



What does Pirahã grammar have to teach us about human language and the mind?

Daniel L. Everett*

Pirahã is a language isolate of the Brazilian Amazon. Among the lessons it has to teach us about human language and the mind, two are highlighted here. The first is that recursion is not a necessary condition for human syntax, because there is no evidence for recursive sentential syntax in the language. This is a stark counterexample to the claims of Chomsky and others. The second lesson is that the influence of culture on Pirahã grammar, coupled with much established and newer research, indicates that the idea of an innate, universal grammar has little if any role to play in our understanding of the nature, origins, and use of human language. © 2012 John Wiley & Sons, Ltd.

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NATURE VERSUS NURTURE: A COMPLEX SYMBIOSIS

A basic question that all the cognitive sciences try to answer in one form or another is where the things inside our heads come from, in particular the things that we cannot see directly (Box 1).

For example, where do we get our fear of snakes—from our experiences or from our genes? Where do we get our knowledge of the classification of snakes into different species? Where do we get our taste for snake soup?

The boring and tendentious answer to many questions about human cognition is that this or that bit of knowledge is either derived completely from nature or completely from nurture. Closer examination in most cases tends to implicate both innate features (e.g., the entire human brain) as well as individual and social learning. Yet, although simplistic answers should be avoided, it is nevertheless useful from time to time to ask where along the nature–nurture continuum some form of knowledge falls.

This is not easy to determine however. The symbiosis of nature and nurture complicates matters, i.e., the relationship between environment, phenotype, and genotype. For example, anthropologists Richerson and Boyd⁵ have argued that genes and culture are

BOX 1

PIRAHÃ DEMOGRAPHICS

There are approximately 700 speakers of the Pirahã language, living along the Maici (my-SEE) river of Amazonas, Brazil. They are monolingual, by which I mean that no one in the entire population can carry on a normal conversation in Portuguese or other language. Several men have learned how to communicate on a narrow range of topics, using Pirahã grammar and a small Portuguese lexicon (see Refs 1–4 for studies of Pirahã language contact). This may be changing. In 2006, the Brazilian government established a permanent post in one Pirahã village and a school was started in 2011. The school and government efforts are being led by Jose Augusto Diarroi-Pirahã, a young man born to a Pirahã father and a Diarroi (moribund Tupi-Guarani language) mother. He learned some Pirahã before leaving the village as a young boy when the Pirahãs expelled his mother and her family from the Maici. His first language, however, is Portuguese, learned from his mother and years of schooling in the Brazilian system. Pirahã culture may be on the verge of momentous change.

*Correspondence to: deverett@bentley.edu
Dean of Arts and Sciences, Bentley University, Waltham, MA, USA

heavily interdependent. Other researchers, such as Keller and Just,⁶ have shown that learning changes

the structure of our brains. Still others have shown, in studies involving lactase persistence in various societies,⁷ high-altitude adaptations among Tibetans,⁸ and so on, that genetic mutations can be selected by cultures in relatively short periods of times.

Universal grammar has emerged as the most prominent hypothesis in the past 50 years on the nature of language.^a It is of the more simplistic variety of the nature versus nurture hypotheses, in that it hypothesizes a single ‘core’ grammar of human languages at the far end of the continuum, deriving from nature alone, unlearned—an elaborate instinct. But, if what follows is on the right track, then Pirahã, as one of many examples that are beginning to come to light, teaches us that universal grammar must be seriously reevaluated.

This conclusion emerges from facts of Pirahã grammar coupled with work by Chomsky and colleagues in the past decade on what is specific to language in the human genotype.

THE NARROW FACULTY OF LANGUAGE (FLN)

In a 2002 paper in *Science*, Hauser, Chomsky, and Fitch⁹ (HCF) proposed that there are two sets of innate components to human language, which they labeled the ‘broad faculty of language’ (FLB) and the ‘narrow faculty of language’ (FLN). They describe the FLB as:

Faculty of language—broad sense (FLB).

FLB includes an internal computational system (FLN, below) combined with at least two other organism-internal systems, which we call “sensory-motor” and “conceptual-intentional”. Despite debate on the precise nature of these systems, and about whether they are substantially shared with other vertebrates or uniquely adapted to the exigencies of language, we take as uncontroversial the existence of some biological capacity of humans that allows us (and not, for example, chimpanzees) to readily master any human language without explicit instruction. FLB includes this capacity, but excludes other organism-internal systems that are necessary but not sufficient for language (e.g., memory, respiration, digestion, circulation, etc.). (Ref 9, p. 1570, 1571)

The crucial ‘internal computational system’, the FLN, was described as follows:

Faculty of language—narrow sense (FLN).

FLN is the abstract linguistic computational system alone, independent of the other systems with which it interacts and interfaces. (Ref 9, p. 1571)

They further clarified the FLN:

FLN only includes recursion and is the only uniquely human component of the faculty of language. ... In particular, animal communication systems lack the rich expressive and open-ended power of human language (based on humans’ capacity for recursion). (Ref 9, p. 1569, 1570)

There are many potential senses of the term ‘recursion’, so it is vital to understand what HCF had in mind. The paper as written leaves no doubt that they intend a process that applies to its own output without limit. This is clear when they claim that when a language has recursion then ‘*there is no longest sentence (any candidate sentence can be trumped by, for example, embedding it in ‘Mary thinks that...’), and there is no non-arbitrary upper bound to sentence length*’. (Ref 9, p. 1571 [emphasis mine]) (Box 2).

Thus, HCF makes the non-finiteness of human language—describing it in non-formal terms as the ability to always add one more constituent to a sentence (as opposed to adding another sentence to a discourse)—the defining characteristic of the human language faculty. Therefore, any language for which it can be shown that the sentences are bounded in length is a counterexample to this proposal.^b

PIRAHÃ

Pirahã Grammar

Before beginning this section, I would like to put the rest of the oft-repeated idea that I am the only outside speaker of Pirahã and therefore that researchers have no way to independently test what I am saying. There are four outsiders who speak Pirahã and there is one nearly-bilingual Pirahã. José-Augusto Diarroi-Pirahã was born to a Pirahã father and Diarroi mother. He learned some Pirahã until he left the reservation with his mother when he was about 8 years old. His first language is Portuguese. But, since 2001 he has lived off and on back among the Pirahãs and has achieved near-fluency in Pirahã. Researchers going to the Pirahãs these days, unlike the circumstances of my own fieldwork, could avail themselves of his help.

There are three Americans who speak Pirahã to varying degrees besides me. The first is Keren Madora (formerly Everett) whose fluency in the language is equal to my own, if not superior. Steven Neil Sheldon, former missionary to the Pirahãs (1967–1976), speaks the language very well and has collected a large amount of data and texts that he has made available to researchers. Arlo Heinrichs, the first evangelical missionary among the Pirahãs (1959–1967) still remembers a good deal of the language and has data that he collected during his years among them that he

BOX 2

RECURSION OR MERGE?

The quote from HCF above is straightforward, although some syntacticians claim for it a more esoteric meaning. According to this initiate exegesis, recursion means for the authors only a (singleton) subset of recursive operations internal to the program known as Minimalism, what Chomsky calls 'Merge'.¹⁰ Merge is a function that takes two objects (α and β) and merges them into an unordered set with a label. The label identifies the properties of the phrase. In Minimalism, no phrase structure can be formed without undergoing Merge. As Merge is by definition a recursive operation, no language can exist without recursion. Q.E.D.

For example: Merge (α, β) \rightarrow $\{\alpha, \beta\}$

If α is a verb, e.g., 'eat' and β a noun, e.g., 'eggs', then this will produce a verb phrase (i.e., where α is the head of the phrase), 'eat eggs'. The operation Merge incorporates two highly theory-internal assumptions. Both have been called seriously into question in recent literature. The first assumption Merge is based on is that all grammatical structures are binary branching. Thus, Merge produces only such representations. Second, Merge requires that all syntactic structures be endocentric (i.e., headed by a unit of the same category as the containing structure, e.g., a noun heading a noun phrase and a verb a verb phrase). This means that Merge is potentially falsified by any non-endocentric or ternary (quaternary, etc.)-branching structure, e.g., a structure with flat syntax. Culicover and Jackendoff¹¹ have argued, to my mind convincingly, that ternary structures exist in the syntax of some languages, and I¹² have argued that non-derivable ternary structures exist in the metrical structure of Pirahã phonology. Further, I¹³ have argued that the syntax of the Wari' language of Brazil makes widespread use of non-endocentric constructions. Yet, even though counterexamples exist, the authors insist that Merge is what they meant by recursion.

However, the Merge interpretation has to tear and strain to produce the 'no longest sentence' clause of their earlier quotation, because that is a result of the more general notion of recursion. Even, Chomsky¹⁴ allows that Merge itself may be blocked from repeating endlessly by language-specific stipulations. But, such stipulations play no part in the mathematical notion of recursion.

There are several reasons why theory-internal reasoning is unhelpful. First, it excludes an important empirical space, namely, the class of languages that lack Merge but have other forms of recursion, such as languages with ternary branching but no longest sentence. Second, it ignores the possibility that some language may lack any form of syntactical recursion, such as Pirahã. Third, it overlooks what is to my mind the most important consideration in understanding the role of recursion in natural language—natural conversations, narratives, and other discourses.

Lobina and Garcia-Albea¹⁵ offer a helpful elucidation of various notions of recursion that have been employed in mathematics, computer science, linguistics, and cognitive sciences. As they observe, even Merge needs not be a recursive operation, because iteration does not properly fall within the standard mathematical or computational definitions of recursion. However, I will assume here for the sake of discussion that Merge is recursive.

has made available to some researchers. These people read email, have answered questions about Pirahã for inquiring linguists and anthropologists (including my own queries), and all have data that could be used to independently test my own proposals. In fact, in the work referred to in this paper by Jackendoff and Wittenberg¹⁷ and Piantadosi et al.,¹⁸ data collected by Sheldon formed a major part of the studies.

I¹⁶ have argued that culture can influence grammar. This is still the most important lesson of that paper. I develop this thesis in four recent works^{16,19–21} and I return to that claim directly.

But, I also claimed that the Pirahãs lacked recursion, based on a number of sources of evidence, including the fact that Pirahã does appear to have sentences of bounded length. For example, a sentence like the following cannot be made longer in Pirahã:

Xahoapióxio	xigihí	toioxaagá	hi	kabatíi	xogíi	xi
Another day	man	old	he	tapir	big	it
mahaháhiigi	xiboítópí	pi	-ohoao	hoíhio	piiohoaoxio.	
Slowly	cut	river	-beside	larger quantity by		the river.

'Another day an old man slowly butchered a couple of big tapirs, by the side of the water'.

Anything else added to this, like the word 'brown' in 'two brown tapirs' would render the sentence ungrammatical. Phrases can have a single modifier (phrases that are found in natural stories—I

do have some artificial examples where I was able to get some Pirahã to place more modifiers in the phrase, but they did not like these and never use more than one in a phrase in natural stories). A second one can occasionally be inserted at the end of the sentence as an afterthought—like the ‘a couple of them’ at the end of this phrase. If this is correct, then Pirahã is finite and cannot be recursive. This boundedness is principled, producing a maximum phrase consisting of the verb’s lexical frame plus as much as one modifier word per constituent of the phrase and up to one prepositional adjunct phrase.

Pirahã speakers reject constructed examples with recursion, as I discovered in my translation of the gospel of Mark into the language (during my days as a missionary²⁰). The Bible is full of recursive examples, such as the following, from Mark 1:3:

‘(John the Baptist) was a voice of one calling in the desert. . .’

I initially translated this as:

‘John, the man that put people in the water in order to clean them for God, that lived in a place like a beach with no trees and that yelled for people to obey God’.

The Pirahãs rejected every attempt until I translated this as:

‘John cleaned people in the river. He lived in another jungle. The jungle was like a beach. It had no trees. He yelled to people. You want God!’

The non-recursive structure was accepted readily and elicited all sorts of questions. I subsequently realized looking through Pirahã texts that there were no clear examples involving either recursion or even embedding. Attempts to construct recursive sentences or phrases, such as ‘several big round barrels’, were ultimately rejected by the Pirahãs (although initially they accepted them to be polite to me, a standard fieldwork problem that Jeanette Sakel and I discuss²¹).

Since the recursion proposal came from Chomsky it was taken very seriously and my claim that it was false was given considerably attention in both the popular and scientific media. Since my original paper¹⁹ there has been a considerable amount of debate, some quite heated, about whether or not Pirahã is such a counterexample, that is, a language without recursion.^{22,23} New studies based on data from the field research of myself and Steve Sheldon are currently in progress.^{17,18} In the current stages (these works are not yet final), they show that many standard arguments for recursion fail to find support in Pirahã (that is no conclusive examples of relative clauses, conjunction, disjunction, embedded clauses, recursive possessors, etc.).

Assuming that my analysis of Pirahã is correct here, then the first lesson to draw from Pirahã for human language and the mind would be that, contra HCF, *recursion is unnecessary for human sentential syntax*. There are languages with upper bounds to sentence size. Like any grammatical property (prenominal possession, center-embedding, etc.) we know that recursion is not a necessary condition for human language just in case we find a single language that lacks it. Moreover, according to the analysis of Jackendoff and Wittenberg,¹⁷ at least one other language in addition to Pirahã, the Indonesian language Riau, documented by Gil²⁴ appears to lack recursion, meaning that at least two languages from opposite sides of the earth lack the purported *sine qua non* of human language.

Hurford,²⁵ attributing the idea to Nevins et al.,²² argues that my claim that Pirahã lacks recursion is ‘defused’ by the ability of the Pirahãs to use words productively: ‘It [this idea] simultaneously defuses the claim that Pirahã lacks recursion, because Pirahã obviously combines words productively more than once, while not undermining Hauser et al.’s claim that recursion is unique to human communication’.

However, both Hurford and the source he cites here reveal a lack of understanding of recursion and word usage, confusing iteration with recursion and types with tokens. First, it is only a metaphor to say that words are used multiple times. There is presumably a type stored in the mental lexicon. Tokens of this type find their way into the syntax. How do they do this? Assume that the process is Merge. Take a word and combine it with another word. Then combine the result of that operation with another word. This is neither using the same word over and over (it is using separate tokens) nor recursive—it is iterative. But, even if we grant that lexical insertion of this type is recursive, it is only one theory’s way to get word tokens into sentences. Other theories do not use recursive processes. The Merge proposal is in fact the minority opinion. In *Role and Reference Grammar*,²⁶ to take one example, word tokens are inserted simultaneously or one at a time (it does not matter) into a prespecified template. Recursion is not required (though of course *Role and Reference Grammar* allows for recursive syntax).

Moreover, if several recent research claims are correct,^{27–30} (but cf. Ref 31 for a critique of some of this research), animals can also recognize and use recursive structures. If these studies are correct, then recursion is also not a sufficient condition for human language. Taken together with the Pirahã study, these results lead us to conclude that there is no FLN in the sense of HCF.

In fact, even if we focus exclusively on the idea that recursion is not a necessary condition for a human language, then based on the above discussion, the FLN proposal is either—depending on one’s perspective—vitiated or empirically vacuous. It makes no predictions (whether one is talking about recursion in a general sense or in the more specialized proposal, Merge).

But, if there is no FLN, then according to HCF there is nothing specific to human language in the brain. This finding alone would leave very little work for a universal grammar in Chomsky’s sense to do, at least taking literally the claim that the only thing specific to human language, the FLN, is recursion. There are several works available that provide further discussion of these issues.^{32–35}

Moreover, if we are additionally able to show other external factors that shape the forms of human grammars, then we will have shown that universal grammar’s purported role in shaping grammars is less than essential. The upshot is that it should be set aside for a more interesting and viable set of alternative hypotheses.

I-Language Versus E-Language

When linguists talk about ‘language’ or ‘grammar’, however, it is not always clear what they have in mind. They could mean the set of sentences that are found in a corpus. Or they might be referring to a disembodied mathematical or quasi-mathematical system. Or they might even mean the mental capacity to generate the sentences of a corpus. For many years, Chomsky has been careful to distinguish the corpus understanding of grammar from the mental capacity perspective. He refers to the former as E(xtensional)-language and the latter as I(ntensional)-language.¹⁰ The E-language is generated by the system of the I-language, so, from this assumption, the proper element of study is the mental linguistic capacity of speakers, rather than any particular set of sentences that they might utter. The E-language is but one source of evidence for understanding the true objective of linguistics, i.e., I-language.

The same type of objection to my claim that Pirahã is non-recursive can arise from those who distinguish between ‘competence’ and ‘performance’—or what people know versus what they do. Here too it is not enough to argue that Pirahã is a non-recursive language merely because the corpus is bounded. It is also necessary to show that the mental grammar of the Pirahãs itself does not generate recursive sentences, phrases, words, etc. This is not a trivial task. We can only infer that the I-language is non-recursive via indirect evidence.

Therefore, a generativist might reply to the absence of recursion in Pirahã by saying that if I am correct, this is little more than a fact about the E-language. These data do not tell us that the Pirahã lacks a recursive I-language, not under any definition of recursion.

A recursive I-language could indeed generate a non-recursive E-language. This would require placing an upper bound on the Merge operation, via an ancillary *ad hoc* condition. Under this hypothetical I-language perspective Pirahã does have recursion, we simply cannot see it in the E-language because of the I-language constraint on Merge (as in Chomsky’s recent work¹⁴). In fact, in other publications,³⁶ I have argued that Pirahã discourse shows clear evidence of recursive reasoning. If this is correct, then can’t we simply concede the I-language point, namely, that Pirahãs clearly do recursion, but that a stipulation of some sort on Merge prevents us from seeing the results in their actual utterances?

This would not be a sound move. There is a huge conceptual jump from the fact that the Pirahãs reason recursively to the proposal that they possess a recursive I-language or mental grammar. The evidence for their grammar must be independently established, apart from non-grammatical mental operations, if claims about I-language are to hold any empirical content. In the absence of evidence for a recursive I-language in the E-language (or other experimental sources), the I/E-language distinction is of little interest or use.

The evidence against a recursive I-language in Pirahã comes from various sources. First, we find evidence in the absence of recursive structures and lexical items associated with recursion. Second, as already mentioned, Pirahã sentences are not merely bounded, but they are *principally* bounded. Third, recursion is unnecessary at any level of the sentence grammar, including the building of sentences from lexical items. Fourth, there is currently no evidence for recursion in Pirahã morphology or phonology.

EVIDENCE AGAINST A RECURSIVE I-LANGUAGE FOR PIRAHA

Gaps in the E-Language

I have argued above that Pirahã lacks recursion. I discuss here a few of the predictions that such an analysis makes that can be independently tested in the grammar of Pirahã.

First, the lack of recursion correctly predicts that factive and epistemic verbs will be absent (though there is a—crosslinguistically common—use of the verb ‘to see’ for ‘to know’). This prediction is made

because if Pirahã lacks recursion, then there is no way to express factive verbs as independent verbs, because these would require a complement clause, requiring embedding and thus, *ceteris paribus*, a recursive rule in Pirahã syntax. Pirahã expresses such notions via verbal suffixes, consistent with the ‘no recursion’ hypothesis, not with complement clauses.

Second, Pirahã has no marker of subordination. This is also predicted by my hypothesis, because if Pirahã lacks recursion, there is no subordination to mark.

Third, Pirahã has no coordinating disjunctive particles (e.g., or). The absence of explicit markers of disjunction is predicted by my hypothesis, as disjunction entails recursion.

Fourth, Pirahã has no coordinating conjunctive particle (e.g., and). There is only a more general particle, *píaii*, which may appear preverbal or sentence final and which means ‘is thus/simultaneous’ (vague meaning), which never works like proper conjunction, but only supplies the information that these two things were simultaneous (it is related to *pixai*, now). Again, this is predicted by my analysis, as coordination also entails recursion.

Fifth, Pirahã has no syntactic complement clauses. If Pirahã has recursion, where is the unambiguous data? I have claimed that it lacks embedded clauses. Others claim that it has them,²² but they only show that quotatives *could* be embedding. No work has ever suggested that there are multiple levels of embedding, which certainly would be expected if Pirahã has recursion (modulo Chomsky’s¹⁴ recent ancillary constraint on Merge, discussed earlier).

Sixth, Pirahã does not allow recursive possession. The point of Pirahã possessives that I have made is not simply that it lacks prenominal possessor recursion, but that it lacks recursion of possessors *anywhere* in the noun phrase. Nevins et al.²² might be correct to suggest that German, like Pirahã, lacks prenominal possessor recursion. But, German does have postnominal possessor recursion. Pirahã has *no* possessor recursion. This is predicted by my analysis, but not by theirs.

Seventh, Pirahã prohibits multiple modification in the same phrase. As I have discussed above and in Refs 20 and 23, there can at most be one modifier per word. You cannot say in Pirahã ‘many big dirty Brazil-nuts’. You would need to say ‘There are big Brazil-nuts. There are many. They are dirty’. This paratactic strategy is predicted by my analysis as multiple adjectives, as in English, entails recursion, but the paratactic strategy does not.

Eighth, Pirahã semantics shows no scope from one clause into another, e.g., no ‘Neg-raising’. Piraha

lacks examples such as ‘John does not believe you left’ (where ‘not’ can negate ‘believe’ or ‘left’, as in ‘It is not the case that John believes that you left’ vs ‘It is the case that John believes that you did not leave’). In this example, ‘not’ can take scope over ‘believe’ or ‘left’. That is not possible without recursion, so my analysis predicts the absence of such scope relations. This is also predicted, correctly, to be impossible in Pirahã under my account, as it would entail recursion.

Ninth, Pirahã shows no long-distance dependencies except between independent sentences, i.e., discourse. The kinds of examples that are standardly adduced for long-distance dependencies include:

‘Who do you think John believes ___ (that Bill saw___)?’

‘Ann, I think he told me he tried to like ___’

Sentences Are Principally Bounded

The upper limit of a Piraha sentence is a lexical frame with modifiers—the verb, its arguments, and one modifier for each of these. And up to two (one at each edge of the sentence) additional sentence-level or verb-level prepositional adjuncts, as seen earlier. This is not merely a sampling error. It is predicted by lexical semantic frames and the absence of recursion.

An Argument from Parsimony

As shown above, there is no visible evidence for recursion in Piraha, regardless of whose definition is adopted. There is nothing in the data that would support a recursive I-language or iterative sentence-formation process such as Merge. Especially in light of Chomsky’s recent move to allow Merge to be limited by stipulation, thus removing all the force of the arguments of HCF,⁹ parsimony would lead us to adopt a ‘Simpler Syntax’¹¹ approach to Piraha, Riau, and other languages and not force them into the procrustean bed of recursion.

In light of all of these facts, if one were to insist that language is innate and that children acquire their languages by means of a *language acquisition device* (LAD) or universal grammar, one could say that recursion is either a parameter or simply one of the tools in the innate linguistic toolbox. But, an alternative solution, advocated in my recent work,¹⁶ is that there is no LAD and no universal grammar. Recursion is just a general human cognitive ability—not specific to language—that languages may or may not enlist in the construction of their individual grammars.

CULTURE, LANGUAGE, AND OTHER EXTERNAL FACTORS

I believe that the most important lesson of Pirahã for theories of the mind and language is that culture may exert an architectonic effect on grammar.

The cultural constraint on Pirahã grammar, which I have termed the ‘immediacy of experience principle’ (IEP), is based on the deceptively simple fact that the Pirahãs require evidence (as Missourians supposedly do). The IEP requires, among other things, that all Pirahã sentences be ‘warranted’ by evidence and that this warrant be represented on the verb. There are three relevant suffixes that mark this, known more technically as ‘evidentials’. These mark ‘hearsay’ (someone told you about you are saying, you did not see it yourself); ‘deduction’ (you see the evidence, but did not see the act, as in ‘John left + deductive suffix’, meaning something like, ‘John must have left, because his canoe is gone’, or ‘... because I can see his footprints leading off into the jungle’); and ‘direct observation’ (as in ‘John left. I saw him leave’—where, unlike the English language, in Pirahã the ‘I saw him leave,’ part of the sentence would be suffixes).

Nothing can be uttered unless it is in principle warranted by one of these suffixes. The interesting consequence for Pirahã grammar (and theories of human language) is that this culturally based requirement for evidence makes recursion in the grammar impossible. Recursion is ruled out because any grammatical category (noun, verb, sentence, and so on) specified in a verb’s meaning (its lexical frame) must be ‘authorized’ by the evidential suffix and only categories so authorized may appear. But, a phrase buried within another phrase carries units that are *not* part of the meaning of the verb in which they are embedded and so they are not authorized by that verb’s evidential marker.

For example, the verb ‘give’ requires three nouns (or ‘arguments’): the giver, the thing given, and the goal of the giving. John (the giver) gave the book (the thing given) to Bill (the goal). It is not strictly grammatical in English to say only ‘John gave’ or ‘John gave the book’. Outside of literature, you have to give all three arguments each time. So, there are three arguments required of the English ‘give’.

Pirahã’s cultural requirement on evidence allows only three arguments. To say in Pirahã something like: ‘John’s sister’s best friend gave Bill’s father-in-law’s buddy a book’ would leave ‘sister’s’ and ‘father-in-law’s’ unwarranted—these are not found in the verb’s required three arguments (giver, given, and goal). In *Language: The Cultural Tool*, I explain in more detail how this cultural requirement for evidence rules out recursion in Pirahã. Although other languages also

have evidentials, it is the high priority the Pirahãs attribute to the IEP, which underlies Pirahãs unusually strong evidentiality–recursion connection.

So, not only does Pirahã represent a severe counterexample to the idea that recursion is the principle genetic facilitator of human languages, it also shows that grammar in its most fundamental forms cannot be merely the unfolding of a built-in genetic program, but can be shaped profoundly by the values of the culture of which it is part. This, along with the lack of an FLN and external factors (discussed briefly below) affecting linguistic forms render the idea of a universal, innate grammar largely, if not totally, superfluous.^c

The concept of language as a cultural tool makes it easier to understand why, after nearly 100 years of modern linguistics studies and field research we are still lacking a non-controversial proposal on the nature of universal grammar. What we see instead is that each culture adapts language and grammar to its own ends. This concept helps us to get beyond some of the politically correct notions of language, such that all languages are ‘equally complex’. No one knows what that would mean because there are so many ways to measure linguistic complexity, even though this is asserted regularly under the assumption that language is found in the genotype.^d

The evidence rendering universal grammar ever less interesting is not limited to Pirahã, however. On the one hand, there is evidence from several languages that culture can affect grammar. On the other hand, there is a body of literature on functional, non-language-specific constraints on grammar (e.g., Ref 38).

There are other lines of research showing connections between language and culture that further undermine the utility of the UG hypothesis. One of the most interesting is what Enfield³⁹ refers to as ‘Ethnosyntax’ (and what I have long referred to by the similar title of Ethnogrammar), which is, like my study of Pirahã, the effort to understand how cultures can affect grammars. Ethnosyntax/Ethnogrammar looks at, among other things, grammatical constructions and considers how they have been formed by cultural values. For example, Enfield⁴⁰ offers an important study of Lao, in which he argues that morphological (verb serialization) and periphrastic constructions exist to encode events. The morphological structure will be selected just in case the event it is communicating is seen as a ‘natural event’ according to Lao culture (which he independently defines in the paper). Thus, to know whether to use one construction or another in Lao, one must know the culture. This is completely compatible with the theory of language as a cultural tool I¹⁶ have developed.^e

Many researchers over the years have also shown that there are numerous functional factors that affect grammatical form. One of those factors is *iconicity*, the idea that the structure of language reflects in some way the structure of experience.³⁸ For example, longer grammatical forms reflect more content-filled ideas. More complex forms (such as causatives) are used to express more complex ideas (such as causation).

In recent years, some very interesting work in this vein on external factors affecting the grammars of human languages has emerged from work at MIT's Department of Brain and Cognitive Sciences, from Tedlab, the language laboratory of Edward Gibson and his students and colleagues. They have shown that ambiguity, word order, and complexity of forms can all be explained by non-grammatical factors.^{42–44}

The principal lesson from Pirahã for theories of the mind and language is this: human languages and their grammars fall much farther to the nurture side of the continuum than the nature side, contrary to decades of assertions to the contrary in nativist linguists. Languages are learned, not grown. Each of the world's 7000 or so languages are the products of external and functional constraints on linguistics form, general properties of human cognition, the human need to communicate (what Aristotle called the 'social instinct') and the not so invisible hand of culture.

NOTES

^aThis paper does not address all versions of the Universal Grammar hypothesis. Although I believe that the conclusions below ultimately apply to all versions, I am not arguing for that in this paper. Here, I address only the implications of Pirahã for Chomsky's proposals.

^bThere are proposals that would render various components of languages—including recursion—both optional and innate (hence universal). One is the idea

of parameters. Another is the idea of a linguistic 'toolbox', containing components to build a language.¹¹ I agree strongly that language and its individual components are tools. But, I am unconvinced that the tools are either innate or dedicated to language. In recent work,¹⁶ I make the case that general cognitive and physiological platforms, many unique to humans but none unique to language, are enough to enable humans to develop language, as a response to the problem of building communities, themselves an outgrowth of what Aristotle called our 'social instinct'.

^cI assume that every language shows similar effects of culture on grammar. Pirahã just has some that are particularly easy to see. Another obvious example of the influence of culture on grammar is literacy. As societies adopt a written language, for cultural reasons, their grammars often change. Perhaps, more accurately, they begin to adopt a second grammar—the grammar of written versus spoken speech. Many studies show that written language and spoken language differ in numerous, often profound, ways, such as in the length of sentences and complexity of paragraphs. The new features of the written language are alterations in our relationship of the way we express our syntax, owing, ultimately, to the cultural decision to write the language.

^dAtkinson³⁷ argues for a common origin of all spoken languages, dating from 80,000 to 160,000 years ago in Africa. This is perfectly compatible with the tool hypothesis, as I point out in *Language: The Cultural Tool*.¹⁶ The fact that the tool has been modified by local cultures in the course of time, sometimes quite radically, is not incompatible with the idea that it was a tool for the original community in which it was developed.

^eKeller⁴¹ and her laboratory in Osnabrück have shown convincingly that children begin to acquire culture at least as early as they begin to learn their syntax.

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