Introduction

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This volume is based on a conference the original intent of which was to survey the updated landscape of research directions sparked by Hauser, Chomsky, and Fitch's seminal "The Faculty of Language: What Is It, Who Has It, and How Did It Evolve?", a paper that appeared in *Science* in 2002 and was significant, not only in framing current debates on language evolution within and across disciplines in anthropology, biology, neurosciences, cognitive sciences, philosophy, and, of course, linguistics, and not only for the novel and provocative views it advanced, but also for the controversies it ignited through its focus on recursion as central to the evolution of the language faculty. The chapters in this book present a collection of reflections and further research conducted by top scholars working in the evolution of language, nearly all influenced in one way or another by the Hauser, Chomsky, and Fitch (HCF) paper.

For many, including us, HCF and related efforts have signaled a symbolic lifting of the ban on investigations into the origin of language officially imposed by the Linguistics Society of Paris in 1871. Although this ban is often cited as an example of arbitrary scientific legislation, commanding no real respect, its effects have been surprisingly potent in our own field of linguistics. Whereas anthropology, biology, psychology, and philosophy have happily ignored the Paris ban, addressing evolutionary questions of all sorts, including those that encompass language and its origin, linguistics, as a field, has shown surprising reticence on the topic. Whereas anthropology, biology or anatomy departments routinely treat evolution as a core area meriting specialized faculty, no linguistics department would view language evolution as more than an intellectual sideline, certainly not a core area of specialization in the usual sense.

In view of the dramatic change in the theoretical landscape, with linguists of all theoretical persuasions now active in debates about human language origins, it is interesting to ponder two historical questions. First, why were linguists, and generative grammarians in particular, so little interested in the origins questions that seemed so central to many outside the field? And second, what has changed to justify current interest?

The origins question

When addressed by Chomsky in the past, the question of human language origins has been pronounced uninteresting on grounds of being at once too easy and too hard. It appears too easy because there seem to be so few constraints on theorizing in the domain, and no difficulty in coming up with broadly plausible tales of how language began. At the same time, as attested by the childish names labeling the most popular accounts (the "Bow Wow" theory, the "Pooh Pooh" theory, the "Yo He Hoo" theory, etc.), such theorizing does not seem to rise above the level of children's just-so stories in having little empirical or theoretical foundation, and few testable consequences.

On the other hand, the question seems too hard, because it is far from obvious what kind of scientific evidence could, in fact, be brought to bear on the question. As HCF put it, even if we move from the common view of language as a "culturally specific communication system" to the modern linguistic conception of language as "one of the biologically-grounded, internal components of the human mind/brain," potentially meaningful questions like "what components of the human nervous system are recruited in language?" turn out to have answers that are largely meaningless or untestable, such as: "probably most of them." For fruitful research to be possible, scientific questions must be divisible in such a way as to be answerable. Paraphrasing Descartes, we must be able to "divide a problem into parts that admit of separate solution." According to Chomsky, the question of how language evolved simply lacked this divisible character, under even the most scientifically up-to-date conceptions of language of the time, and indeed it is not hard to see why.

The principles and parameters model

In the 1980s, generative models took the language faculty to consist of an intricate set of universal generative "principles and parameters," interacting in modular fashion to yield both the human, biologically unique language faculty, and the variety of its social manifestations. These models were strongly motivated by the twin goals of understanding linguistic diversity and explaining the nature of language acquisition. On the one hand, the considerable apparent variation across the world's languages argued for a language faculty permitting a large space of possible human natural languages. At the same time, the facts of language acquisition – the fact that it seems to occur quickly and reliably in the face of an intrinsically "noisy" and error-filled environment – argued for a language faculty enabling children to select their language effectively within that large space on the basis of minimal input. The model ultimately settled on was one that analogized the language faculty to an electrical device of fixed architecture that included a small set of dials that could assume a finite (and

presumably small) number of settings. Linguistic input would allow the learner to determine the "dial settings" appropriate for his or her language. At the end of this "setting acquisition period" the device would simply function. On this picture, the principles of the language faculty constitute its fixed architecture, and the parameters in these principles represent their "tunable" aspects. The set of distinct possible human languages corresponds to the collection of distinct possible dial/parameter settings that yield a functioning language faculty. To achieve a large space of variation from a small number of settings, the principles were assumed to be interactive, so that a particular setting for a parameter would have cascade effects in the ultimate shape of the grammar.

In this period, most of the principles and parameters hypothesized as part of human universal grammar had a character so language-specific that questions about their counterparts in non-linguistic cognitive faculties simply seemed out of place. To take a specific technical example, it would have made little sense at the time to wonder whether the linguistically core notion of 'government' had any counterpart in non-linguistic cognition. Within this framework, the uniqueness of the language faculty to humans appeared to be a matter of its foundational principles and their interactive architecture. Human language was unique because the linguistics "module" was unique in content among all our faculties.

Given this general conception, it comes as no surprise that the question of language origins could gain no empirical or theoretical traction. Faced with principles and parameters of the language faculty so obviously unique in nature, theoretical linguists had little choice but to assume that faculty had evolved all at once, with no precursors in other species, and no counterparts in non-linguistic domains, a view so obviously unsatisfactory that it could only serve to highlight the impasse. Perhaps for these reasons, in this period Chomsky repeatedly pondered in print the biological oddity of language. If evolution is a "tinkerer," as Nobel Prize-winning biologist Francois Jacob put it, then language, as conceived in the principle and parameter framework, seemed at once too unique, too complex, and too perfect a system to be a product of evolution. The situation was therefore a paradox. And a not uncommon (nor unreasonable) strategy when faced with paradox is simply to ignore it until a new perspective can emerge that will allow questions and problems to be parceled out afresh. In our view, this picture accounts not only for earlier lack of interest in questions about the evolution of language, but also for the renewed interest that has emerged.

New beginnings: "minimalism" in linguistic theorizing

A new way of parceling out the problem of language evolution has recently begun to develop as part of an independent theoretical shift in the conception of the language faculty itself, based in particular on a revised view of the core

computational mechanisms of language. As noted above, in the principles and parameters framework of the 1980s, the computational mechanisms of language were taken to involve an intricate interaction between complex modules at various levels of representations. In recent years, however, the so-called minimalist program has sought to replace this complexity with a theory consisting of a single, core computational mechanism, *Merge*, embodying the central recursive property of language, and two interfaces to which it links: a sensory-motor interface, and a conceptual-intentional interface. On this picture, human language is conceived as an "interfacing mechanism," linking sensory-motor to conceptual-intentional information in an infinite, recursive manner. The three taken together are referred to by HCF as the "faculty of language broadly construed" (FLB), and the core computational mechanism is referred to as the "faculty of language narrowly construed" (FLN).

Within this broad picture, the two main motivating concerns of the earlier principles and parameters framework – diversity and acquisition – are significantly recast. The invariant architecture of the language faculty is now located in its recursive, hierarchical structuring mechanism, together with principles of efficient computation that govern its operation. "Deep" constraints on linguistic derivations, such as those governing movement (island-hood, superiority, locality), are currently being pursued as issues of computational efficiency and economy in the basic recursive mechanism. By contrast, linguistic variation – the earlier domain of parameters – is now being pursued as an interface phenomenon, arising from how the recursive mechanism interacts with the sensory-motor and conceptual-intentional domains. Thus, word order variation, a primary point of linguistic difference, is viewed as a "linearization phenomenon": an aspect of how the two-dimensional hierarchical structures yielded by core computation are projected into the strings of sequentially pronounced forms required by the sensory-motor system. Languages are assumed to be able to linearize their structures differently. Likewise, variation in expressive relations – how a given notion is lexicalized and subsequently projected – may reflect variation at the conceptual-intentional interface. Thus, in the construction of English motion concepts, manner of motion is incorporated into the verb, while direction is realized in a satellite phrase (*John rolled down the hill*), whereas in other languages, such as French, direction of motion is expressed in the verb, while manner is realized in the satellite (*Le ballon est descendu la colline en roulant* cf. 'John descended the hill rolling'). Such broad differences in lexicalization patterns may well reflect systematic differences in how the linguistic system interfaces with the (presumably pre-existing) domain of motion concepts. Finally, issues of language acquisition – how children are able to achieve rapid, reliable mastery of their language in a noisy, error-ridden environment – also now presumably reduce to interface matters, although intriguing questions remain regarding variation in movement possibilities across languages.

The origins question reconsidered

The conceptual subdivision of language mechanisms into three core components – two interfaces and a recursive link between them – has allowed for a new parceling-out of the problem area from an evolutionary point of view. As HCF have emphasized, when we consider the origins of natural language, and the components comprising it, three core questions may be posed:

1. Is it uniquely human or shared with other species?
2. Was its evolution gradual or saltational?
3. Did it evolve as a unique adaptation for communication or one for another purpose?

As we noted, such questions were difficult to frame and address in earlier stages of linguistic theory. The complex interaction of the components made it difficult to extract a set of properties that could be meaningfully isolated for appropriate investigation. What kind of evidence could be brought to bear on whether Move α – the central transformational component of the computational mechanisms in the principles and parameter model of language – was or was not uniquely human? Such questions can, however, be asked separately of each of the three core components of the newly conceived language faculty: the sensory-motor component, the conceptual-intentional component and the core computational recursive component, and indeed can also in principle be answered differently.

These questions also serve as a useful way of organizing the contributions represented in this volume.

Part 1: Language architecture

Understanding the evolution of language clearly presupposes understanding of what a language is. Only then can we determine what features of it can or should be traced to capacities or structures found in other species, and what (if anything) is truly innovative in it. The authors in this section offer basic views about the language capacity, how it might be studied from a comparative point of view, and what evolutionary expectations might accompany differing theories of it. The volume reprints the original Hauser, Chomsky, and Fitch 2002 *Science* paper "The faculty of language: what is it, who has it, and how did it evolve?" as a convenient reference point for the discussion that follows.

Chomsky begins from a basic view of language as a computational system bridging the human motor-perceptual and conceptual-intentional systems. He surveys the bare conclusions that may drawn about this system, given its empirical properties as revealed by linguistic research, and given the three main factors available to shape it: the experience that forms its input, the genetic factors that encode its specific format, and those principles of design that are known to govern the growth and evolution of biological systems generally

(e.g., efficient computation). Chomsky isolates the basic operation of Merge, which "takes structures already formed and combines them into a new structure" as a candidate for what is unique in human language. Chomsky suggests the presence of Merge, together with the assumption of maximally efficient computation, yields the fundamental observed configurations of linguistic structure, including basic thematic Merge (external Merge) and the phenomenon of movement, here analyzed as internal Merge. Chomsky also considers the fascinating question of whether language bears a symmetric relation to its interfaces, or whether one is primary. Based on a range of suggestive evidence, he concludes that the conceptual interface is indeed primary. The picture of language evolution is thus one of the development of recursive Merge in an individual (or small group of individuals) that exploited it initially for its enhanced symbolization and reasoning advantages, and only later deployed it for communication, once its genetic basis had spread to a sufficient number of creatures to make "externalization" adaptively advantageous. Developing this line, Chomsky further suggests that externalization may well be the source of variation in the world's languages: in effect, although natural language has an invariant interface with a single conceptual-intentional system, there may be a multiplicity of ways in which it can interface with motor-perceptual systems.

Chomsky makes a number of closing observations about human symbolic capacity that, superficially at least, appear to complicate our picture of human language evolution and challenge its prospects for success. Specifically, he notes that even if recursive Merge was a key innovation in human language origins, as described above, the conceptual-intentional system with which it interfaces must have already been distinct from that observed in the animal world. As he notes, reference to the world by human language symbols has a mind-dependent quality not found in the communications systems of other animal species. So the picture cannot simply be one of recursive Merge imposed on a system of linguistic/cognitive atoms of the sort found routinely in the animal world. In a certain sense, these atoms must have already been distinct before Merge came upon the scene, leading to separate and intriguing questions about how this particular development might have come about.

Jackendoff's paper presents an interesting counterpoint to Chomsky's, exploring how alternative views of the language capacity and its make-up might generate alternative hypotheses about its evolution. Jackendoff separates four different ways in which a necessary component C of human linguistic capacity might derive: (i) C required no evolutionary innovation and was present in the ancestral lineage in essentially modern form; (ii) C required evolutionary innovation, but its function extended beyond language; (iii) C required evolutionary innovation, but was secured by alteration of an existing non-linguistic feature/capacity; (iv) C required evolutionary innovation, and

was secured by something entirely new. Jackendoff advocates "reverse engineering" as the best way to study the language capacity in terms of (i)–(iv). That is, one should look at modern human linguistic capacity in terms of normal linguistic evidence, in terms of evidence from other cognitive, perceptual or motor capacities in humans, and in terms of evidence from comparable capacities in other organisms. Jackendoff contrasts two detailed views of the human linguistic capacity with these distinctions as background: what he calls the "syntacto-centric" picture of Chomsky's minimalist program, in which linguistic syntax is the source of generative capacity in grammar and cognition, and the parallel architecture that Jackendoff advocates, in which independent generative systems interact.

For Jackendoff, language and cognition are essentially distinct systems with their own atoms and combinatory structures, and mapping relations between them. On his view, linguistic evolution begins with a pre-existing system of combinatory thought that might have been initially externalized in ways not relying on hierarchical structure (cf. Bickerton, this volume), but which ultimately came to incorporate it. This picture, somewhat like the one entertained by Chomsky, shifts important aspects of the question of human language origins to questions about the origins of human concepts, although Jackendoff does not discuss here the mind-dependent aspects of symbolism that Chomsky focuses on.

Fitch's paper provides a detailed look at the property of recursion, identified in HCF as one of (if not the) key innovation in the development of human linguistic capacity. Fitch begins by briefly reviewing the history of HCF and the debate that ensued from it, reiterating the position (echoed in Chomsky's discussion of *Merge*) that recursion is a central feature of human language. Fitch identifies three different meanings/interpretations of recursion employed by the different fields of computer science, linguistics and meta-mathematics. For computer science, a recursive function is one that calls itself during the course of execution. For linguistics, a recursive rule is one that yields self-embedded structures. For meta-mathematics, a partial recursive function is simply a computable function. Fitch shows that unclarity about recursion has been a source of confusion in the animal communication literature regarding what species have recursive capacities, and what tests we can do to probe this.

Hauser's contribution has two goals: to address some of the crucial points in HCF that were misunderstood in ensuing debate, and to restate the research program outlined there and its prospects. Hauser reiterates his conviction that the distinction between the faculty of language broadly and narrowly construed (FLB and FLN, respectively) is an important one for guiding research in understanding linguistic evolution, whether or not any particular item is ultimately found to inhabit FLN.

Part 2: Language and interface systems

Language interfaces with the conceptual system on the one hand and with the motor-perceptual system on the other. Could non-linguistic cognitive abilities on either end of these interface systems have played a triggering role in the emergence of the human language faculty? In this section, the authors differently explore the cognitive systems that language interfaces with and raise the question of whether and how some of the interface properties interact with language and could be regarded as precursors.

For Gärdenfors and Osvath, a key and unique property of human language is the ability it affords to describe or plan situations that are not present. Working backward from this insight, Gärdenfors and Osvath argue that "anticipatory cognition" is a prerequisite for the action-planning capacity that language allows. They attempt to trace the emergence of this anticipatory cognition in the new feeding habits of prelinguistic Oldowan society; from fruit gatherers, the Oldowan hominins became hunters or scavengers of large carcasses. These changes in feeding habits required, on the one hand, the use of stone tools for butchering activities and, on the other hand, the anticipatory stashing of stone tools in various geographical locations throughout the hunting domain, given that the locations of large animal carcasses cannot be predicted ahead of their discovery. Stashing of stones provides proof of anticipatory cognition, an ability not commonly found in the animal world. Anticipatory cognition, once acquired, can serve as the backdrop of action planning. It allows one to step away from present circumstances and abstractly project oneself in the not-yet-existent future. Plausibly, it represents a precursor of the language-unique ability for displacement and representation of future possible worlds.

Corballis explores the motor interface, arguing that language must have preceded speech in the following sense: gestural communication has its roots in the ability that great apes and humans share for fine-grained movements. Furthermore, both humans and great apes have been shown to exhibit mirror neurons connected to hand and oral gesture. From this basis, it is but a short step to imagine that gestural communication preceded speech and that some of the complexity of language was present even before humans moved to oral communication. As Corballis puts it, speech is essentially "swallowed gestural communication" that resonates via the mirror system in same-species brains. It is thus possible to imagine that language preceded speech, being gestural at first, but possibly with some of its formal properties already in place. It was this gestural communication, Corballis suggests, that underlay the use of speech sound to effect essentially the same type of communication.

Finally, Sperber and Origgi explore the relationship between language and the theory of mind. They make the strong and convincing point that variations in a code, which human languages profusely exhibit in contrast to animals codes,

can be evolutionarily advantageous only to beings capable of inferential communication – communication that reflects the speaker's intention to affect the addressee's mental representation, and the addressee's understanding of this intention. Such an inferential system of communication is in turn possible only between beings that share a naïve psychology and possess the ability to attribute to others mental states identical to their own.

Part 3: Biological and neurological foundations

What role do biology, genetics, anatomy, and neurology play in the evolution of language and how are they connected? In this section, the authors address this question from a variety of perspectives rooted in their respective disciplines. The answers offer a diversity of views and provide a stimulating sampling of how divergent conclusions can be drawn from within the very same disciplines. This divergence forcefully illustrates how deeply one's conception of language infuses and frames explorations of the evolutionary problem. Dor and Jablonka, and Piatelli-Palmarini explore the role of biology in language evolution. The former adopts the common-sense conception of language as a culturally specific type of communication, with syntax a minor complication introduced in the course of evolutionary history. By contrast, the latter starts from the Chomskyan notion of I-language (internal language) as a biologically grounded component of the human mind/brain with syntax as its core component. Not surprisingly their perspectives on language evolution arrive at very different views. Lieberman and Stromswold, in contrast, offer rather convergent views, both noting intriguing parallelisms that neurological and biological experimental evidence reveal between the linguistic computational properties of phonology and syntax and those of the motor system.

Dor and Jablonka begin by pointing out how developmental considerations have led to a shift in perspective in the so-called "evo devo" view in biology, bringing new focus on phenotypical development, rather than on genetic variation as the point of departure for evolutionary analysis. They discuss general evo devo concepts and processes centering on plasticity, canalization and genetic accommodation, and offer conjectures about the role that each may have played in the evolution of linguistic communication. The picture they develop envisions the cultural evolution of language as preceding speakers' genetic readiness. On their perspective, language came into being because the human social world evolved to the point where collective inventions became possible. Language results from speaker invention and is a manifestation of humans' exceptional (but not unique) behavioral and neural open-ended plasticity. Invariance of general linguistic properties is attributed to *canalization*, the other side of developmental plasticity. Their perspective, not surprisingly, leads to a picture of gradual evolution: language invention started with the creation of

words and gradually complexified, under pressures for communication, to eventually encompass syntax. Why words should have conferred their initial adaptive advantages is, however, largely taken for granted and left unexplained, as are as the specifics of the communication pressures and their importance in shaping language. The picture of language is one of a self-developing process directed by increased canalization, which eventually imparted a certain architectural logic, in turn imposing system constraints on the next innovations. Partial genetic assimilation then started a co-evolutionary spiral in which "language not only adapted to the brains and minds of individual speakers, but the brains and minds of the speakers also adapted themselves to language."

The view of language evolution offered by Piatteli-Palmarini is diametrically opposed to that just sketched. Beginning with general "parables" from the history of physics, demonstrating the fruitfulness of scientific inquiry that places no prior bounds on abstract theorizing, Piattelli-Palmarini forcefully argues for a perspective that takes I-language and its recursive syntax as the relevant object of inquiry for language evolution, and not E-language or linguistic communication. He offers a brief, but pointed demonstration (based on ellipsis phenomena) that syntax and not communication must be recognized as the driving force that shapes language as soon as factual analysis of any depth is attempted. He goes on to argue against views that take language evolution as "the cumulation of a host of smaller steps" and calls for a general reexamination of the notion of evolution, even biological evolution as applied to language. Finally, Piatteli-Palmarini stresses the danger of the subtraction fallacy, which applied to language suggests that word concatenation could be seen as a precursor to fully developed syntactic language. Words, he counters, are not simplex atoms but already highly complex syntactic entities, as demonstrated by Pylkkänen and Marantz (2003), using both linguistic evidence and experimental brain imaging results.

In his contribution, Philip Lieberman offers a broad overview of recent neurological findings ranging from classic aphasia to brain imaging and studies of Parkinson's disease, all highlighting the central role of basal ganglia in both linguistic and non-linguistic cognitive abilities involving reiteration. These findings, Lieberman argues, strongly suggest that the neural circuitry rooted in the basal ganglia should supersede classic neurological models associating core computational components of language and syntax with cortical structures in Broca's area. His survey reasserts the neurological overlap between fine motor skills and linguistic capacities, an overlap also supported by recent genetic findings that identify FOXP2, not as a language-specific gene, but as a gene governing fine motor control, coordination and human reiterative capacities. Lieberman suggests that the capacity for reiteration, which in his view subsumes recursion, is rooted in fine-grained motor control and planning, and is hence neither unique to the language faculty nor to human cognition. On