Syntax as an Emergent Characteristic of the Evolution of Semantic Complexity

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Abstract. It is commonly argued that the *rules* of language, as distinct from its semantic features, are the characteristics which most clearly distinguish language from the communication systems of other species. A number of linguists (e.g., Chomsky 1972, 1980; Pinker 1994) have suggested that the universal features of grammar (UG) are unique human adaptations showing no evolutionary continuities with any other species. However, recent summaries of the substantive features of UG are quite remarkable in the very general nature of the features proposed. While the syntax of any given language can be quite complex, the specific rules vary so much between languages that the truly universal (i.e. innate) aspects of grammar are not complex at all. In fact, these features most closely resemble a set of general descriptions of our richly complex semantic cognition, and not a list of specific rules. General principles of the evolutionary process suggest that syntax is more properly understood as an emergent characteristic of the explosion of semantic complexity that occurred during hominid evolution. It is argued that grammatical rules used in given languages are likely to be simply conventionalized, invented features of language, and *not* the result of an innate, grammar-specific module. The grammatical and syntactic regularities that are found across languages occur simply because all languages attempt to communicate the same sorts of semantic information.

Key words: language, grammar, syntax, semantics, evolution, emergence, brain size

1. Introduction

While many organisms communicate, none do it with the sophistication and complexity that humans find so easy. When trying to unravel the riddle of how language evolved, we must keep in mind that language itself has many different features, each of which have different evolutionary explanations. Three theoretically independent categories of language phenomenon can be distinguished: phonetics, semantics, and syntax. Phonetics refers to the production and perception of the actual sounds (or signs) used by language. Semantics refers to the meanings attached to different patterns of these sounds, which we call 'words.' Syntax refers to the set of rules which allow us to encode specific information about the interrelationships between various semantic units.[1] Some features of human language have more obvious origins in the neurocognitive abilities of non-human animals than others, and are therefore easier to explain from an evolutionary perspective. Explanations for such features require simply the modification of pre-existing abilities. The aspect of language that is hardest to demonstrate in other species is syntax, which is the reason it represents, for many, the distinguishing characteristic of language and therefore the biggest challenge to our understanding of language evolution.

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There are a number of models which have been proposed to explain the evolution of syntax. These models can be loosely grouped into two basic types, which I will call “innatist” vs. “emergent”. The first type of explanation maintains that syntax is in some specific sense genetically encoded. Exactly what is thought to be genetic is usually not rigorously and explicitly detailed. However, innatist arguments do not hold that syntax is acquired like sneezing, gagging and other basic reflexes, in which there is essentially no learning component at all. Rather, the idea is that there is an innate cognitive structure, unique to human language (though potentially co-opted by other cognitive processes), that determines what sort of basic structures and processes will be reflected in the syntax of any natural human language. This is the basic position championed by Chomsky (e.g., 1972, 1980), and also found in recent interdisciplinary discussions of the evolution of language (Bickerton 1990; Pinker and Bloom 1990; Pinker 1994). It would appear to be the dominant perspective among linguists today. Allied with this perspective is the notion that there is a physical location in the brain, which we might call a “syntax module,” devoted exclusively to syntax processing.

By contrast, emergent views of syntax suggest that syntax is not the result of genes specific to syntax, or some sort of “syntax module”, but rather that the rules of syntax emerge as *consequence* of how language develops both evolutionarily and ontogenetically, given both the function of language and the extent of human semantic complexity. Syntax is seen as a set of conventions that were invented to allow us to convey important dimensions of our semantic universe. Just as English speakers are not genetically programmed to associate the pattern of sounds in the word “hand” to the concept this word represents, English speakers are also not genetically programmed to use word order to convey argument structure, for example. Syntax, from this perspective, is not the result of an innate, grammar-specific module, even though it uses brain mechanisms which may well be genetic in origin. The brain mechanisms involved in processing syntax (such as the ability to understand hierarchical structure) are not specific (or limited) to language. They are mechanisms which evolved for other (presumably more general) purposes and are used and adapted by language, but only in the same way that, for example, bipedal locomotion uses cortical and sub-cortical circuits that existed long before the evolution of bipedalism. The innate structures of language, to the extent they exist at all (see below), are semantic structures, which thereby influence syntax only indirectly. The grammatical and syntactic regularities that are found across languages occur because of the universals of semantic cognition, not universals of syntax and grammar. Arguments along these lines can be found in Sampson (1978, 1979, 1980, 1997), Lieberman (1984), Hopper (1987), Savage-Rumbaugh and Rumbaugh (1993), and Deacon (1997). Functionalist models of language acquisition and origins also reject the notion that syntax is innate (see Bates and MacWhinney 1990; Bates et al. 1991). In addition, a number of alternative models of language have been proposed by linguists which, to a greater or lesser extent, emphasize the fundamental importance of semantics in understanding syntax and grammar (e.g., Haiman 1985a; Langacker 1987; O'Grady 1987).

While innatist explanations are currently more popular, I will show that there are a number of reasons to seriously doubt their validity as explanations for the evolution of syntax. One problem is that the features of syntax found universally in the world's languages are so general in scope that they are really nothing more than descriptions of our cognitive semantic universe. This fact is consistent with emergent explanations that the actual grammatical rules in any specific language are simply cultural inventions created to allow speakers to describe the salient features of their semantic universe. Another problem is that innatist perspectives are less compatible with what we know about how evolutionary change occurs, particularly with respect to behavioral evolution. There are a number of important evolutionary principles which have been either ignored or not fully appreciated in a number of recent interdisciplinary discussions of this topic in the literature (e.g., Bickerton 1990; Pinker and Bloom 1990; Pinker 1994). Among the principles having important ramifications for the evolution of syntax are the fact that evolutionary change occurs overwhelmingly through slight modifications of existing designs (versus independent creation), that behavioral change drives genetic change (particularly in behaviorally complex species, see below), that complex features evolve only if they are adaptive, that different evolutionary explanations can apply to different aspects of an adaptive unit, and that simple changes often have far reaching effects.

For the argument that follows, it is crucially important to remember that *syntax is not a unitary phenomenon*. Even innatists would agree that a large portion of the syntax we learn is not innately given (see below), which means the question is really one of *how much* of syntax should be explained by emergent vs. innatist explanations. The argument advanced here is that emergent explanations have at least three advantages over innatist positions: they are more parsimonious, in that syntax grows out of semantics and does not require dedicated, syntax-specific modules; they are more consistent with general evolutionary principles; and they make specific predictions about the nature of syntax – in contrast to innatist positions for which any arbitrary device is as good as any other. As Sampson (1979) notes:

> Chomsky argues that if men inherit complex non-plastic mental structure it is likely that the languages they are capable of mastering will be limited to some narrow class, *but he does not pretend to show that we could know in advance what that class would be* – his rationalism would be as compatible with the observation that no transformations are structure-dependent [see below] as with the observation that all transformations are structure-dependent, for instance (p. 103, emphasis added).

Emergent explanations, in stark contrast, *do* make specific predictions about the structure of language, and therefore are inherently more testable (Sampson 1978, 1979, 1980, 1997).

The real power of the emergent perspective is that it is a more parsimonious explanation. It is more parsimonious both because it does not require independent modules, but also because it requires, as an initial condition, simply the ability to communicate mental concepts through the use of signs, which is something that is demonstrably not limited to humans (as discussed below). What *is* limited to humans in this regard is a large quantitative difference in the degree of complexity of our semantic universe. Thus, this model shows that even if the rudiments of syntax truly are missing from non-human animals (which is still an open question; see Savage-Rumbaugh et al. 1993; Savage-Rumbaugh and Rumbaugh 1993), we would still not require a separate evolutionary explanation for syntax apart from increasing semantic complexity. The innate constraints that guide the acquisition of syntax are therefore not specific to syntax, nor did they evolve (in the genetic sense) *for* syntax. They are best understood as conventions that reflect evolved semantic constraints.

The specific model of syntax evolution presented here is derived from and consistent with the emergent models in Sampson (1979, 1980, 1997), Hopper (1987), Bates and MacWhinney (1990), Bates et al. (1991), Lieberman (1984), and particularly Savage-Rumbaugh and Rumbaugh (1993), and differs only in some details from these earlier discussions. The contribution of this paper is to show that 1) a number of theoretical evolutionary arguments support and strengthen the emergent perspective on language origin and evolution and point away from innatist ones, and 2) that a close analysis of the universal features of natural language grammar undermines the argument that grammar can only be explained by an innate, grammar-specific, brain module.

2. The Importance of Evolutionary Principles

Any model that attempts to explain the evolution of some feature must, of course, be grounded in the logic of evolutionary biology. Chomsky once argued that "... human language appears to be a unique phenomenon, without significant analog in the animal world. If this is so, it is quite senseless to raise the problem of explaining the evolution of human language from more primitive systems of communication that appear at lower levels of intellectual capacity." (Chomsky 1972, p. 67). He saw this only as "... a problem for the biologist ..." (p. 70), but in fact it is a problem for linguists and cognitive scientists because our understanding of how language evolved is necessarily constrained by what we know about evolutionary processes. Not all evolutionary scenarios are equally likely. Understanding derives from an application of evolutionary principles to the specific facts of language. Lashley (1951) pointed out, in another context, that, "If there exist, in human cerebral action, processes which seem fundamentally different or inexplicable in terms of our present construct of the elementary physiology of integration, then it is probable that that construct is incomplete or mistaken, even for the levels of behavior to which it is applied," (p. 135). Similarly, if a particular model of language precludes our ability to understand how it evolved, it is quite legitimate to question the validity of the model itself, particularly when there are alternative models of language available (see below).

How can general evolutionary principles explain language if it is a unique occurrence? Cartmill (1990) points out that if some feature is truly unique, then by definition it shares no homologies or analogies with any other feature found in some other evolved organism. If this is the case, its existence cannot be explained in the scientific sense of the word because scientific explanations (as opposed to religious or mythical ones) are descriptions of the interplay between the laws of the natural world. These laws are necessarily general – they cannot be applicable exclusively to unique instances because they would then be nothing more than descriptions of an event. Thus, we must start our quest for a scientific explanation for the evolution of language by recognizing the general expectations governing evolutionary change. It is only when the specifics of natural language are viewed in the context of these general evolutionary principles that we will be able to obtain a realistic appraisal of language evolution.

3. Principles of Evolutionary Change

Our understanding of the evolutionary process derives not only from an analysis of the fossil record, but also from comparative studies of the variety of species living today. While we cannot know every detail about the history of life, we nevertheless know enough about the processes of evolutionary change to recognize a number of important general principles. In this section I will review the principles most crucial to the question of language origins and evolution. Some of these principles have been emphasized (to various extents) in previous discussions of language evolution (e.g., Bates et al. 1991; Lieberman 1984; Pinker and Bloom 1990; Pinker 1994; Bickerton 1990; Deacon 1997).

Principle (1) Evolutionary change most likely occurs through incremental steps. Small changes (mutations) that have beneficial consequences are rare enough. Large changes that have very beneficial consequences are exceedingly rare. Any evolutionary scenario which depends critically on large adaptive mutations is therefore *a priori* less likely than one that depends only on small changes. In order to evolve from a state that lacks a particular complex functional feature (such as language) to a state which has this feature, there most likely exists a series of intermediate steps – each of which are small enough to be the result of simple mutations. If there are reproductive costs involved in these changes, then we can be sure that each of these steps must have been adaptive advances (in the Darwinian sense that they increase individual fitness) over the immediately prior step.

Principle (2) These steps are most likely to build on prior adaptations. As Jacob (1977) points out, "Evolution does not produce novelties from scratch. It works on what already exists, either transforming a system to give it new functions or combining several systems to produce a more elaborate one," (p. 1164). The evolutionary changes that *can* occur are always constrained by what *has* occurred. If there is selection in some direction (e.g., towards linguistic ability) and if there are several evolutionary paths that potentially lead in that direction, the actual path taken is always more likely to occur along the path of least resistance (Dawkins 1982). If there is some selective advantage to communicating at any given moment in time, individuals that utilize any existing anatomical/auditory/neurological structures to this end will necessarily have an advantage over those that wait generations for unique adaptations to arise, regardless of how much more advantageous the unique adaptations might ultimately be.

A corollary of this principle is that homologies are likely to be the rule, not the exception. In fact, the widespread existence of obvious homologies among species that was one of the most powerful arguments Darwin used to demonstrate that evolution had occurred (e.g., Chapter 14 of *On the Origin of Species*). Even though Pinker (1994) argues that language is an adaptation designed by natural selection, he does not believe that syntax, at least, has any homologies in closely related species. Pinker (1994) notes that the eye evolved in perhaps 40 independent evolutionary lineages, which he believes shows that we should not necessarily expect to find homologies: Organisms with eyes can (and have) evolved from organisms without eyes. The problem with this argument is that eyes as sophisticated and elegant as ours did not evolve suddenly in one dramatic speciation event, nor are they likely to have evolved rapidly along a single lineage between speciation events. Each species, and each generation (on average) showed improvements to a much older design. Independent evolution is simply not an argument against the overwhelming likelihood of finding homologies. Given how closely related humans are to the African apes, it would be extremely unlikely for something as complex as language to have no homologies. In fact, there appear to be many, as Snowdon's (1990) review indicates (though the evidence specifically with respect to syntax is debated). Pinker (1994), Pinker and Bloom (1990), Bickerton (1990) and Chomsky (1972, 1980), among others, adamantly maintain that there are no behavioral homologies that relate to syntax, even though it has been known for a quarter century that chimps *Pan trolodytes* can learn to distinguish argument relationships marked only by an arbitrary device (in this case, serial order; Premack and Premack 1972). Note that it is beside the point that not all human languages require the use of serial order for this purpose. Chimps clearly have the cognitive structures which underlie the concept of "argument relationship," just as do humans, and they can use an arbitrary device to distinguish it, just as do humans. To argue that this is not evidence of homology is to argue that humans and chimps *independently* evolved underlying cognitive structures that allow them to mark the same semantic features with equally arbitrary syntactic devices. Recent investigations of the syntactic capabilities of a pygmy chimp (*Pan paniscus*) are even more convincing of a similarity in underlying cognitive structures (Savage-Rumbaugh et al., 1993). The extreme lengths to which one must go to deny homology for even basic features of language structure belies a profound and unreasonable bias.

But regardless of where one stands on this issue, we must not overlook the fact that if syntax truly has no homologies, it would appear to be the *only* cognitive feature in modern humans for which this is true. Other uniquely human adaptations, by contrast, show clear homologies. For example, habitual bipedalism is a unique hominid adaptation within primates, but hominids did not have to evolve unique neural structures (or cognitive modules) to accomplish it. In fact, we use the same neural circuitry (not to mention the same muscles, underlying physiology, skeletal structure, etc.) as is found in other primates. Bipedalism is the result of relatively basic adjustments of the underlying hominoid anatomical design (see, e.g., Lovejoy 1988). The evolution of bipedalism in humans is of course much simpler to explain because of these facts. The belief that syntax is alone in having no homologies should trouble anyone who takes evolution seriously.

At the same time, the general principle of building upon previous adaptations makes it very likely that features will share characteristics with other, pre-existing (and therefore more general) cognitive abilities. For example, both speech and non-verbal oro-facial movements (e.g., masticating food) involve similar motions and muscles. No one would argue that we evolved a complete and independent set of circuits connecting the cortex to oro-facial muscle fibers in order to accomplish human speech. A large portion of the circuitry (including cortical circuitry) used for speech was co-opted (and enhanced) from circuitry for non-verbal movements. Since evolutionary change is most likely to occur along a path of least resistance, this invariably results in making use of pre-existing traits and abilities. Recognition of this fact has led Wang (1991b) to describe the product of language evolution as a “mosaic”.

Principle (3) Behavioral change drives genetic change. An individual organism cannot change its genes, but it can change its behavior. Mayr (1978) believes that “there is little doubt that some of the most important events in the history of life, such as the conquest of land or of the air, were initiated by shifts in behavior.” (p. 55, as quoted in Lieberman 1984). This avenue will be especially important for organisms (like primates) which have a great degree of behavioral flexibility. If some kind of change will benefit the individual organism (in this case, more complex communication ability) it is much more likely to occur on a behavioral level first (within the confines of the biological adaptations that are immediately available). Some individuals will have biological adaptations that better enable them to accomplish whatever behavioral changes confer a selective advantage, and this will set up a feedback process over succeeding generations between increasing behavioral ability and increasing biological change along some dimension. The actual path of evolutionary change will be constrained at each step by biological limits to behavioral flexibility. Thus, once again we should expect features like universal grammar to be built on a bedrock of pre-existing abilities and cognitive structures.

A corollary of this is that if some behavioral change is beneficial, we are therefore provided with an explanation for why it evolved. In contrast, Pinker and Bloom

(1990) argue that "need" is an insufficient explanation for the existence of syntax in natural language. They believe that this reflects an essentially Lamarckian perspective on evolution. To the extent that syntax is specifically genetically encoded, their argument is relevant. However, this begs the question of how much of syntax *is* specifically genetic, which is exactly the question at issue. Both Darwin and Lamarck believed that if something was advantageous (i.e., there was a "need" for it), it would be passed on. The difference is that Lamarck argued that adaptations acquired during an organisms lifetime would be passed on to its offspring, whereas Darwin (initially) did not.[2] However, it has long been recognized by anthropologists that much of human behavior is clearly "Lamarckian" in this sense. If some mechanism is needed by a language in order for that language to effectively communicate certain aspects of the reality of its speakers, then a mechanism will be invented or a convention will be settled on to accomplish this (this process need not be conscious – see Section 4 below). This mechanism will not, at first, be innate in the common sense of this word. But it will necessarily be consistent with pre-existing cognitive abilities, many of which *are* innate. The innate part of syntax is, under the emergent model, the manner in which we divide up the world semantically, not any specific rule or device used to convey information about this mental world.

Principle (4) Complex features evolve only if they are adaptive. It is true that evolutionary change can occur through random processes (e.g., mutation and genetic drift), but this will almost always lead to chaos, not to complex, integrated, functional systems. A corollary of this principle is that if a feature has evolved which functions for a particular purpose, the likelihood is very remote that the organism will evolve a completely different feature which functions for the same purpose. That is, unless the new feature is functionally much better than the original. However, even in this case there is no guarantee that it will succeed in spreading through the gene pool, since the developmental costs of switching to the new feature may be prohibitively high.[3] Even if it does succeed, the likelihood is that the functionally inferior feature will be replaced, *not* that both features will be fixed in the population. The evolutionary process is not frivolous. This will become important when we discuss the proposed features of universal grammar.

Principle (5) Evolutionary explanations can be different for different aspects of a evolved feature. It is clear that there are both universal and non-universal aspects to language. The features that vary among modern languages are likely to involve explanations based on cultural evolution rather than biological evolution. Few would argue, for example, that a genetic change was responsible for the gradual replacement of case systems with serial order as a method of signifying argument structure in English. By contrast, universal features across languages are more likely to involve explanations based, at some level, on biological evolution. This is because we expect purely environmentally influenced features of languages to more rapidly drift apart from culture to culture.

The specific sound patterns used to signify particular semantic units, and at least some of the specific rules of syntax (and other aspects of the grammar) of an individual language are not genetically determined. If they were, adopted children would grow up speaking the same language as their *biological* parents, regardless of what their adoptive parents spoke. However, at another level, language must have a genetic influence. Children do not have to be taught language in the same way as they have to be taught how to play baseball, cook, or drive a car. One has to go to extremely inhumane lengths to disrupt a child's natural acquisition of language (see, e.g., Curtis 1977). There are clear cross-linguistic similarities which suggest some sort of genetic influence, but this does not mean that every important feature of syntax is specifically genetically encoded.

Principle (6) Special, separate evolutionary explanations are not necessary for features which are logically necessary for a given adaptation. Gorillas, for example, have massive jaws, huge teeth, and a sagittal crest (a large bony fin running down the midline of their skull) to anchor powerful temporalis muscles (used in mastication). All of these relate to one another in a logically necessary way: You simply cannot have large teeth in small jaws; large jaws and teeth imply heavy chewing, which in turn means you will have powerful masticatory muscles and a concomitant increase in the size of their bony attachments. Since these all relate to a single behavioral adaptation, proposing separate evolutionary explanations for each of these traits would be a mistake.

Furthermore, many features (such as the sagittal crest in gorillas) are not genetically based *per se*, but rather are the result of other genetically based features. There are apparently no genes specifically *for* sagittal crests. Instead, sagittal crests are the result of the growth of immense temporalis muscles which, in turn, are the result of the immense amounts of chewing demanded by the diet of the gorilla. The dietary preferences of the gorilla presumably are genetically influenced, and these preferences have far reaching consequences for the gorilla's anatomy. We need not postulate a specific gene for a specific feature in order to understand the evolution of this feature.

The evolutionary explanation for sagittal crests is analogous to emergent explanations of the evolution of syntax: semantic complexity drove the development of syntactical conventions. Any features of syntax that do not follow logically from (1) the rich semantic texture of our mental world, and (2) our desire to communicate, would not be explained by an emergent model. However, this would *not* undermine the validity of this model for other syntactical features, of course. Recognition of this logical fact is missing from most innatist arguments on language origins – a fact that further undermines their validity.

In summary, there are six basic principles of evolutionary change whose importance has not been sufficiently appreciated by innatist arguments of the origin of syntax: (1) evolutionary change most likely occurs through incremental steps, (2) these steps are also likely to build on prior adaptations that already exist, (3) evolutionary changes are likely to occur at the behavioral level first and only later at the genetic level, (4) complex features likely evolve only if they are adaptive, (5) evolutionary explanations can be different for different aspects of a evolved feature, and lastly, (6) special evolutionary explanations are not needed for features which are logically necessary for a given adaptation.

4. The Evolution of Semantic Complexity

Before analyzing the specific features of syntax in an evolutionary context, it is important to clarify what is meant by "increasing semantic complexity," and lay out the evidence for its importance in hominid evolution.

I will take for granted that there are features of the real world which exist regardless of whether an organism perceives them. Just because a snail lacks the ability to visually see an approaching car on the highway does not mean the car does not exist and that the snail will not suffer from its lack of awareness. There is a common reality outside of any individual organism even if the individual is not aware of all its dimensions. Furthermore, evolutionary considerations require that a species view of reality be 'honest,' even if limited to a subset of the total reality.[4] The dimensions of reality perceived by an organism can be concrete things that can be directly sensed, or they can be increasingly abstract. For humans, concrete features would include rocks, water, smooth skin, colors, and so forth, while abstract features might include "sleeping," "love," and "evolutionary fitness." Different organisms will divide up the world differently, in accordance with their unique evolved neural systems, but they all divide up the world in *some* way. These "divisions" are what I mean by "cognitive categories," or "semantic units." Increasing semantic complexity therefore refers to an increase in the number of divisions of reality which a particular organism is aware of and can respond to in some meaningful way.

Humans are not limited to simply having cognitive categories and acting on the basis of these categories, but are also able to use some sort of sign to stand for a cognitive category. A sign would simply be anything which stands for something else for somebody (following Charles Pierce's definitions – see Fetzer 1988).[5] By communicating with signs one can arouse in another individual's mind a close approximation of a certain cognitive category. This ability to use a sign to communicate some sort of cognitive category is clearly of essential importance to the evolution of language, but it is not limited to humans. It has been demonstrated repeatedly in the various ape language studies (e.g., Premack and Premack 1972; Gardner and Gardner 1984; Savage-Rumbaugh 1988; Savage-Rumbaugh et al. 1993), studies of Vervet monkey calls signifying different types of danger (Seyfarth et al. 1980), and even in an African Grey parrot who uses the English (!) words to correctly identify different categories of objects (i.e., their shape, type of material, color, number, etc.; Pepperberg 1990).[6] In this context, then, "increased semantic complexity" means an increase in the number of cognitive categories, along with an increase in their perceived interrelationships, and an increase in the number of signs that can be productively used.

Unlike Sampson (1980), I would argue that most cognitive categories are independent of, and exist prior to, language itself. Words (symbols) for things must logically be applied to things that in some sense already exist in our own cognitive world. From an evolutionary perspective, there would be no point to communication (and therefore language would not have evolved) if such cognitive categories did not already exist. The fact that we often have a difficult time verbalizing ideas and thoughts (particularly complex ones) also suggests these ideas and thoughts are not equivalent to language.[7] Furthermore, patients with anomia (a particular type of aphasia) have great difficulty finding the word for a particular cognitive category. They can often describe in great detail the features and important aspects of the referent of a word, but are unable to produce the word itself (Gardner 1974). Since anomia in many cases does not affect non-linguistic abstract thinking (Gardner 1974), it suggests that words, and by extension the grouping and manipulation of words in sentences, is a secondary process to thought itself. Furthermore, normal individuals sometimes experience the situation in which they cannot remember a particular word, even though they "know" a word exists for the thing they are trying to refer to. It is possible that this phenomenon reflects a disjunction of one area of language processing with another, but it is also possible that this indicates a true separation between thinking and language.

New words are often invented to refer to things that do not exist in the real world (e.g., "hyperspace"), but this does not suggest that they somehow have no meaning for us. Their meaning ultimately depends on their relationships to cognitive categories that already exist in our minds (e.g., understanding "hyperspace" requires that we understand what "space" is, and have a recognition that the physical properties of one place can differ from those in a different place, and so forth). Even the most abstract words are signs for connections between cognitive categories that already exist, either innately, or through the interaction of innate constructions with experience in the world.

Because different organisms are aware of different aspects of external reality, they will necessarily be limited in the range of things they can effectively communicate about. This is not to suggest that experience is irrelevant to the construction of cognitive categories and that all aspects of all cognitive categories are innate. Rather, the ways in which we experience the world are dependent on evolved sensory systems, which bias our perceptions in various ways, and therefore guide the acquisition of cognitive concepts in predictable ways. Certain arrangements of carbon, hydrogen, and oxygen taste sweet to us, for example. This sensation is an evolved preference that colors our perception of various foods, and creates cognitive distinctions that would not be evident to us if our evolutionary history had been different. It is in this sense that cognitive categories can be said to have a genetic component. Sampson (1978, 1979, 1980) appears to reject the idea that our semantic world-view has any strong innate components. Sampson (1980) is probably correct that we are not born with a *complete* set of pre-formed, universal semantic units (such as, “animate”, “human”, “liquid”) which then combine in various ways to provide semantic interpretations of each word, as Fodor (1975) has argued. Nevertheless, as with the case for sugar, some semantic categories are likely innate at some level. Furthermore, cognitive categories – as distinct from the neural representation of a word – do in fact exist in our consciousness. These cognitive categories are most likely simply patterns of interconnections between various processing areas of the brain. For example, the cognitive category “lemon” presumably involves a network connecting visual, gustatory, and olfactory cortical and subcortical centers (at a minimum). This is supported by evidence from anomic patients who have less difficulty remembering words for things that affect multiple senses (e.g., “flower,” which refers to something that can be held, has a fragrance, and is colorful, as opposed to “sky,” which refers to something that can only be seen; Gardner 1974). It is also consistent with what we know about the distributed nature of neural functions (Damasio and Damasio 1994).

Bates et al. (1991) outline a model of language acquisition in children (and adults) which is quite compatible with this perspective. They argue that children at first associate an arbitrary chunk of speech with a particular context in which this chunk occurs (using “context” here in the broadest possible sense), and then superimpose subsequent contexts in which the same (or very similar) chunk of speech occurs, resulting in an increasingly specified association of a particular word with certain contextual features (see also: Savage-Rumbaugh and Rumbaugh 1993). These sets of contextual features associated with a particular word are what I mean by cognitive categories.

What sort of evidence is there that an increase in semantic complexity occurred in hominids? An important clue can be found in the specifics of hominid brain size evolution. It has long been known that there is a large degree of variation in encephalization (relative brain size) between mammals.[8] Given the evolutionary costs of maintaining brain tissue (see e.g., Smith 1990; Schoenemann 1997), it is unlikely that these differences have no effect on behavior. Jerison (1985) notes that the differences between grades of encephalization presumably “... correspond in some way to the complexity of the reality created by the brain ...” (p. 30). Increasing brain size has a number of general consequences, one of the most interesting being that it appears to go hand in hand with increasing specialization of the cortex (Ebbesson 1984). Ringo (1991) showed that cortical white matter (made up mostly of axonal connections between different areas of the cortex) does not increase across mammals as fast as it would need to in order to maintain the same degree of cortical interconnectedness. That is, individual cortical units (either neurons or cortical columns) in larger brained organisms would appear to be directly connected to a smaller percentage of the rest of the cortex than is the case for smaller brained mammals. This means that cortical areas have a greater degree of independence in larger brained mammals, and therefore a greater likelihood of cortical specialization (which is empirically true; Ebbesson 1984; Ringo 1991).

Humans are by far the most highly encephalized of all primates, which would suggest that we also have the most complex and varied reconstruction of external reality. This is simply another way of saying that hominids experienced a massive increase in semantic complexity beginning at least 2.5 million years ago with a first unequivocal increases in hominid encephalization.

The fact that chimps and other animals have been trained to communicate using various arbitrary symbols is unequivocal evidence that they are able to: (1) form mental concepts, (2) attach signs to these concepts, and (3) communicate specific ideas concerning these concepts via purely symbolic means. However, humans and chimps do differ in crucial ways. Snowdon (1990), in his review of these studies, makes the very telling remark that, "Although the abilities of Kanzi and his companions are remarkable and come very close to some of the capacities shown by young children, there still appear to be limitations. Bonobos [pygmy chimpanzees] and chimps *appear to be more limited in the topics that they find interesting to communicate about*." (p. 222, emphasis added). Furthermore, although it is not completely clear how human children learn arbitrary signs for different cognitive categories (i.e., how they learn words), we do know that they seem primed to learn them in a way that chimps simply are not. In one experiment which investigated the acquisition of color words in 3 year old children, Elsa Bartlett found that only a single exposure to a new color term was required to begin the reorganization of their color lexicons (Miller and Gildea 1991). The difference between humans and non-humans thus does not lie in the ability to create concepts (cognitive categories), or even to assign symbols to these concepts, but instead lies in the complexity and variety of the concepts that they are able to form, as well as in the ease with which they form them. This is a difference in degree, not in kind, as Lieberman (1984) and others have noted.

It is even possible to make a rough quantitative assessment of this difference. Studies of the linguistic abilities of apes typically report vocabulary sizes on the order of a few hundred items at the most (e.g., Savage-Rumbaugh 1988; Gardner and Gardner 1984). Estimates for humans, in contrast, are orders of magnitude higher. It has been estimated that reading vocabulary of the average high school student is in the neighborhood of 40,000 items (defining groups of related words, such as "write," "writes," "written," "writer," etc., as single vocabulary "items"; Miller and Gildea, 1991). If we add proper names, the estimate approaches 80,000 items, which means children are presumably learning new words at an average rate of about 13 per day (Miller and Gildea, 1991). This suggests, purely as a rough guide, that the difference in cognitive complexity between apes and humans is on the order of a 200- to 400-fold change, at a minimum. Such a huge quantitative difference must surely engender effects which would appear qualitative in nature, even thought the steps necessary to get from apes to humans in this regard obviously can be seen as incremental. One of these effects, I suggest, was the progressive construction or invention of conventionalized syntactic structures.

It is important to note here that although the words “construction” and “invention” carry with them the suggestion of conscious awareness of the process and an understanding of the ultimate goal, this is not necessarily the case. Hayek (1973) has pointed out that various kinds of complex human order can and do arise spontaneously. Adam Ferguson (1767) was perhaps the first to make this explicit: “Nations stumble upon establishments, which are indeed the result of human action, but not the execution of any human design.” (p. 187). There are in fact many cultural patterns and institutions for which the ultimate origin remains obscure to anthropologists and social scientists (e.g., religious institutions and practices), yet this does not lead us to suppose that they must therefore be the result of specific innate brain modules. It is a false dichotomy to assume that our choice is only between unconscious innate brain modules and fully conscious inventions.

5. Putting Syntax into Context

At a superficial level, syntax is extremely complicated, consisting of intricate rules governing the formation of sentences. As more and more examples of “grammatically correct” sentences in a particular language are examined, one finds that increasingly specific rules are required to account for the data. However, it turns out to be very difficult to pinpoint what constitutes “grammaticality” within individual languages. In fact, Haiman (1985a) argues that grammaticality judgments by grammatical theoreticians are not independent of some predetermined theory of grammar: “Utterances are marked ungrammatical if they are incompatible with a tightly constrained theory, and acceptable if they are compatible with it.” (p. 258). This, of course, is cheating, because it assumes what it is trying to prove. Ross (1979) has shown that the set of sentences for which every English speakers agree are grammatically correct is simply too small to be of interest to linguists. Ross (1979) showed experimentally that the core of universal agreement on English syntax is supplemented by a number of continua leading away from this core, with each speaker placing the cutoff point for grammaticality at a different place on each continua.

We therefore have two options with respect to the hypothesis of an innate syntax module. Either this module is responsible for the core only (with the continua of differing acceptability being inventions and/or non-universal extensions of the core), or the module is responsible for more than the core, but some individuals have not been properly exposed to these grammatical forms.[9] Given the simplicity of core syntax, the first possibility is more consistent with the emergent hypothesis. The latter possibility is not obviously true, because it assumes a formalism which is the very center of the argument: It assumes we can demonstrate that there is a logical point on each continua that unequivocally divides grammatical from ungrammatical sentences. We can do this only if we accept *a priori* that syntax is governed by some form of mathematical logic. Clearly, some portion of grammar (i.e., the core) can be described in formal terms, but the crucial question here concerns *how much* of language can usefully be explained by formal rules.

There is a useful analogy here with the Ptolemaic views of the celestial universe, which dominated scientific explanations during the Middle Ages in Europe. Ptolemy believed in a geocentric model of the universe and sought to explain both retrograde planetary motion and changes in luminosity of various planets over time by means of a system of up to 40 offset (eccentric) circles and epicycles arranged in various combinations (Christianson 1978). His system did in fact reasonably predict the observed motions and changes in luminosity of the planets, even though the model later proved to be demonstrably wrong. His error lay not in his method, which was strictly quantitative and mathematical, but rather in his starting assumption of geocentrism (Christianson 1978). With respect to syntax, Langacker (1987) notes, "A linguist can never legitimately proclaim the worthiness or superiority of a theory on grounds of mathematical rigor alone," (p. 43). Chomskian formalism is only one hypothesis of language processing – detailed alternatives have been proposed which instead heavily emphasize the semantic basis of language (e.g., Langacker 1987; O'Grady 1987). It is simply not clear how much of language actually involves the application of rules. The problem for syntacticians is that it is not enough to prove that a particular formal model of syntax works (i.e., produces the desired output). One must also prove that that language *actually works that way*. What is needed is a demonstration not simply that syntax *can* be explained by a particular formal model, but rather that it can *only* be explained by that particular model. Judging from the fact that there is no agreement on the particulars of UG to begin with (Crain 1991), we haven't even reached the single most crucial step yet.

Nevertheless, in the next section I will be concerned simply to take for granted that all important aspects of grammar are the result of formal rules, and will put aside the fact that there is clear disagreement among linguists as to the specifications of the structure of grammar. The question will be whether the proposed universal features of human language grammar do, in fact, support an innatist perspective, particularly when viewed from an evolutionary perspective.

6. What Exactly Does Universal Grammar Look Like?

The set of features which are thought to be part of the underlying evolved grammar module has been called "universal grammar" (UG) by Chomsky and others. Pinker (1994) includes the following definition in his glossary:

> **Universal Grammar.** The basic design underlying the grammars of all human languages; also refers to the circuitry in children's brains that allows them to learn the grammar of their parents' language. (p. 485)

For Pinker and others, universal grammar is thought to be genetically wired into the brains of children, forming what Chomsky has called a "language organ," (Chomsky 1980). As mentioned above, there is apparently no agreement among linguists over the exact specifications of UG. Thus, the claim is that UG must be innate, even though we are not sure of the details at present. Crain (1991) suggests there is an overall agreement about at least some aspects.

A key question concerns exactly what a cross-linguistic analysis of syntactic structures tells us about the components of UG. One possibility is that UG is what is left after we peel away the aspects of grammar that vary from language to language. In this view, UG is a description of what is common about all languages. Alternatively, some linguists would also include in UG features which find expression only in certain languages, but which seem to be arbitrary and specific enough that it is difficult to see how a child could learn these features without some form of innate constraint (e.g., Pinker, personal communication, Chomsky 1981).

One proposal has been that that a number of alternative grammatical structures are programmed genetically, but the specific features a child will learn are set by exposure to one or another grammatical structure (often referred to as "parameter setting"). This idea is highly problematic for a number of reasons. First, where do we draw the line with respect to innate versus non-innate features? Why not include features that are found only in one language? Furthermore, what exactly is 'too difficult to learn,' and how do we know? This is essentially an "argument from personal incredulity," to use Dawkin's (1986) phrase, and should therefore be viewed with great caution. It may be correct in specific instances, but it is asking much more of our understanding of how children learn language than is warranted. It is easy to *postulate* that innate constraints are involved, it is much harder to prove that it can only be learned in this way (the learnability question will be addressed in more detail in Section 9 below).

More importantly, the idea that features of UG could potentially be found in only a subset of languages requires us to believe that genetically based features evolved *even though they were not needed by language*, which, as we have pointed out above, is not credible on evolutionary biological grounds (principle 4). The logic here can be summarized as follows. Language evolved from simpler origins. At some point, a genetic change would have occurred which allowed humans to use a particular device of grammar, that they could not have used before, to accomplish the communication of a particular kind of information. If we assume that natural selection was at work here (e.g., Pinker 1994, Pinker and Bloom 1990), then it does not make sense to argue that at some later point *another* genetic feature would be selected for, which accomplishes exactly the same thing as the pre-existing feature, and does it with no more (or less) efficiency. What evolutionary scenario would have led to the acquisition of numerous genetically-based devices which accomplish the same things, only one of which being potentially used in any given language? Take word order as a means to communicate argument structure as an example. What would select for a system of case markings once word order had been established? The argument here, of course, does not depend on which system happened to have evolved first (unless we wish to argue that word order is an inferior design, of course). The first to evolve would eliminate selection for any alternative systems. If different syntactic devices are used by different languages to accomplish the same goal, we should conclude either that these devices are non-genetic conventions invented to facilitate the communication of some important semantic feature, or that these devices are genetic but did not evolve specifically for language, and instead evolved for some other reason and later co-opted by language.

For these reasons, the most defensible method for determining which linguistic features should be considered part of UG is to limit it to those features which are common to all languages. Features which are not common to all languages are either not genetically influenced (and are by definition not part of any "language organ") or are genetically influenced but evolved for reasons other than language and were then co-opted. Note that we might ultimately be forced to conclude that some features not universally found are indeed only used for language, and therefore should be considered part of UG. But simply because we don't yet understand how children could learn some specific set of features does not license us to condude that all features must be part of UG. Each feature may well have its own evolutionary explanation (in fact, this is by far the most likely possibility). It is imperative that one recognize that each feature must be judged on its own merits, and no single feature can decide the issue for grammar as a whole.

With these principles in mind, what exactly does UG look like? Given that formal theories of grammar have been (and still are) in a constant state of flux, it makes no sense to outline a particular theory here. Doing so would assume that a particular theory has been shown not only to be adequate (i.e., explains all the data), but is also correct (i.e., is actually used by humans). Since there is no such theory at present, we are limited to examining substantive universals. A list of such universals can be gleaned from Bickerton (1990) and Pinker and Bloom (1990). Pinker and Bloom (1990) suggest that their list outlines "the building blocks of grammar that all theories of grammar posit either as an explicit inventory or as a consequence of somewhat more abstract mechanisms." (p. 713). Some of these features are clearly related to one another and therefore probably do not require separate explanations, as I will argue later. In addition, Pinker and Bloom note that they consider their list only a partial one, "... focusing on sheer expressive power" (p. 714). They leave out "... the many syntactic constraints and devices whose structure minimizes memory load and the likelihood of pursuing local garden paths in speech comprehension, or to ease the task of analysis for the child learning the language" (many citations omitted; p. 714). Since these have obvious functional explanations, their existence in languages does not require an innatist explanation, except insofar as memory loads (and other non-language-specific cognitive functions) are innately specified. Of course, the extent to which any published list can be considered exhaustive is irrelevant to the question of whether *these* universals (which we are safe in assuming are the most uncontroversial and important in language) are better explained by emergent or innatist models of syntax evolution. At the same time, even if all these features can be explained by emergent evolutionary models, this says nothing about other features not outlined here. One would assume, however, that such published lists would include the most clear and convincing evidence of innatist explanations (Sampson, 1997).

The actual proposed characteristics of UG are the following (unless otherwise noted, these features are from Pinker and Bloom, 1990)

(A) It has a hierarchical structure. This is inferred from the fact that grammatical rules apply in a hierarchical manner to parts of a sentence. For example, "Singing makes John sad and Jennifer happy." We know that "singing" refers to both John and Jennifer, but "sad" refers only to John and "happy" refers only to Jennifer. This demonstrates not just that different words in a sentence can be reliably associated with different components of a sentence, but that some apply to many components, while others only refer to a single component. This is the essence of a hierarchical structure.

(B) Its rules are "structure dependent". This is a specific term used to indicate that rules apply to structures within the hierarchy, they do not apply in any simple manner to surface features of a sentence. Crain (1991) uses the following example. English grammar contains rules governing the construction of Yes/No questions from statements. From statement (1) below we can derive a Yes/No question by moving the first verb (in this case, "is") to the beginning of the statement, as in (2):

    (1) John is tall
    (2) Is John tall?

    This simple rule works in a large number of cases. However, when faced with a statement such as (3) below, we would end up with an unacceptable sentence (4) if we follow this simple rule literally. Instead, we recognize that the first verb encountered is actually part of a subordinate phrase, and that the movement rule applies only to the verb found in the main phrase, such that sentence (5) is the correct transformation in this case:

    (3) The man who is running is bald
    (4) *Is the man who running is bald?
    (5) Is the man who is running bald?

(C) All grammars entail rules which specify how lexical categories ("noun," "verb," "adjective," etc.) are arranged in the surface structure of a sentence such that it is possible to distinguish these categories in the speech string.

(D) Lexical items by themselves only represent abstract general categories, and must be combined with various affixes and phrases to create "major phrasal categories" (i.e., "noun phrase", "verb phrase," etc.), which actually refer to the specific events, things, states, locations, etc..

(E) Phrases are combined according to a set of rules (i.e., "phrase structure rules") which allow the hearer to decode the underlying relationships between phrases, and hence the underlying meaning intended by the speaker.

(F) Mechanisms exist with allow the hearer to distinguish among various possible argument relationships between the constituent phrases of a sentence. Word order is often used (as in English: "Car hits boy" vs. "Boy hits car"), but some languages use case markings instead of (or in addition to) word order.

(G) Devices exist that serve to indicate when a particular action occurred in relation to the present. English uses verb affixes, but many languages do not (e.g., various Chinese dialects).

(H) Verbs can be divided into three classes according to the minimum number of arguments they take (See Bickerton 1990). For example, sleep requires only one argument: "[someone] slept," whereas give requires three: "[someone] gave [something] to [someone]."

(I) "Auxiliary" devices allow one to convey relations such as truth value, modality and illocutionary force (Steele et al. 1981). These devices appear as either verb auxiliaries or they occupy predictable locations in the sentence.

(J) Mechanisms exist which allow the speaker to indicate the relationships between propositions in cases in which one proposition is an argument of another.

(K) Constructions exist which allow the speaker to refer to a specific entity simply by specifying its role within a proposition.

(L) Anaphoric lexical items (e.g., pronouns) allow the speaker to repeat a reference to something without having to repeat the entire noun phrase.

(M) Mechanisms exist which license the omission of repeated phrases

(N) Mechanisms exist which allow the fixing of a "tightly constrained co-occurrence pattern between an empty element.., and a sentence-peripheral quantifier." (p. 714).

7. Explaining UG

How can these features be explained without recourse to syntax-specific language modules? The remarkable thing about this list is that UG is characterized not by specific devices used to accomplish a particular communicative goal. I have used the phrases: "Mechanisms exist ..." or "Devices exist ..." to introduce several of the universals listed above. This must be done because the actual mechanisms/devices/constructions used vary tremendously across languages, and for this reason are not even listed by Pinker and Bloom (1990) and Bickerton (1990). The specific mechanisms/devices/constructions used by languages to communicate one of these goals are therefore, by definition, not part of UG. To the extent this list is exhaustive of the key elements of UG, it would appear that UG may be characterized simply by the fact that *some* kind of device exists to accomplish a particular type of communication.[10]

The goal here is simply to point out that the substantive universals of UG with the broadest support among innatists are in fact nothing more than simple descriptions of aspects our semantic universe, and in fact are not rules in the traditional sense of the word at all. The central thesis here is that the *specific ways in which different languages accomplish the task of successfully communicating these se-*

mantic universals are just invented conventions – they must be invented because they differ so much from language to language.

A clear example of the extremely general nature of this list of UG can be seen in feature F. The specific use of word order to communicate argument relationships among phrases is not a characteristic of UG, since some languages use case markings instead. Rather, the characteristic of UG alluded to in feature F is simply that argument relationships among phrases are made clear. If we are trying to explain the evolution of this feature, therefore, the question is not "Why did languages evolve *to use word order* to mark argument relationships?" but instead becomes, "Why did languages evolve to mark argument relationships?" These are two very different kinds of questions, and they require two very different evolutionary explanations.

Features of UG which only require answers to general questions (like "Why did languages evolve to mark argument relationships?") can be easily explained with reference to constraints that are imposed by the nature of reality or by logical necessity. If language is a mechanism for communicating features of our reality (regardless of the ontological status of this reality), it must be able to codify those features of our existence that are important to us. If it did not, we would not call it a language. The point here is that these features do not, in and of themselves, indicate that they must be the result of an innate syntax module. For example, when new semantic categories are created, natural languages invent ways to describe these things. Radios did not exist 100 years ago, but we invented an arbitrary pattern of sounds that serve to signify these devices. An analogous process has occurred with respect to grammatical devices. In fact, a significant portion of the syntax of a given language is obviously NOT genetic (see Section 8 below) and was necessarily invented. The question is, exactly how much of syntax can be considered essentially cultural inventions (or "emergent," as in Hopper 1987), and how much must be innate? No one would want to argue that *all* aspects of syntax must be innate simply because the acquisition of some *specific* features are not easy to explain otherwise.

The explosion during the course of human evolution in the number and diversity of semantic categories that hominids were able to process, as documented above, created a need to specify relationships among these categories in an increasingly sophisticated manner (Savage-Rumbaugh and Rumbaugh 1993). Note that even if there actually is a grammar specific module in the brain, semantic evolution must still have occurred first. If a grammar module evolved first, but did not have a linguistic need to fill, then it could not have arisen by natural selection for language. If natural selection is causally implicated, then the need (or benefit, if you prefer) must have appeared *before the grammar module evolved*.

It is of course true that just because various syntactical devices are obviously useful for communication, it does not follow that they consequently *must* exist. However, it is equally true that their existence cannot therefore be used as evidence favoring innateness over emergence, since emergence predicts that, if useful (and if devices are in fact possible given the nature of the semantic characteristics involved), they will be invented (in the sense discussed at the end of Section 4 above). To insist that usefulness is not an explanation for the evolution of some feature is to misunderstand not only the evolutionary process but also emergent explanations. This argument is akin to suggesting that the demonstrable usefulness of vision in certain organisms does not help explain the existence of eyes in those organisms. More fundamentally, usefulness *does* explain the existence of features that are the result of emergence.

Furthermore, the fact that not all conceivable features of our semantic universe are coded grammatically does not constitute an argument for innateness either. There are all sorts of reasons why we should expect some aspects to be coded, and others not, that do not require innate grammar modules. All languages distinguish "actor" from "acted upon", even though none (to my knowledge) obligatorily code the smell of the actor. Why? Because the actor/acted-upon distinction is more fundamental (semantically) across more contexts than is the smell of the actor. Emergent explanations predict that languages will grammatically code those semantic features most consistently important and fundamental to our understanding of the things (events, interactions, etc.) that are not already intrinsic to the nouns in a sentence, but for which we nevertheless find useful to communicate to others (there may of course be redundancy, such that individual lexical items and grammar code the same property, but this also follows from an emergent perspective).

How did the multitude of grammatical forms used around the world actually come to find themselves in different languages? This is analogous to asking how all the various ceremonies that mark the union of a male and female across the cultures of the world came into existence. The answer to this question is in general unknown, but our ignorance of the particulars in no way requires us to believe that there must be an innate "marriage module" in the brain. Exactly the same argument can be made for syntax.

Let us examine closely each of the proposed features of UG listed above and see how many of them can be explained as reflections of our semantic universe.

(A) **Hierarchical structure.** Bickerton (1990) does an elegant job outlining the similarities between the structure of language and of many other aspects of our nature, such as our social structure and the way we perceive reality. His conclusion, however, is that human language is the *cause* of these parallels. In effect, he believes that language is causing us to see the world, and to organize the world, in a hierarchical way.[11] This, from an evolutionary perspective, puts the cart before the horse. How can we be sure that the similarities are not due to some common causal factor external to language and these other systems? How can we be sure, without accepting what we are trying to prove, that the causal arrows do not point in exactly the opposite direction, such that the hierarchical structure of language is caused by our perception of reality, rather than the other way around?

Simon (1962) has pointed out that, "On theoretical grounds we could expect complex systems to be hierarchies in a world in which complexity had to evolve from simplicity" (p. 134). The evolution of hierarchical systems becomes increasingly probable as the level of complexity of the resultant systems increases. This is due both to the fact that hierarchical systems are composed of stable sub-systems as well as to the fact that evolution is driven by natural selection. A half-complete, non-hierarchical arrangement will necessarily be at a selective disadvantage in competition with another arrangement that is, by definition, already functional at some lower level of complexity. This is, of course, why evolutionary explanations of complex systems that argue for the modification of existing systems (as opposed to the spontaneous creation of entirely new systems) are inherently more likely.

Simon's (1962) argument was apparently first used to explain the evolution of the hierarchical structure of language by Sampson (1978, 1979, 1980) where he showed that hierarchical organization is exactly what one would expect if we assume that language evolved from simpler phrases to more complex ones, without requiring us to posit any innate structures (even semantic ones) at all. Wang (1984) makes a similar point (see also Schoenemann and Wang 1996). What about examples such as [[The dog] barked], which has the hierarchical structure as indicated? Wouldn't one expect a child to start with simply [Dog bark], and then move incorrectly to [The [dog barked]? We would not, because the word "the" never occurs independent of a noun (which is a particular category of semantic unit – see below), while "dog" frequently occurs independent of "barked". This difference occurs for semantic reasons, not necessarily because of any feature of syntax.

To Simon's argument we can add a related one that since language serves to communicate information, we should expect it to be able to reflect reality as accurately as possible, and it is therefore not surprising that language shows structural similarities to other aspects of the world. Language structure itself would appear to be iconic at some level (Haiman 1985a, 1985b; see footnote 5). Iconic signs are easier to learn than arbitrary symbols because they have some direct, obvious connection to the thing they are referring to. Since language is fundamentally about communicating aspects of our reality, we should expect that it reflect that reality. Recall again that if syntax truly evolved by natural selection, we must believe that new semantic conceptualizations of the world *must necessarily have evolved prior to the evolution of the syntactical devices which allow us to codify these semantic concepts* since there would otherwise be no selective reason for any given syntactical structure to exist. Given that the world is hierarchically organized (or at the very least that we have evolved to conceptualize the world hierarchically) should we not also expect the syntax of our languages to reflect this? Notice that this particular argument does not depend on there being an objective reality external to human cognition.

(B) **Structure dependency.** Crain (1991) calls structure dependency "The parade case of an innate constrain ..." (p. 602). Recall that structure dependency refers to the fact that the rules of syntax operate not on simple surface features of a sentence, but rather on units, or phrases. This follows from the fact that grammar is hierarchically organized (a language that is not hierarchically organized cannot be structure dependent). Phrases encapsulate specific concepts, ideas, relationships, things, etc. That is, phrases code specific semantic units, or "packets of meaning." The existence of structure dependency makes perfect sense given that we are trying to convey information about relationships among specific semantic units. It is possible to devise a grammatical system which states that the first verb is always moved to the front to change a statement into a question, but it would require that we ignore the semantic unity of individual phrases, as well as the hierarchical nature of how we conceptualization the information we want to communicate. If we look closely at the examples given above (sentences 3 through 5, repeated here for convenience), this will become clearer.

(3) The man who is running is bald

(4) *Is the man who running is bald?

(5) Is the man who is running bald?

Clearly, the phrase "The man who is running ..." is a single, subordinate semantic unit (subordinate to the main phrase "The man is bald"). That is, to form sentence 3 we must have in our minds a running man. To inquire about his baldness, it makes no logical sense, from a semantic standpoint, to disrupt the phrase that indicates a completely different characteristic, one which differentiates him from other (presumably non-running) individuals we could possibly be inquiring about. It makes much more sense to take the "is" out of the phrase that relates specifically to the issue we are asking about. Now it is true that we must first know some syntax to understand what is meant by "The man who is running ...", but this has the order of events backwards: we must necessarily have a semantic idea in mind (e.g., a running man) before we construct any sentence about that idea. Since semantic units and ideas must have evolved prior to syntax (and must exist prior to any speech act), we should *expect* structure dependency.

Given the general processing limitations (not specific to language or syntax) of the human brain, some symbolic systems are likely to be more efficient than others for conveying relational information. Consistent with this, there is a large body of evidence indicating that syntactical structures are affected by – and make sense in light of – these general cognitive processing limitations (e.g., Bever 1970). Structure dependency is simply another example of this: it limits the fragmentation of semantic units and therefore limits the amount of cognitive processing involved in unraveling the underlying semantic units. We should not be surprised that the actual rules used in English or any other language makes minimal demands on our existing cognitive systems by leaving semantic units intact. Because relational information is an important part of the cognitive architecture of human semantics, we invented (in the sense described at the end of section 4) simple ways to convey this information.

Pinker, in his latest book, describes an experiment by Crain in which young children demonstrate that their syntax follows structure dependency. He argues that a semantic explanation, such as I have outlined here, cannot explain how children would be able to respond correctly to a command like:

"Ask Jabba if it is raining in this picture."

Their response was:

"Is it raining in this picture?"

Pinker writes: "The *it* of the sentence, of course, does not refer to anything; it is a dummy element that is there only to satisfy the rules of syntax, which demand a subject." (p. 42)

But is it Pinker's own particular theoretical model of *syntax* that demands a subject, or is it our semantic conceptualization of the world? The word "it" is a dummy element in this sentence *only* we assume that nothing is causing the rain to occur. Is there really nothing causing rain? Perhaps not, but we certainly do not conceptualize our world in this way. Pinker further objects that children correctly move subjects that aren't things, such as with the following request:

"Ask Jabba if love is good or bad."

To which the children respond:

"Is love good or bad?"

This example, however, does not constitute a refutation of the idea that syntactical rules will obviously operate at the level of already formed semantic units. Love is, conceptually, a self contained, meaningful unit (it makes no difference whether or not this is true independent of language – the argument only requires that it be true independent of syntax). Of course the children would move the verb in front of it to form a question. The argument is *not* that children do not follow simple rules, but rather that there is nothing surprising about the fact that these rules operate on groups of words which form complete semantic units (regardless of the ultimate ontological status of these semantic units).

What about sentences with other subjects that are even less obvious, such as in the following request:

"Ask Jabba if there is a snake in this picture."

To which the children answer:

"Is there a snake in this picture?"

Now in this case, it is true that the word "there" has a more subtle meaning than words like "it" or "love" in the previous examples, but does it really have no meaning? Perhaps. However even if this really is the case, this sentence does not demonstrate structure dependency because there is only one verb to be moved ("is"), and there is only one thing (the word "there") for it to be moved ahead of. Again, the problem with these supposed counter-examples is that they miss the point. The alternative model does not argue that children are not following rules, but simply that the rules will obviously operate at the level of already formed semantic units. If in a few cases the semantic units are not clear (as with "there") it does not follow that *no* rule will be followed under the semantic complexity model. Rather, we should expect that people will try to apply the rules established in sentences which have clear semantic units (i.e., the majority of sentences) to the few cases in which are ambiguous.

It is crucial to understand also that there are semantic units within semantic units. Thus, the argument is not that syntactical processes always leave semantic units intact, but rather that when they break up semantic units, they will do so in a way that minimally divides semantic subunits.

Structure dependency, therefore, can be explained simply by reference to the fact that language structures were invented (though not necessarily consciously) to mimic our semantic conceptualization of the world. Viewed from the perspective of human semantic capabilities, structure dependency is not an arbitrary, complicated feature that can only be explained with some sort of innate constraint specific to syntax. Because Chomsky and others completely sever syntax from semantics on theoretical grounds at the outset, they cannot see the connections. Recall also that Chomsky's formalism makes no *a priori* predictions (Sampson 1979). It would be as consistent with the possibility that language is *not* structure dependent as with the empirical finding that it is. The present model, by contrast, specifically predicts structure dependency, and must be favored for this reason (Sampson 1979). Structure dependency may well be an innate constraint, but only because of the innateness of *semantics* not because of the innateness of syntax *per se*.

(C) **All grammars entail rules which specify how lexical categories ("noun," "verb," "adjective," etc.) are arranged in the surface structure of a sentence such that it is possible to distinguish these categories in the speech string.** Why should all grammars have rules which allow the hearer to distinguish different lexical categories in the speech string? The alternative would be a situation in which all lexical categories are indistinguishable, but this would mean that the complexity of our mental world would not be expressible. The *entities* that nouns stand for really are different than the *actions* that verbs stand for. I find it at least plausible that this conceptualization of reality has some innate influences. But regardless of the ontological status of semantics, it is entirely understandable that we would invent rules that allow us to communicate these aspects of our reality. This feature of UG, therefore, does not require an innate grammar-specific module to explain its existence.

(D) **Lexical items by themselves only represent abstract general categories, and must be combined with various affixes and phrases to create "major phrasal categories" (i.e., "noun phrase", "verb phrase," etc.), which actually refer to the specific events, things, states, locations, etc.** Why should lexical items represent abstract general categories, such that they must be combined with various other lexical items to refer to specific things? The answer here is that the categories that any organism creates must necessarily be general. If they were not general, each animal would not be able to survive, since it would not be able to make predictions (which are based on generalities) about whether a certain item could be eaten, might be dangerous, might be safe to walk on (if it is a branch), or whether any number of other critical generalizations about the outside world are true. Such an organism would have to interact blindly with each and every individual entity it comes across during its entire life. No such organism exists. We should, in fact, be surprised if we found the opposite, in which lexical items by themselves represented only specific, single entities.

What about the fact that lexical items must be combined with various affixes and phrases to make phrasal categories? This is not an argument for innateness because it follows directly from the fact that lexical items by definition refer to abstract quantities. There must, therefore, be some method to allow specific information to be communicated. The fact that the specific methods used to accomplish this vary from language to language is evidence that the methods themselves are not genetic, even if we wish to maintain that the need to specify is innate.

(E) **Phrases are combined according to a set of rules (i.e., "phrase structure rules") which allow the hearer to decode the underlying reIationships between phrases, and hence the underlying meaning intended by the speaker.**

(F) **Mechanisms exist with allow the hearer to distinguish among various possible argument relaionships between the constituent phrases of a sentence.**

(G) **Devices exist that serve to indicate when a particular action occurred in relation to the present.**

(H) **Verbs can be divided into three classes according to the minimum number of arguments they take.**

(I) **"Auxiliary" devices allow one to convey relations such as truth value, modality and illocutionary force.**

(J) **Mechanisms exist which allow the speaker to indicate the relationships between propositions in cases in which one proposition is an argument of another.**

These can also be explained as simple reflections of our semantic universe. Why should languages find it important to convey relationships among "meaning units" (i.e., phrases), indicate argument relationships, indicate the temporal aspects of actions, require different numbers of arguments for different types of actions, convey truth value, modality, or illocutionary force, or make clear the relationships between propositions in which one proposition is an argument of another? The answer is that languages invented mechanisms to allow us to communicate these things because these are features of our reality that are important to us. The evolutionary explanation for the existence of these features in all languages therefore lies within our perception of the world around us, not in an independent, innate grammar module.

As an example, let us focus on one of them that is particularly instructive: Feature H (Verbs can be divided into three classes according to the number of arguments they take). Bickerton (1990) believes that these are not logical requirements demanded by the real world. His reasoning is that one can think of more numbers and types of roles than are actually used (why don't we use: "[someone] slept with [someone]" in the same obligatory sense as we have to say: "[someone] took [something]?"). He believes this indicates that the categorization of verbs into number of required arguments is arbitrary and therefore cannot be an objective reflection of reality. Bickerton is correct that there are potentially more aspects of reality that could be attached to a particular verb than are actually required by languages, but this does not constitute evidence that verb arguments are somehow innately given by way of a grammar-specific module. Given the semantic meaning underlying each verb, the number of arguments it requires is perfectly consistent with our perception of reality.

Bickerton (1990) maintains that the roles assigned to verb arguments are high-order abstractions and for this reason are "... certainly not given by nature ..." (p. 186). This statement implies that reality can only include individual, concrete objects, like rocks or bodies of water. From an evolutionary perspective, however, this is clearly incorrect. If a bobcat (a 'real' object) races toward an immature rabbit (also a 'real' object), the rabbit is in danger of attaining a fitness of zero. The rabbit's fitness is, of course, a higher-order abstraction, but it is also a reality, which is why rabbits run from bobcats. Bickerton himself notes that a species view of reality "... cannot stray too far from the surface of things-as-they-are. If it did ... the creature would quickly starve or be killed and eaten" (p. 247). He does not explicitly apply this logic to humans, but it is obviously no less true for us as well.

(K) **Constructions exist which allow the speaker to refer to a specific entity simply by specifying its role within a proposition.**

(L) **Anaphoric lexical items (e.g., pronouns) allow the speaker to repeat a reference to something without having to repeat the entire noun phrase.**

(M) **Mechanisms exist which license the omission of repeated phrases.**

Features K, L, and M are simply devices which allow us to simplify the signal so that it is less repetitive (i.e., they take advantage of our short term memory systems). The usefulness of not having to repeat portions of a signal are obvious. They take advantage of the fact that a particular entity (e.g., "John") has already been called to mind (evoked) by either a prior sentence, or a prior part of the same sentence. Bever (1970), for example, showed that at least some of the rules of pronominalization can be explained with simple reference to the fact that pronouns must be clearly connected with their referents. For example, in the sentence:

(6) "He played pool after John went home."

the pronoun "he" cannot refer to John, whereas it may (or may not) in the following sentence:

(7) "John played pool after he went home."

What about the sentence (Bickerton, personal communication)?

(8) "After he went home, John played pool."

In this case, "he" can refer to either John or someone else, depending on context. Therefore, it is the context that determines who "he" refers to, not syntax at all. However, why cannot the "he" in sentence 6 refer to John, when it can in sentence 8? The explanation lies in the fact that the word "After" at the beginning of sentence 8 tells us that the initial phrase is dependent on some information to follow, which allows us to accept that the pronoun "he" that follows may also be dependent on the main clause. There can be no such explanation in sentence 6. These examples demonstrate that context and word meanings are the determining factors of how we interpret who pronouns refer to, not syntax. These features simply do not require separate syntax modules for explanation.

(N) **Mechanisms exist which allow the fixing of a "tightly constrained co-occurrence pattern between an empty element – and a sentence-peripheral quantifier."**

The idea of empty elements, and their constrained location, follows directly from the fact that in related contexts they are not empty (Wang, personal communication). Hence the existence of empty elements is not evidence for innateness since, again, emergent explanations predict the same phenomena.

In conclusion, it would appear that every single aspect of the proposed "syntax module" in the list above is either a reflection of our semantic universe, or a shortcut that allows us to simplify the speech signal. While innatists insist that this doesn't explain the existence of these universals, they are mistaken. To the extent that this list of universals is exhaustive (which is something only linguists can answer), the innate constraints which guide children the world over in their acquisition of language would appear to be constraints on how we perceive and organize our reality, *not* constraints on the kinds of rules or grammatical structures we can learn. The evolution of the features of syntax listed above can be reduced to the evolution of semantic complexity, which led people everywhere to invent devices that allowed them to communicate this semantic complexity (c.f., Savage-Rumbaugh and Rumbaugh 1993). Other features may be found that cannot be explained in this manner, but even if such features exist, they cannot speak for those listed here. No single feature can possibly decide the issue for all of grammar.

8. Much of Syntax is Demonstrably not Innate

The idea that syntax is not innately given is quite reasonable when viewed in light of the vast set of linguistic features, grammatical and otherwise, which demonstrably cannot be innate. To start with the obvious, each language has different patterns of sounds for different semantic units: The specific sequences of sounds which correspond to a given concept is different in different languages. Each individual child must of course learn the correct pattern of sounds that matches up with the correct cognitive category, for each of more than 40,000 different concepts. As I pointed out above, human children are very adept at learning to associate a huge number of arbitrary sound patterns to semantic units. This *ability* may well be innate, but the particular sounds that signify particular semantic units are obviously not innately given.

Similarly, there are a number of features of syntax that are not innate. Different languages order the subjects, objects, and verbs in a sentence in different ways, for example. English is a subject-verb-object language, but practically every other possibility is known among languages around the world (Steele 1978). The particular order the child has to learn is therefore not genetically encoded. Even the use of word order is not strictly essential, though it apparently is used to convey at least subtle differences in meaning even in languages without strict word order. Some languages, like Latin, are so highly inflected that word order is not necessary to convey information about the argument structure of the sentence.

Irregular verbs, in which the "normal" tense rules are not followed, are another example of grammatical features that must simply be learned. The rule in English for indicating past tense involves adding the suffix "-ed" to verbs (e.g., "walked," "cooked"). However, Vargha-Khadem, et al. (1995) note that the *majority* of verb tokens used in everyday speech are actually irregular (e.g., "ran," "flew"). Each of these must be learned independent of the grammatical rule.

That much of grammar is not innately given can also be seen from the well known and apparently widespread phenomenon of "grammaticalization," (as mentioned above) in which words with concrete meanings gradually lose their concreteness and become purely grammatical in function (Hooper and Traugott 1993). Also noted previously was the fact that many grammatical features appear to be designed with our cognitive limitations in mind (Bever 1970). Note also that historical changes in syntax have been clearly documented (see, e.g., Ogura 1993, Traugott 1972).

Add to all of this phrases that the linguist William Wang (1991a) calls "language pre-fabs," which are linguistic units stored and used as wholes. Examples would include cliches, proverbs, idioms, slogans, maxims, and so forth. While these prefabs usually follow the standard grammatical rules of the language, they are not independently constructed each time they are spoken. This means that knowing when they are appropriate to use, and knowing what their true meanings are, and even learning the prefabs in the first place, does not require innate grammar modules.

While we do not know the details of how these learned features of syntax were invented in the first place (or even if they were conscious inventions), even the most die-hard innatist would agree that most of the specific features of syntax in any given language are not innately given. This fact, along with the fundamentally semantic nature of UG, undermines the argument for an innately given syntax module. Since evolutionary change is most likely to occur first at the behavioral level (principle 3), we must explain as much as possible on the basis of such learning before leaping to the conclusion that syntax must be coded separately in our genes.

9. The Learnability Problem

A common argument for innateness comes from the apparent lack of negative evidence that children receive from their linguistic environment (e.g., Bowerman 1988). That is, children are not consistently corrected for speech errors (Brown and Hanlon 1970) and rarely pay attention even when corrected (McNeill 1966). If we make the assumption that children learn language by testing hypotheses about what constitutes the formal structure of their language, this lack of negative evidence makes it extremely unlikely that they will be able to come across the correct hypotheses in a finite amount of time (Gold 1967).

However, this learnability argument applies equally to regularities which are specific to certain languages (and are therefore not innate) but which are learned nevertheless (Bates et al. 1991). The learnability problem holds for *any* acquisition process in which negative evidence is lacking (Regier 1996). For example, children are presumably only exposed to positive examples of the referents of spatial words (such as “above”, “on”, “outside”, “off”, etc.), yet somehow learn from a finite number of specific positive examples exactly how other speakers delimit the meaning of these words, without over-generalizing (Regier 1996). Since children do in fact learn the correct meanings of words using only positive evidence, unless we posit that word meanings like “outside” are innately given, the model of language acquisition that led to Gold’s proof must be in error. Since rule systems that are obviously not innate are learned, there is no basis for assuming that aspects of UG cannot be learned. Even Chomsky (1981) himself points out that a type of negative evident is available to children:

> ... a not unreasonable acquisition system can be devised with the operative principle that if certain structures or rules fail to be exemplified in relatively simple expressions, where they would be expected to be found, then a (possibly marked) option is selected excluding them in the grammar, so that a kind of ‘negative evidence’ can be available even without corrections, adverse reactions, etc. (p. 9).

Thus, children would still be creating and testing hypotheses, but they would be using, in effect, a general parsimony principle to greatly limit their search (note that this principle is not a part of syntax, *per se*). That is, they would have to notice that certain forms are not used, even without being explicitly told.

Such a model circumvents the learnability problem. Furthermore, Regier (1996) has demonstrated that such a model can be operationalized using a neural network designed to learn the meanings of basic spatial terms. The learning algorithm uses the concept of “mutual exclusivity,” wherein positive evidence for the meaning of one spatial word (e.g., “outside”) is taken as weak negative evidence for the meanings of other spatial words (e.g., “on”, “above”, “off”, etc.). His model correctly learned the meanings of such spatial words when trained only with positive examples. Thus, it simply is not the case that if there is an absence of negative evidence during learning, there must therefore be innate structures specifically defining those exact features.

Regier (1996) notes that the concept of “mutual exclusivity” actually comes from the field of child language learning (see, e.g.. Markman 1987). A number of other general cognitive features would appear to facilitate language acquisition as well (Bates et al. 1991). For example, imitation is a general feature of human behavior (though its existence in monkeys is questionable; Visalberghi and Fragaszy 1990). Bates et al. (1991) point out that this leads naturally to the desire to imitate language, which in turn requires that the child be able to associate a pattern of sounds with a particular semantic context. This, of course, facilitates the process of hypothesis formation by ensuring that the child has the raw data to tease out the patterns (i.e., grammatical rules) implicit in language. A number of other social-motivational factors greatly facilitate language acquisition by narrowing the range of possible meanings associated with a given set of speech sounds (Bates et al. 1991; see also Savage-Rumbaugh and Rumbaugh 1993).

Fundamentally, however, the argument for nativism based on the supposed learnability problem depends critically on a specific formal model of grammar that emphasizes a complete separation between syntax and all other aspects of cognition. There is, however, no *a priori* reason to believe this, and good evolutionary reasons to reject it. Until it is shown that alternative grammatical models denying the strict independence of syntax *cannot* work, are invalid, or are unworkable, the argument for nativism based on formal models of grammar has no force. O'Grady (1987) outlines an approach which explains syntax as a natural outgrowth of basic (and probably innately influenced) semantic contrasts. Similarly, Langacker (1987) has proposed a model of language which claims that syntax and semantics are in principle inseparable: "... grammar is symbolic in nature, consisting in the conventional symbolization of semantic structure," (p. 2). These alternative models are completely consistent with the observation that the proposed features of UG – features which ironically are derived from a research program which insists on the separation of syntax – are in fact fundamentally semantic in nature. When viewed from an evolutionary perspective, highly formalized models that insist on the complete independence of syntax from semantics are simply not the default hypotheses.

10. Grammar Genes

What about evidence for so-called grammar genes? There is, in fact, no evidence that *any* specific grammatical devices are innately given, except insofar as they depend on our semantic conceptualizations that may well have a significant innate component. It now appears that a family in Canada described by Gopnik and Crago (1991), which supposedly showed a specific deficit in morphosyntax, actually suffers from a broad range of problems, many of which are not related to syntax (Vargha-Khadem et al. 1995). They have on average a verbal IQ 19 points lower than non-affected family members, they have pronounced impairment in articulation, and have difficulty copying arbitrary orofacial sequences. By definition, since their linguistic deficits do not occur in isolation from other important aspects of brain function, they cannot be considered definitive evidence of completely independent, innate syntax modules in the brain (even if they are consistent with this view).

The belief that these individuals support the view of an innate syntax module also suffers from the finding that, contrary to the initial report by Gopnik and Crago (1991), 41% of the morphosyntactic errors the affected individuals make are actually consistent with the syntactic rules regarding inflection for tense in English (Vargha-Khadem et al. 1995). Recall that the most commonly used English verbs often do not follow the regular past-tense "-ed" rule. Thus, these individuals with this supposed faulty "grammar gene" must actually know the rule, and must be apply it productively, else they would not make so many errors which are consistent with it in the first place (Schoenemann and Wang, 1996; Sampson, 1997, also makes this point).

Even more fundamentally damaging, however, is the fact that the specific form of morphosyntax thought to be deficient in these SLI individuals (the inability to generate proper verb inflection) isn't even a part of UG to begin with (Schoenemann and Wang 1996). Verb inflection is simply not used in many languages, including, for example, all dialects of Chinese (Wang 1991b). As I have pointed out above, it is extremely unlikely that the evolutionary process would result in selection for multiple features which accomplish the same task, only one of which is subsequently used in any given language. Assuming there actually is a gene specifically for inflection, it most likely evolved for some other purpose, only to be co-opted for linguistic purposes at some later point. We should expect languages to use whatever cognitive devices already exist to accomplish the communication of important features of our semantic universe.

Williams syndrome patients are also often given as probable examples of the innateness of grammar (e.g., Pinker 1994). These individuals are highly retarded (IQ of ~50), but are remarkably verbal, suggesting that language competence can occur in the face of broad cognitive deficits in other realms. However, Bates (1992) has pointed out that they have other spared abilities as well (e.g., face recognition), which indicates that they do not constitute definitive evidence of independent syntax modules. Furthermore, their language competence is not normal. They show impairments of lexico-semantics, morphological feature analysis, and at least some syntactic abilities (Karmiloff-Smith et al., 1998). None of this is inconsistent with the view that syntax is an emergent characteristic of increasing semantic complexity.

Evidence for genetic influences on linguistic ability (e.g., Carroll 1979) are also not inconsistent with the emergent perspective presented here. The argument is not that language completely lacks genetic influences, but rather that these influences are not specific to, and did not evolve for, grammar itself. Thus, the evidence for genes specific to given grammatical devices is extremely weak. But in any case, even if there was such evidence, it would have implications only for that specific grammatical device, and not for grammar as a whole. Concluding that grammar is the result of an innate brain module on the basis that a few features might be genetic would be akin to suggesting that reading is innate because certain aspects of our visual systems are wired at birth.

11. Conclusion

The hypothesis that syntax is a separate, species-specific "language module" is highly dubious from an evolutionary perspective. We cannot ignore the fact that language, as with everything else, has an evolutionary history. Given this, we must be guided in our understanding of its evolution by a recognition of how evolution works in general. All evolutionary hypotheses are not equally likely. The emergent hypothesis outlined here is consistent with all the basic principles governing the evolutionary process, explains the same facts equally well, and is much more parsimonious than models postulating the evolution of an innate, grammar-specific module.

The features of UG which have been so far proposed are so general in nature that they do not resemble rules, but instead are simple descriptions of our semantic conceptualization of reality. Because syntax varies so much across languages, we know that huge portions of syntax are not innate. There is no evidence that any portion of syntax is innate, in the sense of being the direct result of some sort of "syntax module" or language genes. Given our current understanding of how language works, there is no reason to suppose that syntax is anything other than conventionalized (i.e., invented) rules that allow languages to accurately communicate human semantics (the features of which may or may not have innate components). This model also makes moot the controversy over whether or not apes can master any basic ingredients of the syntax of natural languages. Even if they cannot, we would still not require a separate evolutionary explanation for syntax other than a dramatic increase in semantic complexity over what they already demonstrably possess (see Snowdon 1990; Savage-Rumbaugh et al. 1993, for reviews). There may well be innate constraints that guide the acquisition of syntax, but these constraints are not specific to syntax, nor did they evolve (in the genetic sense) *for* syntax.

This conclusion of course applies only to the substantive features of UG that are currently generally agreed on. It is possible that this list is incomplete, and that there are some specific grammatical devices which should also be considered part of UG. It is incumbent upon those who argue that UG is more than just a description of our semantic universe to document the existence of such UG features that cannot be explained this way. These features could then be evaluated when and if they are documented. But regardless of the ultimate status of any possible new features, their explanations would be logically independent of (and would not affect) the explanations for the features listed here. Thus, it makes no logical sense to claim that "syntax is innate" simply because some aspects might prove to be.

If we look at human behavior it is clear that humans have a much richer set of semantic categories than sea anemones, frogs, and apes. We also have much more complex interactions with the external world. This world includes other complex humans with whom we must interact with in order to survive. At the same time, we have brains that are much larger than are necessary to maintain bodies of our size. This size increase most likely relates to the difference in the degree of richness of our mental worlds (Jerison 1985). There is no reason why we must assume a qualitative difference (in the sense of some fundamental change in the way humans use symbols) to explain this difference in the richness of our semantic worlds, or in the use of syntax.

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Notes

[1]Syntax is a part of grammar, but grammar also includes other language rules, such as knowledge of which sound patterns (or hand movements, in the case of sign language) connect with which semantic units (i.e., the meanings of words), for example.

[2]Darwin, like his contemporaries, did not understand the mechanisms of inheritance. He did argue that heritable variations with beneficial effects would be passed on, but he increasingly embraced the idea of the inheritance of acquired characteristics. For example, nine years after The Origin of Species he wrote: ‘The fertilized germ of one of the higher animals, subjected as it is to so vast a series of changes from the germinal cells to old age, ... is perhaps the most wonderful object in nature. It is probable that hardly a change of any kind affects either parent, without some mark being left on the germ.’ (Darwin, 1868, p. 35)

[3]One interesting example (pointed out by, among others, Lenneberg 1967 and Dawkins 1982) is the recurrent laryngeal nerve in mammals, which on the left side travels from the brain down into the chest, wraps around the aorta, and travels back up to the larynx. This pattern is found even in giraffes, for which the detour amounts to literally yards of extra nerve tissue. The problem is that developmentally the nerve finds its target at a time when the aorta is above the tissue which eventually become the larynx. The easiest and most convenient path at this early developmental stage does not necessarily lead to an efficient adult nervous system, but the costs of rewiring are apparently higher than the costs of simply extending the nerve incrementally.

[4]Bickerton (1990) appears to reject this general claim when he argues that reality is only a useful fiction created by each species. “...We cannot lay claim to *any* knowledge of what reality is really like or even know whether it makes any sense to talk about ‘what reality is really like’ independent of any creature that may observe it” (p. 233, emphasis added). However, Bickerton (1990) also notes that pigeons have been shown to have visual categories for such things as ‘people’, ‘trees’, ‘fish’, and even ‘Snoopy cartoons’ that are essentially the same as our own (Herrnstein 1979). Thus, to some extent at least, human languages and cultures have made use of categories that are ‘real’ to a wide variety of animals. He also later acknowledges that a species view of reality “... cannot stray too far from the surface of things-as-they-are. If it did ... the creature would quickly starve or be killed and eaten” (p. 247). Natural selection ensures that our conception of reality is a reasonable representation of external reality.

[5]In Pierce’s terminology, there are three types of signs. An “icon” is a sign that resembles the thing it stands for, an “index” is a sign that bears some causal connection to the thing it stands for, and a “symbol” is a sign that has only a conventional (arbitrary) connection to the thing it stands for (see Fetzer 1988).

[6]Notice that I am not arguing that these animals have “language,” which is really an argument about definitions.

[7]The more linguistically proficient someone is, the more likely they will have difficulty sensing in themselves that language and thought are separate processes.

[8]"Encephalization" is used here as per Jerison (1973), in which brain size is compared independent of body size differences.

[9]Alternatively, one can always make the non-argument that: "Ross (1977) ... is not a source that any serious syntactician is going to take seriously" (Bickerton, personal communication).

[10]At the 1995 meetings of the Human Behavior and Evolution Society, Steven Pinker responded to this observation by saying that the list he and Bloom (Pinker and Bloom 1990) published was simply an outline pointing to a vast array of specific features. It is curious that in their paper they did not provide even a single specific formal universal feature found across all languages. Pinker did provide examples of features found in at least some languages that he found difficult to explain without recourse to some sort of syntax-specific genes/modules. For example, Kiparsky (1982) noted that compound words can be formed out of irregular plurals, but not regular plurals, and Gordon (1986) showed that young children follow this rule even though they would likely only have heard (from parents, etc.) compounds with singular words. Pinker found it difficult to understand how children could have learned a rule without hearing examples. This is an interesting problem, but since it is not a feature universally found across languages, and isn't even found universally in English (see Sampson 1997!), it cannot be considered a part of UG (for the reasons outlined in the text). A non-innatist explanation for this phenomenon might simply be the following: If children only hear compounds made with singular nouns, they will never hear a final alveolar fricative ("s") at the end of the first word of the compound. Furthermore, irregular plurals in English are often irregular because the singular form already ends in an alveolar fricative (which ordinarily indicates pluralization), and some other distinction must therefore be used to indicate pluralization for these nouns (e.g., "geese" for "goose", "mice" for "mouse", etc.). This means both singular and plural forms of these irregular nouns will end in an alveolar fricative, and therefore using the singular form does not sound any more similar to the typical examples a child hears than the plural form when made into a compound (recall that the argument is that both plural and singular forms of irregular nouns are acceptable in compounds, but only singular forms are allowed in regular nouns). Thus, this peculiar feature does not require anything of the child other than a desire to mimic adult speech, and a memory for past forms. The validity of this proposal is open to question, of course, but the point remains that just because it is not immediately obvious how children might learn some aspect of grammar (or any other feature of human culture, for that matter), we are not licensed to conclude that specific innate structures must be the explanation.

[11]Bickerton (1990) argues, for example, that since human social structure has been rapidly transformed (supposedly too fast for any genetic changes) into a highly hierarchical arrangement starting with the origin of agriculture, and since language is also hierarchically organized (feature A), language must therefore have played a role "... in the creation of a new system of social control ..."

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