Linguistic Differences and Language Design

Mark C. Baker

Department of Linguistics

Rutgers University

18 Seminary Place

New Brunswick, NJ 08901

mabaker@ruccs.rutgers.edu

Summary: The major grammatical differences among languages can be attributed to a small number of discrete choices, known as parameters. For example, Japanese syntax differs from English syntax in the order of words within phrases; Mohawk differs from English in that Mohawk verbs must be semantically complete. Current theories of the evolution of language give little insight into why the human language faculty should have this capacity for extensive but finite and discrete variation built in. I conjecture that the function of language was not just to provide a simple medium of communication, but to serve as a code.

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Languages obviously differ from one another. No one would mistake Mohawk or Japanese for English, for example. But linguists doing large-scale comparisons of languages are going beyond this triviality to discover that the differences among languages have a peculiar quality.

Languages are not *completely* different. Not just any representation system that bears the relevant information can serve as a human language. Rather, all known language obey abstract general principles that are not logically necessary. Once one knows where to look, it is quite easy to find many substantive similarities across languages. These are usually not pointed out in grammars or classes because they are so

natural to us humans that we take them for granted, even though artificial languages do not follow them.

But languages are not just *slightly* different either. One might imagine that learning a new language would only be a matter of learning some new words, but that is not the case. There are also profound-looking differences in sound patterns, in word orders, in how sentences can be combined, and in how meanings are expressed. No aspect of language is immune to variation.

The curious overall result, then, is that languages vary only slightly in terms of the general principles that shape them, but they vary greatly in the actual sentences formed [1,2].

1. Japanese versus English

Comparing the Japanese and English sentences shown in Box 1 illustrates this point [3]. When an English speaker reads the word-by-word translation of the Japanese sentence, it comes across as gibberish. The difference in how words are ordered seems huge. Yet the rule that underlies the differences is remarkably simple: English forms phrases by adding new words at the beginning of previously constructed phrases, whereas Japanese forms phrases by adding new words at the end [4, 5]. Both languages make prepositional phrases (PP) out of noun phrases (NP): English does it by putting *of* before the NP (*of himself*); Japanese does it by putting *no* after the NP ('himself of'). English puts a noun before a PP to make a NP (*pictures of himself*); Japanese puts a noun after a PP to make an NP ('himself-of picture'). English puts a verb before a NP to make a verb phrase (VP) (*showing pictures of himself*); Japanese puts a verb after a NP to make a VP ('himself of

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picture showing'). This difference applies systematically to the full range of phrases found in both languages.

Notice the many similarities between the two languages. They have the same types of words (nouns, verbs, prepositions, auxiliaries), and they group them into the same kinds of phrases. The English sentence structure is the mirror-image of the Japanese structure, not some arbitrarily different arrangement. Nevertheless, the one small difference in phrase construction has a huge impact on the phenomenal character of a language, simply because it applies many times in a sentence of moderate complexity. This kind of choice between two discrete grammatical options is known as a "parameter" [1]. The two options come close to partitioning the set of languages: 45% of the languages in the world are clearly of the Japanese type and 45% are of the English type [6,7].

2. Mohawk versus English

A second paradigmatic illustration of the quality of linguistic differences comes from comparing the Mohawk language with English. Mohawk is a *polysynthetic* language, meaning that its sentence structures seem simple and fluid, but word structures are complex and rigidly structured [8,9]. The examples in Box 2 give a sense of this. The first two sentences in Box 2 have different word orders, but they express exactly the same event. Mohawk is different in this respect from English, where changes of word order express major changes in meaning (compare 'Man bites dog' with 'Dog bites man'). The words of a Mohawk sentence can generally be put in any order, without affecting basic meaning.

Small changes in the verb form have a large impact in Mohawk, however. The third sentence shows that changing the prefixes on the verb while leaving word order constant is enough to reverse the meaning of the sentence. Moreover, the thing being given in these sentences is not expressed as a separate noun phrase at all; it is "incorporated" into the verb, forming a kind of compound. The fourth sentence shows that the incorporated noun can only be understood as the given thing, never as the giver or as the recipient.

The unifying property of Mohawk, then, is the requirement that every participant of an event be expressed somehow in the main verb, either as a pronoun-like prefix, or as an incorporated noun [9]. A sentence without these features is ungrammatical. No such requirement holds in English.

Again we see an interplay between what is universal and what varies. Mohawk is like English in that 'give' names an event involving three participants, a subject (the giver), an object (the given thing), and an indirect object (the receiver). All three must be expressed in both languages. The observation that a noun incorporated into a compound can only express the object is also valid for both languages: English has the compound form *gift-giving,* but *baby-giving* could only have the unlikely meaning that people give away their babies [10,11]. The one difference is an easily-stated parameter that governs how participants are expressed in each language. But this simple parameter has a large overall effect, because it applies to every phrase in every sentence of the language.

3. A Finite System of Discrete Differences

If these examples are typical of how human languages differ from one another, we have a curious situation. Most of the structure of language is universal, and hence potentially innate to the human mind. This invariant machinery includes the part-of-speech distinctions, the notions of phrase and clause, the distinctions of subject, object, and indirect object, and much else. But not all of the structure of language is invariant. Rather the language faculty makes allowance for a few basic choices (parameters) within the universal machinery. These choices are only a subset of the options that could "do the job" in an information-theoretic sense, but they are more than any one person would ever need. Only a small number of parameters is required; current work suggests that the major syntactic distinctions among the world's 6000-odd languages can be explained with 10 to 20 parameters [2]. Most curiously of all, these parameters seem perfectly placed within the overall language system so that they will have the maximum impact on the appearance of a language, without fundamentally changing its basic structure.

This result is of inherent interest to cognitive science. In some domains, such as perceptual and motor systems, one assumes that the cognitive processes at work are essentially invariant across the human species. In other domains, it has been standard to assume that the cognitive system can vary across populations in arbitrary ways.   This has been the normal view about social and cultural cognition, at least until recently. Language demonstrates something in between: striking superficial diversity that can be reduced to a small number of discrete factors within a universal matrix. This is a model of cognitive architecture that should be kept in mind when studying other aspects of human culture.

4. Implications for Origins of Language

This picture of linguistic variation poses an interesting puzzle for theories of language origins. After years of reticence, discussion about the evolution of language has exploded in the last fifteen years. But one striking feature of this literature is how little it has to say about cross-linguistic variation. Most discussions are completely silent on this point; for all one could tell from them, only one language ever existed [12-17]. This simplification might make sense if linguistic variation were a minor phenomenon, or if it had no interesting structure. But the opposite is true.

The most obvious way to give an evolutionary account of the human capacity for different languages looks like a non-starter. The cognitive systems of some animals leave parameters open for learning so that so that those animals can function in different environments. Bees, for example, can live at different latitudes because their solar navigation system leaves open parameters for sun angle [18]. But this is not a good model for understanding linguistic parameters, despite some suggestions along these lines [19,20]. There is nothing that makes using Japanese word order more effective on islands in the Pacific and using English word order better on islands in the Atlantic. There is (unsurprisingly) no ecological regularity in how the major linguistic types are distributed around the world [2,9]. And in the absence of fitness advantages to being able to learn one language rather than another, mathematical studies show that a parameterized language faculty is disfavored, because it makes language learning less reliable [20].

The other obvious line of analysis is to say that our capacity for linguistic variation is not part of the adaptive design of the human language capacity, but a kind of evolutionary accident, as suggested by Pinker and others [21-23]. The idea here is that

evolution has fixed many properties of the human language capacity, but not all of them. Once the innate endowment became rich enough to make learning a complex language reasonably reliable, there was little selectional pressure to keep elaborating it until all grammatical properties were determined. "Parameters" are simply those grammatical points that are still left open by the innate endowment.

While there may be no direct way to refute this view, I do not find it satisfying in light of the quality of the linguistic differences we know about. The known parameters do not seem like minor quirks at the edge of language that were not worth worrying about. Rather, they seem like gadgets put close to the heart of language, exactly where they can have maximum impact on surface forms without changing the overall logic. Because of this, I think we should consider the possibility that parameters are a design feature of the human language faculty after all.

5. Languages as Codes?

Most researchers take it for granted that the purpose of language, evolutionarily speaking, is to provide a way of communicating complex propositional information to kin and collaborators. From this point of view, the possibility of very different human languages is perplexing. But this is a pretheoretical assumption, not an established result.

Suppose that the language faculty has a concealing function as well as a revealing function. Our language faculty could have the purpose of communicating complex propositional information to collaborators *while concealing it from rivals* that might be listening in. Many products of conscious human engineering have been designed to fulfill this exactly purpose—namely, codes and ciphers. Interestingly, ciphers have a

common structure: they consist of a publicly-known encryption algorithm that defines a family of ciphers and a secret "key" that defines a particular cipher [24]. The human language faculty can be seen as having a similar structure: the universal principles correspond to the general encryption algorithm, and the particular parameter settings correspond to the key. We know that natural languages do in practice make excellent codes; this was proven by the Navajo Code Talkers of World War II, whose native language was perhaps the most effective code of all [25,26]. This perspective makes sense of the fact that many parameters seem well-designed to give languages very different "looks", while not affecting the fundamental relationships expressed. That is exactly the nature of a good cipher.

Evolutionary psychologists tell me that this could not be the whole story. They find it unlikely that languages functioned as effective codes in the small bands of hunter-gatherers that human beings evolved in. Maybe they are right. But we should be wary of a methodology that leads us to downplay what is because of current views of what must have been. The use of language in early human societies is not observable, and the reality of linguistic variation of a particular kind is. So we should focus on that. There are, after all, plenty of unsolved questions about human cognition: intentionality, free will, a priori knowledge, abductive reasoning, and so on [27,28]. Many of these mysteries are clearly related to language [2]. So we need to remain open to new insights from outside the familiar range of theories.

I suggest, then, that the ability to account for the special type of discrete, finite linguistic variation that we observe could be one test by which we might recognize new progress in understanding human cognition.

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Box 1: English and Japanese
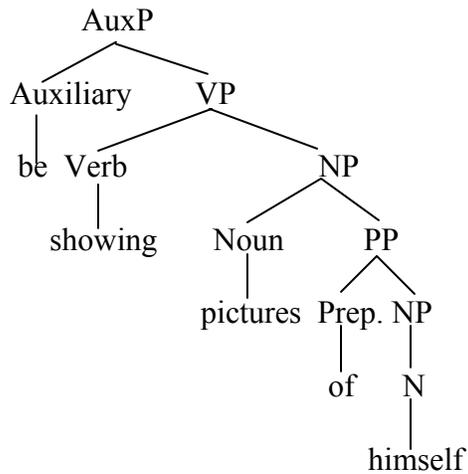

English sentence:

Taro is thinking that Hiro showed pictures of himself to Hanako.
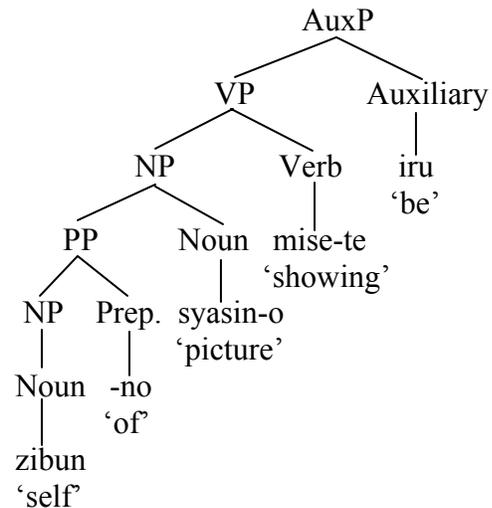

Japanese sentence:

Taroo-ga Hiro-ga Hanako-ni zibun-no syasin-o miseta   to   omotte   iru.

Taro   Hiro   Hanako-to self-of   picture   showed   that   thinking is

English phrases (partial):   Japanese phrases (partial):

English parameter: Japanese parameter:

Build bigger phrases by adding new   Build bigger phrases by adding new

words at the *beginning*.   words at the *end*.

BOX 2: Mohawk and English

(1)   Rukwe' wa-sh-ako-hsir-u   ne owira'a.

        man   past-he-her-blanket-gave the baby

        'The man gave the baby a blanket.'

(2)   Owira'a wa-sh-ako-hsir-u   ne   rukwe'.

        baby   past-he-her-blanket-gave the man

        'The man gave the baby a blanket.'

(3)   Rukwe' wa-h-uwa-hsir-u   ne   owira'a.

        man   past-him-she-blanket-gave the baby

        'The baby gave the man a blanket.'

(4)   Rukwe' wa-ha-wir-u   ne   ashire'.

        Man   past-he+it-baby-gave   the blanket

        'The man gave the baby to the blanket (!)' (only possible meaning)

(5)   NOT: *Rukwe' wa'-u   ne owira'a ne ashire'.

               Man   past-give the baby   the blanket

               'The man gave the baby the blanket.'

Mohawk parameter:

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Express every major participant in an event inside the verb-word that names the event.

English parameter:

Don't express the participants of an event inside the verb-word that names the event.