49.1 Introduction

Syntax is, on the face of things, the most clearly distinguishing mark of human language. The nature of syntax should first be briefly discussed. To the lay person, syntax is essentially a matter of word order, i.e. of linearization. But linear relationships tell us very little about relationships between words. Take for example these two sentences:

(1) a. Bill says he agrees.
   b. Somebody who talked to Bill says he agrees.

In (1a), *Bill* and *says* are adjacent and *Bill* is the subject of *says*. In (1b), *Bill* and *says* are also adjacent but *Bill* is no longer the subject of *says*; in fact, there is no direct relationship between them. Real relationships can only be understood if the sentence is presented as a hierarchical tree structure, since most significant relations are vertical rather than horizontal. Linearization is epiphenomenal, arising from the fact that we have only one communicative channel.

The basic processes of syntax may be regarded as falling under four main heads:
(2) A process for assembling words into hierarchical structures.

(3) Processes for determining the boundaries of segments within such structures; that is, determining where units such as clauses and noun phrases begin and end—for example, determining that a clause boundary falls between Bill and says in (1b) but not, of course, in (1a). One process involves insertion of specialized word-classes like complementizers and conjunctions; another involves case-marking—if you hit a second nominative, you know you must be in another clause.

(4) Processes for moving segments within such structures (for example, question-words such as What in sentences like What does he want?, where what is absent from its ‘expected’ position as object of want (cf. He wants what?).

(5) Processes for determining the reference of elements that are not phonetically expressed (for instance in the sentence She needs someone __ to talk to__, the two gaps indicate, respectively, the unexpressed subject and object of talk to).

All human languages exhibit all four classes of process. However, while in all languages (2) is fully developed and strikingly uniform, the level of development of the other three varies considerably across languages, both in the types of process employed and their degree of richness/complexity. For instance, in some languages (e.g. creoles and some Southeast Asian languages such as Vietnamese) mechanisms for (3) are relatively few and poor, since case systems and specialized boundary-marker words have not (yet) developed, while with respect to (4), movement processes like the question-word movement in What does he want? that are hyper-developed in some (e.g. Slavic) languages may be rare or completely absent in others (e.g. Chinese; Cheng 1997).

While syntax characterizes all languages, whether signed or spoken, in a highly developed form, it is entirely absent both from the productions of ‘language-trained’ animals and the natural communication systems of other species. In part due to this lack of any apparent antecedent, its origins remain highly controversial, and scenarios of its possible development fall into several mutually-incompatible types.

49.2 SCENARIOS FOR THE ORIGINS OF SYNTAX

49.2.1 Cultural invention accounts

A number of authors (e.g. Donald 1991; Deacon 1997; Tomasello 2003 amongst others) have expressed doubts as to whether any system of rules and/or principles could have been absorbed into the human genome. The most recent expression of this viewpoint is that of Kirby et al. (2009) (see also Christiansen and Chater 2008;
Chater and Christiansen, this volume), who note what they regard as three serious problems for any biologically-based theory of syntax: (i) the dispersion of human populations, leading to divergent systems; (ii) the abstract nature of the proposed biological universals, whereas ‘natural selection produces adaptations designed to fit the specific environment’ (original emphasis), hence more superficial properties of language at the time of selection; (iii) the rapidity of linguistic change, providing a constantly ‘moving target’ for selection. However, all three of these objections depend on two assumptions that are themselves questionable: that syntax was still evolving at the time of the human diaspora, and that the unique road along which it evolved was by bootstrapping from contemporaneous production phenomena to the genome via some kind of Baldwin effect (a process by which changes in a species’ behaviour can select for hitherto neutral or unutilized genes).

In fact it is likely, indeed probable, that universals evolved prior to the diaspora of ca. 90,000 years ago; if they had not, then segments of the world’s population would have different ‘universal’ grammars, and a language from one segment might be unlearnable (or would at least present serious obstacles to successful learning) by speakers from another segment.

Moreover, Kirby et al., like most authors regardless of their persuasion, suffer from both a serious omission and a dubious assumption. The omission is any consideration of empty categories: these are referents that are ‘understood’—phonetically unexpressed, like the subject of open fire in I gave John an order to open fire on the mob—but which can be identified by any native speaker. The rules that determine the reference of empty categories are both highly abstract and highly unlikely to be either inventable or learnable by induction. The assumption, admittedly tacit, is that the brain, prior to language, was a tabula rasa that not only had no means for processing words but did not even have any mechanisms that could be adapted for processing words. An alternative approach to this issue is developed below.

49.2.2 Catastrophic accounts

Others in the field of language evolution (e.g. Bickerton 1990—but see subsequent work—Jenkins 2000; Hauser et al. 2002; Chomsky 2010) hold both that syntax is biologically instantiated and that its emergence was quite abrupt, via either mutation or the exaptation of some pre-existing faculty. According to Hauser et al., the unique human contribution was the capacity for recursion, normally described in linguistics as the insertion of a unit of one structural type—NP, S, etc.—into another unit of the same type, as in \( [S \text{ The boy } [S \text{ you saw yesterday}] \text{ is here}] \) or \( [\text{NP } [\text{NP Bill’s nephew}] \text{ is here}] \). All other components of language could be found in other species, and perhaps even recursion had been developed by other species for non-linguistic purposes.
Biologists remain sceptical of any ‘hopeful monster’ mutation, and talk of a task-specific, purpose-built ‘language organ’ has faded as imaging techniques have shown the extent to which linguistic operations are distributed across the brain. The Hauser et al. thesis has emerged as the leading contender among those who wish somehow to reconcile language’s uniqueness with Darwinian continuity. However, that thesis is seriously flawed. For one thing, the status of recursion itself is dubious (Bickerton 2009a: ch. 12). Recursion, if defined as the insertion of one structural type into another of the same type, is no more than an artefact of nowadays-abandoned generative formalisms which are superseded by the Minimalist Program’s Merge—a process that consecutively attaches constituents to one another in order to build complex structures, rather than inserting one structure within another. If as a fallback a broader definition is adopted—a process that takes the output of one step as the input to the next, as suggested by Rizzi (2009)—then many activities of other species, from nest-building by birds to the making of hand axes by *Homo erectus*, involve recursion, and the ‘unique to humans’ claim evaporates.

But a much broader problem arises when we take a cross-species perspective. Not just syntax, but language itself, is unique to humans. To hold that virtually all prerequisites for language are found among other species, particularly among closely-related primates (a view shared by many outside the Hauser–Chomsky school) makes it hard to explain why other species, sharing those prerequisites and under similar environmental pressures, did not also develop language. This problem, severe enough in itself, is compounded by the fact that whereas in humans, language is developed to a high degree of complexity, the communication systems of other species show not the slightest sign of developing in the direction of language.

**49.2.3 Adaptive accounts**

More in line with mainstream evolutionary biology would be a scenario in which language evolved gradually, through natural selection, as other complex adaptations, such as the eye, evolved. The arguments are similar, whether specific rules and/or principles were being selected for (Pinker and Bloom 1990) or whether progress involved a series of discrete stages (nine, in the model proposed in Jackendoff 1999, 2002). But whether the steps were many or relatively few, the same two problems arise with any account that relies on natural selection.

The first problem concerns selective advantage. A behavioural trait will not go to fixation unless it confers an enhanced level of fitness on its possessors. But how exactly would a rule like Passive or a principle like Subjacency enhance anyone’s fitness (Lightfoot 1991, this volume)? The second is basically one of the problems raised by Kirby et al. (2009), but it can be expressed in more specifically evolutionary terms. Natural selection cannot, by itself, create novelties; it can only select from variation in existing traits (or in this case, behaviours).
However, syntactic universals are not only (by definition) novelties, but also tend to be highly abstract generalizations across multiple examples (many of which differ superficially from one another). Consequently, how could they be visible to selection? These problems have not yet been fully confronted by advocates of an adaptive history for syntax; it is not easy to see, even in principle, how they could be resolved.

49.3 The sequence of syntactic evolution

Do the distinct processes of syntax shown in (2)–(5) above provide any clues as to the order in which different aspects of language evolved? It was noted that while process (2) (hierarchical structures) was uniform across languages, there was variation in the extent to which, and the ways in which, the remaining processes are instantiated in languages. Such phenomena accord with the logical relationships between the processes concerned. It is possible to conceive of languages (even though no pure forms exist today) that exhibit (2) but not (3) through (5), while a converse relationship is logically impossible. From this we can draw the following tentative conclusions:

- (2) preceded (3) through (5) phylogenetically.
- (2) may have a stronger genetic basis than (3) through (5).

The latter conclusion may require some degree of qualification; see below. It would be premature to draw further conclusions before considering, first, the basis from which syntax developed, and second, the role that pre-existing types of process within the brain may have played in going beyond that basis.

49.3.1 The origins of hierarchical structure

I am assuming here that in protolanguage, symbolic units (proto-words or proto-signs) were dispatched singly to the organs of speech (Calvin and Bickerton 2000: ch. 8), as appears to be the case in early-stage pidgins (Bickerton and Odo 1976). There is also good reason to believe that in natural language, words are assembled in the brain into roughly clause-sized units prior to being dispatched. The best evidence for this may be found in sentence-pairs like the following (an asterisk indicates an ungrammatical sentence):

\[(6) \quad \begin{align*}
\text{a.} & \quad \text{Who do you wanna meet } \_ \_ \text{ today?} \\
\text{b.} & \quad \text{*Who do you wanna } \_ \_ \text{ meet John?}
\end{align*}\]
The contexts in which \textit{want to} can, in casual speech, be reduced to \textit{wanna} include all cases where no lexical material intrudes between \textit{want} and \textit{to}:

\begin{enumerate}
\item I wanna meet John.
\item I want you to meet John too.
\item *I wanna you meet John.
\end{enumerate}

In other words, the presence of \textit{you} blocks the reduction. On the face of things, this makes the ungrammaticality of (6b) seem mysterious. The only possible explanation is that when \textit{who} in (6b) is moved from its ‘natural’ position, it leaves behind, not a vacuum, but a real, albeit unpronounced, replica of itself—a replica that can be made to surface in ‘surprise-questions’ like (8):

\begin{enumerate}
\item You want \textit{who} to meet John?
\end{enumerate}

It is hard to see how the speech organs could be inhibited from producing the contracted form in (6b) if they did not receive a specific prohibition from higher processing areas, or how such a prohibition could be issued if the brain did not preform the sentences concerned. Unfortunately, it appears that neuroimaging techniques are not yet adequate to determine the processes that preformation utilizes.

However, we know that preformation must build hierarchical structures. These can be produced by any process that progressively merges outputs—that links units A and B to produce a single unit C, then C and D to produce a similar unit E, and so on. In other words, the Merge process central to the Minimalist Program (Chomsky 1995), which progressively merges words to form first phrases, then clauses and sentences, is the expression of (2) above, hence the most basic and universal of syntactic processes. Moreover, this process must have existed before language, not as a specialized operation for a particular non-linguistic function, but as part and parcel of the brain’s normal machinery for merging its own outputs.

In that case, why is it necessary to hypothesize an initial, unstructured protolanguage? Because a potential capacity to build hierarchical structure was a necessary but not a sufficient prerequisite for syntax. Words were total novelties, and however the brain represented them, there is no reason to suppose that the neurons involved were linked with one another any more closely than any randomly-chosen set of neurons. Until direct links between them were established, no signal representing their merger could be generated. Such links could be formed in only one way, by the Hebbian method of repeated simultaneous firing (Hebb 1949), and such firing could only be generated by repeated protolinguistic uses of words in unstructured strings. Note that this sequence is the exact opposite of that envisaged in Chomsky 2010, where Merge appears in the brain prior to any form of language and only subsequently achieves ‘externalization’, i.e. use in the act of speaking. Missing from Chomsky’s picture is any account of what, in the absence of externalization, would have selected for Merge in the context of language.
49.3.2 Merge and its application

Constraints on Merge would at this stage have been exclusively semantic. Merge would, however, have been subject to a problem pointed out by Calvin (Calvin and Bickerton 2000): that, in order to transmit reliable signals, larger groups of neurons relaying the same signal would have been required. The reason for this is as follows. We are assuming that protolanguage utterances were assembled, not by Merge, but by a process that adds individual units in a string, rather than arranging them hierarchically—\( A + B + C \), rather than \( A + B \rightarrow C \), \( C + D \rightarrow E \), etc., so that there would be no way in which we could say that \( B \) was more strongly linked to \( A \) than to \( C \) (whereas with Merge, \( B \) is clearly linked much more strongly to \( A \) than it is to \( C \)). The simplest explanation for this absence of closer links would be that, unlike true language, protolanguage does not assemble utterances in the brain and send them pre-formed to the organs of speech, but transmits each word separately to those organs. Pidgin speech is on average three or more times slower than non-pidgin speech (Bickerton 2008), the likely reason being the difficulty (for pidgin speakers) of rapid lexical retrieval. Thus any message takes longer to deliver, and the longer a message takes to deliver, the greater the possibility that interference from other brain processes or simple leakage of electrical current will distort that message if the speaker is attempting to preform it in the brain. If, however, words are dispatched singly to the organs of speech, the risk of distortion can be significantly reduced.

The problem faced by pidgin speakers must be similar to the problem faced by the earliest speakers of protolanguage. Pidgin speakers are slow because they do not have full and automatic access to a new vocabulary; early protolanguage speakers would have been slow because they did not have full or automatic access to any vocabulary. Even at subsequent stages of protolanguage development, it seems likely that the time taken to preassemble utterances in roughly clause-sized chunks (perhaps corresponding to the ‘phases’ of Chomsky 2001, which are assumed to be fully preassembled before transmission to PF (phonetic form), i.e. to the organs of speech) would have substantially raised the level of sentence distortion. In other words, even when the possibility of Merge had developed, the protolanguage strategy of individual dispatch of single words would have remained a more trustworthy means of transmitting information than the syntactic strategy of Merge. In consequence, the onset of syntax might have been further delayed until the brain could undergo the changes—changes both in wiring patterns and numbers of neurons available for linguistic tasks—that were necessary before rapid and automatic speech could become possible.

We still do not know enough about the nature of meaning-bearing signals in the brain to fully confirm the foregoing account. However, the hypothesized difference between language and protolanguage—that the former employs an \([AB] \ C\)-type processing strategy and the latter an \( A + B + C \)-type—is potentially testable by means of neuro-imaging techniques.
The question naturally arises as to what constraints might have limited the Merge process, other than semantic coherence constraints. The answer would appear to be, none. It will be assumed here, in conformity with most current thinking on the topic (Rizzi 2009), that Merge is a strictly binary process, attaching A to B to form [AB], C to [AB] to form [[[AB]C]], and so on. In modern language,Merge is constrained by a variety of factors, including agreement, anaphoric reference, and others that are unlikely to have been present in the earliest stages of syntax. However, rather than assuming that ascending orders of Merge for three, four, five, etc. constituents had to be specifically licensed in some kind of progressive expansion, it seems reasonable to suppose that Merge was in principle unlimited from the start, and that performance factors alone limited the number of modifiers that could be attached to nouns and verbs respectively.

The developments listed above would suffice to produce a language adequate for the speaker but less than optimal for the hearer. As sentence length and complexity increased, there would be increasing difficulty for the hearer in determining where units of structure began and ended, and what precise relationships existed between them. In modern language, grammatical items, bound and unbound (i.e. those that must attach as affixes to other words, as well as those that are words in their own right) exist in order to make boundaries and relationships explicit, and many of these have been produced, even in historical time, in what represents the only way in which the first grammatical items could have been produced—by processes of grammaticalization, the semantic bleaching of pre-existing referential items (see Heine and Kuteva 2002, this volume; Bybee, this volume; Carstairs-McCarthy, Chapter 47). These processes still operate, and can be seen at work in contemporary languages: for instance, a verb of saying can be downgraded to a complementizer, first introducing reported speech and later spreading to factive clauses of all types; a verb of motion can be downgraded into a directional preposition. Such developments naturally raise the question, to what extent can observable phenomena in the modern world serve as ‘windows’ on the early stages of syntax?

**49.4 WINDOWS ON EARLY SYNTAX?**

The notion that modern phenomena can shed light on language evolution has come under some criticism and should not be approached without caution. Obviously, the circumstances under which phenomena develop in the modern world are very different from those obtaining perhaps some hundreds of thousands of years ago. However, language of any kind offers only a limited set of structural possibilities, and contemporary phenomena may serve as some indication of which were likeliest to
have been developed early. At least three potential ‘windows on early syntax’ are available: child language, creole languages, and historical change. All three will be rather briefly considered here.

### 49.4.1 Child language

It is tempting to take a recapitulationist stance and argue that the ontogenetic development of language mirrors its phylogenetic emergence. Children first acquire nouns, then a few verbs, and only later begin to add other word classes. The acquisition of grammatical items (except for a preposition or two, such as *up*, which is probably interpreted as a verb with the meaning ‘lift’) follows some time after the emergence of recognizable syntactic structures, even if (as suggested here) those structures do not normally begin to appear until age 2 or thereabouts, and the earliest stages of development constitute an example of protolanguage, rather than full human language. The emergence of these structures is typically quite rapid (especially when one considers the preceding 6–12-month period of mostly asyntactic utterances) with several types of both simple and complex sentence appearing within a few weeks. Moreover, some work (e.g. Crain 1991) shows that forms more complex than a child normally produces can be elicited experimentally, therefore must fall within the child’s competence.

However, it must be borne in mind that the behaviour of children may simply result from the fact that they are children. Since we still know next to nothing about how the brain actually produces language in adults, let alone children, we do not know what connection if any there is between the typical stages of child language development and stages of brain maturation (including processes such as myelination). Moreover, it is quite impossible to determine the relative contributions of adults and children to the earliest stages of language evolution. While we may reasonably suppose that the relative plasticity of children has always given them a leading role, the extent and nature of that role remain matters for speculation.

### 49.4.2 Creole languages

Creole languages are really a special case of child language development, representing what is produced by the language faculty when structured input (an early-stage pidgin, in this case) is severely reduced (Bickerton 1981). However, a reduction in the contribution of input makes it correspondingly easier to assess the contribution made by the child’s own mind/brain.

Attempts to support the hypothesis that particular creole structures are invariably inherited from pre-existing language invariably founder when the data base for the hypothesis is extended; it is always possible to find a creole that contains a particular structure even though none of the languages that contributed to its birth exhibit that structure.
For instance, if we look only at English-related creoles, we might assume that
double-object constructions (I gave Mary the book, as opposed to I gave the book to
Mary) were present simply because English has them. However, French and
Portuguese do not have double object constructions, yet these are also present in
French-related and Portuguese-related creoles.

More telling still is the case of serial verb constructions (in which clauses are
merged without benefit of either coordinating or subordinating conjunctions, and
the distribution of phonetically unexpressed items differs from that found in
embedded or coordinated clauses). Such constructions are found in most creoles
and many West African languages, and since most creoles that have them also have
historical West African connections, their presence in creoles seemed to be ex-
plained. Unfortunately Seselwa, the French-related creole of the Seychelles islands,
which never had any input from any language with serial constructions, also
contains a wide range of these constructions (Bickerton 1988).

In terms of the processes listed as (2)–(5) in section 49.1, creoles appear to be
fully developed with respect to (2), (4), and (5). However, with respect to (3)—
processes for determining the boundaries of clauses and phrases—they are mark-
edly deficient. This suggests (while falling, naturally, far short of proof) that if
process (2) was the initial step in language evolution, (3) was the final step.
Certainly, at a first approximation, variation between languages in (3) seems to
be more widespread and diverse than variation in the other categories, which is
what the suggestion predicts. It may well be that a creole like Saramaccan, which
has had less contact with other languages than most creoles, may be closer than
other languages to the state of human language at a fairly late stage of evolution.

49.4.3 Language change

Scholars from Givón (1979a) to Heine and Kuteva, this volume, Bybee, this volume,
have argued that diachronic developments may be indicative of earlier stages in
language evolution. Such developments provide abundant evidence for the process
of grammaticalization, mentioned above, which forms grammatical items from
semantically-bleached lexical items. Other inferences drawn from diachrony are
less firmly based. For instance, it is frequently argued that hypotactic constructions
(constructions that join clauses without overt grammatical markers of coordina-
tion or construction, but also without the distribution of phonetically unexpressed
items and other features characteristic of serial verb structures) are found with
much higher frequency in earlier texts of existing languages, and from this an
evolutionary progression from hypotaxis to subordinating and embedding con-
structions is sometimes inferred. Before accepting such claims, two things have to
be borne in mind. First, the frequency or infrequency of certain types of construc-
tion is irrelevant. What is at issue is what the mind/brain could or couldn’t do with
language at any given period. A single example of complex embedding is all that is needed to show that complex embedding already lay within human competence; even the absence of such examples tells us little, since surviving texts represent only a minuscule percentage of the language actually produced in any given period.

Second, the written record of language goes back only a few thousand years. Are we then to assume that language reached its present stage only within historical time? This seems implausible. What could then have caused language to become more complex? Writing is often blamed, but the languages of preliterate groups typically show a highly elaborated syntax. It is much more likely that cultural forces are at work, and languages merely cycle through the various possibilities that the language faculty leaves open.

A similar argument applies to the claim that, since historical changes from SOV to SVO surface order are more frequent than changes from SVO to SOV, then earlier languages were predominantly or wholly SOV. Granted that if we project current rates of change backwards, in a few thousand years we would reach a stage where all languages were SOV. But since language may have been in existence for an order of magnitude longer, what happened before that? Did word-order change only happen in recent times? It seems likelier that some kind of pendulum process occurs, so that in an earlier period the opposite direction of change could easily have prevailed (see also Nichols, this volume).

49.5 ORDERING OF DEVELOPMENTAL STAGES

In sum, evidence from the three windows is, while short of probative, broadly self-consistent and consistent with the model of syntactic development presented here. To give just one concrete example, creole data suggests the presence of serial verb constructions in early syntax, and logical considerations point in the same direction. If Merge was initially unconstrained (that is, did not have to satisfy the lexical entries of particular items), [V V] merges would have been licit. If vocabulary was initially limited, it would have been natural to use strings of more primitive verbs—common in creole languages, such as take X carry come—to express meanings like bring X. If few or no grammatical items were present, verbs may have been recruited to introduce non-subcategorized arguments, as in common creole expressions such as take knife cut bread for cut the bread with a knife.

Further implications for the ordering of developmental stages come when we consider the conflicting interests of speakers and hearers. Speakers are benefited by anything that makes speech faster, easier and/or more automatic. Accordingly, process (2) plus extensive use of phonetically unexpressed constituents provides most of what speakers need. Hearers, on the other hand, are benefited by anything that makes the
stream of speech more easily divisible into its structural units and generally more 
comprehensible. Accordingly, the means offered by (3) of marking structural bound-
daries and by (5) for identifying the referents of phonetically unexpressed items are 
strongly in the interests of hearers. These considerations reinforce the evidence from 
‘windows’ suggesting a sequence of (2) followed by (3), while (5) may have been 
intermediate.

Processes under (4), permitting the movement of items such as question words and 
emphasized constituents to positions of prominence, would appear to be of equal 
benefit to speaker and hearer. The speaker wants to ensure that the main point of the 
utterance is grasped, and the hearer, equally anxious to grasp it, is benefited by having 
a fixed point in the utterance where it is expected to appear. There appears to be no 
evidence for hypothesizing a stage of language where word order was rigidly fixed and 
thus no constituent could be moved to a position of prominence. To the contrary, 
there seems reason to suppose that the movement rules of syntax may be no more 
than a formalization and restriction of an unordered (or very loosely ordered) 
protolanguage that allowed free repetition of semantically or pragmatically important 
constituents (McDaniel 2005). Certainly such loose ordering and repetition is a 
feature of protolanguage as expressed by trained apes, for example an utterance 
such as the following from the chimpanzee Nim:

(9) Give orange me give eat orange me eat orange give me eat orange give me you (Terrace 1979).

It may even be the case (as McDaniel suggests) that the copy theory of movement 
(which holds that movement is the apparent result of copying a constituent, 
usually to sentence-initial position, and then erasing the original) is equivalent to 
a literal historical account of how movement processes originated.

Returning to (3), it is tempting to claim that these processes were the final additions 
to syntax, a faculty not yet hard-wired at the time of the human diaspora, and hence 
subject to a much higher degree of variation than other processes. It is true that we 
find a wide range of devices for signalling structural relations: case markers, focus 
markers, prepositions, postpositions, each category with its own range of variation. 
However, while the means of marking categories and structures may vary widely, the 
categories and structures that are marked are strikingly consistent across languages.

49.6 Conclusion

The origin and development of syntax remains a contentious and controversial 
field. However, most of the controversy has arisen through contention between the 
two rival paradigms within which most previous thinking on syntax has been
trapped. Either there was a universal grammar that depended on task-specific adaptations yielding some kind of syntactic module, or the creation of a universal grammar was biologically impossible and syntax must derive from human interaction and/or general cognition. These paradigms, over the last half-century, have fought one another to a stand-off. But neither paradigm has taken into account the possibility that a primate brain, once inseminated with symbolic units, would find itself already equipped with ways to process them and to lay the foundations for a universal syntax.

But this third course is what is proposed here. The primate brain reacted to the first words just as earlier brains reacted to the first sights, the first sounds, the first smells. It reacted by processing this new source of data in an orderly and automatic fashion so as to make it usable, just as it had done earlier with sense data. And as with sense data, in order to perform the new tasks, the brain had to develop more cells and more connections between cells. And since words demanded not just some physical reaction but a reaction in kind, an output in the form of words, a development with immense potential significance followed.

The brain had always been potentially capable of creating hierarchical structures—one of its most basic operations is to merge outputs from different neurons. It was only when it became apparent that dispatching words singly to the organs of speech would not support word-sequences of more than a few units that the brain applied its merging powers to words so as to create process (2), a process for assembling words into hierarchical structures. Subsequent use of process (2) served as a selective pressure for the other processes. Thus language bootstrapped itself into existence, and the brain produced language universals through its own modes of activity.