

CHAPTER I

Introduction

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This whole enterprise grew from a delightful equivocation. Everyone involved assumed we would be learning from Noam Chomsky, while he told us he was looking forward to the encounter in order to learn from the participants. We are convinced that the reader will benefit from this equivocation. It is a tribute to Chomsky and the other protagonists of this rich exchange that the layout of, and spirited exchanges upon, multiple central topics are among the most genuinely interdisciplinary to be found anywhere in the literature. We like to think that readers with quite different disciplinary backgrounds (linguistics, psychology, biology, computer science, or physics) will enjoy at least some sections of this book. The organization into parts and sections has been conceived with a view to facilitating such selective access.

The present ordering does not always reflect the chronology of the conference, though the discussions following each presentation, after minimal editing, are all reported here in “real time.” Most of the originality and interest of this volume lies, we think, in these candid discussions, but the reader, depending on concrete interests, may decide to go past some of them and connect to the following sections. In fact, although we tried to organize matters proceeding from the more general to the more specific, it was inevitable that, in the ensuing deliberations, specific, and even sometimes technical, issues be brought to the fore also for quite general presentations.

The book is divided into four parts, almost in contrapuntal fashion. The **Overtures** jointly offer different, but complementary, introductions to the central theme of this volume: biological perspectives on language and related cognitive functions. These presentations are all non-technical and, we think, accessible to readers with different backgrounds. The second part, **On Language**, is a multi-faceted attempt to draw the frontiers of an approach to

language seen as a natural object and, therefore, to linguistics conceived as part of the natural sciences. The third part, **On Acquisition**, focuses on how it is possible for every normal child to converge so rapidly and so efficiently onto the specific language of the surrounding community. Like the final entries of a fugue, the explorations in part four (**Open Talks on Open Inquiries**) enter domains of research that are conversant with, but also attempt to go beyond, the present concerns of linguistic theory (ethics, aesthetics, individual differences, neural correlates of emotion and prosody, and more).

Part I: Overtures

In his **opening remarks**, Chomsky retraces the essential history of the field of biolinguistics and leads us to the present panorama. The chapters that follow explore, from different angles, the present contours of a biology of language. This part could be characterized, paraphrasing a famous paper by W. S. McCulloch,¹ as an attempt to answer the question: What is biology, that language may be part of it?

Starting from very general questions and the premise that the more is packed into the Broad Faculty of Language, the easier it is to understand the overall evolution of this faculty (including its “narrow” aspects), Cedric Boeckx attempts to decompose Merge into more basic operations. He concentrates on endocentric (multiply nested, of the same type) structures specific to language, and seeks to derive this property from elementary “grouping” and “copying” operations, which he speculates may have been recruited from other cognitive systems in animal cognition. This fits into François Jacob’s and Steven Jay Gould’s dictum that new structures in biology are a recombination of old processes that are put together in new fashion, that being the general origin of evolutionary novelty.

Marc Hauser emphasizes the importance of probing the boundaries of animal cognition through “spontaneous methods.” He insists that there is virtually no connection in animals between the sensorimotor output of signaling and the richness of their conceptual systems. In order to bridge this gap, subtle experiments have been carried out to reveal the representation of the singular–plural distinction in monkeys and in prelinguistic children. Hauser then expands the analysis to the mass/count distinction, where he ascertains a contrast between monkeys and infants. He concludes with a proposal for the relations between language and ontological commitments which is sensitive to that mass–count distinction, so that it manifests itself only in some languages.

¹ McCulloch (1961).

Charles Randy Gallistel explains why a materialist conception of mind is compatible with the attribution of high-level abstractions even to birds and bees. Experiments on the mastery by jays of thousands of locations of different food caches show that it is based on their memory of what they had hidden where and when. Moreover, on the basis of data on caching while being watched by conspecifics and then re-caching when out of view, Gallistel concludes that nonverbal animals represent the likely intentions, and reason about the probable future actions, of others. The mastery of solar ephemeris in the foraging bees demonstrates the sophistication of the spatial reasoning that goes on in these miniature brains. Such abstractions are both primitive and foundational aspects of mentation that must have emerged early in evolutionary history.

Gabriel Dover introduces a dissenting opinion. In contrast with Chomsky's plea for focusing on optimal computation in language design, Dover is hesitant to embrace the idea of a "rational morphology" that countenances only a limited number of archetypal body-plans. Detailing some factors in the present picture of evolution and development (modularity, redundancy, genetic regulatory networks, turnover, and degeneracy) Dover insists on a distinction in biology between the micro-level of chemical bonds – where the laws of physics are dominant – and a "higher" level where variation and "interactive promiscuity" reign. His position is that development is a "highly personalized" set of operations from the early inception of the networks regulating gene expression through to the ever changing neuronal connections in the brain. Subjectivity is the name of the game at all levels, even though we are only mindful of it in the brain.

Donata Vercelli, in stark contrast with that view, develops her considerations starting with the characteristics of a biological trait L (thinly disguised as being language) and stresses the importance for L of the dimension of plasticity. She then offers a summary of the mechanisms of epigenetics (under intense scrutiny in biology proper in the last half decade), suggesting that they may have a pivotal role in language development and may have had it too in language evolution. Vercelli and Piattelli-Palmarini conclude by suggesting that parametric variation across languages may well represent a genetic mini-max optimal solution, between the extreme of encoding every aspect of language genetically (thereby minimizing learning) and the opposite extreme of leaving all aspects of language to be learned (thereby minimizing the genetic load).

A counterpoint to Dover's view is also presented by Christopher Cherniak, who discusses his idea of a "non-genomic nativism." As a result of computer calculations (previously published in detail by Cherniak et al. 2004), the minimization of connection costs at various levels of nervous systems in vertebrates

and invertebrates – from the placement of the brain in the body down to the sub-cellular level of neuron arborizations – emerges as being innate, though not genome-dependent. Models that also cover the optimal design of the best commercial micro-chips show that such optimal design comes “for free,” directly from the laws of physics. Cherniak’s “non-genomic nativism” stresses the continuity between this finding and Chomsky’s strong minimalist hypothesis, according to which narrow syntax is like a snowflake, shaped by natural law.

Part 2: On Language

Still in the same spirit of McCulloch’s quote, the second part of this book could be characterized as an attempt to answer the symmetric question to the one posed above: What is language, that it may be part of biology? This general theme is developed in various ways here, even conflicting ones. It is perhaps useful to keep in mind that James Higginbotham will, at the end of the conference, acknowledge that he and Luigi Rizzi identify themselves as being, in some sense at least, abstract biologists – a characterization that probably fairly describes all the language experts presenting their views in this section. That said, it is only natural for “natural philosophers” to explore views like these, rationally disagreeing when the evidence is conflictive.

Wolfram Hinzen defends the radically minimalistic view that structural semantic conditions are satisfied in virtually tautological terms with regard to a corresponding syntax. From his perspective, in effect only syntax is a natural system reflecting Chomsky’s familiar “three factor” considerations, and it is (hopefully) rich enough to provide the essential scaffolding for semantic structuring. In a nutshell, syntax creates its own ontologies by virtue of its core mechanisms, and such ontologies are not independently given in any sense; the issue is to then match such ontologies with those needed to conceptualize, at least in their bare essentials. As Hinzen explains, this thesis extends the idea that language – if analytical tools for its structure go minimally beyond mere bracketing – and basic mathematics are virtually isomorphic.

James Higginbotham explores two putative interfaces of the linguistic system: one between syntax and semantics, and one between the latter and the world. The first implies asking how much of compositionality (the meaning of a whole being a function of the meaning of its parts and their mode of composition) belongs to general features of computation, as opposed to anything specific to language. A central issue is to explain where compositionality breaks down and what differences between languages should be explained in terms of parameters at the syntax/semantics interface. The second interface

involves the relations of semantics to our systematic beliefs about the world: What causes us to think/speak in the specific modes we do – and is this state of affairs necessary?

Sentences are known to ubiquitously contain parts that are interpreted not where they are pronounced. Yet there are strict, partly language-specific, constraints on what is syntactically allowed to be thus “moved,” where and how. Movement to distant sentential locations takes place via successive local steps, called “cyclical.” In his contribution, Luigi Rizzi argues that certain conditions on syntactic “impenetrability” can be derived from “intervention” – that is, effects arising when “movement” of a given element takes place over another of *the same type*. Locality is then relativized to skipping over interveners of equal or higher featural richness, so that elements involving fewer features have more leeway: when not involving, say, question sites, merely topicalized constituents result in less specified interveners. Thus, in the end only elements with rich featural arrays are forced into taking cyclic steps to by-pass “minimality” effects.

Juan Uriagereka discusses so-called uninterpretable features (Case being a paradigmatic example), which pose a puzzle for a minimalist program understood as an optimal solution to interface conditions. Why are there, then, uninterpretable features in languages? His suggestion is that their presence relates to a “viral” take on morphology: that is, the view that displacement correlates with the elimination of morphological specifications that bear no interpretive import. This abstractly recalls the workings of the adaptive immune system, and represents a solution to the parsing puzzle posed by compressing complex recursive (thought) structures into simple linear (phonetic) manifestations: the intricate syntax resulting from excising the viral morphology constitutes an effective instantiation of corresponding nuanced semantic types.

Complementing these approaches with a search for brain correlates to language, Angela Friederici’s proposal is that the capacity to process hierarchical structures depends on a brain region that is not fully developed in monkeys, and that the phylogenetically younger piece of cortex may be functionally relevant for the acquisition of complex Phrase Structure Grammars. The older cortex may be sufficient to process local dependencies, while the human ability to process hierarchical structures could be based on the fully developed, phylogenetically younger cortex (Broca’s area). Similarities and differences with germane studies on humans in other laboratories and with analogous inquiries by Hauser and Fitch into the processing limitations of grammars in tamarin monkeys, as compared to humans, emerge in the important ensuing discussion.

In the **round table on language universals**, Cedric Boeckx invites us to reconsider historically the very idea of language universals, and challenges the

notion of parameters as theoretically relevant in a minimalist framework, where universal grammar (or at least narrow syntax) is supposed to be genuinely universal, and all parametric variation (or at least its “macro” version) is discharged onto the morpho-lexicon. Janet Dean Fodor declares herself not so much as a “discoverer” of universals, but a “consumer” thereof. Fodor conveys the idea of how hard it is to explain the child’s actual acquisition of grammars, concretely how laborious the process of hypothesis-testing is in the abstract. She candidly declares herself to be “shopping for” hypotheses that can constrain the acquisition of grammars in real life, to avoid hosts of overgeneralizations that are possible on paper, but that no child ever makes. Lila Gleitman emphasizes the puzzle of the acquisition of the meaning of “simple” verbs like *bug* or *give* for ten-month-olds, which combines the “poverty of the stimulus” problem with its virtual opposite: the richness of the stimulus problem. How does a baby know enough to ignore irrelevant accessory objects or events in a scene? She stresses that a mosaic of conspiring cues – each of them inadequate or even obfuscating by itself – are exploited by babies to converge, almost errorlessly, on the lexicon of their native tongue. Finally, Luigi Rizzi retraces the transition from generalizations about particular grammars to the principles of UG and the notion of parameter. He reviews the recent history of Principles and Parameters, from the Extended Standard Theory to consequences ensuing from the current Cartographic Program.

Part 3: On Acquisition

Ever since Chomsky stressed the importance of attaining “explanatory adequacy” for any linguistic theory, all hypotheses on processes, mechanisms, constraints, and computations that are not supposed to be innately available have had to be answerable to the possibility of acquisition by the child on the basis of normal linguistic input. For instance, it is a true descriptive generalization about English that all verbs derived from Latin are regular (form the past tense by adding the suffix *-ed*). But since this is patently a generalization that the monolingual child acquiring English has no access to, a theory based on such a generalization would have no explanatory adequacy whatsoever. This part of the book offers several interesting approaches to theories and data by researchers who are highly sensitive to explanatory adequacy, from various angles.

Rochel Gelman deals with the issues of similarity, causality, and core or “skeletal” (innate) versus non-core (acquired) domains. She insists that appeal to universal innate principles does not exclude learning; rather, it forces us to

ask what kind of theory of learning is needed to account for early learnings and the extent to which they help, redirect, or hinder later learnings. Taking up the hard case of counting and natural numbers, and subtraction, Gelman concludes that core domains provide structure to the learning process, because they provide a mental skeletal structure that helps search the environment for relevant data and move readily onto relevant learning paths. The difficulty about non-core domains is that both the structure and the data have to be found. In her words: “It is like having to get to the middle of a lake without a rowboat.”

Instead of marveling at how fast children acquire their mother language, Lila Gleitman invites us to wonder why it takes so long. Although prelinguistic infants discriminate kinds of relations, such as containment versus support or force and causation, they tend to understand and talk about objects first. Since objects surface as nouns, these overpopulate the infant vocabulary as compared to verbs and adjectives, which characteristically express events, states, properties, and relations. Why are verbs “hard words” for the infant? Explaining the acquisition of “perspective verbs” (*chase/flee, buy/sell*) and “unobservables” (*know, think, believe*) leads us into a circle: the transition from the word to the world must be made to a world that is observed *in the right way*, that is, under the characterization that fits the word being used. The central datum is that syntax, in itself, is not only a powerful cue, but the *strongest* of all.

Janet Fodor explores plausible linguistic inputs (“triggers”) that allow the child to fix syntactic parameters. If ambiguous, such triggers do not solve the acquisition process; in that hypothetical situation, the acquisition mechanism must evaluate (as in Chomsky’s original 1965 formulation) competing grammar hypotheses. How this could be done by a learner is not obvious, and the possibility is explored here of building on “partial decoding” of competing grammar hypotheses. The approach is based on organizing grammars (vectors of parametric values) in terms of a lattice that learners must tacitly assume for the orderly setting of parameters. As learning proceeds, the smallest grammars are tried out on input sentences and some fail, then being erased from the learner’s mental representation of the language domain. In effect this “keeps track” of disconfirmed grammars, by erasing them from the presumably innate lattice. The paper ends by puzzling over the nature of such a lattice.

Thomas Bever was unable to attend the conference, although his approach to the EPP (Extended Projection Principle) had been discussed at the meeting. In light of exchanges with Chomsky, and after reading relevant sections of the transcripts, Bever offered the present paper. The odd requirement that sentences must “sound” as though they have subjects, even when there is no semantic

motivation for this (cf. *It rained, There are problems, It seems that he left*, etc.) is still an anomaly within the minimalist program. The condition was initially proposed as a syntactic universal, but while it is roughly correct for English, its presence in other languages is less obvious. Bever takes the EPP out of syntax and explains the vagaries of its generalization by means of a Canonical Form Constraint (CFC). His contribution also explores the implications of this constraint for language comprehension, language acquisition, and Broca's aphasia.

Part 4: Explorations

The final section of the proceedings is based on more open-ended talks, some of which were delivered to a more general audience, after the end of the ordinary sessions. In these, broader speculations are often attempted, although, once again, occasional disparity exists between the normally non-technical character of the presentations and the tone of some of the ensuing discussions, as different participants eagerly engage the speakers in lively discussion.

Marc Hauser anticipated some of the issues that were to appear in his recent book on "Moral Minds." His point of departure, methodologically and conceptually, is Chomsky's insistence on universal innate constraints on humanly possible mental procedures and contents, and the notion of generativity. These are tentatively expanded by Hauser to the domains of ethics (via the work of John Rawls) and aesthetics, with special reference to musical tastes in humans and non-human primates. Universal minimalism is, in his own words, what he is arguing for. Connecting his considerations with other presentations at the conference (especially those by Chomsky, Gallistel, and Cherniak), he offers an interesting panoply of novel experimental data to support his hypotheses. In the discussion, several of Hauser's hypotheses are sympathetically, but also rigorously, challenged by other participants.

Itziar Laka retraces the early steps of the innatist hypothesis for language, probing its limits and suggesting the hardest tests. Thus she takes up a challenge launched by the organizers in the invitation document: thinking about what we know and what we would like to know about minds and language. She examines innate mechanisms disclosed by the study of the perceptual salience of rhythmic/prosodic properties of speech, some specific to humans, some also found in other species. The acquisition of phonemes across different languages suggests that the peculiar thing about human babies is that they are very quickly able to construct something new, using largely an old perceptual mechanism. At the end of her exploration of the conceptual and empirical development of the field of generative linguistics, connecting with several other issues freshly

discussed at the conference, Laka cannot help but wonder about the nature of parameters.

Nuria Sebastián-Gallés explores the reasons why some individuals are better than others at acquiring a second language (L2). After discussing the issues the literature has raised with regards to possible causes for this disparity, she presents several data showing differences in brain structure and function in relevant groups tested (of poor versus good L2 learners). Importantly, in general these differences are not in language-related areas. This leads her to conclude that it is probably not the language faculty as such that is involved in proficient L2 learning, but other, perhaps general, cognitive capacities. Inasmuch as such differences are not at all important for the acquisition of a first language, these results suggest that the two processes may be quite distinct.

Angela Friederici examines the different computations carried out by the two hemispheres of the brain and tests the prediction that there are separate, and sequential, phases in processing syntactic and semantic information. She also reports on data suggesting that the right hemisphere is responsible for the processing of prosodic information. The focus of her presentation is intonational phrasing and the hypothesis that it tracks syntactic phrasing. Processing structural hierarchies activates Broca's area, parametrically as a function of the number of syntactic movements involved. A judicious insertion of morphological markers in German allowed her also to conclude that local structure-building processes precede lexical-semantic processes. Curious data on sex differences in the interactions of semantic-emotional and prosodic-emotional processes during language comprehension show women using prosodic-emotional information earlier than men.

In Chomsky's **concluding remarks**, virtually all of the different threads spun during the conference finally come together. Sharing with us his unique impressions, perplexities, excitements, and after-thoughts – and merging some of the issues discussed during the conference, while suggesting disparities between others – Chomsky retraces the main lines of development of the generative enterprise. With his vast knowledge and perspective, after reconstructing historical antecedents, he insists on the strangeness of the amnesia that has struck the cognitive sciences in the last couple of decades. Many of the fundamental problems that still (should) define the agenda for our understanding of mind at work, how it evolved and develops, and how it is embodied in brains, were openly discussed from the eighteenth century on, but appear to have been partially forgotten in our times. Perhaps Chomsky's most lasting message in this book, in our view full of both humility and insight, is that a look into the future must be accompanied by a rediscovery of the intellectually relevant past.