FACING THE LOGICAL PROBLEM
OF LANGUAGE EVOLUTION

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1. Introduction

Like the vertebrate eye, language is a biological organ of extreme perfection and complication. The primary goal of generative biolinguistics is to unweave the (apparently) perfect design and function of this mental faculty of Homo sapiens—the language organ—at the ontogenetic and phylogenetic levels (development in the individual and in the species), so that we can delve more deeply into the nature of human capacities. As Richard Dawkins puts it, biology is a science of complexity and "the biologist tries to explain the workings, and the coming into existence, of complex things, in terms of simpler things," his job done when entities are arrived at which are "so simple that they can safely be handed over to physicists" (Dawkins (1986: 15)). The same

commentary applies to today's biolinguistics, especially at this turning point in the long history of linguistic science when generative linguists have finally taken to the task of discovering the ultimate simplicity of language design hidden underneath the superficial complex diversity. It is no exaggeration to say that the Minimalist Program (MP) is *the* long-awaited research strategy for the biology of language.

Variation and Universals in Biolinguistics is a good sampler of the state of the art in modern biolinguistic studies. Published as a spin-off of the 2001 *The Genetics of Language* symposium held at Tilburg University, this outstanding collection covers a broad range of topics from a variety of interconnected research fields in biolinguistics; parametric syntax, language acquisition, brain and neuroanatomical science, origin and evolution of language and, perhaps mostly importantly, philosophical and methodological issues, to mention only a few. Multidisciplinarity is the current trend in scientific endeavors everywhere, but no other fields would match up to generative biolinguistics in approaching the target of inquiry from every perspective conceivable. In this respect, this volume is also only a tip of the iceberg and should not be understood to provide a complete description of the whole field.

The book consists of the following 15 chapters plus a concise introduction by the editor: 1. Antisymmetry and Japanese (Richard Kayne), 2. Toward a Theory of Language Growth (Charles Yang), 3. Phase Transitions in Language Evolution (Partha Niyogi), 4. Genetic Differences and Language Affinities (Isabelle Dupanloup), 5. Beyond Narrow Syntax (Sergey Avrutin), 6. Evidence for and Implications of a Domain-Specific Grammatical Deficit (Heather K. J. van der Lely), 7. The Representation of Grammatical Knowledge in the Brain (Alfonso Caramazza and Kevin Shapiro), 8. Variation in Broca's Region: Preliminary Cross-Methodological Comparisons (Yosef Grodzinsky), 9. Language Emergence in a Language-Ready Brain: Acquisition (Judy Kegl), 10. Lenneberg's Dream: Learning, Normal Language Development and Specific Language Impairment (Ken Wexler), 11. Exploring the Phenotype of Specific Language Impairment: A Look at Grammatical Variability (Larry Leonard), 12. The Investigation of Genetic Dysphasia (Myrna Gopnik), 13. Unification in Biolinguistics (Lyle Jenkins), 14. The Immune Syntax: The Evolution of the Language Virus (Massimo Piattelli-Palmarini and Juan Uriagereka), and 15. Language and Mind: Current Thoughts on Ancient Problems (Noam Chomsky). Many of these chapters have been previously published

independently, and some others are already familiar to us in one form or another. Most notably, Chapters 2 and 13 are helpful roundups of some chapters in Yang (2002) and Jenkins (2000), respectively.

In this paper, instead of unwisely trying to review and discuss all the chapters one by one, I will focus on and expand my view about what is presumably the most controversial and hotly contested topic of biolinguistics—language evolution. One of my main concerns will be to show the tight connection that exists between current studies in the MP and researches in language evolution. In section 2, I will argue that a theory of UG must now meet the condition of "evolutionary adequacy," and that the MP is the right framework for that purpose. In section 3, I will examine the methodological and conceptual parallelism between studies in language acquisition and language evolution. In passing, the topic of selectionism in generative grammar will be discussed. Section 4 will be a brief note on Chomsky's (2004a, 2005a, 2005b) "third factor" considerations and their natural place within biological science in general. In Section 5, I will take up the idea of "Action Grammar" advanced by Patricia Greenfield, which I will suggest is a plausible precursor to the syntactic operation Merge, the definitive recursive function of human language. Section 6 will explore some analogies between language and molecular biological phenomena as one possible avenue to pursue a further development of biolinguistics. In Section 7, I will take up the case of category-specific deficits in aphasia and discuss its theoretical implications with respect to the recursion-only hypothesis of Hauser et al. (2002). Section 8 will suggest a possible unification of the three levels of investigation in biolinguistics by way of conclusion.

2.   Universal Grammar and Evolutionary Adequacy

Recent development in generative grammar is best characterized in terms of its broadening perspective which now covers the origin and evolution of human language as one of its main topics. This expansion is squarely proclaimed at the beginning of Chapter 13, for example, where Jenkins proposes to approach the unification problem (the problem of integrating biolinguistics into the natural sciences) by distinguishing three levels of investigation on biological systems:

(1)   a.   mechanism (structure/function)
      b.   development
      c.   evolution

For our case at hand, (1a) concerns the nature of I-language (the steady state of the language faculty) and how it interacts with other mental/physical organs, and (1b) the nature of UG (its initial state) and its interaction with other factors in the growth of I-language. In contrast, (1c) refers to the growth of UG in our species during hominid evolution. For any biological organ, ontogenesis (ontogeny) and phylogenesis (phylogeny) are the conventional terms for the two kinds of growth in the individual and the species, namely (1b) and (1c), respectively. We may add the term "microgenesis" to refer to (1a) as far as the mechanism of I-language is concerned, in the sense that its study primarily investigates the generative procedure of linguistic expressions. The Strong Minimalist Thesis (SMT) holds that this procedure (the computational system of the human language faculty) is optimally designed in its inner working, in linking sound and meaning via the sensorimotor (SM) and conceptual-intentional (CI) interfaces (Chomsky (2004a) among many others).
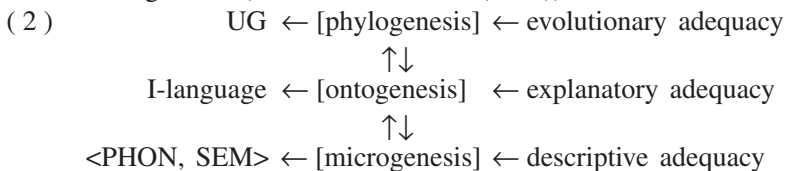
In the past history of generative grammar, the concepts of descriptive adequacy and explanatory adequacy have been neatly distinguished as two distinct theoretical goals, with the former applying to any theory that provides an adequate model of I-language, and the latter to a correct theory of UG which can explain how ontogenesis of I-language becomes possible through the interaction of UG and primary linguistic data (PLD). These goals correspond to investigations at the levels (1a) and (1b), respectively. With the topic of the origin and evolution of language coming to the fore, the validity of this familiar distinction now seems to be at stake. As observed by Chomsky (2002: 130−131), UG as the initial state of the language faculty is nothing more than one of its real instantiations, and the SMT should hold of all of them equally. The Principles and Parameters approach has eliminated the tension that once appeared to exist between descriptive and explanatory adequacy, and minimalist considerations urge us to proceed further and ask why UG has the design specification it does.

The (re)interpretation of UG as one actual instance of the human language faculty is most obvious and further pursued in the discussion of language acquisition in Chapter 2, where Yang argues against the classic parameter-resetting model (as found in Chapter 10 and elsewhere in the book) in favor of his variational model. According to this new model, different grammars coexist in the child's brain from the start and compete with each other for "survival." The result is an acquisition theory

that combines innate parametric variations and statistic or probabilistic learning. Yang's proposal is a good example of conceptual integration in science, unifying seemingly conflicting ideas into a more comprehensive framework. The idea of what is essentially an overgeneration and later pruning of competing grammars is strongly reminiscent of the Neo-Darwinian selectionist theory of evolution and, in particular, its extension to brain development by Gerald Edelman known as the neural Darwinism (Edelman (1992)). This in turn suggests a possible unification of ontogeny and phylogeny of language in the human brain.[1]

At this point, UG is not only an explanans for the logical problem of language acquisition (LPLA), but is itself an explanandum in the broad context of human evolution and biology. How did UG first come to the human species and why does it have the properties it has? Echoing LPLA, we may dub this new problem the "logical problem of language evolution" (LPLE), under which what Derek Bickerton once called the "continuity paradox" can be naturally subsumed. As UG is by definition a species-specific genetic endowment unique to us, the ultimate explanation for its properties must be sought in our biological evolution. Investigations at the level of (1c) is therefore mandatory, if we are to gain a deeper, more principled understanding of this mental capacity of ours, if we are to move forward "beyond explanatory adequacy" (Chomsky (2004a, 2005b)).

Let us introduce the term "evolutionary adequacy" and say that a theory of UG meets evolutionary adequacy when it allows us to understand how it was possible for UG to emerge in the human brain through evolution. Bringing this new and higher standard of theoretical goal into the picture, we now have the following roadmap of the development of generative biolinguistics (see also Bierwisch (2001)):

(2)   UG ← [phylogenesis] ← evolutionary adequacy
                            ↑↓
      I-language ← [ontogenesis]   ← explanatory adequacy
                            ↑↓
   <PHON, SEM> ← [microgenesis] ← descriptive adequacy

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[1] Whether right or wrong, Neo-Darwinism is itself a superb example of scientific unification, in that it bridges the gap between Mendelian genetics (a theory of conservation) and Darwinian evolution (one of variation), integrating them together with modern molecular genetics. Hence the name "Modern Synthesis."

Importantly, moving toward the goal of evolutionary adequacy does not entail or presuppose that explanatory adequacy has been achieved. Rather, considerations of evolutionary adequacy have the effect of a guiding principle in choosing among several competing theories of UG with proclaimed explanatory adequacy, as it is now required that a true theory of UG be able to show that UG is "evolutionarily plausible" as well, meaning that the emergence of UG is compatible with and comprehensible within the scope of evolutionary biology (which, crucially, is NOT synonymous with the Neo-Darwinian theory of gradual adaptation by natural selection). The quest for evolutionary adequacy and the one for explanatory/descriptive adequacy should proceed in a parallel fashion, constantly informing each other instead of neither waiting for the completion of the other. Hence the bidirectionality of the vertical arrows in (2).[2]

Seen from this perspective, the MP can be regarded as a research paradigm for building an evolutionarily adequate theory of UG through factorization of the language faculty to its bare minimum and a principled explanation of what is truly unique to humans and human language. The SMT holds that no part of UG defies a deeper, language-independent explanation. In terms of evolutionary adequacy, this means that nothing is special about the origin and evolution of language, perhaps too remote a goal for the moment. Hauser et al. (2002; henceforth HCF)) draw a distinction between FLN (faculty of language in the narrow sense, which is unique to humans and human language) and FLB (faculty of language in the broad sense, which is not), and suggest that FLN consists of nothing other than the recursive combinatory procedure in the form of unbounded Merge. This recursion-only (or Merge-only) hypothesis on language evolution is succinctly schematized by Jenkins (2000: 231) as in (3).

(3)   conceptual capacity + Merge/Move → human language

Take Move to be an instance of Merge (internal Merge, as opposed to

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[2] This supposition has a clear resonance with what Chomsky (2005b: 2) takes to be a proper balance between explanatory and descriptive adequacy, as he states: "... search for explanatory adequacy not only does not await achievement of descriptive adequacy, but rather contributes to that goal and even to discovery of the nature of the task, by clarifying the true nature of the object of inquiry (I-language) and of descriptive adequacy." He continues: "It is no less a truism that the same relation holds between both inquiries and the search for principled explanation."

external Merge, in Chomsky's (2004a and elsewhere) sense), so that it was Merge alone that combined various preexisting (and disconnected) cognitive capacities into a wholly new system called human language. In short, "once Merge arose, the stage for natural language was set" (Berwick (1998: 339)).

Admittedly, arguments can be raised against this rather oversimplified saltationist scenario of language evolution. For example, Pinker and Jackendoff (2005) as well as Jackendoff and Pinker (2005), themselves strong Neo-Darwinian theorists, have already taken issue with the recursion-only hypothesis of HCF by pointing out that recursion can be found in other cognitive domains (such as vision), and also that language has other unique properties than recursion (such as words).[3]

This recursion-only hypothesis, whether to be confirmed or disconfirmed in the end, has the heuristic merit that allows us to focus, first and foremost, on finding the origin or precursor(s) of unbounded Merge in discussing language evolution, while attributing other components of language (conceptual structure, predicate-argument structure, articulation and perception, etc.) to more general considerations concerning primate and even nonprimate evolution. The MP, by maximally simplifying the architecture of UG, has exactly this effect of pinning down what really has to be explained in order to understand the emergence of language in our species. In this respect, the MP is a far more promising framework than, say, the Government and Binding theory. The latter posited a rich and complex interacting system of highly elaborated, language-specific submodules of grammar, all of which would have to be examined in the search for their evolutionary origins—a hopeless enterprise. Chomsky (2005a: 8) summarizes the situation very appropriately: "evidently, the more varied and intricate the conditions specific to language, the less hope there is for a reasonable account of the evolutionary origins of UG." In the same vein, Chomsky (2005b: 3) notes that "inquiry into evolutionary origins becomes more feasible the less special structure is attributed to UG." Accordingly, the goal of evolutionary adequacy seems to be more accessible in the MP than any other genera-

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[3] The force of their claim is weakened if we adopt an anti-lexicalist approach to words (see Section 7). See also the rejoinder by Fitch et al. (2005), to the effect that PJ and JP fail to recognize the import of the FLN-FLB dichotomy, with the recursion-only hypothesis pertaining to FLN alone.

tive framework. In fact, the GB-style highly modular view of grammar is likely to be a worst scenario as far as evolutionary adequacy goes.[4]

One thing is very clear, then. Quite contrary to what has occasionally been complained about both within and outside the generative camp, generative grammar in the MP period today faces the topic of language evolution more seriously than ever before. The situation seems as if nothing in generative grammar makes sense except in the light of evolution (after Theodosius Dobzhansky's oft-quoted remark that "nothing in biology makes sense except in the light of evolution").

3. Language Development and Language Evolution

3.1. The *Evo-Devo* Approach

This expansion of research scope in generative biolinguistics, from explanatory adequacy to evolutionary adequacy, can find a conceptual counterpart in the recent development of core biological science. Known as "evo-devo" (evolutionary developmental biology), this new trend seeks to investigate biological evolution by means of information gained from biological development, especially morphogenesis and its genetic mechanism. The biologists' expectation that developmental researches will throw new light on evolution is well reflected by the generative linguists' supposition that studies in child language acquisition and early grammar, along with those in language deficits, pidgins and creoles, and sign and gesture languages (notably the Nicaraguan Sign Language, as discussed in Chapter 9 of the book), will inform and

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[4] As the discussion here is restricted within the I-language-based generative framework, an *EL* reviewer suggests that reference to other E-language approaches to language evolution would be helpful. There are several factors rendering a direct comparison between the two sides rather tricky, however. First of all, to the extent that one adopts the internalist thesis that language does not exist outside each individual's mind/brain, there is no well-defined notion of an E-language to be discussed at all. Secondly, language evolution in the generative perspective is primarily a biological, genetic phenomenon, whereas E-language approaches are rather concerned with the cultural or "memetic" phenomenon of language change, a process of linguistic micro-evolution to be sharply distinguished from the macro-evolution of UG in the human species. E-language approaches (notably the framework of "population linguistics" outlined in Chapter 3 of the book) attempt to understand how an already existing linguistic system turns into a more complex one over generations, and therefore their relevance to LPLE is rather thin.

promote studies in language evolution.[5]

Contrary to what Ernst Haeckel had believed, we now understand that ontogeny does NOT literally recapitulate phylogeny, and evo-devo does not claim a rediscovery of the recapitulation theory, of course. The same caveat applies to the relation between language development and language evolution. It is crucial to note that language development, as well as other cases cited above, is a biological phenomenon that is based on and presupposes the end product of language evolution, i.e. the human brain with UG already installed. Obviously, the question of how UG first came into existence in human evolution must be answered without recourse to UG itself.

Yet when these cautions are duly recognized, there are many areas where talking about language evolution and language development in parallel is very instructive. As noted, Yang's variational model of language growth (Chapter 2) is a good example of conceptual expansion from evolution to development, both being subject to essentially the same Darwinian selectional process. Upon reflection, it may be noticed that the whole idea of UG turning into different I-languages under the influence of environmental factors, the shift from deep uniformity to surface diversity, is modeled on Darwin's conception of evolution as "descent with modification" from a common ancestor, or even on Goethe's idea of "Urpflanze" in plant morphology. In fact, the latter can be more appropriately regarded as a predecessor of the notion of a single Deep Structure being mapped onto distinct Surface Structures via grammatical transformations, the linguistic version of Goethean metamorphosis and, one may add, D'Arcy Thompson's morphological transformations. This last point in turn renders some plausibility to the view of morphosyntactic derivation as a form of language growth at the microscopic level—"microgenesis" in the sense suggested above.

3.2. Selectionism in Generative Grammar

Note in this connection that, despite Chomsky's persistent rejection of the selectionist theory of language evolution, strong selectionism can

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[5] Chomsky also makes reference to the "evo-devo revolution" in his more recent manuscript "Approaching UG from Below," which, unfortunately, was brought to my attention only after the submission of this review article, and is therefore not taken into consideration here.

be found in other areas of research within the generative tradition. Piattelli-Palmarini (1989), largely on the basis of Nils Jerne's network theory of the immune system (see Jerne (1985)), has observed a tight connection between the antigen-antibody reaction and language acquisition by parameter setting; both are selective, eliminative processes working on internally preexisting options, rather than direct learning from outside. Prior to exposure to experience, the necessary ingredients are all there, within the organism, and "when we think we are learning something, we are only discovering what already has been built in to our brains" (Gazzaniga (1992: 8)). This model of "learning by forgetting" or "knowing by unlearning" common to generative linguistics and immunology not only argues for a strong nativist position in both fields, but it is all the more important for its implications for a possible unification of molecular and cellular biology and cognitive sciences.

In Chapter 14 of the book, Piattelli-Palmarini in collaboration with Uriagereka continues to pursue the parallel between language and the immune system further, this time investigating the computational system and in particular the feature detection/elimination mechanism, and then extends the analogy to the origin of language by proposing a "virus" theory of language evolution. The idea of viral intervention in biological evolution in general is nothing new, and it has been known that about 45% of the human genome sequence consists of DNA derived from merger of a transposable element (TE) with a preexisting gene, a clear indication that evolution is a process of tinkering in the sense of François Jacob (see Jordan (2006)). Whether there was indeed something like a language virus that was horizontally transferred to the human species, or whether their whole conjecture must be regarded as a mere metaphor, remains to be seen, however. The import of Piattelli-Palmarini and Uriagereka's contribution lies in the demonstration that morphosyntactic studies and evolutionary researches are not two separate fields.

Selectionism in generative grammar manifests itself most conspicuously in such theoretical devices as filters, output conditions, constraints, etc., all sharing the function of selectional pressure on linguistic representations which can be compared to that of natural selection working on biological traits of organisms. In GB theory, for example, free application of Move α allowed an infinite magnitude of overgeneration, and all deviant outputs were subsequently eliminated through an interaction of autonomous grammatical principles, with the problematic result

that ungrammaticality was sometimes overdetermined by several modules of grammar. According to this theorizing, language was thought of as a redundant system in a dual sense—overgeneration followed by overdetermination—in sharp contrast to the SMT. Add to this the fact that acquisition theories under the P&P approach, in particular Yang's variational model, ascribe remarkable biological redundancy to UG, for the brain must contain a number of parametric variations that are to be eliminated (i.e. unexpressed as an I-language) in the end. The GB-style selectionist model still continues to be pursued under the rather mismatched rubric Optimality Theory (OT), the basic claim there being that a set of innate constraints, when properly ranked, choose among competing candidates so that only optimal outputs are allowed. This model's descriptive architecture is quite similar to that of the Neo-Darwinian hyper-selectionism, except that OT has nothing to do with adaptation or fitness in the biological sense. In both cases, what is left discarded in a black box is the very mechanism by which alternative options to be chosen among (mutants, outputs, etc.) are generated in the first place. In OT, this black box is dubbed GEN(enator), without the slightest indication of how it actually generates candidates. But that should be the most important part of the explanation if it is to be a valid one. As sometimes pointed out, "survival of the fittest" is a rather tautological concept (since survivors are the fittest by definition) and it only describes the result or epilogue of evolution. Instead, "arrival of the fittest" is the key problem that has to be seriously addressed.

Seen from this viewpoint, the strictly derivational model of the MP is a very plausible approach to answering the first question of how each linguistic expression comes into existence, before discussing its functional/adaptive properties. It is not a matter of choice between derivations and constraints, nor of constraints allowing "simpler" explanations than derivations (as mistakenly announced by proponents of OT). We are facing the fundamental question of which approach seeks a deeper, true explanation. The answer is obvious. Let us note that exactly the same argument can be raised in favor of the nonadaptational, pluralistic view of language evolution shared among MP practitioners. We may safely say that the MP is unique in the history of generative grammar also in its rejection of selectionism in explaining linguistic facts as well as language evolution.

3.3. Clarifying the Logical Problem of Language Evolution

Above I have introduced the terms evolutionary adequacy and the logical problem of language evolution (LPLE) as comparable to explanatory adequacy and the logical problem of language acquisition (LPLA), to make it explicit that the primary focus of the MP is placed on the origin and evolution of language. In the final chapter of the book, Chomsky also comments on the common nature of the problems posed by language acquisition and evolution, perhaps foreseeing the relevance of the evo-devo paradigm in biolinguistics.

As depicted in (3) above, the MP adopts a rather saltational model of language evolution and rejects the idea of gradual adaptation, much in line with the theory of Punctuated Equilibrium. In fact, it is well understood that Chomsky's view on evolution largely coincides with that of Stephen Jay Gould and Niles Eldredge. Sometimes called Neo-Neo-Darwinism or the Expanded Synthesis, their position holds that evolution is best characterized as long periods of stasis occasionally interrupted by abrupt large-scale changes and that evolution has many important dimensions to it other than adaptation by natural (and sexual) selection, as originally suggested by Darwin himself; most importantly, evolution always proceeds within a limited channel determined by physical laws, in which selection may play only a minor role. The design specification of language, like that of snowflakes or the Fibonacci series ubiquitous in nature, is a result of such natural laws guiding the process of self-organization, rather than being directly shaped by natural selection in a gradual manner. Language evolution was presumably a rather sudden event, as corroborated by the recent finding of the human-specific functional change in the FOXP2 gene on chromosome 7 that appears to have taken place and been fixed only within the last 200,000 years (see Marcus and Fisher (2003) and references cited therein).[6]

Now Chomsky's favorite "fable" on language evolution goes like this: "Suppose a mutation took place in the genetic instructions for the brain, which was then reorganized in accord with the laws of physics and

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[6] Although, as also noted by Jenkins in Chapter 13, FOXP2 is not a so-called "language gene" (nor is there any such thing, perhaps), its involvement in the expression of speech and language in humans has been evidenced by studies of SLI that can be caused by a point mutation in this gene (Lai et al. (2001), Enard et al. (2002)).

chemistry to install a faculty of language. Suppose the new system was, furthermore, beautifully designed, a near-perfect solution to the conditions imposed by the general architecture of the mind-brain in which it is inserted, another illustration of how natural laws work out in wondrous ways ...” (Chapter 15: 394−395). In an important sense, the MP is an attempt to make a true theory of language evolution out of this fable. Chomsky goes on and notes a certain “resemblance” such an instantaneous model of language evolution bears to the instantaneous model of language acquisition, while correctly admitting that neither process is literally instantaneous. He states: “Plainly, the faculty of language was not instantaneously inserted into a mind/brain with the rest of its architecture fully intact. But we are now asking how well it is designed *on that counterfactual assumption*. How much does the abstraction distort a vastly more complex reality? We can try to answer the question much as we do the analogous one about the logical problem of language acquisition” (395; emphasis mine).

One might wonder, however, to what extent this parallel between instantaneous language acquisition (ILA) and instantaneous language evolution (ILE), or between LPLA and LPLE, can be sustained as an empirical claim. Botha (1999) squarely challenges Chomsky’s (and our) analogy and argues that it cannot be supported in any meaningful way. Botha’s counterarguments are based on the observation that, unlike in the case of ILA, the abstraction of ILE does not have anything corresponding to i) the basic problem to be solved, ii) the tension between the richness of the acquired knowledge and poverty of the input data (essentially, Plato’s problem), and iii) the distinction between the initial state S_0 and the steady state S_s of knowledge of language. The abstraction of ILE also differs, in Botha’s view, from that of ILA in its epistemological status in that it does not work as a conceptual tool to make the study of highly complex phenomena possible. Quite contrary to Botha’s contention, the fact of the matter is that ILE and LPLE have all the virtues once attributed to ILA and LPLA.[7]

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[7] As correctly observed by an *EL* reviewer, LPLE turns out far more serious than LPLA, since in the former case there is no linguistically relevant initial state or input data available. The same reviewer also questions the falsifiability of hypotheses on language evolution. Evolution is a process of chance and necessity, and reproducibility and repeatability are very hard to guarantee in this domain. As

Excluding divine intervention, we take it for granted that human language evolved from preexisting capacities and came into being in several steps like other biological organs. The problem is that no direct precursor to language as a whole system can be found anywhere in the biological world. The Bickertonian concept of protolanguage covers a diverse area ranging from the "language" of trained chimps to pidgins and very young children's speech, but for the reason already given, no form of human language, however immature or pathological, is directly relevant to the study of language evolution, while chimps' and other animals' languages are qualitatively too different from ours to be possible precursors to it. The continuity paradox continues to exist.

Recall at this point the distinction between FLN (narrow language faculty) and FLB (broad language faculty) made by HCF. FLB includes components of the conceptual-intentional and sensorimotor systems that are not unique to humans, but those components in themselves presumably did not exist in other animals as fragments of linguistic abilities. Rather, at least some of them were nonlinguistic or even noncommunicative in nature, and only when they were interconnected by recursion (FLN) to jointly form the human language faculty did they become components of language. As Chomsky puts it, language is a true case of emergence; the emergent nature of language evolution lies in the fact that totally new properties arose from a recombination of preexisting old capacities, none of which may have originally been linguistic at all. Importantly, the same remarks hold true of FLN itself, too. Though syntax is definitely the hallmark of human language, the search for its precursor(s) should not be confined a priori to language-like abilities of apes and other animals. We can say with certainty that syntax made language possible at all but, by doing so, syntax itself became part of language for the first time.

This, then, is the essence of evolution as "specialization through reconfiguration" (Marcus (2004)). "To create is to recombine," says Jacob, and this view is very clear to Chomsky when he says: "...

Gould once put it, rewinding the tape of evolution and running it again might yield a drastically different result. At best, we can only give a certain level of credibility to the hypothesis in question by showing that it is compatible with every piece of evidence from genetic and neurophysiological, as well as behavioral and ethological, studies.

domain-specificity of language is reduced to some special arrangement of elements that are not language-specific" (Chomsky (2004b: 163)).   In fact, basically the same conceptualization of domain-specificity of language was already present to Charles Hockett (see Hauser (1996), though Hockett's contribution is negatively reviewed there), who examined 13 design features of human language communication (displacement, duality of patterning, discreteness, arbitrariness, etc.) and found that only a few, if any, of them were truly unique to it while all the rest were shared by some or other animal communication; in other words, human language is unique in showing all those features in total combination, not in any of them taken in isolation.

LPLE can now be sharpened in the following form: How did UG (now the steady state), with qualitatively different properties, first emerge out of a new reorganization of yet disconnected mental or physical abilities of our ancestors (the initial state)?   The instantaneous model of language evolution confers on us the methodological advantage of limiting the focus of inquiry to the way the recursive combinatory procedure of syntax interconnected other abilities, as well as to the identification of the precursor(s) to syntax itself, while the other components of language can safely be assumed to have already been present in us and other animals.   These considerations clearly argue against Botha's objections; in particular, ILE, in tandem with HCF's recursion-only hypothesis, DOES work as a conceptual tool to make possible the study of a highly complex phenomenon—language evolution.

4.   The Third Factor

The evo-devo approach allows us to consider language evolution on a par with language development, and this is certainly a case of unification in biolinguistics, which is one of the main issues discussed in this book, too.   As noted, however, there is one crucial barrier for this conceptual integration to be achieved: As we view language acquisition from the perspective of language evolution, UG ceases to be a major factor in explaining language design.   This is not to say, of course, that UG must be eliminated altogether, but that UG should be minimized in its explanatory force.   The MP is the right kind of research strategy for this goal, because it is an attempt to show that our faculty of language is optimally designed with a minimum set of apparatus just enough to link sound and meaning.   We are here talking about the maximal parsi-

mony of the language organ itself (substantive minimalism) in addition to that of a theory about it (formal minimalism).

Take the case of phrase structure theory for instance. Bare Phrase Structure theory has shown that syntactic structure is determinable by iterated applications of feature-driven Merge, without recourse to phrase structure rules or X-bar schemes. This means, virtually, that phrase structure results from self-assembly, in an analogous manner to the self-organization of snowflakes, or perhaps more appropriately, to the process of protein folding, in which the primary structure of amino acid sequence folds spontaneously into the secondary structure and then into the 3-dimensional tertiary and quaternary structures of thermodynamically optimal conformation, in accordance with physical and chemical laws. Notice that the same problem of computational complexity is involved here as is posed by the global economy of syntactic derivation. Note also that protein functions are determined on the basis of such folded structures, in the same way that the resulting phrase structure serves as an instruction to the interpretive systems. The abandonment of X-bar theory in this case not only leads to a further simplification of the grammatical theory, but it is also an empirical claim that UG contains nothing to be described by such a grammatical submodule.[8]

Reducing the substantial content of UG to the bare minimum has the advantage of rendering the topic of its origin and evolution more accessible. Chomsky's (2004a, 2005a, 2005b) recent proposal to decompose the determinants of language design into three distinct factors is of immense import here, which can be generalized to the study of biological design and form in developmental morphology. To rephrase, the three factors are:[9]

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[8] Whether such a distinction is always respected by researchers is another matter. Li (1987) has already pointed out the potential confusion of "bioredundancy" and "cognoredundancy" that may be found in the minimalist theorizing.

[9] Carstairs-McCarthy (2007) observes a parallel between these three factors and the biologist George Williams' distinction between (i) organism-as-document, (ii) organism-as-artifact, and (iii) organism-as-crystal. The parallel should remain loose, however. For one thing, Williams' three categories are far more general than those in (4), so that genetic material (category (i)) refers not to UG per se, but to whatever genetic composition of pre-linguistic hominids pertains to language evolution. The following discussion does not purport to claim that genetic contribution in this wider sense can be discarded in the MP.

(4)   a.   genes
        b.   environment
        c.   general principles of structural organization

For ontogenesis of language, (4a) corresponds to UG and (4b) largely to PLD. For phylogenesis of language, however, these are irrelevant, and the third factor must play a vital role. In turn, if this third factor succeeds in explaining a large portion of language design in the evolutionary context, the same can be expected to hold also in the developmental context. It is a logical necessity, then, to try to seek a deeper explanation of UG in this domain, which is exactly what the MP is at. In molecular and cellular developmental biology, too, we can see the shift of weight taking place from genetic information per se to its epigenetic modification (typically, "DNA methylation") in explaining morphological features. This also falls naturally under the third factor in the general sense. The shift of focus from the first to the third factor in the MP can be thought of as another instance of natural progress in biological science.[10]

These considerations force us to rethink the notion of domain-specificity in evolutionary and developmental terms, too. We now understand that it is highly unlikely for any genes, proteins or neurons to be strictly language-specific, and that specific traits result from a specific combination of nonspecific ingredients, a view already expressed in Chomsky's remarks quoted above. No doubt, human language as a whole system is the most unique thing in the biological world, but this does not prove the uniqueness of its essential components. Language evolution and language development are both dynamic processes of specificity emerging from a mess of nonspecificity. The same commentary should apply to current analytic tools used in the MP (Merge, probe-goal relation, Phase Impenetrability Condition, etc.), tools that seem genuinely language-specific, so that it is necessary to account for these properties in terms of their evolutionary origins if we are to build

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[10] Lorenzo and Longa (2003) also observe that the MP attempts to minimize the explanatory role of UG in favor of epigenetic processes, and is therefore more suitable for the biological study of language. Their use of the term "epigenetic" is not to be confused with "epigenetic modification" mentioned above. The latter belongs to the new field of epigenetics, and has no counterconnotations to the concept of preformation.

a theory of language that may attain evolutionary adequacy.

5. Action Grammar as a Precursor to Merge

So where did Merge, the recursive function that made language possible at all, come from? Speculations abound, ranging from insect navigation and foraging to bird song, music, manual dexterity, and to social intelligence (inc. Theory of Mind, reciprocal altruism, etc.), but in the present state of our knowledge none are either more or less plausible.[11]

For example, HCF hint at the number faculty, among several other possibilities, while Chomsky himself suggests that our understanding of natural numbers and the capacity of arithmetic may have been a by-product of (i.e. exapted from) Merge in the simplest form, which would give rise to the successor function (Chomsky (2005a) and others). True, linguistic computation and numerical computation share the common properties of discrete infinity and structure dependency (so that *Japanese linguistics students* has different interpretations depending on its internal structure in the same way that (3–2)+4 differs from 3–(2+4)), and there must be some evolutionary link between the two capacities.

It is terribly hard to turn this link into a relation of cause and effect, and even more so to tell which is which, without further evidence from comparative studies. The situation becomes worse when we take into account the recent observation that patients with severe aphasia still retain their mathematical abilities intact, which verifies surprising autonomy between linguistic and arithmetic syntax (Varley et al. (2005)). This kind of dissociation data tells us nothing conclusive about the evolutionary (dis)connection of the two faculties, however, no more than

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[11] With respect to foraging by insects, it has been known that the flight of *Drosophila* from yeast colony to yeast colony may instantiate an optimized strategy, in the sense that the fly's movement maximizes net calories per visit time. Piattelli-Palmarini and Uriagereka (Chapter 14: 352) note: "In general, the animal often adopts strategies that coincide with the best solutions painstakingly discovered also by means of massive computer simulations, solving systems of differential equations under constraints." Perturbations may arise and affect the overall optimality, however, so that the question remains as to whether their strategies are indeed the best choice. This is "the classic problem in dynamics of whether a maximum or stable point is local or global." (Lewontin (1987: 155)).

the autonomous status of UG from other mental faculties in modern humans proves the autonomy of UG in its evolutionary origins—a point correctly made by Chomsky (2005b: fn.15), too. One possibility we can entertain is that there was originally a common recursive combinatory capacity in a primitive form, from which both linguistic and mathematical syntax were co-opted along separate paths.

In this connection, consider what the neuropsychologist Patricia Greenfield identifies as Action Grammar, hierarchically organized object manipulations as found in tool use and tool making (Greenfield (1991); see also Maynard Smith and Szathmáry (1995)). Greenfield observes three different stages of Action Grammar developing gradually in young children, as seen for example in their performance of nesting cups of different sizes (Fig. 1), a transition which seems to have a striking similarity to the development of linguistic structure. The first stage, called the pairing method, simply puts the smaller cup in the larger one, while the second stage, the pot method, duplicates this simple embedding and puts another smaller cup sequentially in the larger one.

Fig. 1 Action Grammar
from John Maynard Smith and Eörs
Szathmáry (1999) *The Origins of Life:
From the Birth of Life to the Origin of Language,*
p. 167, Oxford University Press, Oxford.

The third stage, called the subassembly method, is the crucial one, which allows the children to treat a previously organized structure, with one cup inside another, as a subunit and put it in still another cup. Correspondence between these three levels of Action Grammar and the application of the syntactic operation Merge in the order of increasing complexity is obvious, though such is not Greenfield's contention.
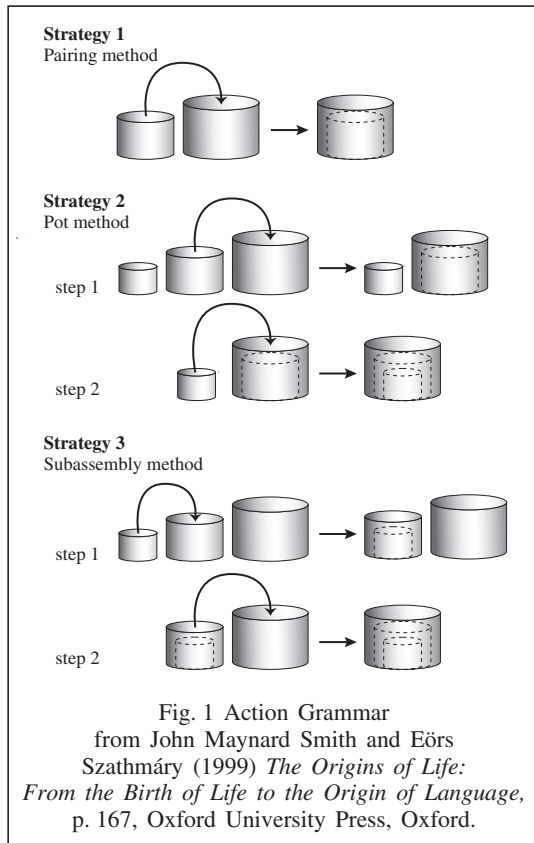
Consider VP formation as in (5a–c), for example (here we ignore a small verb (*v*) for expository simplicity).

(5) a. pairing method:
           Merge (loves, Mary) → {loves, Mary}
       b. pot method:
           i.   Merge (loves, Mary) → {loves, Mary}
           ii. Merge (John, {loves, Mary}) → {John, {loves, Mary}}
       c. subassembly method:
           i.   Merge (loves, Mary) → {loves, Mary}
           ii. Merge (the, boy) → {the, boy}
           iii. Merge ({the, boy}, {loves, Mary}) → {{the, boy}, {loves, Mary}}

Unquestionably, the subassembly method entails a version of generalized transformation.

The impact of Greenfield's developmental studies becomes clearer in a comparative evolutionary context. It has been suggested that only the subassembly method is unique to humans (and chimps in captivity with intense linguistic training; see Matsuzawa (2000)), while the pairing and pot methods are available to apes in the wild, too. A natural conjecture is then that Merge itself evolved in the corresponding stages, from simpler to more complex ones, and the true human language, with its fully developed syntax and concomitant infinite creativity, started with the advent of the subassembly method, i.e. generalized transformation. Since Action Grammar and linguistic syntax do not develop simultaneously in children and are therefore considered to be subserved by different neural structures in the brain, a further conjecture will be that Action Grammar functioned as a precursor to Merge (i.e., Merge was exapted from Action Grammar). If so, such a simplistic model of language evolution as depicted in (3) can be further elaborated accordingly.

Here I refrain from considering the place of Move (internal Merge) in this gradual evolution of Merge, although it can be guessed with certainty that Move resulted from a kind of "reversibility" in Action Grammar. It is also natural to think that Move came to work for communicative functions later in the evolution of language, given the observation that Merge and Move serve the distinct purposes of thematic and discourse-related interpretations, respectively—the duality of semantics pointed out in Chomsky (2005a), etc. This of course does not mean that Move itself was a later innovation. Rather, Merge and Move

became available at about the same time, but the latter remained latent until utilized by communicative needs.[12]

A rather interesting corroboration for such a concept of Merge in graded complexity comes from Roeper and Snyder's (2005) crosslinguistic studies on root compounding. They observe that in Swedish, in contrast to English, root compounds are strictly right-branching, so that (6a) is not ambiguous the way (6b) is:

(6) a. barn bok klub   [barn [bok klub]] but *[[barn bok] klub]
        b. child book club

                        [child [book club]] or [[child book] club]
Without entering into the details of the analytical device adopted by Roeper and Snyder, we can understand that Swedish root compounding does not allow the subassembly method (which of course does not mean that Swedish grammar lacks generalized transformation). The point is that different types of recursion are available in UG, and languages differ with regard to which type(s) they utilize for what kind of structure building. We also learn from simple cases like this that comparative morphosyntactic studies in descriptive linguistics can have a tight connection with evolutionary researches in generative biolinguistics.

Needless to say, the prospect of searching for the evolutionary origin of syntax in language-independent capacities of humans and other animals has become realistic only as a result of the minimalist syntax factorizing the syntactic component to its bare minimum, again an indication that the MP is a hopeful paradigm for achieving evolutionary adequacy. In more general terms, it is the theoretical linguists' primary role in the collaborative studies of language evolution to provide an

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[12] That considerations on communication may enter into the design specification of syntactic machinery may sound odd in light of the anti-functionalist view of syntax shared among generativists, but this is not so. Most importantly, reference to functions is not intended as a true explanation for the evolution of a design (there is no teleology). It is interesting to note in this connection that in an appendix to Eric Lenneberg's seminal book, Chomsky (1967: 435), rather surprisingly, speculated on the adaptive value of transformations in natural language as follows: "We would expect a system designed for the conditions of speech communication to be somehow adapted to the load on memory. In fact, grammatical transformations characteristically reduce the amount of grammatical structure in phrase-markers in a well-defined way, and it may be that one consequence of this is to facilitate the problem of speech perception by a short-term memory of a rather limited sort."

explicit model of the human language faculty and point out which part of it (e.g. syntactic recursion) is the key to understanding its evolution and requires a deep explanation in evolutionary biology. Accordingly, the significance of descriptive studies such as the one just seen also becomes greater in the MP than ever before.
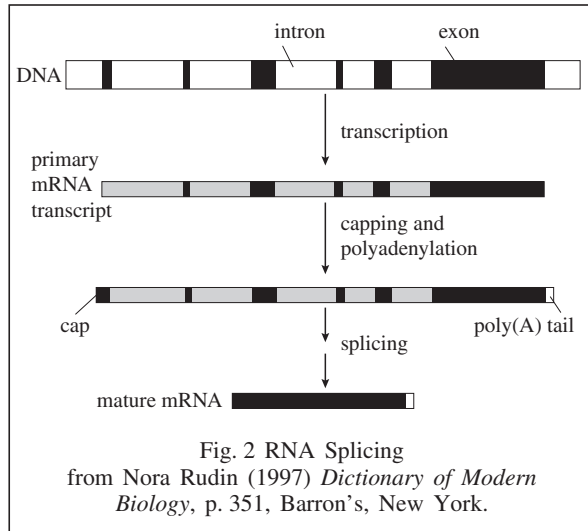
6. Lessons from Molecular Biology

Merge has as a prerequisite for its proper application a featural cognitive reaction, called feature checking/agreement or the probe-goal relation in more recent terms (Chomsky (2004a) and others). To fully understand the origin and evolution of the recursive function of human language, it is mandatory to investigate the root of this cognitive faculty and of the formal features (esp. the "edge feature") themselves, too. Emonds' (2004) speculation is very suggestive in this respect. He observes that although syntax is unique to our species, the basic ingredients for it, i.e. formal features, do not seem so, at least as far as the semantic import of ϕ-features goes, because not only humans but other animals detect differences in number or gender. This paradox is solvable, for Emonds, by assuming that the formal feature system derived from preexisting animal concepts. If correct, this constitutes another piece of good evidence for the exaptive nature of language evolution.

As for the origin of the feature checking mechanism, Piattelli-Palmarini and Uriagereka (Chapter 14; see Section 3 above), inspired by its striking similarity with the antigen-antibody recognition of the immune system, present a virus theory of morphological feature checking and language evolution, a theoretical embodiment of the familiar metaphor of strong uninterpretable features as a kind of virus to be immediately eliminated once detected. In fact, analogies between human language and biological phenomena at the molecular and cellular levels have long been pursued by linguists and biologists alike. The universal genetic code is a classic example of Saussurean arbitrariness and redundancy, both of which typically characterize the human lexical system. As HCF put it at the outset of the paper, "the human faculty of language appears to be organized like the genetic code" (Hauser et al. (2002: 1569)). It is arbitrary, in the sense that each codon (nucleotide triplet) codes for a particular amino acid without any logical necessity, and is redundant in that the 64 mRNA triplets specify only 20 amino acids (plus the start and the stop codons, specifying the start-

ing and ending points of the translation).

A more interesting analogy can be found between the feature elimination procedure in syntactic derivation and the molecular editing mechanism known as "splicing" (Fig. 2). DNA and primary mRNA transcripts contain a huge region of noncoding sequences (intragenenic regions, or introns) intervening between coding

Fig. 2 RNA Splicing
from Nora Rudin (1997) *Dictionary of Modern Biology*, p. 351, Barron's, New York.

regions (expressive regions, or exons).   Rephrased in the minimalist terms, introns are uninterpretable elements, so that they must be eliminated before a fully interpretable mature mRNA can be formed for protein synthesis, to satisfy the interface conditions, so to speak.   RNA splicing refers to this pruning of introns, and is strikingly similar to the checking and elimination of uninterpretable morphological features in human syntax.   The analogy is all the more important because it tempts us to proceed further and ask more fundamental questions: What are these uninterpretable elements for?   How did they evolve in the biological system?

Contrary to what was once believed, our current understanding is that introns are not mere junk or selfish DNA but function as a kind of regulators for exons; one may even compare introns and exons to functional and lexical categories in human language, respectively, and speculate furthermore that introns have derived from what were once exons, through a process analogous to grammaticalization.   Needless to say, pointing out that introns have one function or another is no explanation of their existence unless one is willing to accept functional/teleological storytelling (cf. fn. 12).   The same is true in explaining the existence of uninterpretable features in language; the observation that those features, and the displacement property of language they bring about, serve the pragmatic function of surface interpretation (the edge property; see Chomsky (2005), etc.), is not very informative when we investigate how

those features first came into being.

There are other biological phenomena at the microscopic level that are surprisingly analogous to what is taking place in human language, and Ji (1997), for instance, argues that out of the 13 design features of language listed by Hockett, as many as 10 are also shown by the molecule-based "cell language." This isomorphism leads Ji to suggest that "human language is ultimately founded in cell language," that "human language can be viewed as a transformation of cell language," and to conclude that "a complete understanding of the nature of DNA requires applying the principles of human language to biology" (Ji (1997: 36)). This prospect of a collaboratory project by linguistics and biology is what makes biolinguistics worthy of the name, as reflected by Jenkins' (2000: 232) following remarks: "In essence the problem confronting the biolinguist is quite similar to that of the molecular biologist seeking ... to reveal the "regulatory syntax" of UG ... And, ultimately, to understand better human language, we can also be helped along by a better understanding of the language of the cell." The answer to the problem largely depends on the elucidation of the "third factor," of course. Lenneberg's dream lives, and continues to grow, now in the form of unification in generative biolinguistics.

7. Nouns, Verbs, and the Recursion-Only Hypothesis

Some other chapters in this book center around the topic of language deficits, typically the familial SLI, and their implications for the claim of domain-specificity of grammatical modules and also for genetic and neural researches. These studies occupy a pivotal place in biolinguistics today and must be taken into full account in the discussion of language evolution, too. Here I will briefly take up the issues of category-specific deficits in aphasics (Chapter 7) and genetic dysphasia in inflectional morphology (Chapter 12), because they seem to have a direct bearing on HCF's recursion-only hypothesis and its theoretical import.

Cases of double dissociations between nouns and verbs, where patients with brain damage and consequential aphasia show selective deficits only in the production of nouns or verbs, are well documented in the literature. Based on the detailed review of relevant neuropsychological and neurophysiological studies, Caramazza and Shapiro (Chapter 7; see also Shapiro and Caramazza (2001)) argue that at least some of

these cases are purely morphosyntactic and not semantic in nature, and suggest that distinct neural circuits are involved in nominal and verbal morphosyntax; fronto-temporal circuit (inferior and posterior prefrontal structures) for nouns and fronto-parietal circuit (anterior and superior prefrontal structures) for verbs. It is important to note, however, that this dual-circuit model does not tell anything decisive about the theoretical organization of our lexical knowledge. In particular, as the authors themselves remind us, it is compatible with a lexicon with no distinction in grammatical categories. The lexicon may contain only underspecified materials and they become "specified to grammatical class only when it is inserted into a particular context (à la Distributed Morphology)" (Chapter 7: 166).

There is a hotly contested discussion going on within the generative arena between lexicalists and anti- or non-lexicalists concerning the proper treatment of lexical categories, about whether they are individually listed in the lexicon or instead generated in syntax. Contrary to the misconception commonly held among lexical semanticists, and as stressed by Marantz (1997), the Lexicalist Hypothesis in fact argued for an undifferentiated lexicon. Thus, "... when the lexicon is separated from the categorial component of the base and its entries are analyzed in terms of contextual features ... we can enter *refuse* in the lexicon as an item ... which is free with respect to the categorial features [noun] and [verb]" (Chomsky (1970: 190)). With the abandonment of both D-structure and the Projection Principle, the anti-lexicalist position is again gaining ground in the MP, most notably because of the success of the split VP structure which captures the advantage of lexical decomposition. Against this background, we can take the category-specific dissociations as occurring not from a lexicon-internal selective deficit on nouns or verbs but rather from "damage to mechanisms that operate contextually to specify words as nouns or verbs" (Chapter 7: ibid.); more specifically, damage to the functional categories *v* (verbalizer) and *n* (nominalizer) or their selectional features, or even to the post-syntactic morphophonological realization.[13]

Similar considerations apply to Gopnik's well-known genetic dyspha-

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[13] Barner and Bale (2002) convincingly show that category-specific deficits are better explained by a non-lexicalist model of grammar, while distinguishing nouns and verbs in the lexicon is descriptively wrong.

sia studies (Chapter 12).   As attested, affected people have difficulties inflecting nouns in the regular plural forms or verbs in the regular past forms, and this situation has been interpreted as showing that they have a damaged computational/syntactic capacity so that regularly inflected forms must be retrieved as single units, on a par with irregular forms. This view depends crucially on the dichotomy of irregular inflection as lexical knowledge vs. regular inflection as syntactic knowledge, the plausibility of which is cast into serious doubt even when we consider simple examples of VP ellipsis like the following:

(7)   a.   John laughed, but Mary will not.

(will not {laugh / *laughed})

b.   John came, but Mary will not.

(will not {come / *came})

If *came* constituted a syntactically unanalyzable lexical unit, then the ellipsis site in (7b) would not have an appropriate filler.   We must con-clude, at the present moment, that neuro- and psycho-linguistic evidence is too coarse to (dis)prove a purely theoretical model of linguistic knowledge (see also Ullman et al. (2005) and Embick and Marantz (2005) for relevant discussion).   The problem is general and becomes more serious as drastic simplification of UG is pursued in the MP.   To bring the findings of theoretical and neurological linguistics into a clos-er contact, so that the two fields can learn more from each other, will be a prerequisite for future development of biolinguistics.[14]

Let's finally note the implications of the above observation for the

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[14] In Chapter 8, Grodzinsky reviews the analysis of aphasic patients' chance level performance in comprehending certain constructions in terms of their inability to link a moved element to its trace (the Trace-Deletion Hypothesis), to corroborate the claim that Broca's region (Left Inferior Frontal Gyrus) is critically involved in the computation of XP-movement.   Is this good neurological evidence showing that Move is "special" and cannot be treated on a par with Merge, in direct opposition to current minimalist theorizing? Maybe not.   The TDH deals with the processing of θ-interpretation via argument traces, rather than the operation Move itself, and there-fore the observed impairment may be associated more appropriately with the perfor-mance system(s) than with the core computational system.   After all, there is no direct knowing what the activated part of the brain is actually doing in linguistic performance, except by building a hypothesis on the basis of a theory of grammati-cal knowledge.   Brain and neurological studies, boosted by new imaging technolo-gies like PET and fMRI, are a substantial component of biolinguistics, but it awaits future, in-depth investigations to determine what exactly the findings in these fields are pointing at.

study of language evolution. The recursion-only hypothesis contends that syntactic recursion is the sole component of the language faculty that is unique to it. On the face of it, this is a questionable claim, as objected by Pinker and Jackendoff (2005) and Jackendoff and Pinker (2005). Among others, the rich and productive lexical system seems to be another definitive hallmark of human language. To the extent that syntax and lexicon constitute two separate modules of grammar that jointly form the cognitive system of the human language faculty, we must seek an independent evolutionary path for the lexicon, which may render the topic of language evolution more difficult to address. Suppose, then, that an anti-lexicalist theory is correct and that words are also generated by the language's single generative engine, i.e. syntactic recursion. By assuming that there is virtually no lexicon (the basic tenet of DM) as a working hypothesis, we can take a step further toward the solution of the logical problem of language evolution. The recursion-only hypothesis stands as a firm guideline in the search for a deeper theory of language attaining evolutionary adequacy.

8.   Conclusion: Unification *for* Biolinguistics

Many other chapters are left untouched here, but there is no implication at all that they are less important for biolinguistic researches, not even for the study of language evolution. Take Kayne's Linear Correspondence Axiom (LCA) and Universal Base Hypothesis (UBH) for instance (Chapter 1). The standard supposition in the MP now seems to be that there is no linear order within phrase structure, but linearity emerges from structural hierarchy during morphophonological interpretation, with the LCA functioning as a kind of mapping principle at the sensorimotor interface. This "order-out-of-disorder" model appears to be in better conformity with the MP, since it eliminates redundant information from the core computational system and lets the linear structure self-assemble through symmetry breaking. It also renders some plausibility to the recursion-only hypothesis and thereby makes the topic of language evolution more accessible for the familiar reason. Kayne's theory, to the extent that it is empirically desirable, presents a challenge against which we must justify this null hypothesis; if only the UBH offers a correct account of observed linguistic facts, then we face the problem of how the suggested universal order got into UG during its evolution. This is another instance of purely descriptive

work coming into direct connection with evolutionary studies, and the same is true of other researches undertaken in the MP, too.

To return to the three levels of investigation set at the outset, we now see that not only development (ontogenesis) but every step in the generation of each linguistic expression (microgenesis) deserves a closer examination from the viewpoint of evolution (phylogenesis). After all, syntactic derivation is an evolution-like process; it does not look ahead but still, like a blind watchmaker, it gives rise to an infinite variation of perfectly designed structure. It remains to be seen if such a conceptual integration leads to a fruitful unification for the future of generative biolinguistics, of course.

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