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Summary

The ability of human beings to exchange ideas through language is frequently cited as one of the greatest achievements of our species — indeed, one that separates us from other animals. This paper brings together the major arguments put forth in the debate as to whether this uniquely human capacity has evolved by Darwinian natural selection and examines what each position presupposes language to be. By clarifying what it is that we refer to when we consider the evolution of language, it is observed that many of the arguments made are in fact orthogonal to one another. It is imperative that we separate language evolution (the diachronic change in a language) from the evolution of language (the phylogenetic development of the capacity for language). Similarly, we must also distinguish properties of language from properties of *a* language. The question of whether language has evolved in a manner akin to something like the human eye or our capacity for fine motor control is simply not addressed by characteristics of English, or French, or Japanese. The relevant structures to be considered include the innate mechanisms predisposing infants to the acquisition of language the organic components of the brain believed to subserve language functions and the relevant paleontological facts provided by the fossil record. It is hoped that by revealing and debunking misguided arguments, the evidence for language having evolved by natural selection will be seen to be compelling.

Every human being is endowed at birth with the capacity to acquire the language of the social environment in which he or she is raised. How has this uniquely human ability evolved in our species? What contributions can linguistic theory or evolutionary theory make to address the issue? Such questions require a broad interdisciplinary dialogue drawing on expertise from a diverse group of scholars including theoretical linguists, evolutionary biologists, anthropologists and philosophers. Pinker and Bloom (1990) (henceforth P&B) contend "that natural language is no different from other complex abilities such as echolocation or stereopsis, and that the only way to explain the origin of such abilities is through the theory of natural selection" (p. 708). In contrast, such distinguished scholars as Noam Chomsky (1972; 1982a; 1982b; 1988) and Stephen Jay Gould (1987; Gould and Piatelli-Palmerini, 1987) "have repeatedly suggested that language may not be the product of natural selection, but a side effect of other evolutionary forces such as an increase in overall brain size and constraints of as yet unknown laws of structure and growth" (P&B: 708). Thus, the path by which our capacity for language has evolved is not an uncontroversial topic. Unfortunately, attempts to debate the issue have often confused and sometimes confounded three very distinct aspects of the question. This blurring of the issue falls largely out of an unfocused definition of what it is we refer to when we speak of *language* and how *it* evolved.

The present paper is an attempt to clarify what it is that has evolved in order for *homo sapiens* to use language. In particular, we will review claims about the selectional pressures for the development of neural structure in the brain to subserve linguistic competence. Paleontological data about the evolution of brain structures will be introduced in the hope of determining whether the fossil record can provide any evidence that might speak to the issue. First, however, it

will be necessary to distinguish the underlying linguistic competence that characterizes the implicit knowledge every speaker has about his or her language(s) from the innate linguistic knowledge that linguists hypothesize each member of our species to have as part of his or her biological endowment. Furthermore, these must be distinguished from the neural substrate which underlies the mechanisms of language processing. Finally, by refining the definition of what we are examining (i.e., language), it will be demonstrated that the polar claims which appear contradictory are, in fact, not mutually exclusive. Rather, the complex language abilities of our species are quite compatible with an evolutionary sequence of adaptation, exaptation, and natural selection.

Universal Grammar and Linguistic Competence

Within the evolutionary debate as to whether human beings have developed language capacities by natural selection or by some other evolutionary means, the assumption that all human beings are born with a genetically determined innate system for language has not been controversial. Both P&B on the one hand and Chomsky on the other assume all individuals of our species to be endowed at birth with neural mechanisms "hard-wired" in their brains that predispose them for the acquisition of language. Because these innate properties are presumed universally to subserve language (*langage*), irrespective of individual tongue (*langue*),[1] it is generally referred to as "Universal Grammar" or "UG". One current framework of linguistic theory, indeed that founded by Chomsky, centers on an elaborate system of linguistic representation with a finite set of principles and parameters which motivate and constrain the phenomena that distinguish natural languages from one another. *Principles* of UG are universal and, therefore, characteristic

of all natural languages. *Parameters* constitute options made available to grammars that serve to limit the range of variation across languages as well as to constrain the process of language acquisition. Since UG subserves all language, regardless of which particular language is acquired, all languages reflect properties of the principles of UG and properties of specific parameter settings. Consider, for example, a parameter P with two possible settings, A and B. All natural languages will fall into one of the two categories A' or B' (read A-prime or B-prime). The members of the set of languages A' resemble one another with respect to parameter P and distinguish themselves from the members of the set B' based on the same parameter. Likewise, the languages with setting B of parameter P resemble one another, but do not resemble languages with setting A, with respect to the linguistic phenomena that follow from parameter P. Speakers of languages in set A' will have constructed mental grammars (i.e., linguistic competence) that contain parameter setting A, whereas speakers of languages in set B' will have included parameter setting B in their linguistic competence.

Every child has the capacity to learn any natural language. A child of Urdu speaking parents will, if transplanted to a Swahili speaking community, begin speaking Swahili along with the other children of the community. Children are not born with a grammar for a particular language. Rather, they have, as a property of how their brains are wired, the capacity to construct a mental grammar based on the input from the linguistic environment around them. For example, assume that Urdu represents a language in category A' and Swahili is a member of category B' with respect to parameter P. One distinguishing characteristic of these two languages is the setting each has for parameter P. The parameter itself is part of UG, but the particular

setting (A or B) must be chosen by the child based on information in the input. With implicit knowledge of the parameter P, the child knows what aspect of the linguistic input is relevant and worthy of attention and can use that information to construct her grammar.[2] By selecting the proper parameter settings, the child accurately constructs a grammar which allows her to communicate in Swahili (or in Urdu) with other members of the community.

The language faculty, or capacity for language, that has evolved in our species can only refer to UG and not to linguistic competence. There is no language, "UGese", which a child speaks at birth. There is no language UGese that anybody speaks for that matter, precisely because Universal Grammar, despite its name, is not a *grammar* at all. It is the implicit knowledge about language (*langage*) that a child must use to build her linguistic competence with the information provided by the input (i.e., the language produced around her). Thus, it is somewhat surprising that specific details of variation across natural languages should ever enter the debate on the evolution of linguistic ability. Nevertheless, Maratsos (1988; 1990) seems to confound the synchronic variability in languages (*langues*) with the variability in language (*langage*) required by evolutionary theory if it is indeed a product of natural selection. One well-known product of evolution by natural selection is variability in design for adaptive function. "[O]ne can make the case that variability in the lexicon could be adaptive (it allows new words to be entered), but P&B can really find no such adaptive function for variability in grammar" (Maratsos, 1990: 745). Whether a given language identifies who did what to whom by agreement morphology on the verb, case markers on the nouns, or strict word order indeed represents variability in language, but this variability is internal to the particular mental grammar an individual has

constructed and internal to the grammar of a particular language (*langue*). What is at issue is not the adaptive function of specific grammatical devices within linguistic competence, but the adaptive function of UG and its principles and parameters (i.e., the language faculty). Regardless of whether the particular language of the environment is heavily inflected for Case (e.g., Turkish) or has relatively strict word order (e.g., English), a neonate of our species has the ability to construct a grammar which allows her to use that language competently. However, whether a phylogenetically recent ancestor of ours could acquire either of these languages would more closely address the issue.

In addition to the imprecise nature of the discussion of variability, the debate seems to blur language evolution (i.e., the diachronic change in structural properties of a language—e.g., Old English to Modern English) with the evolution of language (i.e., the phylogenetic development of the capacity for language). A change in form by evolutionary adaptation presupposes adaptation *by design*. In other words, if a complex structure or mechanism changes through evolution, some positive effect of the modification is assumed to result for the species. Of course, there may be coexisting negative effects on another aspect of the structure which will produce competing pressures for change. The reduction of morphological inflection and concomitant stricter word order that has developed as Old English evolved into Modern English imparts neither positive nor negative effects on the effectiveness of "English" as a means of verbal communication. Like variation across the world's natural languages, structural variation following diachronic change does not bear on the issue of the evolution of a capacity for language. Such "variations almost certainly correspond to differences in the extent to which the same specific set of mental devices is put to use, but not to differences in the kinds of devices that

are put to use" (P&B: 716). Although it is entirely possible that a child learning Turkish might utilize cognitive structures differently than a child learning English, one would not suggest that some children are born with the capacity to learn Turkish but not English.

Linguistic competence cannot be the product of natural selection. "Natural selection can only operate on innate mechanisms; it cannot operate on overt behavior (Cosmides and Tooby, 1987) or on its external products. Those external products of human behavior may themselves 'evolve' over time; however, that evolution does not operate via sexual reproduction of genetic material" (Freyd, 1990). The linguistic competence that each individual human being has is simply the product of his or her innate linguistic knowledge and the relevant information derived from the input during language acquisition. Thus, within the debate of linguistic evolution, linguistic competence and the related topics of diachronic and synchronic variation constitute non-issues. They do not bear on the question of how our capacity for language has evolved. UG and the neural substrate of the brain necessary to subserve a grammar, on the other hand, are precisely those elements of our linguistic capacity that demand an evolutionary explanation.

Neurological Foundation of Language

As a type of human behavior, language relies on neural substrate for its function and control. A rather voluminous literature of clinical and experimental studies exists in which findings support the hypothesis of a localizable representation of language in the brain. In particular, in the overwhelming majority of right-handers, the left peri-sylvian cortex is crucial in the normal processing of linguistic stimuli. Impaired linguistic abilities follow pathology to this area of the brain.

Similarly, experimental paradigms in which this area of the brain can be artificially "blinded" to incoming linguistic stimuli (i.e., tachisto-scopic and dichotic listening presentation) demonstrate that without the use of this cortical area, normal language processing cannot proceed. This kind of evidence, of course, can only permit us to speculate on the localized representation of linguistic competence. By extrapolating which areas of the brain are crucial for language use from the study of language impairment, studies of this nature assess the residual abilities of individuals to comprehend and produce language and their ability to do so in the particular language that they speak. We cannot discuss UG in the context of localized neural representation. This is not to say that UG is necessarily represented diffusely in the cortical tissue of the members of our species, only that clinical and experimental studies to date simply do not tap this aspect of the language system.

Despite the irrelevance of linguistic competence in the dialogue about linguistic evolution, the neural substrate required to subserve the linguistic competence that mature members of our species have con-structed (i.e., the mental grammars we have built) constitutes real, tangible, physical structures that must have an evolutionary history. It is possible that language is an emergent property resulting as a natural consequence of the physical properties of the particular brain that has developed in *homo sapiens* (Chomsky, 1982b). If such were the case, then natural selection could decidedly not be the driving force behind its evolution. Rather, language would be, in the terminology of evolutionary theorists, a spandrel, a natural by–product of some other mutation that may or may not have occurred by natural selection. Offering very general proposals of what these other mutations might be, such as "selection for bigger brains, more cortical surface, hemis-pheric specialization for analytic processing, or many other structural

properties that can be imagined" (Chomsky, 1982b: 321) without suggesting what pressures might have led to their development only serves to make the speculations more vague and more imprecise.

Assuming that the evidence from clinical and experimental neuropsychology has some validity in attributing language functions to specific brain structures, the evolutionary history of those structures would bear directly on the evolution of our capacity for language. Specifically, the area around the third frontal gyrus (i.e., Broca's area) has been established since 1865 to be an integral area of cortex for speech. When trauma or pathology injures cortical tissue of this area, expressive speech disorders, termed *aphasia*, consistently result. Similarly, the posterior area of the first temporal gyrus (i.e., Wernicke's area) contributes to the comprehension of linguistic stimuli. Brain damage to this area consistently produces aphasia marked by comprehension deficits and word finding difficulty. Figure 1 illustrates the relevant areas of the brain that are believed to subserve much of language processing in *homo sapiens*.
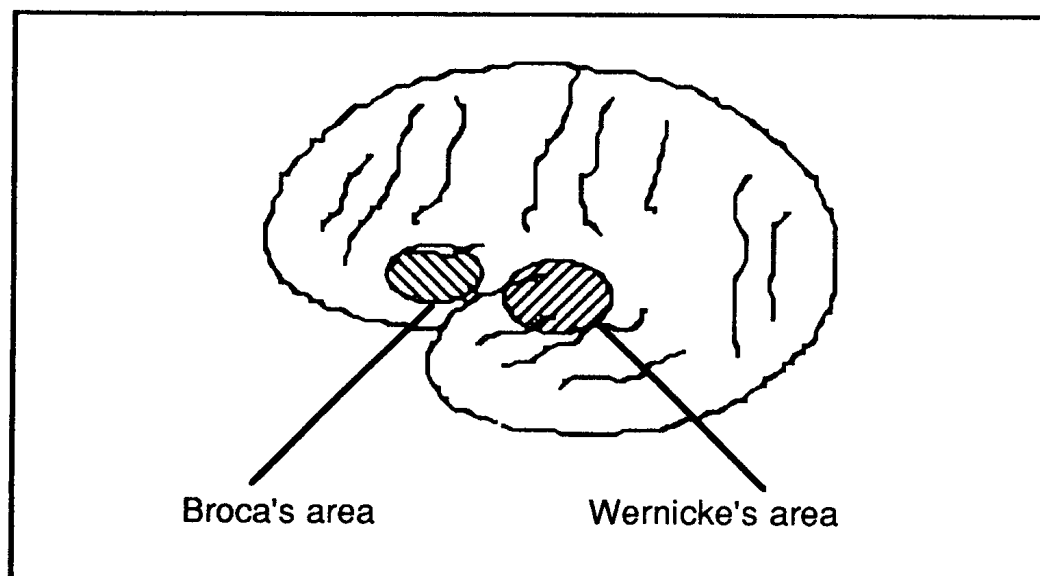

Figure 1   Localized language centers in the brain

Cortical tissue of the human brain can be categorized into three different types. *Primary cortex* receives afferent fibers ("inbound" transmissions) and sends efferent fibers ("outbound" transmissions) directly from and to peripheral mechanisms of sensation, perception, and motricity. Primary *auditory* cortex is located in the temporal lobe bordering the Sylvian fissure; primary *sensory* cortex borders the posterior edge of the Rolandic fissure; and the primary *motor* cortex rests at the anterior edge of the Rolandic fissure. Control of the articulatory musculature utilizes cortex at the inferior extreme of the Rolandic fissure (i.e., the peri-sylvian region). Connecting primary cortical areas of different modalities to one another are the second type of cortical tissue, *secondary cortical areas*. Finally, linking these secondary cortical areas to one another are *tertiary cortical areas*. Comparative neuroanatomy has identified the tertiary cortex as the major characteristic distinguishing human brains from the brains of primates. Therefore, it is tempting to attribute that area of the brain a significant role in the development of language capacities. However, evolutionary theorists frequently mistake comparisons between modern human beings and modern apes for twigs along a single branch of an evolutionary family tree. However, we are not descendants of the apes co-existing with us at the present time. Like human beings, the apes have experienced their own evolutionary history since the era of our common ancestor. Ideally, the fossil record, and not comparisons of temporally co-existing species, should serve as a source of evidence for the evolutionary sequence of development in the brain structures active in language processing among *homo sapiens.*

By examining fossils of cranial bones from our phylogenetic ancestors, paleontologists are able to document the appearance of brain structures of greater and greater complexity. Brown (1979) explains

that contrary to previous theories of cortical evolution, the primary cortical areas did not give rise to secondary cortex, nor did secondary cortex derive tertiary cortex. Rather, when following the course of phylogenetic development of cortex, the primary cortex most directly linked to peripheral systems (i.e., konicocortex) appears most recently in evolutionary time. That is, the cortical tissue supporting finer and finer sensory, perceptive, and motoric precision developed later and later in the course of evolution. A straightforward process of adaptation and natural selection can be imagined in which such improvements of visual and auditory acuity, tactile sensation, and tool handling contributed to the fitness of the species. P&B discuss the evolution of the vertebrate eye as the quintessential example of complexity by design through successive stages of development and improvement. However, the most effective optical organ is only as useful as the visual cortex to which it transmits efferent impulses. Thus, improved visual acuity would surely improve an organism's ability to see prey as well as predators and improve its overall fitness. Likewise, improved auditory discrimination abilities would benefit an organism in that the presence of prey or approaching predators could be detected more readily. Greater precision in sensation and motricity would allow an organism greater control in useful dexterous behaviors such as tool making and handling. Then, greater control of articulatory gestures might allow the organism to accurately produce distinct vocalizations. Each of these behaviors, dependent upon neural control, required the adaptation of afferent or efferent projections for modality specific systems to develop. Then, by natural selection systems of greater and greater complexity and precision developed.

The primary cortical areas are highly complex and modality specific. Interestingly, where the primary auditory, sensory and motor

cortical areas intersect happens to be largely coextensive with the areas of brain in *homo sapiens* underlying language functions. Any suggestion of subsequent evolution of these areas *for the purpose of language* could only appeal to a process of exaptation (i.e., the use of selectionally advantageous mutations for purposes other than those for which they were designed). Even then, however, it is not clear how the adjacency of these primary cortical areas could be taken advantage of among non-linguistic species.

Natural Selection for Communication

The evolutionary history of the neural structures underlying language represents an altogether different issue from the evolution of the human capacity to learn the language of the social environment. In other words, the claim that our ability to acquire natural language has evolved by natural selection (P&B) does not entail that these particular neural mechanisms evolved by natural selection for the purpose of language. As with the diachronic evolution of language (*langue*), the debate over linguistic evolution has been blurred with the evolution of those neural mechanisms that subserve linguistic behavior. It is crucial that we refine our view of linguistic evolution in order to clarify the questions motivating the debate.

It is likely that language constitutes a refined system of communication. Just as gross motor control preceded finer manipulation and fuzzy visual acuity preceded sharp visual perception, ambiguous, indeterminate communication probably preceded concise, grammatical expression. Bickerton (1990) posits a system of mental representations that might have developed into the language system of *homo sapiens*. He reasons that prior to any complex system of mapping propositional

content onto a serial channel, a system in which the propositional content can be represented must already be in place. Thus, we can imagine a species whose verbal communication system is comprised of one-to-one mappings of concepts (i.e., mental representations) to vocalizations. Such a system would obviously be limited in its expressiveness by the number of distinguishable "words" that made up the "lexicon".

By now it is clear that linguistic evolution does not refer to how linguistic competence has evolved in our species. Nor does it describe the development of neural structures that subserve our language capacities. Rather, linguistic evolution is the phylogenetic development of the uniquely human capacity to construct a mental grammar for a particular language based on exposure to that language. Thus, both UG and the learning mechanism that integrates UG with the information derived from the input comprise the language faculty that P&B propose to have evolved by natural selection. With that established, how might the language faculty of *homo sapiens* have evolved from a simple system of mental representations like the one proposed by Bickerton (1990)? Does the process of evolution reflect the characteristics of natural selection: gradualism, variability, and complexity by design?

The study of pragmatics recognizes the componential role of a theory of grammar within a larger theory of verbal communication in which grammar and pragmatics are complementary elements (Leech, 1983). Unlike the century old literature on aphasia and grammatical deficits following unilateral focal brain damage, the decade old study of pragmatic deficits following brain lesion has only very recently received serious systematic attention among the research community. As mentioned above, aphasia primarily follows damage to a region of

the left cerebral cortex.   In contrast, the deficits in pragmatic abilities result from impairment of the right cerebral cortex.   Although this particular research direction is in its infancy, one particular fact seems clear.   Linguistic communication requires both pragmatics and the grammar as necessary, although neither is sufficient alone, for the normal use of language.   Furthermore, these two components appear to be neurofunctionally modular insofar as double dissociations of behavior are reported among the two impaired populations (left and right hemisphere brain damaged individuals).

Within this context, we are interested in the evolutionary history of the language faculty that gives rise to the grammar.   Following Bickerton (1990) there likely existed a species which had a system of internal mental representations of the external world.   It became useful to be able to communicate, say, the presence of a predator or of prey.   Those individuals whose modified cognitive capacities (modified by genetic mutation, presumably) allowed such a communicative system enjoyed greater fitness.   Such a mechanism might place rather heavy processing demands on the organism's cognitive mechanisms and, thus, require close attention and considerable energy.   If, however, the species could develop a means to process this code automatically or algorithmically (a type of processing for which the left hemisphere appears ideally suited), individuals would benefit greatly.   Such lateralization and specialization of processing would allow individuals with this type of cognitive structure to continue hunting, eating, or using tools while communicating with another individual.   As the system of communication comes to rely more and more heavily on the parsing and processing of an auditory signal to understand messages being communicated, the language faculty which contributes to the construction of the linguistic competence which allows this automatic process-

ing must evolve so as to allow "languages" of greater and greater complexity. There are, of course, constraints as to how complex the "language" can be (e.g., processing capacity and speed). Thus, it is not the case that the language faculty will increase in complexity *ad infinitum*. Rather, as long as the mutation in the organization of innate linguistic knowledge and learning mechanisms contributes to more efficient communication, the characterization of UG will change.

By carefully distinguishing UG from linguistic competence from the neural substrate underlying language, we have allowed for three different, yet related, evolutionary histories. Evidence from the fossil record is compatible with the proposal that the brain structures used by *homo sapiens* for language processing followed a path of adaptation for finer and finer precision. As pressures for automatic, algorithmic processing of verbal communication developed, the peri-sylvian cortical area of highly specialized modality specific mechanisms evolved by exaptation into a system integrating fine articulatory motor control, with accurate kinesthetic sensation, and precise auditory discrimination necessary for the processing of speech. As greater selectional pressures developed for improving the "grammar," the amount of internal information encoded in the linguistic competence had to increase. In order to improve the efficiency of the system, the language faculty had to allow more refined principles and parameters such that more complex grammars could be learnable and functional.

Natural Selection for the Language Faculty

Does the language faculty as we have defined it (UG and learning mechanisms) demonstrate the characteristics of gradualism, variability, and complexity of design reflecting an evolution by natural selection as

P&B claim? Natural selection does not produce complex structures or behaviors out of the blue. They follow a gradual sequence of modifications to previous forms, such that each stage is, in itself, a functioning element. What would a more primitive UG have to look like? Contrary to P&B's discussion in which they confound UG with linguistic competence, an earlier form of the language faculty would not be a grammar of (n rules - 1). In fact, two current natural languages could differ in that way. The UG of *homo proto-sapien* (UG') would not constrain the set of possible languages in the same way as the UG posited by linguists to characterize *our* innate linguistic knowledge. That is, the languages allowed by UG' need not be possible languages for the UG that members of our species are born with. Assume for the purpose of illustration that UG' differed from UG only in terms of a single grammatical principle. For instance, one principle of UG proposed by theoretical linguistis has been the principle of Subjacency. Without getting into too much technical detail about how this principle functions in different grammars, it is sufficient to understand that it constrains the movement of question elements (e.g., *who*, *what*, *when*, *where* in English) when formulating interrogatives. All natural languages conform to the restriction on movement of these elements past no more than two "bounding nodes". However, languages can vary as to which grammatical constituents qualify as bounding nodes. In fact, this variation is captured in terms of particular settings of a parameter in UG. In this context, UG' might contain a principle (call it Subjacency') that restricts movement of such elements to pass only a single bounding node. Both innate systems have parametric variation as to which constituents count as bounding nodes. The set of possible languages for the species with UG would be of greater complexity than the possible languages among the species with UG'. In fact, many of the

possible languages allowed by UG would be impossible for an individual of the species with UG' to learn. As the pressures of communicative efficiency drive the changes in the innate linguistic system, subsequent generations will be able to carry out automatically the processes that might have required their ancestors to use conscious inference strategies.

Lieberman (1984) criticizes nativist theories of language and language acquisition for their lack of understanding of biology. He claims that for any complex behavior or structure to have evolved, there must necessarily exist variability across individuals. What would it mean for two individuals to differ with respect to their innate UG? Given our careful distinction of UG and linguistic competence, differences in their grammars would not constitute evidence. Given our distinction of UG and the neural substrate underlying language, differences in laterality or localization would not constitute evidence. Rather, variability in the genetic make-up of UGs across individuals should produce a continuum on which individuals differ in matter of degree. At one end of the continuum will be individuals with the idealized UG discussed by theoretical linguists. At the other end of the continuum will be individuals who differ from those at the first end by some genetic specification which causes them to construct different grammars based on the same input. The cases of genetic dysphasia reported by Gopnik (1990; 1991) represent precisely this type of variability. Within a single family of 30 members, 15 are unable to construct grammars which mark morphological features in a rule-governed way. The other half of the family, presumably exposed to the same sort of input while constructing their grammars, demonstrate absolutely normal behavior in this regard. The genetic transmission of this type of variability is exactly what we would expect. The two ends of the

continuum obviously offer a very clear distinction. Subtler differences surely exist that simply escape general observation. For example, there can be some variation in the order of acquisition of certain grammatical rules. Language-delayed children develop normal grammars, but they require a longer period of exposure to input than other children. As research into developmental dysphasia advances, subtler variations in what different children are able to do given the same type of input will likely surface demonstrating finer gradations on the continuum.

The innate mechanisms with which infants of our species construct mental grammars are uncontroversially complex. However, in order to make a case for natural selection, they must demonstrate complexity *by design*. That is, the form of the language faculty must show design for a particular function. P&B fall into the trap of confounding the language faculty with linguistic competence and argue for the functional design of language as a means of mapping propositional concepts onto a serial channel. This is, of course, true of language, but, more generally, it is true of communication. Thus, the true test is whether the innate mechanisms with which we construct grammars based on input show signs of complexity by design. Unfortunately, given the theoretical nature of our understanding of these mechanisms, we risk the circularity of asserting that the mechanisms we propose to account for language variation and stages of language acquisition show design for function because they explain language variation and stages of language acquisition. However, one possible step, albeit a small one, might be the specificity of UG. Although the uniquely linguistic nature of UG is a stipulation internal to the theory that conceived it, there does not seem to be any other cognitive functions that require the type of elaborate innate specifications to successfully construct rule-governed

reasoning that language acquisition requires. Admittedly, this is not very strong support for the complexity by design. However, because of the abstract nature of the mechanism under debate, indeterminateness is preferred over contradiction or circularity.

Conclusion

In order to clarify the rather cloudy debate about the evolution of our uniquely human capacity for language, three separate aspects to the issue have been distinguished. The neural substrate that underlies our production and comprehension of speech, centered largely around the left peri-sylvian cortex, is a phylogenetically recent addition to the structure of our species' brain; the linguistic competence (i.e., grammar) that theoretical linguists hypothesize represents the implicit knowledge with which each of us knows what can and cannot be a licit structure in our language (s); and, finally, the innate knowledge of language that every member of our species has as part of his or her biological endowment (i.e., UG) in addition to some specialized learning mechanisms constitutes the language faculty with which individuals of our species can construct a grammar of a particular language based on exposure to that language. Our innate knowledge of UG is the relevant aspect for the debate about whether our capacity for language has evolved by way of natural selection. Linguistic competence is the endpoint once we have analyzed the input and constructed the mental grammar with which we can communicate. In fact, linguistic competence is precisely what we construct when we build our grammars. Thus, this aspect of the issue completely side-steps evolution insofar as it is an ontogenetic product rather than a phylogenetic process. The neural substrate employed for the processing of language is both a

phylogenetic product and an ontogenetic process, and as such demands an evolutionary story of its own. However, it represents an altogether different issue from the capacity to acquire the language of the environment. Each aspect of the issue discussed is a necessary but not sufficient component in the overall development of the uniquely human capacity for language. Taken together, the evolution of our linguistic ability is compatible with a successive sequence of adaptation of refined konicocortex, exaptation of neural substrate for the purpose of linguistic communication, and natural selection for the innate mechanism for acquiring the language of the environment. This evolutionary product provides each member of the species with the capacity for the ontogenetic process of constructing an implicit mental grammar for the language to which her or she is exposed.

Notes

[1] In order to overcome the unfortunate ambiguity the exists in English with respect to the term 'language', I have resorted to the distinct French concepts of *langage*, i.e., the system of linguistic communication, and *langue,* i.e., the particular language (English, French or Japanese) one speaks.

[2] I follow the convention in the developmental linguistics literature of using the feminine pronoun *her* as the generic anaphor when referring to a hypothetical child despite my view that this usage reflects a contemporary confusion of grammatical gender with sex. Of course, I do not mean to imply that the proper referent of the feminine pronoun, namely any female, is any more sex-less than the proper referent of the masculine pronoun.

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