect users, and contrasting normative grammars with scientific ones.

I want to avoid any such terminological conflation here, because I need to lean on a fundamental terminological distinction between normative statements and prescriptive judgments or motivations. This is not too radical a terminological revision: I am merely separating two documented senses for the word *normative*.. *Webster's Third New International Dictionary* (1961, p. 1540) assigns distinguishes four main senses, sense **1** being 'of, relating to, or dealing with norms' and sense **4b** being 'prescriptive.' All I am doing is choosing to use 'normative' solely in sense **1**, as a predicate of statements that defines them as being about what ought to be, not what is – the way analytic philosophers use it. I want to reserve use the adjective 'prescriptive' only as a predicate of judgments or educational endeavors associated with the presupposition that some people's language is culpably bad, and with the business of trying to get people to use their language better than they do.

It seems to me that any grammar worthy of the name has to be normative: if a grammar for a human language does not define correctness for sentences, and define non-sentences as incorrect, it is not doing the job that we have traditionally expected grammars to do – like enabling foreign learners to figure out what they have to learn. Learners of a second language are interested not in learning what sorts of things happen in cases where native speakers make slips of the tongue, but in what it would be right for them to say when using the language themselves.

Notice that we do not get a definition of a language out of saying that a sentence is grammatical in the language of a speaker A if and only if A regards it as such when successfully accessing his or her intuitions, and that those intuitions are as specified by a generative grammar that is somehow inaccessibly inscribed in A's brain. The putative systems inscribed in A's mind, whatever they are, have some sort of electrochemical or neurophysiological reality. Claims about them constitute statements of plain empirical fact about the way the world is (Chomsky has repeatedly asserted that they are biological facts). And the world, whether on a geophysical or intracranial scale, cannot be said to be right or wrong: things simply are the way they are. Neither tectonic plates nor brain states are subject to rules that can provide a basis for judging them to have done something wrong.

It seems to me that the traditional view under which a grammar has normative force is compelling, and linguists (as distinct from psycholinguists, whose business is the study of what actually goes on in speakers' brains and behaviors) have made a mistake by forgetting or outright rejecting this during the past half century.

2.1 Prescriptivism and prejudice

What I have said so far might seem to be bringing grammar in the linguist's sense much closer to prescriptivism than most linguists would ever expect. When I began the study of linguistics as an undergraduate I was rapidly and easily convinced to dismiss prescriptivism as silly prejudiced nonsense, something we should pay no attention to at all, and after encountering the radically anti-prescriptivist rhetoric of works like Robert A. Hall Jr.'s *Leave Your Language Alone* (1950), I simply forgot about prescriptivism for at least thirty years of working on syntax and phonology. I was only brought back to considering it seriously by working on the reference grammar Huddleston and Pullum (2002) and by starting to write posts about language for a general non-linguist readership on the group blog *Language Log* (see Liberman and Pullum 2006 for a selection of those posts).

One of the reasons linguists dismiss prescriptivism, and even find it distasteful, is that the prescriptive motivation is so often accompanied by DIALECT CHAUVINISM: the touting of one dialect as clearly (almost morally) better than another. Yet this is solely a contingent association: it is not a necessary part of wanting to help others write better that noting a difference between our own variety of English and a different one should immediately inspire us to despise or condemn the latter. Yet suppose someone states that the right way to get a hotdog without onions is to utter (i) not (ii), signaling that judgment in the standard notation of linguistics by putting an asterisk on the latter.

(i) I do not want any onions on it.

(ii) *I don't want no onions on it.

(The asterisk on (ii) should be taken as relative to the assumption that we are judging things from within the terms of Standard English.) Many English teachers have tried to teach children that even the *don't* of example (ii) is an error – meaning, of course, that they regard 'contractions' as inappropriate in serious written English and want to inculcate in students the habit of not using them; but set that aside and consider just the fact that both *don't* and *no* co-occur in (ii), yet (we will assume) it is intended to mean what (i) means.

The teachers who say that (ii) is incorrect English will almost inevitably be interpreted as suggesting not just that (i) is correct English, but that people who say (i) are in some sense better than people who say (ii). Yet the construction seen in the syntax of (ii), which linguists refer to as negative concord, is a feature of most nonstandard varieties of English, whether in the British Isles or North America or Australasia. There are quite probably half a billion speakers who do not comply with the regularity the teacher is attempting to teach: they would regularly say (ii) – and use analogous sentences like *I never meant to hurt nobody*, and *We ain't got none*, and so on.

So theoretical linguists try to maintain a non-judgmental perspective and say that there are two dialects here, and that ultimately the task of linguistics would be to characterize them both accurately, not attributing ignorance or lack of education to the speakers whose native dialect exhibits a negative concord system and who therefore favor (ii). But it is very easy for a hint of social judgment to creep in, or to appear to have crept in.

It is not good enough to just set dialect chauvinism aside as something that sensible linguists or philosophers like us do not have to worry about. The issues have to be faced even in the most aridly mathematical contexts. There are (surprisingly perhaps, for some) dialects in arithmetical notation: an expression like `x^y^z` will not be evaluated identically by all calculators and commercial computer software: `4^3^2` may produce 4,096 (Microsoft Excel, MATLAB) or 262,144 (Google, Wolfram Alpha, the Unix **bc** calculator) or an error message (the LaTeX system used to typeset this book will not treat `4^3^2` as a possible expression in math mode).

The point here is that a different dialect is not necessarily a contemptible one. If you are using MATLAB, it definitely is WRONG to type `4^3^2` if your intent is to enter an expression that evaluates to 262,144 (you need to introduce some bracketing); but that does not license either the inference that MATLAB is better and more socially acceptable than the Unix **bc** utility, let alone the conclusion that it is contemptible and should be eradicated.

The issue of dialect chauvinism can be separated off from prescriptivist practice: it may be common to find prescriptivsts taking a snobbish attitude toward non-standard dialects, but that is only a contingent fact about prescriptivists, not a necessary attribute (I argue this point more fully in Pullum 2023).

2.2 Rule-following, internalized grammars, and culpability

The key worry expressed by Kripke (1982) about linguistics, and in particular the Chomskyan concept of competence, is that he does not see how any substantive fact about a human being – the property of having a generative grammar inscribed in their brain or any other property – could possibly give rise to the normativity he assumes to be there in grammar. How could any kind of property of a human being make it the case that some specific indefinitely large set of sentences are defined as well-formed and all other potential sentences defined as ill-formed. He unfortunately uses only a single example, the the meaning rule for the term 'plus,' and never considers grammatical rules at all, but in a couple of footnotes he expresses a worry that the mentalistic interpretation of generative grammar is in trouble.

He may be right, though deciding whether he is will be extraordinarily difficult: Kripke's book has been the subject of controversy in the philosophy of linguistics for sixty years now. He challenges us to characterize an independently specifiable fact about a person that could count as fixing some rule that the person follows. In effect, he doubts that the contingent fact of some stable element of the constantly fluctuating electrochemical state of a grapefruit-sized brain of a hairless mammalian biped could satisfy that condition: it could not be coherently held to determine that the members of some indefinitely large class of never-yet-uttered sentences are well-formed and the members of its complement ill-formed.

Chomsky has certainly never made clear how such a stable element of brain states could conceivably be interpreted as an inscription of some unique formal system: we know nothing about how to identify such inscriptions. Nor do we know how having one's brain in a state containing a formal system defining of a certain set could actually play a role in the tasks of uttering and understanding sentences, or how having an inscription of some generative grammar in one's brain could impart any conscious knowledge of the properties common to the sentences of the language.

Basically the mentalist interpretation of the generativist view on grammar seems too lawlike. If inscribing a generative grammar in the brain of some primate causes it to utter and understand sentences in a certain way, thus defining for it a universe of possible sentences, then those sentences would be the ones the primate was biologically limited to. Understanding a sentence in a novel way, or understanding a sentence containing a previously unencountered word, would be impossible. That's not about correctness, it's about ability.

And the Chomskyan distinction between competence and performance does not seem to help here: it merely posits one conjectural cognitive module in combat with others. It does not bear on the issue of what the grammar should properly call 'right' or 'wrong.'

These are the worries that I think Kripke is touching on. Chomsky (1986) seems to think so too, because he mounts a major challenge in response, devoting most of a long book chapter to Kripke's objections (see Wright 1989 for a deep and interesting critical response to that chapter). One point Chomsky makes – a very natural one – concerns the issue of obligations to act. To say that a grammatical constraint has normative force might seem to imply something about WHAT SOMEONE SHOULD DO (or not do). That is, it might seem that if someone does not obey one of the rules – any condition that is part of the grammar – has thereby done something that they shouldn't have done.

Chomsky sees this implication and objects. Characteristically perceptive, he gives exactly the right reason. For an arbitrary speaker Jones, says Chomsky (1986, p. 241),

> The rules of Jones's language ... entail nothing about what Jones ought to do (perhaps he should not observe the rules for one reason or another; they would still be his rules).'

This is exactly right: your 'rules' – the system of principles you respect regarding your idiolect – are the same whether you obey them on any given occasion or not. You might have good reasons for not obeying them (you're acting in a play, or you're trying to fool enemy agents by pretending not to be a native speaker, or you're imitating someone else's bad English in a comedy routine, or whatever).

But how can there be a NORMATIVE rule defining what is right without it therefore being the case that you ought to do what's right? Isn't the notion of what's right intimately tied up with the concept of duty and what you ought to do?

Alan Millar (2004) elaborates at length on what is effectively this point. He draws exactly the distinction we need – between (i) defining what is correct and (ii) advising people about what they should do. When a practice is governed by a certain 'rule' (or respects a certain constraint, as I would say), 'Participating in the practice makes one subject to that rule' (pp. 168–9); and if you are subject to it there is a certain sense in which you ought to obey it. But 'rules' (constraints) are not laws of physics: they can be ignored or broken. You 'may participate in the practice and also flout the rules.'

Of course, it is true that 'participating in a practice incurs a commitment to following its governing rules and therefore to doing what the rules prescribe': if you aim to be thought of as a participant in a practice and you don't even follow its defining principles, you're not even trying. (Compare Ruth Millikan's remark that 'The rules of chess don't tell you that you can't quit, but only what would constitute going on': Millikan 2005, p. 148.)

However, crucially, according to Millar 'It does not follow that one ought to follow the rules.' Why not? Why is that not a self-contradiction? Because 'it might be that one ought instead to withdraw from the practice.'

To apply this to the case of a linguistic prescription (though that is not Millar's focus), consider the constraint that defines the so-called 'split infinitive.' Defining it with full rigour is not entirely straightforward (because of phenomena like verb phrase ellipsis and parenthetical interruptions), and the term is a misnomer (English does not have an infinitive verb form), but here we can simply say that the constraint forbids adjuncts from being linearly positioned between the infinitival marker *to* and the head verb of the infinitival complement that it introduces. The constraint draws a distinction between phrases that respect it (which are tacitly defined as well-formed or 'good') and phrases that don't (which the constraint defines as erroneous or 'bad'). Yet nothing follows from it about what anyone should do.

A syntactician might formulate the constraint against 'split infinitives' simply as a prerequisite for searching out sentences in literary works that violate it, exactly as George Curme (1930) did more than a century ago – his compendious work *Syntax* cites large numbers of attested literary examples (pp. 458–467, esp. pp. 461–465). Curme held the view that 'split infinitives' are natural, frequent, and useful in English writing, and have been attested over many centuries. In his view it is the people who urge avoidance who are making a mistake.

You can always respect the constraint against 'split infinitives' if you want to, and that may serve a useful purpose, such as ensuring that your writing is not criticized by those who wrongly think the construction is a grave error; but you can instead simply withdraw from the practice of writing the kind of English that respects the constraint. Curme thought that was exactly what we should do; he even asserts (p. 461) that using the construction 'is more characteristic of our most prominent authors'; it tends to be shunned more in the work of 'the minor writers, who avoid it as they fear criticism.'

Normative statements of constraints, then, do not intrinsically imply any recommendation about the use of any construction, or about using the relevant language at all. Linguists hypothesize sets of grammatical constraints in order to characterize phenomena accurately. If that is done well, people inclined toward supplying prescriptive advice may be better placed to consider how people should be advised to use the language; but stating the constraints is not to be equated with advising people to respect them. The rules of Standard English, or of any other dialect, don't tell you that you can't quit using it, but only what would constitute going on using it.

3 Generative grammars are not (and cannot be) normative

I will refer to formulæ like ‘X $\rightarrow$ Y’ from now on as PRODUCTIONS, never calling them ‘rules’ the way linguists informally do. You might think that a production such as ‘Sentence $\rightarrow$ NP + VP’ could be interpreted normatively, as saying something about sentences in English are supposed to be like, but that is not so.

- It does not say that every Sentence contains an NP and a VP, or even that every Sentence contains a VP, because the grammar might also contain a formula saying ‘Sentence $\rightarrow$ Interjection’ (to allow for utterances like *Wow!*).
- It does not say that when an NP and a VP are found in a Sentence they come in that order, because the grammar might also contain a formula saying ‘Sentence $\rightarrow$ PP + VP + NP’ (to allow for utterances like *After that came a plague of locusts*).
- It does not say that where an NP and a VP are found, they will make a Sentence, because the grammar might also contain a formula saying ‘VP $\rightarrow$ V + NP + VP’ (to allow for utterances like $[_{\text{VP}}\,[_{\text{V}}$ *make* $]\ [_{\text{NP}}$ *the world* $]\ [_{\text{VP}}$ *go away* $]\,]$).
- It does not say that at least some Sentences will be found to contain an NP and a VP, because either NP or VP might be rewritten by other formulæ in the grammar, or completely deleted by rules of the type $\alpha \rightarrow \varepsilon$.

A production (whether context-free or context-sensitive) is actually an **operation**, in the algebraic sense, like set union, set intersection or addition. A production (and for simplicity I’ll give examples of the context-free type) is formally equated with a subset of $V_N \times (V_N \cup V_T)*$ where V_N is the inventory of categories and V_T is the set of all words or morphemes or other formatives (thus $V_N \times (V_N \cup V_T)*$ is the set of all possible strings of category names and/or formatives, of zero length or greater).

Just as the operation ‘+’ is defined to be a binary operation on the set $\mathbb{N}$ of natural numbers, the operation that maps two natural numbers j and k to the natural number that comes k steps after j in the order defined by the successor relation on $\mathbb{N}$, so analogously, a standard way of interpreting the phrase structure formula ‘VP $\rightarrow$ V NP’ is as an operation on $(V_N \cup V_T)*$ that maps any string ‘X Sentence Y’ to the string ‘X NP VP Y’ and thus defines one possible pair of adjacent lines in a derivation. A terminal string is defined as well formed iff there is a derivation for it in which every pair $\langle \varphi \mathrm{X} \psi, \varphi \mathrm{Y} \psi \rangle$ of adjacent lines (φ and ψ being strings over $(V_N \cup V_T)$) is licensed by a phrase structure operation saying ‘X $\rightarrow$ Y.’

There are other interpretations of productions, as McCawley (1968) famously pointed out, but they are not quite as different as some have supposed. One reinterpretation, which McCawley attributed to Richard Stanley, essentially equates ‘VP $\rightarrow$ V NP’ with the binary local tree that has root label VP and frontier ‘V NP.’ It is treated as a picture of a tiny tree with only one step between root and frontier. But this merely provides for a different way of characterizing a set. It is in fact a set of trees, not strings (McCawley pointed out that the algorithm for building parse trees from phrase structure derivations did not always lead to a unique result unless certain rules about building derivations were carefully observed). The set of trees defined is the set of all trees in which every local subtree exactly matches one of the (reinterpreted) productions.

One can envisage either a process of randomly selecting local subtrees in a tree and verifying them by finding formulæ that license them, until all of the tree has been verified (this is basically the view that McCawley attributes to Stanley), or one can visualize a process of randomly constructing trees by plugging together local subtrees (matching non-terminal frontier nodes to root nodes of local subtrees). Either way, what you have is simply a definition of a set of trees. A formula 'A $\rightarrow$ B C' – whether interpreted in Stanley/McCawley mode or not – does not say that the tree contains an A or a B or a C; it does not say that every A in a tree will have a B daughter; it does not say that every B C sequence will have an A parent. It does not say anything about trees at all.

Something very similar could be said about composition-oriented grammars like categorial grammars. The starting point is a lexicon of items with categories of the form R/G (think of G as mnemonic for 'given' and R for 'result'). An item belonging to the category R/G, if given something of the category G, yields a resultant object belonging to the category R. (In Mark Steedman's combinatory categorial grammar, constituent order is handled by having both R/G and R\G categories. An R/G item yields a resultant object of category R if combined either with a G item that follows it, or with a G item that precedes it; see Steedman 2019 for an overview.) A tree is well formed if and only if there is a way of building it using the combinatory operations.[2]

'Transformational rules' in Chomsky's original sense likewise say nothing about languages. Take a 1957-style transformation abbreviable thus:

- X – *wh*-phrase – Y $\Rightarrow$ *wh*-phrase – X – *t* – Y

It does not say that all *wh*-phrases will appear at left-hand ends of clauses, or even that they CAN appear at left-hand ends of clauses, because there could be another rule that moves them back again, or moves them to the end of the clause, or deletes them in all cases. It says nothing about what clauses will actually look like. It merely defines one operation that may be used in the course of constructing a derivation, which if it succeeds (if it doesn't dead-end in a situation where there are still non-terminal symbols but no further transformational operation can apply) will terminate in the construction of a sentence.

4 What generative grammars really are

The nature of the formal systems known as generative grammars has been much misunderstood by philosophers of linguistics and even by generative linguists themselves. A generative grammar is a rather peculiar formal system. Its components – phrase structure formulæ, transformations, composition operations, or whatever – are identifiable but non-autonomous components of a system that overall defines a HOLISTIC, NONDETERMINISTIC, RANDOM, CONSTRUCTIVE set definition. Let me explain the four modifers I used in that sentence.

[2]Chomskyan minimalism, with its binary 'Merge' operation, looks to me to like very casual categorial grammar that pays insufficient attention to the details of lexical items. But this is not the place for a critique of the 'minimalist program.'

- A generative grammar is HOLISTIC because no element of it has any consequences independently of the whole; the entire grammar defines the whole set all at once (it is the smallest set containing everything that can be built using the formulæ), and no proper subpart of the grammar defines any element or subset of the set.

- A generative grammar is NONDETERMINISTIC because at any point in a derivation there may be a choice (or multiple choices) about what could be done next. (In fact usually there are large numbers of such choices.)

- A generative grammar operates in a RANDOM way in the sense that there is no way to tell which string will be built on any given run through the operations. The strings in the set will not be produced in a fixed order, like shortest first, or without repetitions. (Indeed, if an infinite set can be enumerated in a strict ascending order, it is decidable: see Janssen, Kok, and Meertens 1977, p. 115. Some sets that can be generated by transformational generative grammars, however, are not decidable.)

- A generative grammar is CONSTRUCTIVE in that its sole function is to supply a method for building algebraic objects to form a set – the set of all objects that could in principle be built from one of the start strings using the operations.

Since 1957 people have been referring to generative grammars as algorithms, or have compared them with algorithms. They have nearly always been mistaken. Turing machines are abstract computational systems (nobody ever tries to build one) much used in theoretical computer science for studying algorithms: a frequently used way of showing that some task could in principle be accomplished by an algorithm is to exhibit a way in which (however inefficiently) a Turing machine could accomplish it. And the following weak equivalence theorem holds for generative grammars in their most general form: in this sense:

> If L is a set of strings generated by some generative grammar, then there exists a Turing machine that will read a string and accept it if and only if that string is in L.

But that does not mean a generative grammar actually is, or can be conceptualized as, a machine or program or algorithm.

Chomsky has not helped to spread understanding about this; he has made a number of confusing and incorrect statements about generative grammars over the years, sometimes seeming to imply they are computable functions taking arguments, or algorithms for computing the values of such functions.

- Chomsky (1959, p. 138) says: ‘A grammar of L can be regarded as a function whose range is exactly L. Such devices have been called “sentence-generating grammars.” ’ But generative grammars (the rewriting systems that Emil Post developed in order to study logical proof, and called ‘production systems’) are not functions at all, and cannot be ‘regarded as’ functions in any way. Functions take arguments and yield unique values; rewriting systems do not do anything of the kind.

- In a footnote attached to the words ‘sentence-generating grammars,’ correctly crediting Post (1944) as the source for this use of the term ‘generate,’ Chomsky elaborates on his error. He says: 'We can consider a grammar of L to be a function mapping the integers onto L, order of enumeration being immaterial (and easily specifiable, in many ways) to this purely syntactic study' (p. 138, fn. 1). But since generative grammars are not functions, *a fortiori* they are not functions from integers to sentences. Nobody has ever suggested a variety of generative grammar that takes an integer as argument and gives a string as value.

- He proceeds to say of such a function F from integers to sentences of L that 'The weakest condition that can significantly be placed on grammars is that F be included in the class of general, unrestricted Turing machines.' But Turing machines are not functions any more than grammars are. (The transition table is a function, but not a function from integers to symbol strings: it maps a pair of a state and a current tape symbol to a symbol to be written and/or a direction in which to move the read head.) Although it would be possible to write a program for a universal Turing machine that would map integers to the sentences of a language (that is, taking an integer as input it would write out a specific sentence of English as output), that program would not be a function either.

- A quarter century later we find a strange passage in Chomsky (1986, p. 26) claiming that a generative grammar of English will assign an analysis to any input at all, even a Japanese sentence or the sound of a squeaky door hinge. This might seem to echo the 1959 idea that generative grammars are functions taking inputs, but it is not true: generative grammars of the various kinds Chomsky has proposed have never had the property of taking an input, so they cannot assign an analysis to anything. They simply define strings over a given finite vocabulary, possibly generating some kind of structure for it as well.

Pullum and Scholz (2001) discuss generative grammars under the heading 'generative-enumerative syntax,' but in light of what has just been said, the reference to enumeration might be called misleading: a generative grammar for a language cannot really be said to enumerate the sentences of a language at all, in the sense of placing them one by one on a growing list, without repetitions, so that the first can be called sentence number 1, the second number 2, and for each $n > 0$ some unique sentence is number n. This is not what a generative grammar does.

Trying to visualize a machine or algorithm that closely corresponds to what a generative grammar really does is rather strange. In effect it starts with a blank output tape, writes a string on it (bounded by left and right end markers), then moves on and writes another string, and so on, forever. In a sense it embodies a set of precise step-by-step instructions for doing something, but it does not meet the other condition we normally assume for an algorithm: IT DOES NOT HALT.

Ryan Nefdt suggests an original conception of grammars that does not equate them with accepting or enumerating machine programs; rather, it relates them to COMPRESSION algorithms (Nefdt 2023, pp. 70–79). He is reminding us here of an important insight: by capturing generalizations, grammars permit information about syntactic distribution and morphological structure to be expressed vastly more compactly (infinitely more, if the language is infinite), and we a smaller grammar that covers the same set of strings is taken to be a better grammar. Kolmogorov complexity (the theory of 'minimum description length') is thus a fundamentally important branch of mathematics for formal linguistics if we want to understand how grammars could be evaluated as better or worse than others and on what criteria they might be learned.

Nefdt's suggestion that 'grammars can be viewed as compression algorithms' should not be taken to mean that grammars literally take languages as input and produce compressed representations of their structure as output. Nefdt (p. 71) quotes Millhouse (2021) as saying that the statement 'C is a compressed representation of D' should be taken to mean 'C is considerably smaller than D and that there is some practical method for generating C given D and *vice versa*.' But although it is right that D (the grammatical sentences) can be generated from C (the grammar), generating a grammar from the language, or from the unbounded set of intuitions a speaker of it has about sentences, is a very different matter. It was in a sense the goal of the methods of analysis that American descriptive linguists (often known as the 'structuralists') were trying to develop in the decades before 1957, and success in any such project would be a gigantic advance in developmental psycholinguistics.

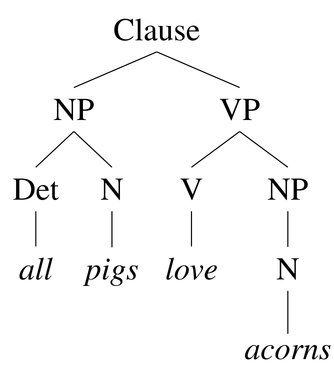
What is right about Nefdt's remarks is that any explicit and complete grammar for a language does offer a compressed account of the structure shared by a vast array of linguistic expressions. But we certainly do not (yet) have a procedure (analogous to the **gzip** program for computer files) for converting a set of sentences into a grammmar.

5 The model-theoretic alternative

There is a way in which grammatical statements can be given in a form that makes them much more like rules in the everyday sense: they can be given as CONSTRAINTS on linguistic structures, not operations forming part of a generative mechanism for building the entire (potentially infinite) set of linguistic structures. What I mean by a constraint is simply a statement that may be true or not true when evaluated within a certain kind of object. A structured object counts as well formed according to a constraint if it evaluates as true when evaluated in the structure of that object.

What I'm suggesting is that grammatical constraints can simply be statements about the structure of phrases, clauses, and sentences – statements of a sort that any traditional grammarian would recognize. And there is a kind of mathematical machinery tailor-made for theorizing about their relation to these objects: the machinery of model theory.

For simplicity and concreteness, assume that phrases, clauses, and sentences have structures represented adequately by the phrase structure trees that linguists use. A sentence like *All pigs love acorns* might be diagrammed like this:



A mathematician might look at this representation in terms of graph theory, seeing it as a directed, ordered, singly-rooted, acyclic graph, with nodes labeled by either one of the six category names

(Clause, Det, N, NP, V, VP) or by one of the four word forms (*acorns*, *all*, *love*, *pigs*). But a logician could view it (in an entirely compatible way) as a particular type of relational structure: a set of 12 members (the nodes), with ten unary predicates (the category names) and two binary relations: **parent of** (depicted by the lines) and **precedes** (represented informally by horizontal positioning on the page). Constraints on such tree representations for Standard English might include statements that could be expressed very informally like this:

(C1) If any node is parent of both an NP node and a VP node, the NP node precedes.

(C2) If any node is parent of both a V node and an NP node, the V node precedes.

These are particular facts about the structure of English sentences; in Malagasy, the opposite of (C1) holds, and in Turkish the opposite of (C2) holds. There might also be constraints that hold universally, like these:

(C3) Every VP node is parent of a node labeled V.

(C4) Every NP node is parent of a node labeled N.

We could add a statement that the Det node has to precede the N node that has the same parent, and that if the word form under the Det is *all* then word form under the N node with the same parent must be plural. We could connect the fact that *love* appears in its plural form (not in its 3rd-person singular form as *loves*) to the fact that *pigs* is in its plural form (the traditional way of stating this is that the verb agrees in number with its subject noun).

Such statements can be made increasingly general as the range of sentence types is expanded, and they can be formulated with as much precision as desired, using a description language with a model-theoretic semantics, such as first-order logic, or monadic second-order logic. A great deal is known mathematically about the expressive power of systems of constraints on structures. There is a mathematical literature devoted to proving theorems about them: it falls within a subdiscipline known as finite model theory. Different types of generative grammar are provably equivalent in certain respects to properties of trees defined using description languages of different expressive power. Libkin (2004) gives a general introduction to finite model theory; Rogers (1998) provides a sophisticated application of the theory to linguistics, introducing the term 'model-theoretic syntax.'

Pullum (2013) argues that stating grammars as sets of constraints has genuine conceptual advantages over stating them as holistic nondeterministic random sentence construction systems. For example, under model-theoretic as opposed to generative assumptions, we are not forced to assume a sharp boolean distinction between sentences that are generated and nonlinguistic material that is not. Instead you a finely graded theory of degrees of ungrammaticality becomes available (because more constraints or fewer may be violated, and at more or fewer points in the structure).

Intuitively, this makes it somewhat easier to see how the halting utterances of a toddler or a foreign learner, or a speech blunder by a native speaker, can be understood: *Is our children learning?* is not grammatical, but it comes close enough that we can see what the blunder-prone President George W. Bush was intending to ask, since it satisfies all the constraints of English other than agreement of the verb with the subject noun.

The acquisition problem also becomes a little easier to conceptualize in a plausible way. Generativist views of first language acquisition have tended to hypothesize that human infants have a mysterious innately-driven and species-limited ability to rapidly identify a generative grammar that generates the entire language perfectly, after exposure to a relatively small number of its shorter sentences. (Notice, grasping only part of a generative grammar would be utterly useless.) But if we take the model-theoretic view, acquisition can be envisioned as a gradual process (perhaps lifelong) of coming to grasp constraints on expressions that make the childs own utterances, and interpretations of other speakers' utterances, more similar in structure to those of parents or peer groups.

We can also avoid the intuitively false prediction made by a generative grammar to the effect that a nonsense sentence like *The gostak distims the doshes* will not be recognizable by an English speaker as linguistic material at all: if the lexicon is treated as a set of constraints on phonological or orthographical material requiring certain forms to be associated with certain grammatical and semantic properties, then no constraint is violated by *gostak* or *dosh* being treated as nouns (simply because there is no constraint saying that they aren't), or by *distim* being treated as a regular verb. The sentence can be depicted, correctly, as the active counterpart of *The doshes are distimmed by the gostak*, and so on. (This important point was, in effect, made 120 years ago in Ingraham 1903, p. 154, quoted at length by Ogden and Richards 1923, p. 46. Essentially the same insight, together with its relevance to the model-theoretic view of syntax, was independently recognized much later in Chapter 14 of Johnson and Postal 1980.) It is true that the addressee of a sentence like *The gostak distims the doshes* will be puzzled, but only about what gostaks and doshes are, and what distimming involves – not about whether the sentence says something in English.

Finally, what I have called syntactic quandaries – cases of apparent clashes of grammatical requirements where no possibility comes out fully well-formed – are predicted to be possible under the model-theoretic view, whereas generative grammars make them impossible to represent (since any given sentence is either generated, meaning that it is perfectly grammatical, or not generated, in which case it has no linguistic properties at all). And the fact is that quandaries do arise in human languages. A simple example in English is pointed out by Fillmore (1972). He notes that the choice between alternatives like these seems vexingly impossible to make:

> $^{?}$?*Either I or my brother am responsible.*
>
> $^{?}$?*Either I or my brother is responsible.*
>
> $^{?}$?*Either I or my brother are responsible.*

The problem is that *am* doesn't go with *my brother*; *is* doesn't go with *I*; and *are* doesn't go with either. Intuitively, the verb paradigm is demanding a choice between *am*, *is*, and *are* according to person and number, but the disjunctive singular subject NP is non-committal as to the choice between 1st person and 3rd person. Fully satisfying all of the constraints is not possible, and that forces a quandary. A generative grammar for English is in the unfortunate position of having to get off the fence: it must generate either three, two, one, or none of them. But none of those four ways of setting up the grammar would yield a theoretically-based recognition that there is a grammatical quandary here; a generative grammar cannot provide it. A model-theoretic account can, by saying that (i) *am* must have a 1st-person singular subject NP, (ii) *is* must have a 3rd-person singular subject NP, (iii) *are* must have a subject NP that is neither 1st-person singular nor 3rd-person singular, (iv) *I* is 1st-person singular, and (v) *my brother* is 3rd-person singular – leaving the person specification of a disjunctive NP like *either I or my brother* undefined.

6 Conclusion

Any philosopher of linguistics will encounter the notion of a grammatical rule repeatedly, and it would be easy to make the mistake of imagining that it is an unproblematic notion that we understand from everyday life, one that the scientific work done in the field known as generative grammar has tried to explicate. But that is not so.

There is an ordinary, everyday sense of the term ‘rule’ under which rules can be obeyed, disregarded, violated, waived, enforced, etc., and their whole point is to define certain things as correct or permitted and others as incorrect, inappropriate, or forbidden; they have NORMATIVE force. But linguists abandoned the ordinary sense of ‘rule’ after 1957, and started using the term to denote such abstract entities as phrase structure formulæ (A $\rightarrow$ B C) and transformations (X $\Rightarrow$ Y), expressions that do not have normative interpretation at all.

Yet grammars must have normative force, or they are not serving their traditional purpose of specifying what is correctly phrased and what is not in the language. They would be of no use to learners of the language if they did not specify what differentiates correct usage from incorrect or mistaken usage.

But normativity (in my terms) is not at all the same thing as prescriptivism. And the fact that some grammatical statement is interpreted as normative does not in any way imply that if you violate it you have done something you ought not to have done: Alan Millar (2004) carefully explicates that point.

The nature of the formal systems known as generative grammars has been much misunderstood by philosophers of linguistics and even by generative linguists themselves: many claims about them are widely believed but are not true.

And I have very briefly pointed out that there is a coherent alternative to generative grammar, fairly well understood in mathematical terms, under which the statements making up a grammar are straightfoward assertions about correctness requirements for linguistic structure. That alternative is associated with various conceptual advantages that generative grammars do not enjoy, in addition to permitting grammars to be seen as having normative force.

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