

The Faculty of Language: What's Special about it?

Steven Pinker
Harvard University

Ray Jackendoff
Brandeis University

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Abstract

We examine the question of which aspects of language are uniquely human and uniquely linguistic in light of recent arguments by Hauser, Chomsky, and Fitch that the only such aspect is syntactic recursion, the rest of language being either specific to humans but not to language (e.g., words and concepts) or not specific to humans (e.g., speech perception). We find this argument problematic. It ignores the many aspects of grammar that are not recursive, such as phonology, morphology, case, and agreement. It is inconsistent with the anatomy and neural control of the human vocal tract. And it is weakened by experiments showing that speech perception cannot be reduced to primate audition, that word learning cannot be reduced to fact learning, and that at least one gene involved in speech and language was evolutionarily selected in the human lineage but is not specific to recursion. The recursion-only claim, we suggest, is motivated by Chomsky's recent approach to syntax, the Minimalist Program, which de-emphasizes the same aspects of language. The approach, however, is sufficiently problematic that it cannot be used to support claims about evolution. We contest other arguments from Chomsky that language is not an adaptation, namely that it is "perfect," nonredundant, unusable in any partial form, and badly designed for communication. The hypothesis that language is a complex adaptation for communication which evolved piecemeal avoids all these problems.

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1. The Issue of What is Special to Language

The most fundamental question in the study of the human language faculty is its place in the natural world: what kind of biological system it is, and how it relates to other systems in our own species and others. This question embraces a number of more specific ones (Osherson & Wasow, 1976). The first is which aspects of the faculty are learned from environmental input, and which aspects arise from the design of the brain (including the ability to learn the learned parts). To take a clear example, the fact that a canine pet is called *dog* in English but *chien* in French is learned, but the fact that words can be learned at all hinges on the predisposition of children to interpret the noises made by others as meaningful signals.

A second question is what parts of a person's language ability (learned or built-in) are specific to language and what parts belong to more general abilities. Words, for example, are specifically a part of language, but the use of the lungs and the vocal cords, although necessary for spoken language, are not limited to language. The answers to this question will often not be dichotomous. The vocal tract, for example, is clearly not exclusively used for language, yet in the course of human evolution it may have been tuned to subserve language at the expense of other functions such as breathing and swallowing.

A third question is which aspects of the language capacity are uniquely human, and which are shared with other groups of animals, either homologously, by inheritance from a common ancestor, or analogously, by adaptation to a common function. This dimension cuts across the others. The system of sound distinctions found in human languages is both specific to language and uniquely human (partly because of the unique anatomy of the human vocal tract). The sensitive period for learning language may be specific to certain aspects of language, but it has analogues in developmental phenomena throughout the animal kingdom, most notably bird song. The capacity for forming concepts is necessary for language, as it provides the system of meaning that language expresses, but it is not specific to language: it is also used in reasoning about the world. And since other primates engage in such reasoning, it is not uniquely human (though parts of it may be). As with the first two questions, answers will seldom be dichotomous. They will often specify mixtures of shared and unique attributes, reflecting the evolutionary process in which an ancestral primate design was retained, modified, augmented, or lost in the human lineage.

In a recent article in *Science*, Marc Hauser, Noam Chomsky, and Tecumseh Fitch (Hauser, Chomsky, & Fitch, 2002) offer a hypothesis about what is special about language. The article (henceforth HCF) has attracted much attention both in the popular press (Kenneally, 2003; Wade, 2003) and among other language scientists. HCF

differentiate (as we do) between aspects of language that are special to language (the “Narrow Language Faculty” or FLN) and the faculty of language in its entirety, including parts that may be shared with other psychological abilities (the “Broad Language Faculty” or FLB). The Abstract of HCF makes the extraordinary proposal that the narrow language faculty “only includes recursion and is the only uniquely human component of the faculty of language.” (Technically, “recursion” refers to a procedure that calls itself, or to a constituent that contains a constituent of the same kind; HCF seem to use it in a more informal sense of hierarchically structured symbol combination.) In the article itself, the starkness of this hypothesis is mitigated in places, but basically the position is that recursion is the mechanism responsible for everything that distinguishes language both from other human capacities and from the capacities of animals. The authors go on to speculate that the recursion mechanism defining what is special about language may not even have evolved for language but for other cognitive abilities such as navigation, number, or social relationships.

HCF’s hypothesis appears to be a radical departure from Chomsky’s earlier position that language is a complex ability for which the human brain, and only the human brain, is specialized:

A human language is a system of remarkable complexity. To come to know a human language would be an extraordinary intellectual achievement for a creature not specifically designed to accomplish this task. A normal child acquires this knowledge on relatively slight exposure and without specific training. He can then quite effortlessly make use of an intricate structure of specific rules and guiding principles to convey his thoughts and feelings to others, arousing in them novel ideas and subtle perceptions and judgments (Chomsky, 1975, p. 4).

Similarly, Chomsky’s frequent use of the terms “language faculty” and “mental organ”¹ underscore his belief that language is distinct from other cognitive abilities, and therefore distinct from the abilities of species that share those abilities but lack the ability to acquire languages. For example:

It would surprising indeed if we were to find that the principles governing [linguistic] phenomena are operative in other cognitive systems, although there might be certain loose analogies, perhaps in terms of figure and ground, or properties of memory, as we see when the relevant principles are made explicit. Such examples illustrate ... that there is good reason to suppose that the functioning of the language faculty is guided by special principles specific to this domain ... (Chomsky, 1980, p. 44).

Indeed, the position that very little is special to language, and that the special bits are minor modifications of other cognitive processes, is one that Chomsky’s strongest critics

¹ “We may usefully think of the language faculty, the number faculty, and others, as ‘mental organs,’ analogous to the heart or the visual system or the system of motor coordination and planning” (Chomsky, 1980, p. 39).

have counterposed to his for years. Not surprisingly, many have viewed the *Science* paper as a major recantation (e.g., Goldberg, 2003).

The HCF paper presents us with an opportunity to reexamine the question of what is special about language. As HCF note (p. 1672), the two of us have both advanced a position rather different from theirs, namely that the language faculty, like other biological systems showing signs of complex adaptive design (Dawkins, 1986; Williams, 1966), is a system of co-adapted traits that evolved by natural selection (Jackendoff, 1992, 1994, 2002; Pinker, 1994, 2003; Pinker & Bloom, 1990). Specifically, the language faculty evolved in the human lineage for the communication of complex propositions. HCF contrast this idea with their recursion-only hypothesis, which “has the interesting effect of nullifying the argument from design, and thus rendering the status of FLN as an adaptation open to question” (p. 1573). In this paper we analyze HCF’s recursion-only hypothesis, and conclude that it is hard to sustain. We will show that there is considerably more of language that is special, though still, we think, a plausible product of the processes of evolution. We will assess the key bodies of evidence, coming to a different reading from HCF’s, and then consider how they arrived at their position.

Despite our disagreements over the recursion-only hypothesis, there is much in the paper with which we are sympathetic. We agree that it is conceptually useful to distinguish between the language faculty in its broad and narrow sense, to dissect the broad language faculty into sensorimotor, conceptual, and grammatical components, and to differentiate among the issues of shared versus unique abilities, gradual versus saltational evolution, and continuity versus change of evolutionary function. The rigorous laboratory study of possible homologues and analogues to aspects of language in other species is a hallmark of the research programs of Hauser and Fitch, and we agree that they promise major advances in our understanding of the evolution of language. Our disagreement specifically centers on the hypothesis that recursion is the only aspect of language that is special to it, that it evolved for functions other than language, and that this nullifies “the argument from design” that sees language as an adaptation.

2. What’s Special: A Brief Examination of the Evidence

We organize our discussion in line with HCF, distinguishing the conceptual, sensorimotor, and specifically linguistic aspects of the broad language faculty in turn.

2.1. Conceptual structure. Let us begin with the messages that language expresses: mental representations in the form of conceptual structure (or, as HCF put it, outputs of the “conceptual-intentional system”). The primate literature, incisively analyzed in HCF, gives us good reason to believe that some of the foundations of the human conceptual system are present in other primates, such as the major subsystems dealing with spatial, causal, and social reasoning. If chimpanzees could talk, they would have things to talk about that we would recognize.

HCF also argue that some aspects of the human conceptual system, such as Theory of Mind (intuitive psychology) and parts of intuitive physics, are absent in

monkeys, and questionable or at best rudimentary in chimpanzees. They are special to humans, though not special to language. We add that many other conceptual systems, though not yet systematically studied in nonhuman primates, are conspicuous in human verbal interactions while being hard to discern in any aspect of primates' naturalistic behavior. They include essences (a major component of intuitive biology and chemistry), ownership, multi-part tools, fatherhood, romantic love, and most moral and deontic concepts. It is possible that these abilities, like Theory of Mind, are absent or discernable only in rudimentary form in other primates. These too would be uniquely human aspects of the language faculty in its broad sense, but would be part of a system for nonlinguistic reasoning about the world rather than for language itself.

In addition, there are domains of human concepts which are probably unlearnable without language (Jackendoff, 1996). For example, the notion of a "week" depends on counting time periods that cannot all be perceived at once; we doubt that such a concept could be developed or learned without the mediation of language. More striking is the possibility that numbers themselves (beyond those that can be subitized) are parasitic on language – that they depend on learning the sequence of number words, the syntax of number phrases, or both (Bloom, 1994; Wiese, in press). Vast domains of human understanding, including the supernatural and sacred, the specifics of folk and formal science, human-specific kinship systems (such as the distinction between cross- and parallel cousins), and formal social roles (such as "justice of the peace" and "treasurer"), can only be acquired with the help of language. The overall picture is that there is a substrate of conceptual structure in chimps, overlain by some uniquely human but not necessarily language-based subsystems, in turn overlain by subsystems that depend on the pre-existence of linguistic expression. So here we more or less concur with HCF, while recognizing a more ramified situation.

2.2. Speech perception. HCF implicitly reject Alvin Liberman's hypothesis that Speech is Special (SiS), that is, a mode of perception that is distinct from our inherited primate auditory analyzers in being adapted to recover the articulatory intentions of a human speaker (Liberman, 1985, 1991; Liberman et al., 1967; Liberman & Mattingly, 1989). One of the first kinds of evidence adduced for SiS, dating to the 1950s, was the existence of categorical phoneme perception, in which pairs of phonemes differing in say, voicing (e.g., *p* and *b*) are discriminated more accurately than pairs of stimuli separated by the same physical difference (in this case, in voice-onset time) but falling into the same phonemic category (both voiced, or both unvoiced; (Liberman et al., 1967). This particular bit of evidence for human uniqueness was deflated in the 1970s by findings that chinchillas make similar discriminations (Kuhl & Miller, 1975). HCF cite this as evidence against SiS, together with three other findings: that certain animals can make auditory distinctions based on formant frequency, that tamarin monkeys can learn to discriminate the gross rhythms of different languages, and that monkeys can perceive formants in their own species' vocalizations.

These phenomena suggest that at least some aspects of the ability to perceive speech were present long before the advent of language. Of course, some version of this conclusion is unavoidable: human ancestors began with a primate auditory system,

adapted to perform complex analyses of the auditory world, and it is inconceivable that a system for speech perception in humans could have begun *de novo*. HCF go further and suggest that there have been *no* evolutionary changes to the mammalian auditory system for the function of speech perception in humans. They suggest that this null hypothesis has withstood all attempts to reject it. We are not so sure.

Most experiments testing the perception of human speech by nonhuman animals have them discriminate pairs of speech sounds, often after extensive operant conditioning (supervised learning). It is not surprising that some animals can do so, or even that their perceptual boundaries resemble those of humans, since auditory analyzers suited for nonspeech distinctions might suffice to discriminate among speech sounds -- even if the analyzers humans use are different (Trout, 2001, 2003b). For example, a mammalian circuit that uses onset asynchrony to distinguish two overlapping auditory events from one event with a complex timbre might be sufficient to discriminate voiced from unvoiced consonants (Bregman & Pinker, 1978). But humans do not just make one-bit discriminations between pairs of phonemes. Rather, they can process a continuous, information-rich stream of speech. In doing so, they rapidly distinguish individual words from tens of thousands of distracters despite the absence of acoustic cues for phoneme and word boundaries, while compensating in real time for the distortions introduced by coarticulation and by variations in the age, sex, accent, identity, and emotional state of the speaker. And all of this is accomplished by children as a product of unsupervised learning. A monkey's ability to be trained to discriminate pairs of phonemes provides little evidence that its auditory system would be up to the task accomplished by humans. It would be extraordinarily difficult at present to conduct experiments that fairly compared a primate's ability to a human's, fully testing the null hypothesis.

Moreover, there is considerable evidence that *has* cast doubt on the null hypothesis (Anderson, 2004; Liberman, 1985, 1991; Remez, 1989, 1994; Trout, 2001, 2003b). First, in humans the perception of speech dissociates in a number of ways from the perception of auditory events (the latter presumably using the analyzers we share with other primates). Neuroimaging and brain-damage studies suggest that partly distinct sets of brain areas subserve speech and nonspeech sounds (Hickok & Poeppel, 2000; Poeppel, 2001; Trout, 2001). A clear example is pure word deafness, in which a patient loses the ability to analyze speech while recognizing other environmental sounds (Hickok & Poeppel, 2000; Poeppel, 2001). Cases of amusia and auditory agnosia, in which patients can understand speech yet fail to appreciate music or recognize environmental sounds (Peretz, Gagnon, & Bouchard, 1998; Poeppel, 2001), show that speech and non-speech perception in fact *doubly* dissociate.

Second, in intact humans, speech and sound are phenomenologically different: under certain conditions, a given sound can be perceived simultaneously as part of a syllable and as a nonspeechlike chirp (Liberman & Mattingly, 1989), or a stretch of sound can be heard to flip qualitatively between speech and nonspeech (Remez et al., 2001).

Third, comparisons among primates turns up significant differences between their abilities to perceive speech and our abilities. For example, monkeys fail to categorize consonants according to place or articulation using formant transitions alone (Sinnott & Williamson, 1999). They discriminate /ra/ from /la/ at a different boundary from the one salient to humans (Sinnott & Brown, 1997). They fail to segregate the initial consonant from the vowel when compensating for syllable length in discriminating phonemes (Sinnott, Brown, & Borneman, 1998). They fail to trade off the duration of the silent gap with the formant transition in perceiving stop consonants within consonant clusters (Sinnott & Saporita, 2000). They fail to show the asymmetrical “magnet effect” that characterizes infants’ discrimination of speech sounds varying in acoustic similarity to prototype vowels (Kuhl, 1991). And their subjective similarity spaces among vowels (measured by discrimination reaction times analyzed by multidimensional scaling) is very different from that of humans (Sinnott et al., 1997). Chimpanzees, too, have a subjective similarity space for vowels that differs from humans’, and, like macaques, have difficulty discriminating vowel pairs differing in advancement or frontness (Kojima & Kiritani, 1989). Quail (Trout, 2003a)² and budgerigars (Dooling & Brown, 1990) that have been trained to discriminate human speech sounds also show patterns of discrimination and generalization that differ from those of humans. A recent review of research on speech perception in humans, chinchillas, budgerigars, and quail showed that the phoneme boundaries for humans and animals differed in more than a third of the studies (Sinnott, 1998).

2.3. Speech production. Turning to the articulatory side of speech, HCF cite two arguments against evolutionary adaptation for language in the human lineage. One is that some birds and primates produce formants (time-varying acoustic energy bands) in their vocalizations by manipulating the supralaryngeal vocal tract, a talent formerly thought to be uniquely human. Nonetheless, by all accounts such manipulations represent a minuscule fraction of the intricate gestures of lips, velum, larynx, and tip, body, and root of the tongue executed by speakers of all human languages (Browman & Goldstein, 1992; Hauser, 1996). Nonhuman primates are also notoriously resistant to training of their vocalizations (Hauser, 1996), and as HCF themselves note, they show no ability to learn vocalizations through imitation. HCF try to downplay the difference between humans and primates by pointing out that vocal imitation is not uniquely human. But this is irrelevant to the question of whether vocal imitation evolved for language in the human lineage. The other species which evolved comparable talents, namely certain birds and porpoises, are not ancestral to humans, and must have evolved their talents independently of what took place in human evolution.

Other evidence, not mentioned by HCF, also suggests that vocal production has been adapted for speech in humans. In comparison with extant apes and pre-*sapiens* hominids, modern humans have an enlarged region of the spinal cord responsible for the voluntary control over breathing required by speech production (MacLarnon & Hewitt,

² R. Remez, commenting in this reference on the work of (Kluender, 1994), notes that Kluender’s trained quail failed to distinguish labial and palatal phonemes. He also suggests that the quail’s ability to distinguish other place-of-articulation distinctions may hinge on their detecting the salient apical bursts that initiate stop consonants rather than the formant transitions that suffice for such discriminations in humans.

1999).³ Humans also display greater cortical control over articulation and breathing, compared with the largely subcortical control found in other primates (Deacon, 1997) And as Darwin noted, the innate vocal babbling of human infants is one of the clearest signs that “man has an instinctive tendency to speak.”

To reconcile the recursion-only hypothesis with the fact that vocal learning and imitation are distinctively human (among primates), HCF refer to a “capacity for vocal imitation” and assign it to the “broad language faculty” which subsumes non-language-specific abilities. But this is questionable. Apart from a few entertainers, humans are not notably talented at vocal imitation in general, only at imitating speech sounds. For example, most humans lack the ability (found in some birds) to convincingly reproduce environmental sounds. Even the ability to convincingly imitate a foreign or regional accent is the exception rather than the rule among human adults. The “capacity for vocal imitation” in humans thus might better be described as a capacity to learn to produce speech.

HCF’s second argument against human adaptations for speech production is the discovery that the descended human larynx (which allows a large space of discriminable vowels, while compromising other functions) can be found in certain other mammalian species, where it may have evolved to exaggerate perceived size. HCF note that while a descended larynx “undoubtedly plays an important role in speech production in modern humans, it need not have first evolved for this function” but may be an example of “preadaptation” (in which a trait originally was selected for some function other than the one it currently serves). But this suggestion, even if correct, does not speak to the issue of whether the human vocal tract (and not just recursion) was evolutionarily shaped to subserve human language. Modifications of function are ubiquitous in natural selection (for example, primate hands, bear paws, and bat wings are adaptations that evolved by natural selection from the fins of fish), so the fact that a trait was initially shaped by selection for one function does not imply that it was not subsequently shaped by selection for another function. Thus even if the larynx originally descended to exaggerate size, that says nothing about whether its current anatomical position was subsequently maintained, extended, or altered to facilitate speech.

Moreover, evidence that the larynx was recently adapted for speech is stronger than evidence that it was originally adapted for size exaggeration. The human larynx is permanently descended in women, children, and infants past the age of three months (Lieberman, 1984), all of whom speak or are learning to speak, and all of whom, in comparison with adult males engaged in intrasexual competition, had little evolutionary incentive to exaggerate size if doing so would incur costs in other functions. Compare this with a related trait that is clearly adapted to size exaggeration in intrasexual competition, namely lowered vocal fundamental frequency. This trait, as expected, is specifically found in males of reproductive age. Moreover, even with its descended larynx, the human supralaryngeal vocal tract is no longer than what would be expected for a primate of our size, because the human oral cavity has shortened in evolution:

³ The fact that *Homo erectus* had a spinal cord like that of other primates rules out an alternative hypothesis in which the change was an adaptation to bipedal locomotion.

humans, unlike chimpanzees, don't have snouts (Lieberman, 2003). This further suggests that the vocal tract was not primarily shaped for size exaggeration. Finally, the descended larynx is part of a suite of vocal-tract modifications in human evolution, including changes in the shape of the tongue and jaw, that expand the space of discriminable speech sounds despite compromises in other organic functions, such as breathing, chewing, and swallowing (Lieberman, 1984, 2003). These other aspects of vocal tract anatomy are not addressed by HCF.

2.4. Phonology. Having the potential to articulate speech sounds—that is, having a vocal tract of the right shape and controllable in the right ways—is not the same as being able to produce the sounds of a language. The articulatory commands sent to the vocal tract to produce speech are organized in distinctive ways. Speech segments are drawn from a finite repertoire of phonemes, each defined by a set of discrete articulatory or acoustic feature values such as voicing, place of articulation, and mode of onset and release. Speech segments are concatenated into patterned rhythmic constituents such as syllables, feet, and prosodic phrases, upon which are superimposed systematic patterns of stress and pitch. The composition of the segments can then be modified in rule-governed ways according to their contexts (as in the three pronunciations of the past-tense suffix in *walked*, *jogged*, and *patted*). Languages differ in their repertoire of speech segments, their repertoire of syllable and intonation patterns, and in constraints, local and nonlocal, on how one sound can affect the pronunciation of others. This system of patterns and constraints is the subject matter of phonology.

The set of phonological structures of a language forms a “discrete infinity” in HCF’s sense, in that any language has an unlimited number of phonological structures. One can always concatenate segments into longer and longer well-formed phonological sequences (whether meaningful or not). We note that the segmental/syllabic aspect of phonological structure, though discretely infinite and hierarchically structured, is not technically recursive. (As mentioned, HCF use “recursion” in a loose sense of concatenation within hierarchically embedded structures.) Recursion consists of embedding a constituent in a constituent of the same type, for example a relative clause inside a relative clause (*a book that was written by the novelist you met last night*). This does not exist in phonological structure: a syllable, for instance, cannot be embedded in another syllable. Syllables can only be concatenated, an operation that does not require a pushdown stack or equivalent apparatus necessary to implement true recursion.

Is phonological structure specific to language, or does it serve other more general purposes? Hierarchical and featural organization of gestures characterize other domains of motor control, such as manual manipulation. However, the kinds of constituents, the principles of combination, and the nature of the adjustment processes in phonology appear to be specific to language. In particular, the principles of phonology are distinctive in that they apply to a level of representation that is used both in perception and production.⁴ Moreover, every language contains a set of partly arbitrary, learned

⁴ The existence in monkeys of mirror-neurons (Rizzolatti et al., 1996), which are active both in the execution and the sight of particular actions, suggests that some kind of representation shared by perception and production antedate the evolution of language in humans. However, the information coded by such neurons

conventions which permit certain kinds of articulatory shortcuts but prohibit others (that is why there are different accents), rather than being real-time adjustments to ease articulation or clarity. Rhythmic organization similar to that of phonology appears in music, but with somewhat different implementation. The two rhythmic components might be homologous the way fingers and toes are; hybrids of the two appear in poetry, song, and chant (Jackendoff, 1989; Lerdahl & Jackendoff, 1983). We do not know of other human capacities that have been shown reflect this formal organization, though it is an interesting open question.

Is phonology uniquely human? It appears that some of the combinatorial properties of phonology have analogues in some species of birdsong, and perhaps in some cetacean song, but not in any primates; if so, they would have to have evolved separately in humans. The rhythmic properties of language and music may well be unique to humans: evidently no other primate can be trained to move to an auditory beat, as in marching, dancing, tapping the feet, or clapping the hands (Brown, Merker, & Wallin, 2000) - surely one of the most elementary characteristics of the human rhythmic response, and one that is displayed spontaneously by young children. And the rule-governed recombination of a repertoire of tones, which appears in music, tone languages, and more subtly in intonation contours of language, is as far as we know unparalleled elsewhere. So overall, major characteristics of phonology are specific to language (or to language and music), uniquely human, discretely infinite, and not recursive.

We note that there are good adaptive reasons for a distinct level of combinatorial phonological structure to have evolved as part of the language faculty. As noted as early as Hockett (Hockett, 1960), “duality of patterning” – the existence of two levels of rule-governed combinatorial structure, one combining meaningless sounds into morphemes, the other combining meaningful morphemes into words and phrases—is a universal design feature of human language. A combinatorial sound system is a solution to the problem of encoding a large number of concepts (tens of thousands) onto a far smaller number of discriminable speech sounds (dozens). A fixed inventory of sounds, when combined into strings, can multiply out to encode a large number of words, without requiring listeners to make finer and finer analogue discriminations among physically similar sounds. Recently Nowak and his collaborators have borne out this speculation in computer simulations of language evolution (Nowak & Krakauer, 1999).

Phonological adjustment rules also have an intelligible rationale. Phonologists have long noted that many of them act to smooth out articulation or enhance discriminability. Since these two requirements are often at cross-purposes (slurred speech is easy to produce but hard to discriminate; exaggerated enunciation vice-versa), a fixed set of rules delineating which adjustments are mandated within a speech community may

appears to be different from phonological representations in two ways. First, they are specific to the semantic goal of an action (e.g., reaching), rather than its physical topography, whereas phonology is concerned with details of articulation. Second, they do not support transfer from perception to production, since the ability to imitate is rudimentary or absent in monkeys, whereas humans learn to articulate speech sounds based on what they hear.

act in service of the “parity” requirement of language (Lieberman & Mattingly, 1989; Slobin, 1977), namely that the code be usable both by speakers and hearers.

Whether or not these hypotheses about the adaptive function of phonology are correct, it is undeniable that phonology constitutes a distinct level of organization of all human languages. Surprisingly, HCF make no mention of phonology, only of perception and articulation.

2.5. Words. We now come to an aspect of language that is utterly essential to it: the word. In the minimal case, a word is an arbitrary association of a chunk of phonology and a chunk of conceptual structure, stored in speakers’ long-term memory (the lexicon). Some words, such as *hello*, *ouch*, *yes*, and *allakazam*, do not combine with other words (other than trivially, as in direct quotes). But most words (as well as smaller morphemes such as affixes) can combine into complex words such as compounds (e.g., *armchair*) and other derived forms (e.g., *squeezability*) according to principles of the component of language called morphology. Morphology, together with syntax, constitutes the classical domain of recursion á la HCF, which we discuss in the following section.

As acknowledged by HCF in passing, words have several properties that appear to be uniquely human. The first is that there are so many of them – 50,000 in a garden-variety speaker’s lexicon, more than 100 times the most extravagant claims for vocabulary in language-trained apes or in natural primate call systems (Pinker, 1994). The second is the range and precision of concepts that words express, from concrete to abstract (*lily*, *joist*, *telephone*, *bargain*, *glacial*, *abstract*, *from*, *any*). Third, they all have to be learned. This certainly requires proficiency at vocal imitation, as HCF note (see the previous section). But it also requires a prodigious ability to construct the proper meaning on the basis of linguistic and nonlinguistic context. Children come into their second year of life expecting the noises other people make to be used symbolically; much of the job of learning language is figuring out what concepts (or sets of things in the world, depending on your view of semantics) these noises are symbols for.

HCF write in their abstract that the narrow language faculty (which for them excludes the lexicon) is “the only uniquely human component of the faculty of language”; yet in the body of the article they note that “the rate at which children build the lexicon is so massively different from nonhuman primates that one must entertain the possibility of an independently evolved mechanism.” They reconcile this apparent contradiction by relegating word learning to the broad language faculty. They suggest that word learning is not specific to language, citing the hypothesis, which they attribute to Bloom (1999) and Bloom and Markson (1997) that “human children may use domain-general mechanisms to acquire and recall words.” Actually, while Bloom and Markson did argue against a dedicated system for learning words, they did not conclude that words are acquired by a *domain-general* mechanism. Rather, they argued that words are acquired by the child’s theory of mind, a mechanism specific to the domain of intuitive psychology, possibly unique to humans.

HCF may turn out to be correct, but their hypothesis is difficult to evaluate until the “domain-general mechanisms” (or the theory-of-mind mechanisms) are explicitly characterized. Until then, there is a danger that word-specific knowledge (such as an understanding of the capacity to refer using symbols) will simply be relabeled as powers of this amorphous ability.

In any case, the conclusion that there are no word-specific learning mechanisms may be premature. The experiment by Bloom and Markson cited by HCF showed only that children display similar levels of recognition memory for a newly learned word and a newly learned fact. But on anyone’s account, words and facts are stored using the same kinds of neural mechanisms responsible for retention and forgetting. A demonstration that word learning and fact learning have this property in common does not prove they have all their properties in common.

Subsequent studies have shown that in a number of regards, children treat facts and words in different ways, reflecting the hallmarks of words that distinguish them from other kinds of factual knowledge. One is that words are bidirectional and arbitrary (“Saussurean”) signs: a child, upon hearing a word used by a speaker, can conclude that other speakers in the community, and the child himself or herself, may use the word with the same meaning and expect to be understood (Hurford, 1989). This is one of the assumptions that allows babies to use words upon exposure to them, as opposed to having to have their vocal output shaped or reinforced by parental feedback. (Diesendruck & Markson, 2001) showed that young children tacitly assume that speakers share a code. If one speaker labels a novel object as a *mep*, and another speaker then asks about a *jop*, they assume that the second speaker is referring to a different object. In contrast, if one speaker mentions a *fact* about an object (e.g., “my sister gave it to me”) and a second speaker asks about an object characterized by another fact (e.g., “dogs like to play with it”), they do not assume that the second speaker must be referring to a different object.

Another hallmark of words is that word meanings are defined not just by the relation of a word to a concept but by the relation of a word to other words, forming sets such as superordinates, antonyms, meronyms (parts), and avoiding true synonyms (Clark, 1993; Deacon, 1997; Miller, 1991; Miller & Fellbaum, 1991). Behrend and collaborators (Behrend, Scofield, & Kleinknecht, 2001; Scofield & Behrend, 2003), refining a phenomenon discovered by Markman (1989), showed that two-year-old children assign a novel word to an object they are unfamiliar with rather than to one they are familiar with (presumably a consequence of an avoidance of synonymy), but they show no such effect for novel facts.

Another distinctive feature about words is that (with the exception of proper names) they are generic, referring to kinds of objects and events rather than specific objects and events (di Sciullo & Williams, 1987). Waxman and Booth (2001), and Behrend et al. (2001) showed that children generalize a newly learned noun to other objects of the same kind, but do not generalize a newly learned fact (e.g., “my uncle gave it to me”) to other objects of the same kind. Similarly, Gelman & Heyman (1999) showed that children assume that a person labeled with the word *carrot-eater* has a taste for

carrots, whereas one described as eating carrots (a fact about the person) merely ate them at least once.

Our assessment of the situation is therefore that words, as shared, organized linkages of phonological and conceptual structures, are a distinctive language-specific part of human knowledge. The child likely comes to social situations anticipating that the noises made by other humans are made up of words, and this makes the learning of words different in several regards from the learning of facts. Whether these differences, together with the observed rapidity of word learning, implicate a language-specific (or uniquely human) learning mechanism is not a settled question owing to the lack of specification of domain-general mechanisms.

2.6. Syntax. We finally turn to syntactic structure, the principles by which words and morphemes are concatenated into sentences. In our view, syntax functions in the overall system of language as a regulator: it helps determine how the meanings of words are combined into the meanings of phrases and sentences. It employs at least four combinatorial devices. The first is collecting words hierarchically into syntactic phrases, where syntactic phrases correspond (in prototypical cases) to constituents of meaning. (For example, word strings such as *Dr. Ruth discussed sex with Dick Cavett* are ambiguous because their words can be grouped into phrases in two different ways.) This is the recursive component referred to by HCF. The second is the ordering of words or phrases with a phrase, for example insisting that the verb of a sentence fall in a certain position such as second, or that the phrase serving as topic come first. Most languages of the world are not as strict about word order as English, and often the operative principles of phrase order concern topic and focus, a fairly marginal issue in English grammar. A third major syntactic device is agreement, whereby verbs or adjectives are marked with inflections that correspond to the number, person, grammatical gender, or other classificatory features of syntactically related nouns. The fourth is case-marking, whereby noun phrases are marked with inflections (nominative, accusative, and so on) depending on the grammatical role of the phrase with respect to a verb, preposition, or another noun.

Different languages rely on these mechanisms to different extents to convey who did what to whom, what is where, and other semantic relations. English relies heavily on order and constituency, but has vestigial agreement and no case except on pronouns. The Australian language Warlpiri has virtually free word order and an exuberant system of case and agreement; Russian and Classical Latin are not far behind. Many languages use the systems redundantly, for instance German, with its rich gender and case systems, moderate use of agreement, and strong constraints on phrase order.

And this barely scratches the surface. Languages are full of devices like pronouns and articles, which help signal which information the speaker expects to be old or new to the hearer, and quantifiers, tense and aspect markers, complementizers, and auxiliaries, which express temporal and logical relations, restrictive or appositive modification (as in relative clauses), and distinctions among questions, imperatives, statements, and other kinds of illocutionary force. A final important device is long-distance dependency, which

can relate a question word or relative pronoun to a distant verb, as in *Which theory did you expect Fred to think Melvin had disproven last week?*, where *which theory* is understood as the object of *disprove*.

Is all this specific to language? It seems likely, given that it is special-purpose machinery for regulating the relation of sound and meaning. What other human or nonhuman ability could it serve? Yet aside from phrase structure (in which a noun phrase, for example, can contain a noun phrase, or a sentence can contain a sentence) and perhaps long-distance dependencies,⁵ none of it involves recursion per se. A case marker may not contain another instance of a case marker; an article may not contain an article; a pronoun may not contain a pronoun, and so on for auxiliaries, tense features, and so on. HCF cite none of these devices as part of language.

HCF do discuss an ability to learn linearly ordered recursive phrase structure. In a clever experiment, Fitch and Hauser (in press) showed that unlike humans, tamarins cannot learn the simple recursive language $A^n B^n$ (all sequences consisting of n instances of the symbol A followed by n instances of the symbol B ; such a language can be generated by the recursive rule $S \rightarrow A(S)B$). But the relevance of this result to HCF's argument is unclear. Although human languages are recursive, and $A^n B^n$ is recursive, $A^n B^n$ is not a possible human language. No natural language construction has such phrases, which violate the X-bar principles that have long been at the heart of Chomsky's theory of Universal Grammar. If the conclusion is that human syntactic competence consists only of an ability to learn recursive languages (which embrace all kinds of formal systems, including computer programming languages, mathematical notation, the set of all palindromes, and an infinity of others), the fact that actual human languages are a minuscule and well-defined subset of recursive languages is unexplained.

2.7. Summary of evidence on the recursion-only hypothesis. The state of the evidence for HCF's hypothesis that only recursion is special to language is as follows:

- ?? Speech perception. HCF suggest it is simply generic primate auditory perception. But the tasks given to monkeys are not comparable to the feats of human speech perception, and most of Liberman's evidence for the Speech-is-Special hypothesis, and experimental demonstrations of human-monkey differences in speech perception, are not discussed.
- ?? Speech production. HCF's recursion-only hypothesis implies no selection for speech production in the human lineage. But control of the supralaryngeal vocal tract is incomparably more complex in human language than other primate vocalizations. Vocal imitation and vocal learning are uniquely human among primates (talents that are consistently manifested only in speech). And syllabic babbling emerges spontaneously in human infants. HCF further suggest that the distinctively human anatomy of the vocal tract may have been selected for size exaggeration rather than speech. Yet the evidence for the former in humans is

⁵ Long-distance dependency can involve dependencies extending into recursively embedded structures, and on some accounts involves recursive movement of the fronted phrase up through the phrase structure tree.

weak, and does not account for the distinctive anatomy of the supralaryngeal parts of the vocal tract.

- ?? Phonology. Not discussed by HCF.
- ?? Lexicon. HCF do not discuss evidence that words are a distinctive form of mental structure, unique to language. They suggest words are acquired by unspecified “general-purpose mechanisms,” but do not cite the evidence that words work differently from facts, and that children learn them in different ways.
- ?? Morphology: Not discussed by HCF.
- ?? Syntax: Case, agreement, pronouns, predicate-argument structure, topic, focus, auxiliaries, question markers, and so on, are not discussed by HCF. Recursion is said to be human-specific, but no distinction is made between arbitrary recursive mathematical systems and the particular kinds of recursive phrase structure found in human languages.

We conclude that the empirical case for the recursion-only hypothesis is extremely weak.

2.8. Some relevant genetic evidence. A recent finding from genetics casts even stronger doubt on the recursion-only hypothesis. There is a rare inherited impairment of language and speech caused by a dominant allele of a single gene, FOXP2 (Lai et al., 2001). The gene has been sequenced and subjected to genomic analyses, which show that the normal version of the gene is universal in the human population, that it diverged from the primate homologue subsequent to the evolutionary split between humans and chimpanzees, and that it was a target of natural selection rather than a product of genetic drift or other stochastic evolutionary processes (Enard et al., 2002). The phenotype is complex and not completely characterized, but it is generally agreed that sufferers have deficits in articulation, production, comprehension, and judgments in a variety of domains of grammar, together with difficulties in producing sequences of orofacial movements (Bishop, 2002; Gopnik & Crago, 1991; Ullman & Gopnik, 1999; Vargha-Khadem et al., 1995). The possibility that the affected people are impaired only in recursion is a non-starter. These findings refute the hypothesis that the only evolutionary change for language in the human lineage was one that grafted syntactic recursion onto unchanged primate input-output abilities. Instead they support the notion that language evolved piecemeal in the human lineage under the influence of natural selection, with the selected genes having pleiotropic effects that incrementally improved multiple components.

FOXP2, moreover, is just the most clearly identified one of a number of genetic loci that cause specific impairments of language, or of related impairments such as stuttering and dyslexia (Dale et al., 1998; Stromswold, 2001; The_SLI_Consortium, 2002; van der Lely, Rosen, & McClelland, 1998). None of these knock out or compromise recursion alone. As more of such genes are identified, sequenced, and compared across individuals and species, additional tests contrasting the language-as-adaptation hypothesis with the recursion-only hypothesis will be available. The latter predicts heritable impairments that completely or partially knock out recursion but leave the people with abilities in speech perception and speech production comparable to those of chimpanzees. Our reading of the literature on language impairment is that this prediction is unlikely to be true.

3. The Minimalist Program as a Rationale for the Recursion-Only Hypothesis

The main unstated premise that explains the disparity between HCF's hypothesis and the facts of language (as well as its disparity with Chomsky's earlier commitment to complexity and modularity) is Chomsky's current approach to language, the Minimalist Program (MP) (Chomsky, 1995, 2000a, 2000b; Lasnik, 2002). This is a decade-long attempt at a grand unified theory for linguistics, based on the following vision. Since language is a mapping between sounds and meanings, only representations of sound (Phonetic Form) and representations of meaning (Logical Form) are truly indispensable. Other than these representations, whose existence is, in Chomsky's terminology, a "virtual conceptual necessity," all other linguistic structures and the principles applying to them, being conceptually unnecessary, should be eliminated. These include the long-prominent deep structure (or d-structure) and surface structure (s-structure). The minutiae of linguistic phenomena should instead be explained by details of words (which uncontroversially are specific to a particular language and must be learned) and certain principles of economy that apply to the mapping between meaning and sound. In this way, the core of language may be characterized as an optimal or "perfect system," containing only what is conceptually necessary. The messy complexity of linguistic phenomena comes from the necessity to interface with the systems for sounds and concepts, which necessarily embody the complexity of human thoughts and speech organs.

Chomsky proposes to implement this vision by building all of language from two operations. One is Merge, which builds a binary phrase structure tree connecting two smaller constituents (words or phrases). The other is Move, which displaces a constituent to another position in a tree, leaving a "trace." (Some versions of the MP add a third operation, "Agree"; others attempt to treat Move as a special case of Merge.) At some point in a recursive sequence of these operations, the tree undergoes an operation called "Spell-Out," in which the phonological content of the tree is collected in a representation called Phonetic Form and shunted off for implementation by the systems for motor control and audition. At another stage, the tree becomes a structure called Logical Form, a semantic representation suited for use by the conceptual system. The vast number of logical possibilities for constructing erroneous derivations using Merge and Move are kept in check by several principles of "economy." For example, if a constituent may be moved before or after phonological spell-out, only the post-spell-out movement is permitted. And if derivations can be done in multiple ways, some involving short local movements and others involving longer movements, or some involving superfluous steps and others doing without them, the existence of the simple ones renders the more complex ones ungrammatical.

The goals of the Minimalist Program have a certain intuitive appeal, and one can see how it might be regarded as the culmination of Chomsky's 50-year quest for a satisfyingly explanatory account of human language. It appears to be parsimonious and elegant, and to eschew the baroque mechanisms and principles that have emerged in previous incarnations of Chomsky's theory. The implications for the evolution of

language are obvious. If language per se does not consist of very much, then not much had to evolve for us to get it, and the mystery of human uniqueness is solved. And invoking natural selection to explain the adaptive complexity of language (analogously to the way it is invoked to explain the adaptive complexity of the vertebrate eye or echolocation in bats) is no longer necessary (Hornstein, 2002).

The major difficulty with the Minimalist Program, as Chomsky himself says (Chomsky, 2000b, p. 124), is that “All the phenomena of language appear to refute it.” He reassures the reader immediately by adding, “... just as the phenomena of the world appeared to refute the Copernican thesis. The question is whether this is a real refutation.” There follows an extended discussion of how science is always deciding which evidence is relevant and which to discard. The general point is unexceptionable, but it offers few grounds for confidence that the *particular* theory under discussion is correct. After all, any theory can be rescued from falsification if one chooses to ignore enough inconvenient phenomena (see also Newmeyer, 2003). The Minimalist Program chooses to ignore:

- ?? all the phenomena of phonology.
- ?? most or all the phenomena of derivational morphology, such as compounds and complex inflected forms.⁶
- ?? most of the phenomena of inflectional morphology: the leading theory in the Chomskyan framework, Halle & Marantz’s Distributive Morphology, does not naturally conform to the principles of Minimalism (Halle & Marantz, 1993), and considerable work must be done to reconcile them.
- ?? many basic phrase structures, such as those involved in modification.⁷
- ?? many phenomena of phrase and word order, such as topic and focus, figure and ground, and effects of adjacency and linearity.⁸ There is also no account of free word order phenomena, characteristic of many languages of the world.
- ?? the source and nature of lexical entries, which do considerable work in the theory (defining phrase structures, triggering movement), and which therefore are far more abstract and language-specific than mere sound-meaning pairings.
- ?? the connection of the grammar to processing (a difficulty shared with previous versions of Chomskyan theory).
- ?? the connection of the grammar to acquisition, especially how the child can identify the numerous abstract features and configurations that are specific to languages but have no perceptible correlate (see Culicover, 1999; Pinker, 1984, 1987).

⁶ “I have said nothing about other major components of the theory of word formation: compound forms, agglutinative structures, and much more” (Chomsky, 1995, p. 241).

⁷ “We still have no good phrase structure theory for such simple matters as attributive adjectives, relative clauses, and adjuncts of many different types” (Chomsky, 1995, p. 382, n. 22).

⁸ “I am sweeping under the rug questions of considerable significance, notably, questions about what in the earlier framework were called “surface effects” on interpretation. These are manifold, including topic-focus and theme-rheme structures, figure-ground properties, effects of adjacency and linearity, and many others” (Chomsky, 1995, p. 220).

In fact, most of the technical accomplishments of the preceding 25 years of research in the Chomskyan paradigm must be torn down, and proposals from long-abandoned 1950s-era formulations and from long-criticized 1970s-era rivals must be rehabilitated (Pullum, 1996).⁹ And if anything, the number of phenomena relegated to unknown “interface phenomena” has grown, not shrunk over the past decade of Minimalist research.

The conjectural status of Minimalism has been emphasized in all presentations of the theory, including Lasnik’s recent tutorial (Lasnik, 2002), which presents no evidence that actually supports Minimalism compared to its alternatives. Lasnik concedes that after more than a dozen years, “Minimalism is as yet still just an ‘approach’, a conjecture about how language works (‘perfectly’) and a general program for exploring and developing the conjecture” (p. 436). Even more pointedly, Koopman, a practitioner of the Minimalist Program, writes,

... the Minimalist Program led to relatively few new insights in our understanding of phenomena in the first half of the nineties. This is probably because it did not generate new analytical tools, and thus failed to generate novel ways of looking at well-known paradigms or expand and solve old problems, an essential ingredient for progress to be made at this point (Koopman, 2000, p. 2).

We don’t disagree with Chomsky that a new theory should be cut some slack if it promises advances in parsimony or explanatory power. But in practice, the simplicity, elegance, economy, naturalness, and conceptual necessity claimed for Minimalism turn out not to be so obvious. For instance, when Chomsky says that Minimalism does without deep and surface structures, he means only that these structures are not singled out as representations to which constraints such as the Projection Principle or Case Filter apply. The theory still posits that the derivation of every sentence involves a sequence of abstract syntactic trees, related by movement operations. These trees, moreover, are anything but minimal. They contain full branching structures for just about every morpheme (including articles and complementizers), for inflectional features like “tense” and “agreement”, and for numerous empty nodes to which morphemes are destined to move. Moreover, the lexicon is not just a conceptually-necessary list of sound-meaning pairings for identifiable words: it is packed with abstract morphemes and features (such as the “strength” of agreement) whose main rationale is to trigger the right syntactic phenomena, thereby offloading work from the syntactic component and preserving its “minimalist” nature.

Consider also the “principles of economy” that regulate these derivations. As observed by (Johnson & Lappin, 1997, 1999; Newmeyer, 2003; Pullum, 1996), these are not independently motivated by least-action principles of physics, metabolic properties of neurons, resource limitations in cognitive information processing, or even mechanical

⁹ “The minimalist program seeks to show that everything that has been accounted for in terms of [deep and surface structure] has been misdescribed ... that means the projection principle, binding theory, Case theory, the chain condition, and so on” (Chomsky, 2000a, p. 10).

symbol- or step-counting in some formal notation (any of which might, in some sense, come “for free”). Rather, they are a mixture of metaphors involving speed, ease, cost, benefit, and need, and anthropomorphic traits such as “greed”, “procrastination”, and “last resort.” Their desired effects on linguistic structures are explicitly stipulated, and would have to be spelled out as complicated conditions on operations in any explicit implementation.

Most worrying of all, these conditions require choosing the optimal derivation for a sentence from among a *set* of possible derivations constructed from the same initial lexical items, comparing and winnowing them in their entirety, in order to determine how and whether the sentence may be formed. This contrasts with almost most of the other extant theories of grammar, in which conditions may be checked locally against information that is available at each step within a single derivation (Johnson & Lappin, 1997, 1999).

The lack of simplicity in so-called Minimalist analyses can be appreciated by noting that (in the version of Chomsky, 1995) a simple sentence such as *John saw Mary* has a tree with six levels of embedding, four traces (the result of four movement operations), and five alternative derivations that need to be compared just to ensure that the “procrastination” requirement has been satisfied (Johnson & Lappin, 1997). To ensure satisfaction of the full set of economy principles, an even greater number of derivations must be compared. Johnson and Lappin (1999), who develop a formal implementation of Minimalist derivations, argue that such a notion of economy is computationally intractable. In sum, little about Minimalism is truly minimalist.

We conclude that on both empirical and theoretical grounds, the Minimalist Program is a very long shot. This is not to say that we believe all of generative grammar should be abandoned. Indeed, we have both written passionate expositions of the overall program, defending core assumptions such as that language is a combinatorial, productive, and partly innate mental system. But it is necessary to evaluate what aspects of the current mainstream version of generative grammar to keep and what to replace (see (Culicover & Jackendoff, in press; Jackendoff, 2002), for assessments).

Returning to our main question of what is special about language: Behind HCF’s claim that the only aspect of language that is special is recursion lies a presumption that the MP is ultimately going to be vindicated. The linguistic phenomena they ignore, listed in section 2, are among the phenomena also set aside by the MP, listed in this section. Given the empirical status of MP, it seems shaky at best to presume it when drawing conclusions about the evolution of language.

4. Language, Communication, and Evolution

The intuition that Minimalism reduces the amount of linguistic machinery that had to evolve is not Chomsky’s only argument against the possibility that the language faculty evolved by natural selection. HCF touch on three other themes that comprise an overall vision of what language is like. These are:

- ?? Language is not “for” communication and may even be badly designed for communication (thus “nullifying the argument from design”).
- ?? Language is an “optimal” or “perfect” mapping between sound and meaning, and in this perfection it is unlike other biological systems.
- ?? The narrow language faculty was not selected for language but originated in some other cognitive ability.

These three hypotheses challenge a more conventional evolutionary vision of language, according to which the language faculty evolved gradually in response to the adaptive value of more precise and efficient communication in a knowledge-using, socially interdependent lifestyle (Nowak & Komarova, 2001; Pinker, 1994, 2003; Pinker & Bloom, 1990). Gradual emergence implies that later stages had to build on earlier ones in the contingent fashion characteristic of natural selection, resulting in a system that is better than what was before but not necessarily optimal on first principles (Bickerton, 1990; Givon, 1995; Jackendoff, 2002). We consider Chomsky’s assertions in turn, comparing them to our alternative.

4.1. Language is badly designed for communication. Here are two recent quotes from Chomsky expressing this position:

... language is not properly regarded as a system of communication . It is a system for expressing thought, something quite different. It can of course be used for communication, as can anything people do – manner of walking or style of clothes or hair, for example. But in any useful sense of the term, communication is not the function of language, and may even be of no unique significance for understanding the functions and nature of language (Chomsky, 2000b, p. 75).

Language design as such appears to be in many respects “dysfunctional,” yielding properties that are not well adapted to the function language is called upon to perform. ... What we seem to discover are some intriguing and unexpected features of language design ... [which are] unusual among biological systems of the natural world (Chomsky, 1995, p. 162).

These claims are, to say the least, surprising. At least since the story of the Tower of Babel, everyone who has reflected on language has noted its vast communicative power and its indispensable role in human life. Humans can use language to convey everything from gossip, recipes, hunting techniques, and reciprocal promises to theories of the origin of the universe and the immortality of the soul. This enormous expressive power clearly meshes with two of the other zoologically unusual features of *Homo sapiens*: a reliance on acquired know-how and a high degree of cooperation among nonkin (Pinker, 1997; Tooby & DeVore, 1987). Moreover the design of language – a mapping between propositions and sound – is precisely what one expect in a system that evolved for the communication of propositions. We cannot convey recipes, hunting techniques, gossip, or reciprocal promises by “manner of walking or style of clothes or hair,” because these forms of behavior lack grammatical devices that allow propositions to be encoded in a recoverable way in details of the behavior. Though Chomsky denies

the truism that language is a system for communication, he provides no compelling reasons to doubt it, nor does he explain what a communication system would have to look like for it to be more “usable” or less “dysfunctional” than human languages.

Chomsky’s positive argument that language is not “for” communication is that “language use is largely to oneself: ‘inner speech’ for adults, monologue for children” (Chomsky, 2000b, p. 77). HCF makes the point indirectly: “The question is whether particular components of the functioning of FLN are adaptations for language, specifically evolved for reasons other than communication” (Hauser et al., 2002, p. 1574). In part, this is a way of distancing oneself from claims that language is a homologue of primate calls, a point with which we agree. But in order to make this point, one need not deny that language is “for” communication, or claim that it could just as easily be thought of as being “for” inner speech.

For one thing, the fragmentary snatches of inner speech that run through a person’s mind are likely to be quite different from the well-formed sentences that motivate Chomsky’s theories of linguistic competence. Other than in preparation for speaking and writing, interior monologues do not consist of fully grammatical sequences of words complete with functional morphemes, such as *The teachers asked what attitudes about each other the students had noticed*. Whatever inner speech consists of—presumably the phonological loop that makes up a major component of working memory – it is not the subject matter of Chomsky’s theories of language.

Moreover, the key question in characterizing a biological function is not what a trait is typically *used* for but what it is *designed* for, in the biologist’s sense – namely, which putative function can predict the features that the trait possesses. For all we know, hands might be used more often in fidgeting than grasping, but that would not make fidgeting the biological function of the hand. The reason is that hands have improbable anatomical features that are necessary for grasping but not for fidgeting. By similar logic, a system for “talking to oneself” would not need phonology or phonetics tuned to the properties of the human vocal tract, it would not need linear order or case or agreement, and it would not need mechanisms for topic and focus, all of which presuppose that information has to be coded into a serial, perceptible signal for the benefit of listeners who currently lack the information and have to integrate it piecemeal with what they know. After all, when one part of the brain is “talking to” another part, it does not have to encode the information into a serial format suitable for the vocal-acoustic channel; such communication takes place via massively parallel transmission. The visual system, for example, does not have to encode the retinal image into an ordered sequence of phonemes to communicate with the hippocampus or frontal lobes.

Indeed, if language were not designed for communication, the key tenet of Minimalism – that language consists of a mapping from Logical Form to Phonetic Form – would not be a “virtual conceptual necessity,” as Chomsky has repeatedly asserted, but an inexplicable coincidence. The only way to make sense of the fact that humans are equipped with a way to map between meaning and vocally produced sound is that it

allows one person to get a meaning into a second person's head by making a sound with his or her vocal tract.

We note in addition that the innate aspect of the language faculty is for *learning* language from the community, not for *inventing* language. One cannot have inner speech without having words, and words above all are learned. (To be sure, people invent new words from time to time, but this is not the major source of their vocabulary.) Moreover, the fact that the inner speech of deaf speakers of signed languages consists of signs rather than sounds follows from the assumption that inner language is based on learned outer language. If inner speech were primary, this too would be an unexplained coincidence. Turning to cases in which languages *are* invented, we find that Nicaraguan Sign Language, for example, arose in the context of a community seeking communication (Senghas & Coppola, 2001). Similarly, isolated deaf children who create home signs do so in the context of communication with others. We are unaware of cases in which deaf individuals develop a complex vocabulary and grammar just to talk to themselves. And without exception, other linguistic isolates do not develop speech at all (Pinker, 1994).

This is not to deny that inner speech enhances thought (Jackendoff, 1996), and that this enhancement has been a major influence on the growth of civilization. But given that inner speech depends on having outer speech, acquired in a communicative situation, we are inclined to think that if anything is a by-product here, it is inner speech. The primary adaptation is communication, with enhanced thought as an additional benefit.

4.2. Language is “perfect.” Next let us consider the view, central to the Minimalist Program, that language, though dysfunctional for communication, is a “perfect” or “optimal” mapping between sound and meaning, such that its form is structurally inevitable given what it has to bridge between. This claim is not easy to evaluate, because nothing is “perfect” or “optimal” across the board, but only with respect to some desideratum. When one tries to identify Chomsky's criteria for perfection, one finds that they are vague and tendentious. And even by those criteria, Chomsky is forced to concede that language appears to be far from perfect after all.

Language is (mostly) like invented formal symbol systems. In one place, Chomsky explains his criterion for perfection as follows: “A good guiding intuition about imperfection is to compare natural languages with invented ‘languages’, invented symbolic systems. When you see differences, you have a suspicion that you are looking at something that is a *prima facie* imperfection” (Chomsky, 2000b, p. 109). This, however, assumes that invented symbolic systems are designed to satisfy the same desiderata as human language. But there is little reason to believe this. Human languages, unlike invented symbolic systems, must be used in real time and by agents with limitations of knowledge and computational capacity. Languages develop spontaneously in a community subject to the vagaries of history, rather than being stipulated by formal arbiters. And they must be induced by exposure to examples rather than being used in explicit conformity with published standards. Any of these differences could explain why

human languages might differ from invented symbolic systems, quite apart from matters of “perfection” or “imperfection.”

Chomsky’s notion of what ought to be found in a “perfect” symbolic system consist of intuitions about certain kinds of economy in the mapping between meaning and sound (for example, no meaningless grammatical elements left in Logical Form, short derivations preferred to long ones, and movement rules operating after Spell-Out rather than before). Yet as we have noted, judged by other criteria that might be thought to characterize well-designed symbolic systems, language (as seen through the Minimalist lens) is anything but optimal. It is computationally inefficient, perhaps intractable, because the processor must evaluate a combinatorial explosion of derivations for most sentences (Johnson & Lappin, 1997, 1999). And it is far from optimal in terms of parsimony of structure, given that Minimalist tree structures are packed with abstract and empty elements, in fact typically more of these than there are words.

Moreover, even by Chomsky’s own criteria, language is full of “apparent imperfections,” which he sees as challenges to be overcome by future research in the Minimalist framework. (Presumably such research will show them to be exigencies imposed by the semantic and phonological interfaces.) Agreement and case are called “apparent imperfections,” rather than basic design features of language (Chomsky, 2000b, p. 111); their virtues in free word order languages are ignored. Another “imperfection” is the fact that phrases are sometimes moved from their canonical positions, as in questions or passives. Calling this an “imperfection” ignores the fact (which Chomsky elsewhere notes) that movement allows sentences to use some aspects of word order to convey topic and focus while others convey who did what to whom (Chomsky, 2000a, p. 13). The principle that functional systems must trade off conflicting demands is absent from such reasoning; it is as if the “perfect” car is defined to be one that only moves forward, and the discovery of brakes and steering are called “imperfections.” Even more egregiously, “the whole phonological system looks like a huge imperfection, it has every bad property you can think of” (Chomsky, 2000b, p. 118). And “even the fact that there is more than one language is a kind of imperfection.” (Chomsky, 2000b, p. 109). Quite so: there are thousands of different solutions to the problem of mapping from sound to meaning, and they can’t *all* be optimal.

Perhaps “optimal” is meant to refer to the general style of derivational solution. But, as we noted, languages use four different devices for conveying semantic relations: phrase structure, linear order, agreement, and case, often deployed redundantly. In this sense language is reminiscent of other cognitive systems such as depth perception, where multiple mechanisms compute the same output – the relative distance of objects in the visual field – in some situations redundantly and in some not. It looks as if evolution has found several solutions that ordinarily reinforce each other, with some predominating over others in special circumstances; in the case of language, the balance among them shifts depending on the language’s history, the sentence’s context, or both. If so, case and

agreement are not “imperfections” at all, just alternative mechanisms to the same end as phrase order and hierarchy.¹⁰

We conclude that the overall claim that language is “perfect” or “optimal” is a personal vision of how language ought to be characterized rather than an empirical discovery about the way language is. As such it cannot be used to motivate assertions about how language evolved.

Language exists in the only possible form that is usable. One might ask what the relevance of the possible “perfection” of language is to its evolution. The idea seems to be that nothing less than a perfect system would be in the least bit usable, so if the current language faculty is perfect, one could not explain its evolution in terms of incremental modification of earlier designs. Thus (Chomsky, 2000b, p. 58) asks “how closely human language approaches an optimal solution to design conditions that the system must meet to be usable at all.” This echoes an earlier suggestion that “In the case of such systems as language or wings it is not easy even to imagine a course of selection that might have given rise to them. A rudimentary wing, for example, is not “useful” for motion but is more of an impediment. Why then should the organ develop in the early stages of evolution?” (Chomsky, 1988, p. 167).

The “What good is five percent of a wing?” argument has long been raised by creationists, and in every case has been answered by showing that intermediary structures in fact are useful (Dawkins, 1986; Pennock, 2000). In the case of language, pidgins are a key source of evidence. They are mappings of phonological structure to meaning that lack fixed word order, case, and agreement. They also lack subordinate clauses, which are the standard mark of recursion, and possibly lack phrase structure altogether. Yet they definitely are usable, though not as reliably as fully developed language. Bickerton (1990), Givon (1995), and Jackendoff (2002) suggest that modern language is a tuning up of evolutionary earlier systems resembling pidgins. The four major syntactic mechanisms for encoding meaning can be thought of as incremental improvements, each of which makes the system more reliable. There is a progression of functionality, not a dichotomy between one system that is “perfect” and other systems that are “not usable at all.”

Language is nonredundant. Chomsky does adduce one criterion for “perfection” that is explicit and hence easier to evaluate, namely that language is not redundant:

The general conclusion ... is that language is designed as a system that is “beautiful” but in general unusable. It is designed for elegance, not for use, though with features that enable to it to be used sufficiently for the purposes of normal life. ... Insofar as this is true, the system is elegant, but badly designed for use. Typically, biological systems are not like that at

¹⁰ One can imagine other mechanisms, such as using different tones instead of case markers, say high for subject, low for object, and mid for indirect object. We know of no language that does this, but we don’t know whether no system built from ancestral primate brains could have found this solution (in the same way that no mammals could possibly have wheels), or whether it is just one of those accidental contingencies of evolution. Would it be “non-optimal”? We have no way to judge.

all. They are highly redundant, for reasons that have a plausible functional account. ... Why language should be so different from other biological systems is a problem, possibly even a mystery (Chomsky, 1991).

The empirical assumption that language displays no redundancy is puzzling. With regard to the speech waveform, one can high-pass, low-pass, or band-pass speech at various cutoffs, discarding non-overlapping pools of information, yet leave the speech perfectly intelligible; telephones would not work without this property (Green, 1976). With regard to recovering the meaning of words and sentences, one can rxmxve thx vxwxls, rexove exery xecoxd xonxonaxt, order the scramble words the of, or omit functional morpheme, and still retain partial (and sometimes total) intelligibility (Miller, 1967).¹¹ With regard to encoding meanings into words and sentences, there are several ways to do so, one can accomplish the task by multiple methods, and more than one means is available.

What Chomsky seems to have in mind is a claim about the storage of lexical information in memory: “Consider the way an item is represented in the lexicon, with no redundancy, including just what is not predictable by rule” (Chomsky, 2000b, p. 118). At least since Chomsky and Halle’s *The Sound Pattern of English* (Chomsky & Halle, 1968/1991), one line of theorizing in generative grammar has tried to factor the lexicon into a set of rules that capture all redundancies and an irreducible residue that is stored in memory. But this appears to be less an empirical discovery than a methodological dictum, according to which characterizations of language are to be stated in as compressed a form as possible. Psycholinguistic experiments have uncovered numerous instances in which redundant information is stored in memory. For instance, although regularly inflected items can be constructed by rule, at least some high-frequency regulars can be shown to be stored redundantly with their stems (Pinker 1999, chapter 5; Baayen et al. 2002).

But even at the level of linguistic theory proper (without considering experiments), the grammatical structures of human languages appear to be significantly redundant. What would a truly nonredundant language look like? Presumably it would consist only of Saussurean, arbitrary lexical items like *red* and *coat* and rules that create compositional structures on demand, like *a red coat*, obviating the need for storage. But consider exocentric compounds (discussed in (Jackendoff, 1997)). Part of one’s linguistic knowledge is that a *redcoat* is a British soldier of the 1770s who wore a red coat, a *yellowjacket* is a kind of wasp with a yellow “jacket,” a *redhead* is a person with reddish hair, and that a *blackhead* is a pimple with a black “head,” and so on. The general rule for such Adjective-Noun compounds is that they have meanings of the form ‘X with a Y that is Z’, where Y is the meaning of the noun, Z the meaning of the adjective, and X has to be learned item by item. The *red* in the lexical entry for *redcoat* is clearly redundant

¹¹ The following text has recently been circulating over the Internet: “Acocdrnig to an elgnsih unviesitry sutdy the oredr of letetrs in a wrod dosen't mtttaer, the olny thnig thta's iopmrannt is that the frsrit and lsat lltteer of eevry word is in the crcreot ptoision. The rset can be jmbueld and one is stlil able to raed the txet wiohtut dclftfuiiy.”

with the lexical entry for *red* which combines freely with noun phrases: they are pronounced the same, both are adjectives, and both refer to colors in the same range. Likewise for two uses of *coat*. Moreover, speakers recognize that the word *redcoat* is not an arbitrary string of English phonemes but refers to someone who characteristically wore a red coat (that is, *redcoat* is not perceived as an arbitrary, nonredundant, sound-meaning pairing like *soldier*). At the same time, the word cannot be composed out of *red* and *coat* by a general compounding rule, because speakers also recognize that a *redcoat* is not just anyone attired in a rufous outergarment but specifically a late eighteenth-century British soldier. Similarly, speakers know that a *redhead* specifically has red *hair*, rather than a totally red head. This irreducible redundancy is widespread in human languages, such as in idioms, semiproductive derivations, and families of irregular forms (Jackendoff, 1997; Pinker, 1999). If the claim that language structure is nonredundant has any empirical content (rather than being the mathematical truism that a redundant representation can always be compressed and then reconstituted by an algorithm), the facts of English would seem to refute it.

Chomsky's claim that the putative nonredundancy of language poses a "mystery" for modern biology is part of a larger claim that current biology must be revamped to accommodate the findings of Minimalist linguistics:

Any progress toward this goal [showing that language is a "perfect system"] will deepen a problem for the biological sciences that is far from trivial: how can a system such as language arise in the mind/brain, or for that matter, in the organic world, in which one seems not to find anything like the basic properties of human language? That problem has sometimes been posed as a crisis for the cognitive sciences. The concerns are appropriate, but their locus is misplaced; they are primarily a problem for biology and the brain sciences, which, as currently understood, do not provide any basis for what appear to be fairly well established conclusions about language (Chomsky, 1995, pp. 1-2).

Given the relative rigor and cumulateness of biology and linguistics, this strikes us as a wee bit presumptuous (especially since the Minimalist Program is "still just an 'approach'", "a conjecture about how language works"). There is a simpler resolution of the apparent incompatibility between biology and Minimalism, namely that Chomsky's recent claims about language are mistaken. Rather than being useless but perfect, language is useful but imperfect, just like other biological systems.

4.4. The narrow faculty language faculty evolved for reasons other than language. HCF speculate that recursion, which they identify as the defining characteristic of the narrow language faculty, "evolved for reasons other than language," perhaps navigation, social relations, or number. We note that this suggestion (like the suggestion that the vocal tract evolved for size exaggeration rather than speech) assumes a false dichotomy: that if a system originally underwent selection for one function, it did not undergo subsequent selection for some other function. Just as forelimbs originally

were selected for stability in water and subsequently were selected for flight, legged locomotion, or grasping, certain circuitry could have been shaped by selection for (say) navigation and subsequently have been *reshaped* by selection for language.

But even if we allow for the possibility of selection before, during, and after a change of function, the suggestion that the system for linguistic recursion is a minor modification of a system for navigation is questionable. Although Chomsky frequently refers to linguistic recursion as “discrete infinity,” the two principal navigation systems documented in nonhuman animals (Gallistel, 1990) show no such property. Dead reckoning is infinite but not discrete; recognition of landmarks is discrete but not infinite.

As for recursion in language evolving out of recursion in number cognition, the direction of co-opting would appear to be backwards (Bloom, 1994; Dehaene et al., 1999; Wiese, in press). Recursive language is a human universal, emerging reliably and spontaneously in ontogeny in all cultures. But recursive number cognition is not. The majority of human cultures, like all animal species, do not have recursive number systems (or at least did not until recent incursions of Western civilization), but instead quantify objects using a system for estimating analogue amounts and a system for categorizing a finite number of small numerosities (Dehaene, 1997; Wiese, in press). Those that have developed recursive number systems in their cultural history may have exapted them from the recursive properties of language, rather than vice-versa.

We do agree with HCF that recursion is not unique to language. Indeed, the only reason language *needs* to be recursive is because its purpose is to express recursive *thoughts*. If there weren't any recursive thoughts, the means of expression wouldn't need recursion either. So here we join HCF in inviting detailed formal study of animal cognition and other human capacities, so that we can ask what abilities require recursive mental representations and which do not. Plausible candidates include music (Lerdahl & Jackendoff, 1983), social cognition (touched on in (Jackendoff, 1992, in press), visual decomposition of objects into parts (Marr, 1982), and the formulation of complex action sequences (Badler et al., 1999; Jackendoff, in press; Miller, Galanter, & Pribram, 1960; Schank & Abelson, 1975).

Here the problem is not a paucity of candidates for evolutionary antecedents but a surfeit. As Herbert Simon has pointed out (Simon, 1969), probably all complex systems are characterized by hierarchical organization. So if “recursion” is identified with hierarchical decomposition and used as a criterion for identifying some pre-existing cognitive function as a basis for exaptation to language, speculations can proliferate unconstrained.

We also wish to point out that language is not just any old recursive system, but embodies three additional design constraints. First, its recursive products are temporally sequenced, unlike those of social cognition or visual decomposition. Second, it is not just a recursive representational system externalized. It maps multi-directionally (in production and comprehension) *among* systems: recursive semantic representations, recursive communicative intentions, and recursive phonological signals. Third, the details

of the recursive structures are largely arbitrary and learned, conforming to the words and constructions of the linguistic community, rather than being dictated by immediate real-world constraints such as how a scene is put together or which sequence of actions is physically capable of effecting a goal. As such, language is unlikely to be just a straightforward exaptation of a single pre-existing recursive system such as visual cognition, motor control, or social relationships. Rather, it appears to be a kind of interface or connective tissue among partly preexisting recursive systems, mapping among them in an evolutionarily novel manner.

In sum, we find Chomsky's case that language is not an adaptation for communication unconvincing. The argument that presupposes the Minimalist Program to argue that language is so simple as to obviate the need to invoke natural selection is circular, because this is a desideratum that the MP hopes to fulfill (in the teeth of much counterevidence), rather than a discovery it has established. The argument that language is no better designed for communication than hair styles is belied by the enormously greater expressive power of language and the fact that this power is enabled by the grammatical machinery that makes language so unusual. The argument that language is designed for interior monologues rather than communication fails to explain why languages map meaning onto sounds and why they must be learned from a social context. The argument that language is "perfect" or "optimal" has never been stated clearly, and is, by Chomsky's own admission, apparently refuted by many "imperfections." The argument that language is not redundant is false in every domain in which it can be evaluated. Finally, the suggestion that the recursive power of language arose as a simple co-opting of recursion in other cognitive systems such as navigation or number encounters numerous problems: that navigation is not discretely infinite; that recursive number cognition is parasitic on language (rather than vice-versa); and that language maps *among* recursive systems rather than being a straightforward externalization of a single recursive system.

The alternative in which language is an adaptation for the communication of knowledge and intentions faces none of these problems. It is consistent with behavioral and genetic evidence that the language shows multiple signs of partial specialization for this task rather than grafting one component (recursion) onto a completely unchanged primate base. It is based on defensible conclusions about the nature of language established by existing linguistic research rather than a promissory program that is admittedly incompatible with the facts. It does not require tendentious claims such as that language is nonredundant, perfect, unsuited for communication, or designed for beauty rather than use. It meshes with other features of human psychology that make our species unusual in the animal kingdom, namely a reliance on acquired technological know-how and extensive cooperation among non-kin. And in it does not imply that linguistics poses a crisis for biology but rather helps bring them into consilience.

Appendix: Has Chomsky Changed his Fundamental Vision of Language?

It appears to many observers that Chomsky has undergone a major change in his grand view of language: from a complex, powerful, and uniquely human mental organ showing signs of special design (see the quotes on page 4) to a narrow and unusable capacity for recursion that evolved for reasons having nothing to do with language. What led to this apparent repudiation of the very idea with which Chomsky is so famously associated? It cannot be a conclusion forced by the weight of evidence for Minimalist theories, because Chomsky and his defenders concede that Minimalism is still just a “conjecture” or “program” that will need decades of research to vindicate. Nor can it be dismissed as a case of planned obsolescence or change for its own sake. Chomsky is nothing if not a deep and systematic thinker, and it is legitimate to try to understand the motivation for his latest proposals in the context of the larger currents of his thought. Chomsky’s willingness to give up his claims about the complexity, power, modularity, and uniqueness of language suggests that a more fundamental conviction is at stake. We suggest that this conviction lies at the root of Chomsky’s belief system: a conception of human nature that spans his disparate writings in linguistics and in politics.

When pressed on the relationship between his linguistics and politics, Chomsky insists that there is no logical connection, but notes that a vague link is discernable (Barsky, 1997, p. 107; Bracken, 1973; Chomsky, 1966, 1970, 1975; Pinker, 2002, chap. 16). That is a conception of human nature in which people are innately equipped with an ability for spontaneous, creative, free expression, which is neither trained by society nor utilized in the service of some practical end. As he explains in an interview-essay entitled “Linguistics and Politics”:

I think that anyone’s political ideas or their ideas of social organization must be rooted ultimately in some concept of human nature and human needs. Now my own feeling is that the fundamental human capacity is the capacity and the need for creative self-expression, for free control of all aspects of one’s life and thought. (Bracken, 1973, p. 241; Chomsky, 1969, p. 31).

In 1966 Chomsky traced this belief to Wilhelm von Humboldt and others he places in the tradition of “Cartesian linguistics.” Humboldt, for example, wrote,

The production of language is an inner need of mankind, not merely an external vehicle for the maintenance of communication, but an indispensable one which lies in human nature, necessary for the development of its spiritual energies and for the growth of a world view which man can attain only by bringing his thinking to clarity and definition by communal contact with the thinking of others.¹²

¹² Quoted in Barsky (1997, p. 110).

Chomsky explains that his view of human nature is tied not just to Humboldt but to a series of other political and moral thinkers. “A important and detectable thread,” he says (Barsky, 1997), connects his views to

... Rousseau’s opposition to tyranny, oppression, and established authority, ... Kant’s defense of freedom, Humboldt’s precapitalist liberalism with its emphasis on the basic human need for free creation under conditions of voluntary association, and Marx’s critique of alienated fragmented labor that turns men into machines, depriving them of their ‘species character’ of ‘free conscious activity’ and ‘productive life’ in association with their fellows”(Chomsky, 1975, p. 131).

This view of human nature may be the hidden variable that accounts for Chomsky’s otherwise disparate beliefs. In the political arena, Chomsky’s “anarcho-syndicalism” assumes that humans are equipped with a spontaneous tendency to cooperate and to engage in productive, creative work for its own sake. It contrasts with an “anarcho-capitalism” (and other forms of capitalism) in which humans are motivated by the rewards that their activities bring them (salaries or profits) rather than by an intrinsic need to engage in those activities. In the linguistic arena, Chomsky posits a system for productive, creative generation of an infinite number of sentences, a system which allows for the expression of thought for its own sake but is not designed for (and not even particularly good at) the practical function of communication.¹³

In the first decades of the cognitive revolution, a vague notion of innateness was sufficient to distinguish Chomsky’s ideas from those of the behaviorists and other empiricists. He could point to a set of properties that distinguished language from generic learned behavior, such as its complexity, modularity, expressive power, and uniqueness among species. But with the rise of evolutionary psychology in the 1980s and 1990s, the *origin* of innate abilities began to be scrutinized. According to modern biology, complex innate traits arise because they were useful to the organism’s ancestors. This focus reveals a tension between a vision of human nature in which innate traits are exercised for their own sake and a Darwinian explanation in which innate traits evolved for their fitness benefits. Chomsky apparently has responded to this tension by emphasizing the recursive generative capacity that is at the heart of his vision of human nature and distancing himself from the features of language that call for a Darwinian explanation, namely, adaptive complexity in the service of communication. Thus language, for him, is not designed for communication, and the parts of language that had to evolve in humans are so minimal that invoking selection is unnecessary.

Pointing out these connections does not imply that Chomsky’s linguistics, politics, vision of human nature, and skepticism toward natural selection logically entail one another, or that casting doubt on one should bring down the others. His

¹³ Note the subtle contrast with the quote from Humboldt above. Humboldt does not says that language is not for communication, but rather that language is not *just* for communication. Moreover, he stresses the function of “communal contact”, a theme largely absent from Chomsky’s recent writings.

arguments on the evolution of language must be evaluated on their own merits, as we have done in the body of this paper. But we believe that without recognizing their connection to his theory of human nature, Chomsky's latest views on language evolution will appear to be more capricious than they in fact are.

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