Transactional Cognition:
Building a reliable Post-Chomsky Model
for Human Language and Cognition.

Abstract.
An improved model of the relationship between language and human cognition has become critical to a wide spectrum of research, from new studies in neuroscience to new ideas appearing in both literature and philosophy. In recent decades linguistics research has given great emphasis to the analysis of language rules and structures with very positive results. This almost exclusive focus, however, has not come without a certain measure of controversy and neglect of other perspectives from which our understanding of language and its function in cognition might be materially advanced. This study offers a new baseline for understanding human language through a series of transaction-based models that specifically illustrate its use and nature both today and at its point of origin, as a method to assess more accurately underconsidered features in both our individual and social cognitive natures, reconcile features from other research that are explained by these models, and uncover one or more intriguing new hypotheses for further investigation. A model for evolutionary development offers possibilities open to experimental verification. A model for transactional cognition suggests that silent, language-based thinking may be a very recent development. A two-tier, cross-domain neurological model for grammar and language function may resolve, finally, the question of an innate vs. learned grammar.
Linguistic theory today is in need of a stronger effort toward reconciliation. Despite a large body of literature over the last few decades it would appear that few of the most essential questions in the field could evoke from scholars anything close to a consistent response. That makes it all the more difficult for researchers in related fields to harness evidence from linguistics to explain or interpret observations in studies ranging from psychology and neuroscience to literature and philosophy.

Here are six elemental questions which, if a more precise answer could be developed for any one of them, might help lead the field forward in considerably greater unison. The questions are not easy but they need to be addressed:

1. How did humans apparently develop such a uniquely complex, referent-based communication system\(^1\) between individual animals in the species while all other animal species, to this point, apparently have not?

2. What might be a reasonable description of the Darwinian mechanism, or series of mechanistic transformations – if any, – that caused the leap from stimulus-based survival communication to a functionally-efficient form of communication that is abstract in its essence with only the least correlation to the issue of immediate animal survival?

3. How are we to understand the origin or underlying principles, if any, that produce the rules of language we see exposed in the transformational grammar system of Chomsky \( et \ alii \)?
4. Against what credibly rational tests, if any, can we apply Chomsky’s pio-
neering hypothesis of “innate” linguistic structures as a unique human mental
faculty or organ, to use Chomsky’s own descriptive terms for the concept?
5. What is the physical relationship, if any, in terms of corresponding
sequential neurological activity between human speech and human thought?
6. And finally, are there other analytical frameworks available which might
better serve than the now classic “tree” of generative grammar for locating the
causes, maturational processes and physical structures supporting both human
speech and thought activity?

The Grammar Diversion.

Investigation into all of these questions in recent decades has been impact-
ed by the special focus given to Chomsky’s novel analytical approach to under-
standing the sub-evident structures and rule-functioning of modern human lan-
guage. The problem that comes from this emphasis lies not in its signature propo-
sition, which is the essentially simple idea of an innate human genetic resource or
faculty in the brain that differentiates our species from all other species including
primates, but the quality and direction of the evidence cited to support it. For
example it has been widely accepted as inarguable truth by “nativists” that
infants with little or no adult interaction would learn to speak anyway, and essen-
tially just as well as those supported by the intense interactive experience of
“motherese.” When first proposed this argument largely walked away from exist-
ing research that demonstrates how aggressively infants and children themselves
work to build a framework of experience to understand their world. Thus it was
was intuitively unlikely and an ill-considered assumption that even Chomsky has
now wisely chosen to abandon.

This by itself does not serve to close out questions on the existence or nature
of an innate grammar, however a full refutation of nativist arguments for or an
innate or what might be termed “unlearned” grammar function in language is
beyond the scope of this paper. What is more important here is some review of
what has been the “counter-argument” championed by Piaget, that language and all of its functional foundations can be learned by a child.

It’s clear that children, including infants, are built to extract every bit of developmental information out of every social exchange, no matter how small, that they can. Perhaps by largely looking away from infant processes studied exhaustively since the 1920s by Vygotsky, Piaget and many others, nativists have consistently resisted looking for a structural solution more consistent with what appears to be the extraordinary cognitive powers for learning that are evident even in a two-week-old infant. On the other hand researchers who actively study early language development have not overlooked the linguistic studies of Chomsky in the same way. To the contrary, after specifically pointing to the critical value of linguistics discoveries reported by Chomsky (1957) more than two decades earlier, Moskowitz reports in detail the sophisticated learning strategies employed by children in societies worldwide and the myriad interactive adult response mechanisms embodied in the concept of Caretaker speech – rejected by nativist theorists – that enable a massive acceleration in complex language learning. Observes Moskowitz (p. 85):

“It is not surprising that elaborate theories of innate language ability arose during the years when linguists examined the speech adults addressed to adults and assumed that the speech addressed to children was similar. Indeed, it is hard to imagine how a child could derive the rules of language from such input. The wide study of caretaker speech conducted over the past eight years has shown that children do not face this problem.”

The author/researcher reviews in detail the specific strategies employed by a child to master such linguistic building blocks as referent words, function words, plurals, negatives, semantics, phonology and phonetics. Along with general growth and motor and social skills development language learning is the most important issue on their agenda. Children and infants want to interact. They are highly interpersonal in their motivational focus, and only language makes effective interpersonal action possible. At times the determination evident in their strategies is seriously amusing. Barbara Wood reports from the research of Tanya Gallagher on studies of small children slightly older than infants and
toddler that “even the least fluent language users” are aware that if a listener
does not appear to understand you, rather than simply repeat a statement you
may succeed if you restructure it. You don’t quit, you simply test another piece
of language in your tiny arsenal of experience and try again. Wood presents
this example:

Child: *I wanna play dolly.*
Experimenter: *What?*
Child: *Can I play with the dolly?*

“That children know this rule at such an early point in their development of
language and communication,” Wood underscores, “indicates a strong intraper-
sonal force affecting this development. Intrapersonal forces within children
direct their acquisition of communication.” What is important is not inner, but
*inter*. This is a cognitive strategy that simply may not require any pre-wired
innate structure, nor is it one that appears late and only after a child has
already developed a significant ability to speak.

Such studies by no means prove or even present any positive indication that
the idea of a specialized, hardwired innate language module which enables lan-
guage development and syntactic expression might be wrong, but when given due
consideration studies like these do indicate that the ability of infants to establish a
cognitive framework for language employing a more generic, multi-component
neurological development system and a wide arsenal of interactive strategies and
impulses may be seriously underconsidered by the field.

To continue on the same question of learned grammar vs. innate grammar,
however, Jesse Prinz questions (p. 201) whether any rules that might constitute
innate grammatical abilities, supporting a learning process, need even be nonper-
ceptual. Specifically, with respect to motherese Prinz notes that language acquisi-
tion might, in fact,

“piggyback on perceptual and motor systems, rather than systems of
general intelligence. For example, language may depend on picking up
subtle statistics in the primary linguistic data, using perceptual pattern
detectors. It is known that infants attend to maternal speech and that
they use various properties to determine where boundaries within those
sounds occur (DeCasper and Spence 1986, Jusczyk 1997). Shi, Werker and Morgan (1999) have shown that 1-to-3-day-old infants can categorically discriminate lexical and grammatical words in maternal speech. Speech sounds contain a wealth of information that our intellectual faculties tend to overlook. Giving the task to perceptual systems may be the key to bootstrapping into language.”

Prinz further reports (p. 204) the work of Newport (1990) and Ellman (1991) as an alternative direction in theory proposing a full solution for the mystery of language acquisition based on an increase in working memory through maturation.

“It is an advantage to start out with a small working memory. A small working memory forces us to focus on very local patterns, such as two-word pairings, found in the primary linguistic data. Entire sentences can be quite complex. If a toddler had to monitor all the patterns found in speech strings, she would be overwhelmed. With gradual increases, she can build on simple patterns and come to handle full grammatical complexity.”

An artificial neural network comparison test of this theory designed by Ellman confirms a superior ability by way of an expanding memory through the course of the process to achieve “binding agreements in sentences with imbedded clauses.”

Geoffrey Sampson also cites (p. 43) numerous compelling research studies more recent than the original nativist claims on the matter of the special support offered to the developing child by the phenomenon of “motherese” instruction that offer further support to the conclusions of Moskowitz. There is considerable evidence, therefore, from many studies to indicate that grammar as well as a specific lexical vocabulary might in fact be “learnable” by a child. But it is not sufficient to explain, as nativists are quick to point out, why other studies indicate that a fully functional language cannot be taught effectively to other primates.

There is another problem for both sides in the argument, inasmuch as both generally fail to address the question of human language and its special features as an evolutionary product. The Chomsky proposal, in particular, appears to hold out for the evolutionary differentiation of an innate language faculty without any
material consideration of human language, not in all of its complexity and power as it exists today, but as it might have actually emerged under Darwinian forces, and although more simple might yet have been fully abstract as well as very efficient, functional and well-suited to a very basic survival environment. This oversight appears to derive from the current approach to language as a field of almost purely metaphysical investigation, of formalized principles on a plane with mathematics.6

Reconciling the arguments.
Starting over in search of a “provisional approximation” in linguistic theory that’s both plausible and coherent.

With these problems in clear view what we wish to essay here, then, is neither to prove or disprove an “innateness” theory that certainly offered some attractive features to linguists concerned with behaviorist theory forty years ago. Rather we would like simply to submit several propositions, which may be considered either new or reactionary, which may help to turn linguistic discourse in a direction more coherent and, in consequence, more fruitful in the search for answers to the six questions with which we began our inquiry. What we seek is a framework that invites consilience with research from every field with an interest in the inquiry.7

We might help to accelerate the search, as well as to place a reasonable limit on the scope of argument required, by allowing ourselves several working postulates or what Devitt and Sterelny might describe, in philosophical terms, as folk theories. We like the pragmatic utility of folk theories, and here are ten:

1. Other animal species have developed effective communications systems to enhance prospects of individual and species survival, and they did it before the arrival of homo sapiens on the planet.

2. Those communications systems are universally of an immediate order, that is, for the immediate transfer of information to effect an immediate social response or collective action.
3. The immediate or direct survival benefit derived from these systems—food, reproduction, escape from predator threats—is clear. Even “status” signals among primates may be taken as secondary-order signals to optimize social patterns serving reproduction.

4. These systems are, from all evidence, universally stimulus-driven.

From these postulates we would propose to continue directly to several extensions related to the human species:

5. Human language development began as a communication system similar to that presently employed by other primate species, and was initially stimulus-driven and even exclusively stimulus-driven, on the same basis.

6. Darwinian evolutionary processes, of an as-yet undefined nature, caused or enabled a leap to a more complex system involving the use of non-stimulus driven communication. It would be counter-productive, although it might be easier, to invoke as the engine of change either raw natural accidents, specific acts of God, or other forms of *ex nihilo*.

7. That leap had to produce, of necessity, a greater contribution to species survival than a stimulus-driven communication system alone.

This now leads us to a postulate which seems almost overlooked or at least underconsidered in the environment of present-day linguistic research:

8. There is an important distinction to be made between consciousness of self and our perceptual consciousness of thought. We would propose that language and conscious thought\(^8\) perhaps evolved together as a transactional process entirely driven to development in the oral/aural domain of sound and sound signal transfer. Keeping that perspective clearly and directly in our vision becomes critical in a conjoint analysis of what we generally see as separate functions. Further,

9. The solution for the meaning of linguistic rules must begin and end with an understanding of how efficient information transfer of a high order can occur on an oral/aural basis between individuals of a species. And finally,

10. Our understanding of the cognitive processes that are the basis of referent-based communication must take into account the nature of the human oral/aural neurological function as we either know it experimentally, or we can
infer it from our direct observation of the physical structures and sequences which appear to be involved.

These last several postulates would seem to be particularly important in view of the fact that linguistic scholars have only just begun to explore identifying and rewriting grammar rules in a way that is explained by their benefits to or delivery through the process of oral information interchange. For example, why is a question a question, and why does the language – any language – feature the specific transformational rules of word order shifting that Chomsky and others have identified?

A practical answer suddenly becomes evident when one considers the question from the perspective of investigating language – rather than as an abstracted tree of simultaneous glyphs on a piece of paper in the visual domain – as a completely serial stream of sound with clear benefit in the highest compression of meaning and ability either to evoke or actually trigger a beneficial response.⁹ We shall review this more in a moment.

Here we first need to establish two important ideas. One idea has to do with the wholly interpersonal and transactional nature of both speech and thought, not well considered in today’s intellectual culture fixated on the individual as the epicenter of the highest human cognitive processes. The other idea relates to the probable overdevelopment of Darwinian uncertainties as it relates to the emergence of human language. Let’s consider the second idea first.

1. A Provisional Approximation for the Evolution of Human Language and Cognition.

There is a persistent belief that a plausible and reliable description for the evolutionary development of human language, even a close approximation to a proto-language, is not possible or likely to be very useful. Nevertheless in the interest of general coherence for our review we believe it is valuable to advance one here. In part we are encouraged in this exercise because we propose to keep our description simple, and in part we are emboldened in that we join the compa-
The evolution of human speech can be described plausibly and step-by-step as a fortuitous collateral development stemming from higher orders of neurosynaptic function driven by environmental change and related survival hazards. By identifying the essential differentiating nature of both language/speech and writing/reading as unique two-tier cross-domain cognitive functions their origin, functionality and operating structures can be more easily identified and understood.
ny of thousands of otherwise responsible investigators who have already tried it themselves and are in no position to complain.

The reality is that a much simpler model of human language, in terms of its rule structure, than the language we see in evidence today would serve to address all of the immediate and close-to-immediate information exchange needs of early man. That is to say, only a very short list of rules and structures would be sufficient to deliver perhaps 95 percent of the useful information we can produce today with a highly complex rule system and a typical 50,000 word vocabulary, and it probably was sufficient to transmit 100 percent of the information useful for survival in the daily circumstances of Early Man. Consider the following statements and their rule patterns:

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Man kill, eat rat.
Lion here, there, close, far.
Bird in, at, on tree.
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What do these statements imply? The possibility of a complete prehistoric grammar with perhaps only two or three syntactical rules or principles:

Rule One, Event Statement, one fixed word order, three word maximum:

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NV(N)
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Rule Two, One or Several Locator (L) Adjacency Pattern(s):

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NL, NLN, NLVL
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Throw in a half dozen additional object referents for items of daily experience like man, rat and bird, plus a dozen other action substitutes for eat, kill and run, as well as a handful of critical environmental object referents like water, land, air, tree, grass, day and night along with a few more location signifiers and you’ve got a complex language system that can handle an immense number of useful messages. You can identify critical objects (food, hazards). You can describe their presence or distance, and context. You can describe their actions. And finally you can trigger – as we have already seen – a transactional exchange of information between humans (as illustrated in Fig. 1) by introducing a single disordered pattern which the listener/hearer reorders to the one correct order for all statements of
action or being and in the process fills in the missing information to complete the exchange.

For a species that today can learn, identify, and use approximately 50,000 signifiers, including the special rules of their use in relation to other signifiers, before the age of 10 years is it so unthinkable to propose that 60 or 100 thousand years ago an earlier member of the near-equivalent ancestor, basically the same species, might build up a learned base of just 30 critical space, object, and action referents and just three rules of sequence in the sensorimotor system of the voice without a high-complexity, hardwired “grammar?”

If the language delivered by this limited set of rules failed to provide the service of complex if/then logical projections, or recursive sentence structures 25 recursions deep, who would miss them in the standard short-burst information exchanges on the edge of the lion-studded African veldt? To be absolutely explicit, since it appears that even today short-term human memory can hold only perhaps 7 to 9 units of information in an oral/aural stream at one time, what possible sense does it make to invoke the idea of an infinitely long recursive capability as compelling evidence for the necessity of an innate organic base for a language function which in fact and in reality has absolutely no use for an infinitely long recursive capability in the first place?

On the other hand, by insisting on an evolutionary framework for our speech-thought model we can appreciate all the more the significance of recent work by scholars such as Lakoff and Johnson whose metaphor theory – apart from application to the nature of abstract thinking and conceptualization – helps to explain the development over time of a much richer human vocabulary.

Masking, perhaps, the original simplicity of this language learning process is the separate question of how the abstraction of human language became possible in the first place. How did primate proto-humans make the leap from a completely direct stimulus-driven communication system to one in which abstractions are employed to convey knowledge and experiences which are useful for survival, but which do not have a perception that is simultaneous with their communication to others? That is a difficult question but not one that cannot be answered if we resolve to study the problem from a Darwinian, rather than contemporary lan-
language framework.

One way to explain this critical element in linguistic evolution is by bringing several factors of change together in the conditions of primitive man. Here (Fig. 1) is one scenario. Climatic changes gradually or abruptly lead to environmental shifting and in the location of the human food supply, which creates a need to leave a habitat system in which a few simple signals suffice to secure the general security of the species from predators. It might be, for example, an extended move away from the security of forest trees and into open grasslands with no quick escape from ground-based predators.

That, in turn, might lead to a permanent shift in stress along with a continuously elevated state of sensorimotor alert.\(^{12}\) This in turn might, as a side effect, lead to more frequent or simply stronger and more permanent synaptic linkages between elements of sensory experience, including more rapid referent identification and response to sound signals or calls.\(^{13}\) How could this simple adjustment in the threshold for synaptic link formation, however, cause any shift away from a system exclusively driven through stimulus response?

If the neurochemical threshold enabling formation of synaptic connections is elevated to cause more formations, it’s also plausible that more cross-domain messages might come to be generated by internal, rather than exclusively external stimuli. Memory and memory capacity thereby might become a stronger factor in mind function. And, vocalization might be developed for experience categories other than the most urgent survival triggers.

The hunger of an individual animal, for example, might trigger a vocal call or signal to others originally expressing food, as in the proximity or promise of food, whereas in the new environment there is no food that is either immediate or evident. Such a signal might be taken as an error message. Or, it might instead serve, functionally, as an abstract signifier or token triggering the hunger of other animals in the group, and generating an earlier search for a new food supply to support and for the benefit of every animal in the group.\(^{14}\) The weakest or hungriest animal thereby might drive the social focus and motivation of the entire group, and perhaps improves the chances for its individual as well as group survival.\(^{15}\) Messages which have Darwinian implications for survival now move into
new areas not supported by the original stimulus-driven language system, and create a new class of communications whose value does not depend on immediate action or response, but still supports group survival by supporting more complex response options both to immediate experiences and to inter-animal communications.

As noted many of these new synaptic connections might be taken, on an individual basis, as useless “error messages” or otherwise useless referents for the purpose of social interchange. On the other hand it may be exactly this new wealth of referents, frequently erroneous, that made possible a new, Darwinian winnowing process on a higher cognitive level and the rapid addition of an expanded vocabulary of abstract referents. In this context an alternative theory of evolutionary language acquisition recently proposed by Robin Dunbar suddenly makes more sense, not as a substitute for our primary proposal but as describing an adjunct process to enrich and accelerate the utility of the new flood of referents. In simplest terms, Dunbar proposes that the intimate process of body parasite removal between proto-humans facilitated an environment of compressed vocal exchange as well. Dunbar’s classic grooming environment, still uncannily mirrored in hair salons all over the world today, implicitly serves to explain how error referents and useful referents might have been sorted out.16

Another evolutionary factor which might have accelerated referent acquisition and utilization, per Arbib, observed in both chimpanzees and humans, is the functional ability to imitate observed behaviors. In humans more complex patterns of imitation are possible, beyond mere mimicry or emulation. “The ability to imitate has [a] clear adaptive advantage,” Arbib notes, “in allowing creatures to transfer skills to their offspring.” (114)17

If stress allows easier referent formation, and a very simple pattern of referents can be used to convey information about objects and actions as well as to trigger a process of inter-subject information release through “questions,” we suddenly have a viable model for the evolutionary launch of an abstract system of language, one which might even be subject to experimental verification.

First we must consider the idea that the essential nature of human speech and even human thought might not be, in the end, driven by any function of the individual mind as we have been inclined by at least the last four centuries of Western intellectual thought to believe. More specifically, consider Fig. 2 provided here of the contemporary human language interchange:

Essentially an abstract message A, after some order of intellectual processing in some functional brain locus we will call the EPC in the head of the individual early human subject A, is uttered through the vocal sensorimotor system of subject A and captured in the ears of human subject B, where it is processed by some order of sound capture and neurosignal conversion process, to a point of intellectual processing as a sequence of symbolic referents – or message again – in a similar EPC functional brain locus in the head of the individual human subject B, and is then immediately acted upon, stored somewhere within the several memory functions of subject B, or both. Let’s keep this description simple here to permit us to focus on just several factors in what all investigators agree is a highly complex process.\(^{18}\)

Human subject B, then, may also respond resulting in the receipt of a message by subject A which is again processed by the EPC locus, and perhaps stored at the M:SES and/or another language-specific site for further access later. This description, which might at first seem reasonable as a basis for considering the problems and processes of human language, is not actually what occurs at all.

What actually occurs is also illustrated in Fig. 2, and is easy to overlook,\(^ {19}\) but presents conceptual implications to the relationship between mind and language which are prospectively very different. In studying the exchange of information in the oral/aural stream between human subjects in Fig. 2 it is clear that one subject receives information from the other subject which can then be processed and acted upon, and further the second subject can send information for the same purpose back in the other direction.

Interrupting this examination for a moment, however, let us pause to note
that working with this primitive model, at the dawn of language, we are suddenly able to identify the reason for the existence of the rules of word movement encountered by Chomsky and others 60,000 or so years later, in that they demonstrate a practical function in early human conversational interchange as well as offer confirming evidence for the basic plausibility of what we would again like to term our provisional approximation of the early evolution of language. It works like this. The recipient of the communication is conditioned by experience to expect a certain word order in the sequence of the message to convey the informa-

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**Fig. 2**

This model is a fairly generic abstraction for purposes of illustration and does not attempt to reflect every cognitive function or module. Each general function indicated is likely to be made up of multiple independent function-specific modules. We use the term module here in the Fodorian sense, summarized by Peter Carruthers. Neither Carruthers nor Fodor believe the complex oversight functions of what we term the EPC can be build in modular, computational terms and we are not inclined to dispute them, or venture to describe a full alternative here.
tion with the greatest efficiency, that is, the recipient does not need to analyze the identity of each word for its category as an object or action. The message can only be sent as object-action, object-action, object-action. That order is itself a parallel signal stream or code. So when early human subject A, in Fig. 2, reverses the order of words (action-object) preceded by an “empty word” or “weak referent” (what-action-object) it serves as a signal for human subject B who receives the message to correct the “disorder” – with another vocalized response restoring the right order of words to match the very specific code rule while replacing the empty word with new information. In this transactional exchange subject B selects the correct “strong” or specific referent to represent the external reality as it is perceived in his/her mind. The cognitive discomfort arising from the identified signal disorder triggers a correction that serves to enable and complete an information transfer.20

Subject A, if you like, is the equivalent of the contemporary information hacker who sends an electronic instruction into the stream of the web to capture the data he needs to know.21 There’s nothing like information you can use to help you survive. Now Chomsky’s rule for word movement has a practical, Darwinian reason.

Does the model demonstrated in Fig. 2 serve to explain all of the rules of movement encountered in modern language? No, it does not and would not be expected. Further it’s not the responsibility of our “provisional approximation” to do so. Rather, if anything it is the other way around. And as just noted, modern word movement rules do seem to find an explanation under this model that seem to make good sense. What other model provides such pragmatic utility?

But what is perhaps the major significance of this model for investigators is the way in which it serves to illuminate a broad theory of human cognition, particularly the element or experience we perceive not as self-awareness, but as self-aware cognition. It has been frequently observed that our conscious thoughts appear to take the form of language. This model specifically demonstrates why this might be so, and shows how the same Darwinian engine that advanced human language to a higher level of abstraction might be the same engine that now gives us the experience of thought, and perhaps best serves to direct and regulate our executive cognitive functions as well.
What this model takes into particular account is that both participants in the cognitive exchange are listening to both sound sources in the conversational stream. They are each hearing and processing the entire sequence of the orally-encoded, aurally-received stream as though they were outside the process, and they are simultaneously processing their own voice stream through the same functions – memory, comparative, projection – that are employed to analyze the voice of the other party in the dialog. The controlling cognitive functions which initiate their individual speech are not the same set of neural modules which receive and analyze the message content on its return path back into the brain. One benefit of that separation between the engine of vocalization and the reception center for analysis is therefore the activation of an error-correction function, available as an independent comparative, analytical and decision support capability.

A non-native but fluent speaker of several languages, for example, in speaking in one language “on autopilot” without subvocalized rehearsal might spontaneously insert a word from the other language into the stream of his utterance, then hear and recognize the error in his own ears and immediately restate a corrected expression. Individuals are known to “hear” themselves misspeak in many contexts.

The special importance of this analytical function becomes more clear when we consider the wider relationship between the function of human speech and human thought. Fodor and others have pointed to the perception that our internal thoughts show every appearance of expressing the same syntactical rules as spoken language. Searle concurs (p. 201), but asks “How does the brain work in processing these sentences?” and proposes that the brain performs “computational operations over the syntactical structures of sentences in the head.” Chomsky himself flatly rejects (Reflections, p. 56) the precept of Searle that the essential purpose of speech (now firmly in the natural sense) is communication, but rather prefers the converse idea that the essential purpose of speech is to express thought. Regardless of its utility in the brain, we now have, finally, at least a causal explanation for that specific human perception of thought as language, based on the actual neurological flow of language into and out of and back into the human brain. Self-aware thought can be posited (see Fig. 3) as a simplified
interpersonal conversation, with the other, external subject in the process temporarily omitted, and the unchecked original expressive utterance “heard” and analyzed, then given a return response by the same subject in what is quite specifically an indefinitely extended, subvocalized monologue. What its relation might be to subsequent “executive” control of our mental focus, decisions and actions is not immediately evident. What is particularly interesting in this description, however, is that it serves to explain the perception and provides a mechanism for ideas and concepts – even if perceptually-based – to evolve and be modified in the mind. Certainly it would suggest that thought is a fortunate byproduct of speech rather than as Chomsky would have it the other way around.

If we consider, further, the possibility (Fig. 3) that an individual human subject might simultaneously hold conversations both with an external interlocutor and a second, projected or “phantom” interlocutor, we can see how in subvocalized conversation with one (phantom, internal) the individual could effectively mediate his or her conversational interchange with the external interlocutor before any external expression is actually vocalized.

This would serve to explain as well the unique human capacity for complex conversational strategies with other individuals holding different interests, which might include negotiating language or even deliberate lies. Or to reverse the significance, we might suggest that these human capacities tend to support the provisional approximation presented by this model.

This model does, certainly, bring to our special attention the question of subvocalization as a critical human speech capacity. That it exists can now be shown by neurological analysis, but what is particularly interesting is the possibility that it represents a linguistic feature that has been acquired only recently in human history. The cognitive functions that may be based on what our model identifies as silent talking might well have been unknown and unimaginable to humans living as recently as 10,000 to 15,000 years ago. We know that subvocalized reading, a parallel function, is a relatively new human skill gained only about 1,500 to perhaps 2,500 years ago. Prior to 15,000 years ago thinking aloud might well have been, in the sense of abstract reasoning, the only way humans could think. It’s very possible, even probable, that you literally couldn’t
think without talking.

A conversion to widespread silent cogitation, along with improved skills in interpersonal negotiations, may have provided essential new mechanisms of social interaction which permitted the development of human communities larger than small aggregations of families, just as the arrival of writing, taking language to the next level of abstraction, supported the functional possibility of the first small regional empires.

The cognitive model provided here, of course, does not pretend to explain myriad other mental functions, in particular our system of human emotions. It does however complement the insightful recent proposals of Antonio Damasio con-

![Fig. 3](image-url)

*The experience of self-aware thought can be duplicated by this model of subvocalized conversation with a phantom interlocutor, which affords a reasonably simple and plausible explanation for such abstract human cognitive features as strategizing, negotiating, projecting, forecasting, deciding and even, although somewhat less salutary, lying.*
cerning the uses of human emotions in the full processes of cognition as the cognitive “anchors” that keep the rational process linked to pre-set values, as well as of human feelings in the sense of a separate, independent category of neurological self-awareness. Although Damasio’s focus is on the role of emotions in the individual, their transactional importance is affirmed as well by a recent study by Dapretto et alii which showed that a sympathetic neural activity appears in the point in the brain of an individual simply observing the physical activity of another where the activity occurs normally; the failure of this “mirror” transactional function to transfer emotions becomes the serious cognitive malfunction known as autism. A transactional benefit appears to be crucial across the board in higher order human cognitive processes, which includes the key interplay of emotional processes.

Another contribution of this model, therefore, with the new emphasis it places on the transactional and interpersonal nature of language, is to shine new light on an obscure but enormously important aspect of human cognition which is the essence of its expression not as an individual process, but a social process. As the author has previously described this cognitive function, social cognition obviously occurs in a social context with a transactional outcome:

Unlike personal thought by which an individual cogitates alone, social cognition by definition (a) occurs in a cognitive interchange between two or more persons, which is (b) is marked by periodicity, typically features (c) the oral expression of social principles, moral ideas and values, and philosophical or theological beliefs in fixed language which may occur in the form of a fixed credo or narratives reflecting the same ideas, all of which is embedded (d) in one or more concurrent mental processes affecting cognition which are essentially non-rational and involve, in one way or another, the cognitive action of recognition. These processes include dance (response to anticipated rhythm), fixed dance (steps or step patterns) movements, musical or percussive rhythms, known lyric sonorities, known or unknown lyric sonorities arriving at a resolution, known words, known or unknown words in recognizable (recognizable: subject to mental anticipation) rhythmic or rhyming patterns, interactive
signals or (musical) exchanges between performers and listeners, or even all of the above linked together. Generally, however, all of these non-rational cognitive elements are already elements well-known to the listener from one or more previous exposures, and from that there arises the special psychological function of “recognition,” which amounts to a kind of “affirmation of consonance with the embedded known,” linked to all of them. The identifying marker of “periodicity” here refers to an even which is repeated reliably on a calendar basis such as once a year, at the solstice, monthly, or every seven days.

These events are otherwise usually termed rituals, but usually viewed as cultural events or practices without emphasis on their specific cognitive function. It may be surmised that the periodicity of “church” every seven days owes its particular schedule to a certain Darwinian necessity. On a 3-day rather than a 7-day schedule agrarian societies would spend so much time in church that harvests might suffer and people starve. On a 9- or 10-day basis the murder, rape and pillage rate might soar out of control before people could get back together to reset the social calibration for optimum public order.

The emerging neurochemical psychology of music, as reported by Rita Carter (p. 146), explains music’s special power to serve as a kind of social and cognitive glue. Jack Panksepp, per Carter, has proposed that the tension-resolution aspect of music evokes the same kind of psychological response identified in mothers responding to a cranky child. The resolution of the crying child automatically elevates the mother’s blood level of the hormone oxytocin which has been shown to elevate emotional sensitivity, and to strengthen social bonding and trust even among complete strangers. Elements of social cognition, and the special expression of political, moral and social coherence they evoke, can be identified in many if not all human social practices, as well as in some aspects of the arts.

Still another outcome from this model is that helps to explain what Chomsky has pointed to as Plato’s Problem although perhaps not quite as Chomsky intended. That is, Plato per Chomsky wondered how it was possible “we know so much, given that the evidence available to us is so sparse” (Knowledge,
p. xxvii), and his question is raised with respect to language acquisition. Chomsky’s answer lies in innate knowledge. Our view from the model would be quite different, and in a different direction altogether. As individual cognition and knowledge are increasingly viewed as a process of accessing the information and experience of others, and human cognition is recognized with new appreciation as a social process we can immediately see that, rather than a dilemma, Plato’s or more accurately Meno’s Problem is significantly reduced – at least in practical, folk theory terms – in the benefit of an individual human knowledge base, perforce restricted by the limits of direct personal experience, that is actually highly extended through interpersonal experience through communication and cognitive interaction.

3. A Provisional Approximation for the Biological Structure of Grammar.

It remains, however, that early referent-based language was perforce very simple and the next step forward to a high-complexity language driven by the critical structural system known as grammar is not immediately evident. This problem is at least as critical as how *homo sapiens* moved away from vocalizing through a stimulus-based communication system to vocalizing through a referent-based communication system, because only in language structured by grammar can a high order of informational complexity and the full power of oral/aural abstraction be realized.

Therefore do we adopt as our provisional model for the evolutionary development and operation of grammar an empirical model, with assumptions about the brain’s ability to master – presumably through a simple associative learning process executed by infants and small children – rules which appear to be infinitely variable in their application? Or do we adopt a model that calls into operation a differentiating and function-specific cognitive structure that comes to us as a happy evolutionary accident?

Our answer comes out of a consideration of human language grammar not
The extremely powerful human functions of both language and reading/writing reflect a unique two-tier or double abstraction between several cognitive domains: visual experience abstracted to the oral/aural sensory domain and abstracted again in the second mediation by functions back within the visual domain. In the case of reading it is clear that this second level abstraction – the fairly new human ability to understand words extracted from visual domain text – is too recent to derive from a unique genetic structure, but must be entirely learned, after which it becomes unconscious. This suggests that the other two-tier cognitive function known as grammar may be entirely learned, then becomes unconscious as well. Viewed from this structural perspective, then, supported by growing neurological evidence grammar would not appear to require a special-purpose function or organ that is genetically “innate.”
as an element of either a language capacity or animal communication, in fact, but rather as one of several unique cognitive systems in the human brain with capabilities otherwise unattainable by reactive neurological structures. From this perspective we can view grammar, first and primarily, as one of two known two-tier, cross-domain cognitive systems operating in the human brain today.

Two-tiered, cross-domain cognitive systems, we would argue, appear to mark the essential biological difference between humans and all other species, including all other primate species. There may be many such systems yet to be identified, but the one we know about with certainty and the second we believe is indicated must be considered the most significant intellectual cognitive capacities ever to evolve. Both systems achieve their unique functional utility by moving perceptual data from the visual domain to the oral/aural domain of sound, and then by operating on the result a second time through apparently conventional cognitive functions in the visual domain. The result, through the two-tier system we understand the best, offers the power of what is literally a cognitive system for infinite memory storage under the control of the human mind. The second tier function embeds a record of oral/aural abstraction of an object, place, event or other perceptual experience in a second, visual abstract format external to the mind – on a rock wall, the skin of an animal, or modern paper. It’s a specialized human cognitive system called writing and reading, and the fact that it is in part external to the brain is essentially irrelevant to either its neurological structure or its functional power.

The move from a purely oral/aural brain function, even a referent-based oral/aural brain function, to a second tier of abstraction back in the visual domain leads to a function of unquestionable power, in some ways literally without limitation. Yet we know from many forms of evidence that the recapture of visually-encoded information on paper and its reappearance as oral/aural domain information in the mind is not an immediate and specialized evolutionary development. It has occurred only in the last few thousand years. Yet small children can learn to translate the visual code back into an oral/aural domain code in just one or two years, in a process that quickly becomes automatic and unconscious.
In 1980 Noam Chomsky, convinced that the complexities of grammar could not be learned but must be innate, threw out the challenge to Piaget:

1. There are at present no substantive proposals as to how such domain-specific knowledge might be acquired.
2. In the absence of any such proposal, it is reasonable on grounds of theoretical parsimony to conclude that this knowledge, which is apparently species-specific, is, like other species-specific traits, innate; i.e., it is endogenously determined, since to conclude otherwise would be to presume that the development of cognitive structures is to be treated differently than the development of physical structures elsewhere in the body.
3. Hence, it is reasonable in the absence of such proposals to conclude that this domain-specific knowledge is innate. (Matthews, 85)

Chomsky at the time believed that his challenge was unanswerable, but what we have now in view is the specific proposal that Chomsky has asked for.

Could not a two-tier, cross-domain cognitive construction, similar to human literacy, be invoked to explain the extraordinary algorithmic function of grammar in human language in relation to individual word referents? And could it not, like reading, be entirely learned by small children as well, then to disappear into the unconscious? The answer to both questions must be yes, and there is now considerable evidence to support this proposition as the basis for a provisional model with regard to the biological nature of linguistic grammar.

The prospect of a spatially-structured cognitive framework for the management of referents in communication serves our proposition of two-tier cognitive functions in several convenient ways. It offers support, of course, for our emerging view of the nature, structure, and acquisition process for language grammar as we experience it today. But it serves as well to support another very plausible description for the evolutionary development of human language in the first place. John O’Keefe writes:

“Nadel and I opined that the origin of language might have been the need to transmit information about the spatial layout of an area from one person to another ... perhaps as adjuncts to simple maps used to
convey the location of food items or dangers to other family members. Originally the linguistic content of these prototypical Semantic Maps might be rather simple and impoverished. Different sounds might stand for different objects in the map and might serve the additional function of acting as an encrypting device. Over time the pictorial aspects of the structure of the map might be systematically replaced by prepositional and other spatial semantic elements. This increase in syntactic vocabulary would eventually obviate the need for the externalized map entirely but the neural substrate would retain the underlying map-like structure of the original. (O'Keefe, p. 72)

Whether early humans conversing with only a handful of referents in their arsenal of exchange actually devised maps on cave walls to converse like bees or they simply smacked their lips and waved their arms a lot hardly matters. The point is, as soon as you wish to communicate anything significant to another individual in a protoworld environment you can say almost nothing that is either actionable or otherwise meaningful without conveying your information in terms of location in space. It is hardly surprising, then, that O'Keefe is willing to propose that “the representations set up by ... spatial propositions might provide the basis for a more general linguistics.”

But O'Keefe is hardly alone. Sweetzer and Fauconnier, in encountering unanticipated evidence that syntax is highly linked to the structure of human experience and understanding, conclude that “linguistic structure does reflect precisely the aspects of human cognition described above.” Much of the semantic meaning conveyed in language, established through the frame of syntax, comes out of sequence of linked viewpoints, first triggered in association with an original object (Spaces, Worlds and Grammar, p. 19). Sanders and Redeker illustrate how a shifting, sequential mental space perspective supports the semantically coherent communication of a narrative expression (p. 306). George Lakoff explains the essential function of spatial metaphors to enable concept formation, starting with the concept of self and “consciousness” (p. 116). And Slack and Van der Zee do not pretend for a moment that cognitive representation of space/time, inextricably linked with the external perception of time/space, is anything but heavily
dependent on linguistic expressions describing spatial-temporal configurations (p. 1). That makes O’Keefe and Nadel’s proposition that the human hippocampus serves as a cognitive map all the more useful. Updating their 1978 model O’Keefe notes specifically:

In animals, this map is purely or primarily spatial: the hippocampal formation provides the animal with a representation centered on the environment which enables it to locate itself and objects of interest within that environment. In humans however, the hippocampus is necessary for the storage and recall of linguistic and episodic memories as well as for spatial memories and so it was necessary to extend the basic theory to account for the human data. We assume that the right human hippocampal formation continues to have a primarily spatial function, operating in much the same way as the rat hippocampus. The left hippocampus, on the other hand, has been modified in two ways to transform it into a linguistic/episodic memory system. Firstly, this spatial structure has acquired an extra dimension enabling it to incorporate a temporal sense into the basic map to account for the ability of humans to process and store spatio-temporal information. We argue that this framework provides the basis for episodic memory, which is the ability to recall personally experienced events set within their original spatio-temporal context. Secondly, we argue that the primary input to the left hippocampal formation consists of information about linguistic entities rather than about physical objects referred to the external physical world. For example, damage to the left mesial temporal lobe usually results in impairment in the memory for linguistic material and in particular words and narratives (see e.g. Frisk and Milner, 1990).

(O’Keefe, 69)

In this context it does not seem inconsistent to suggest that the function of a grammar under the management of a spatial domain utility in the same region might be worth investigation.

What also follows from this cross-domain perspective is the possibility that grammar, like the body of referents it supports, might have developed over many
generations in a process that reflected both a process of association-based learning and a simultaneous evolutionary process, based on the advantages of use and functional demand, of extensive forebrain expansion and general functional neurosynaptic adaptations. Such an expansion and adaptation do not imply, however, a functionally-explicit and restricted cognitive process, such as an exclusive “language organ,” but merely an adaptive use.

Yet among linguists neither empiricists nor nativists should be materially dissatisfied with a two-tier, cross-domain proposition for the embodiment of a grammar function. For the latter the idea that the function of linguistic grammar is so powerful that it demands a unique framework in neurological systems is affirmed. While for the former the idea that the cognitive embedment and functionality of grammar is actually learned, albeit through a cross-domain transfer and management by a visual domain mapping process, is vindication of their faith in decades of deep research with children.

That this confidence might have been well-placed, it should also be noted, is further indicated by a recent study in visual neurosystem performance by Kosslyn in which the investigator showed that generating mental images is a process coordinating several separate functions, including a visual-domain “class of processes that activate stored spatial relations to arrange shapes into an image.” Out of this the investigator points to the discovery, counter-intuitive perhaps, that “the left hemisphere is better at arranging shapes when categorical information is appropriate,” which is to say, when the parts of a visual domain image must be put together in a correctly connected representation. That this cognitive operation resides on the side of the brain that requires a similar kind of management oversight for the language function described as grammar may not be entirely coincidental.

Summary.

Where does all this leave us? We have explored a number of benefits from the adoption of a coherent transactional model, in three categories, for the evolu-
ation of speech and cognition. Our model has not, by itself, allowed us to answer completely the six questions we raised initially. But in that framework we have suggested what might be a reasonable description of the Darwinian mechanism, or series of mechanistic transformations, that caused the leap from stimulus-based survival communication to a primitive but functionally-efficient form of communication that is abstract in its essence with only the least correlation to the issue of immediate animal survival. A distinguishing characteristic of this model may be the way it both recognizes and then utilizes the problem of error messages to advance the evolutionary process. Further some aspects of this model, most notably the effects of environmental stress, as well as of perceived visual proximity and other survival cues, may be subject to experimental verification.

We have proposed that perceived linguistic rules should be viewed in light of the way they support a credible provisional approximation of language evolution, and we have seen further that the approximation we have proposed here is supported by observed contemporary linguistic rule studies, notably the rules of word movement.

We have shown, with the illustration of a very simple and efficient proto language system, that many Chomskian arguments for an innate grammar function or language acquisition device appear to be strained, that is, they simply do not apply, while recent field evidence puts the empirical validity of others in serious question. It’s simply time, in our view, to move on from these arguments.

On the other hand, we have proposed a novel two-tier provisional model, in part presaged by Chao, for the development of the two most significant functional developments in human cognition. This model offers a new explanation for the biologically-based/learned function of linguistic grammar that might satisfy both empiricist and nativist alike.

We have noted, to explain the possible nature of a two-tier system, that the syntactical structures of language as well as its lexical content, both literal and metaphorically applied, appear – as reported by many contemporary investigators – to hold the same deep dependence on visual-domain cognitive systems capturing and expressing location.

We have proposed, as well, a provisional model suggesting a clear physical
relationship in terms of corresponding sequential neurological activity between human speech and human thought. It holds some correspondence as well to a strong contemporary model for the role of emotions and feelings in the full picture of cognition. If theories proposed by others prove correct it might ultimately be identified as a structure driving at least some of the mind’s executive functions.

And finally we have further identified the strong possibility that the subvocalization of transactional speech, perceived as self-aware thought, might be a very recent human development, pointing to a paradigm shift in our perception of the relative significance of individual versus collective cognition, and perhaps our individual human meaning.
Notes

1 Michael Devitt and Kim Sterelny, for example, have put together a elegantly coherent overview of linguistic problems, with some special emphasis on the problems that issues in linguistics present to the field of philosophy. Their description (p. 6) of eight characteristics that distinguish human language is exemplary in its clarity. Like Chomsky, however, they hold that the best framework on which to consider linguistic problems is from the perspective that “language is a system for expressing or communicating thought.” But as the reader will learn this turns their viewpoint 180 degrees from the perspective we take in this review.

2 Chomsky himself is very specifically non-specific about his views on “innatism” or “the innateness hypothesis” with respect to any “innate” language faculty. He denies he holds any such view (New Horizons, p. 90). Rather, he says, “there are certain proposals about the initial state of the language faculty or language acquisition device (LAD, UG). These are not questioned by the critics.” However this declaration comes in the year 2000. In 1983 in an interview with Omni Magazine he spoke with emphasis on the existence of the language “organ.” In the same year Fodor attempted to define the claims of Chomsky’s thesis as: “what Chomsky thinks is innate is primarily a certain body of information: the child is, so to speak, ‘born knowing’ certain facts about universal constraints on possible human languages.” This of course marks an effort by Fodor to give previous Chomsky assertions a more clearly metaphorical spin, couched safely in the protective embrace of the ambiguously-intended word “information” and thereby constituting an unassailable self-defining piece of techspeak. This description from Fodor in 1983 is cited by Devitt and Sterelny (p. 192) in 1999, some years later, because after rigorous research they apparently could find nothing so well defined or compelling by the distinguished theorist himself. One has the right to change one’s mind about a specific description of an hypothesis, of course, but the underlying question does not change. Is there or is there not some unique, function-specific module, innate faculty, innate endowment or even metaphorical genetic organ in humans at birth which substantially con-
trols and directs specific characteristics relative to the development of a human language and grammar function? Effect ergo cause, certainly. But how vague can the description of any cause be and still remain intellectually useful? The area of the brain called the angular gyrus, which serves in the astonishing task of translating the incoming perception of written words – imbedded in a general visual environment – captured in the Primary Visual Cortex area into a different code of brain signals representing aural/spoken words which are sent on to be received into Wernicke’s Area, certainly is a unique mental faculty which just as certainly has a genetically-based foundation. But must we assume that any aspect of its specific function is innate to the extent that it existed before some small team of Sumerian sherd manufacturers on their day off first invented cuneiform? Of course the question is purely rhetorical. Returning instead to answer the previous question on utility it would appear that in the context of an academic investigation any theorem, if described loosely enough in the first place, can retain its utility almost forever. In 2005 (Mind and Language, February Issue) Pinker describes the current Computational Theory of Mind (CTM) now edging toward center stage in theory discourse in fairly glowing terms and then suggests, “This is behind Chomsky’s idea that there is a single Universal Grammar that applies to all the world’s languages despite their differences in overt words and constructions.” So now the innate specific-application mental organ idea is hastily fused with the still open-ended conception of Fodor’s popular CTM as well. No matter what you propose, it was what Chomsky meant all along.

Human cognitive and speech functions are inarguably different from those of other primates. Pinker gives an excellent review (Language Instinct, p. 342) of the problems encountered in animal speech studies, starting with the observation that the control of vocalization in chimpanzees is not in the cerebral cortex where it is centered in humans, but in a far more phylogenetically antecedent center located in the brain stem and limbic systems where it is most likely subject to mediation by the emotional systems. Fromkin (p. 384) offers another compact overview on this subject. Beyond multiple aural/oral speech studies both reviews take note of what must be taken as largely “failed” ASL studies,
which presumably are built on a structure of functions with no reference to an oral/aural system of functions whatsoever, or their underlying “innate grammar.” These studies certainly demonstrate that our closest biological relatives certainly must lack some functional support for language that has evolved in humans, but if anything they also serve to remind us that whatever exists to serve this outcome may actually have no direct genesis in the general function of communication which we share with all other animals. Any biologically-based neurological platform which serves to anchor all subsequent grammatical functions in language may itself have no exclusive connection with language at all, but may serve many other cognitive functions which are developmentally-dependent as well.

Compelling response to nativist arguments are provided by a number of investigators. Jesse Prinz puts forwards a series of thoughtful counter arguments against the whole array of propositions presented by nativists for a belief in an innate grammar faculty. An equally vigorous case in another extended refutation of nativist absolutism is made by Geoffrey Sampson. Parenthetically Sampson notes as well (p. 50) that Chomsky himself has withdrawn from another previously axiomatic claim of convergence, that is, that individuals with widely varying differences in intelligence and educational exposure show no noticeable correlation in their mastery of their first-language grammar. Scholz and Pullum review, in painful detail, the irrational enthusiasm of nativists for every kind of weak argument leading to a series of highly untenable conclusions. And finally we should note that a quick survey of substantial problems with the entire list of nativist arguments is also presented by Timothy Mason on a very helpful if somewhat less formal website. We must emphasize that we do not believe it is necessary to our purpose here to report every problem with every nativist argument or to completely refute nativism, however, we do think it’s important for all of those concerned with the nature of human language and its key issues to suspend their unquestioning faith, as it were, in the absolute certainty of nativism. Call it simply a kind of prayerful moratorium to consider alternatives which might be more productive in leading to a more coherent solution than can be realized at present from the nativism concept.
The question of what is abstract depends, of course, on how abstract you want to get. Deacon (p. 79) explores the question extensively in his review of iconic, indexical and fully symbolic (abstract) categories of referent but in the end it hardly matters when our focus is on the earliest referent form or forms. The only referent of interest to us is the symbolic referent. Even the notion of indexical referents is after all a relatively recent evolutionary development first noted by Plato as the *ideia*, and only captured as a concept with the appearance of written language (Havelock).

Chomsky himself is careful to distinguish between developing a precise description of linguistic phenomena, operating in accordance with formalized rules, from the processes of mathematics, which he describes as the higher-order identifying and analysis of properties abstracted from the formalization itself. (On Language, p. 125). He was highly skeptical, in fact, of early mathematical approaches to language, in particular Markov structure analysis which remains a central feature of contemporary voiced language analysis and conversion technology. With this, of course, a purely mathematical understanding remains tempting which is what necessitates Chomsky’s distinction. Chao, on the other hand, explores (p. 194) the possibilities of complexity in the relations between objects and their referents to an extent that captures the tantalizing qualities of abstract constructions “which are language-like, but not actually used in natural languages.” But in the end he regains self-control with the perceptive conclusion “that in the long run one can say that the general trend of abstract thinking, be it in mathematics, theoretical physics, and what not, is mainly concerned with symbolizing things.” That definition of referents – “conventional, arbitrary, and fortuitous” – is sufficient for our purpose here although we wish to note, as well, Chao’s early observation that referent systems may occur on multiple levels and may be constructed across different fields of perceptual sense.

For the term provisional approximation we are indebted to Damasio (p. xxii). Of course Damasio himself simply offers with this cautious description a small homage to William James who warned that “any natural science assumptions
must be provisional and revisable things.” (Edelman, p. xiii) We share Damasio’s view that the current state of our understanding of neurobiology will allow no more than approximations, but these can nevertheless be useful inasmuch as that they may offer a measure of broad insight and they can be tested and improved.

8 We will permit ourselves to conflate these two functions for the moment, noting the observations of Fodor and Harmon per Devitt and Sterelny (p. 138) that thought at least in the sense of our perceived internal conversations with ourselves has, apparently, the same syntax as spoken language and can be considered mental sentences using mental words. In this perception Fodor and Harmon are simply reflecting the earlier observations of Charles Sanders Pierce who, per Deacon, argued that “all forms of thought (ideas) are essentially communication (transmission of signs), ordered by an underlying logic (or semiotic, as he called it) that is not fundamentally different for communication processes inside or outside of brains.” (Deacon, p. 70) Both thought and spoken language must therefore have an origin which is at least conjoined with active speech, although we hope later in the progress of this essay to provide some further description for a prospective specific technical cause for this perception.

9 Jackendoff notes, among others, the disposition of linguistic researchers to attempt to understand results without reference to the actual practical meaning and use of language. “What strikes me about this tradition is that it apparently neglects what would appear to be by far the most important function of linguistic working memory: understanding and producing spoken language.” (206) He is speaking with the specific reference to one study on working memory, but with the framework of Chomsky’s insistence that the function of language is to express thought he might as well be referring to the entire field. In Foundations of Language, his extensive review of contemporary linguistics, Jackendoff feels the need, in fact, to offer as a postulate that in his view “language arose primarily in the interests of enhancing communication, and only secondarily in the interests of enhancing thought.” (236) His excellent work on idioms (167), in particular, spotlights the mutual storage of information, or presumed knowledge in the recipient by the speaker, in conversational exchange, and thereby
demonstrates the power of its fundamentally transactional character. Jackendoff even attempts to explore grammar as a phenomenon operating on what he terms its own tier, but he does not propose or identify the foundation of this tier, as we will, as a cross-domain system.

10 Bengston and Merritt have devised a taxonomically-devised list of 27 apparently monogenetic proto-language words that appear across the world’s languages. From their work it is clear that 100 referents would be sufficient for a very rich system.


21 This model was first described by the author in a research proposal which described a test methodology to explore how urgent survival cues might have an impact on the processes of human memory to improve the development of referents. The article did not mention, however, the specific idea that a general shift in species stress levels due to the stronger presence of these same categories of threat might permanently elevate the neural chemistry required to support a stronger memory effect and easier synaptic formation.

13 Rugg et al. have demonstrated experimentally that different levels of brain activity related to exposure of different items correspond to subsequent recollection or non-recollection of those items. However the process of the experiment itself increases the base level of neurological activity as well (p. 220), suggesting that a difference in a basic state the mind’s focus might be an important factor in the frequency or success of individual episodic or long-term memory formation, the basis of referent development. An environment with a higher baseline level of neurological activity specifically induced by stress, has not been studied. However Maunsell and Cook have shown that attention is an important factor in sensory processing, shortens reaction time and confirm the prior studies of Braun et al. (Visual Attention and Cortical Circuits, 2001) that neurons typically respond more strongly when the stimulus that drives them is the focus of attention.

14 In this context something interesting happens to the prospective philosophical conflict between an indicator theory and a teleological approach to the evolution of language argued extensively by Devitt and Sterelny (p. 156): it essential-
ly disappears. Rather than reflecting any operating conflict both actually serve a positive and even essential functional utility in the process. Their own review, in fact, explores this possibility although in terms of species survival and not in the evolutionary development of language itself.

One aspect of this model is the possibility that sensitivity to synaptic formation might be different between human male and female. Their individual roles in language development therefore could conceivably be very different.

Dunbar’s *Grooming, Gossip and the Evolution of Language* is a well-researched and daring speculation. On its own, however, it offers no method of experimental verification.

Arbib’s larger argument is the proposition that the underlying stimulus for referent formation, acquisition and utilization might have been the mirror-neuron systems, per Arbib, found in both monkeys and humans, and identified in the grasping process specifically, where mirror neurological activity to observed acts of grasping (objects) appears at a point in the monkey’s premotor area which is homologous with the Broca’s Area of the human brain. We find nothing objectionable in this speculation, except perhaps that with our own description of a simple stress-based impetus to referent formation, supported in part by studies by Rugg and Maunsell (v. note 12), it is unnecessary. As Arbib himself notes (114), “There is a neurology of writing even though writing itself was invented only a few thousand years ago.” Arbib (118) does, however, offer an excellent description – far more than we can explore here – of the complex communication possible even within the framework of a very simple vocabulary, in which early unitary or one-word utterances might be employed to communicate very complex information, or instructions.

We wish to immediately acknowledge that a very similar recent proposal focusing on the language function at the center of higher human cognitive processes has been offered by Peter Carruthers that antedates our own, and is at variance with our own in only several respects. However these points of difference are central to our own focus, which centered on speech more than language, and are worth noting here. For one thing Carruthers does not acknowledge or perhaps was simply unaware of the earlier theoretical work on the role of emo-
tions in cognition proposed by Damasio; certainly it is not reflected in Carruthers own model structures, would might benefit by a cross-review leading to a theoretical integration. Because our own model is derived from an evolutionary model of speech, it explains the functional necessity of a thought function evolved from speech that includes a factor of evaluation, comparison and analysis; it becomes a structural premise with evident causation rather than a pure hypothesis.

19 That this feature is not clearly established in the framework of linguistic research is inadvertently demonstrated by Steven Pinker in a recent interview with Jerry Mishlove. Pinker notes the amusingly ambiguous newspaper headline about a protest event in the town of Hershey which declared “Hershey Bars Protest.” Comments Pinker, “whoever wrote that headline, it probably didn’t even occur to that person that it had another meaning. He might have reported that he was literally thinking in words, but if he was thinking in words, then both of these meanings should have been apparent, but there’s got to be an idea underlying it that he had in mind, that he probably wasn’t even aware of.” Technically however the reporter was likely thinking in words, but he did not hear them himself through the incoming oral/aural loop which recaptures the spoken word and subjects it to the kind of analysis system which identifies ambiguities and which is emphasized in our own transactional speech model. It may be that that particular function doesn’t serve speech which does not literally return to the ear, but is entirely subvocalized.

20 There are variants to the transactional pattern description which merit further consideration. A question in certain Amerind languages today, as Phillips points out, per Weeks, (p. 67), does not automatically evoke or, at least on a cultural basis, require an automatic response. What automatic subvocalized response might occur has yet to be determined.

21 It might be argued that small secondary confirmation of this thesis is provided by Edward Mueller as noted by Weeks (p. 53). Mueller observing children between 3:6 to 5:6 in situations of spontaneous verbal interaction noted that they had the best chance of generating a response when uttering either a command or a question. Obviously while the response to a command might take
the form of an action the response to a question would invariably be an oral
utterance extending a transactional exchange.

22 Carter, for example, points to the case of a woman who had suffered damage,
not to the angular gyrus itself, but in an area around it (p. 153). The woman
could understand spoken words and write normally. But when she tried to read
back silently what she had just written she could not understand it. Upon read-
ing the words aloud, however, which she could do as easily as she had written
them in the first place, she could then understand their meaning. What might
be missing from her cognitive arsenal? One answer is the hypothesized subvocal-
ization path from Broca’s area or the motor cortex back to Wernicke’s area for
the equivalent of fully-vocalized input and interpretation. This explanation,
however, is our own and is not considered by Carter.

23 The concept of thinking as “speech without sounds” is not new, of course, and
seems almost too obvious. The idea became a pillar of Soviet behavioristic psy-
chology and social philosophy in the 1920s. In that environment of intellectual
dogmatism Vygotsky was constrained to express his own ideas in behavioristic
terminology, despite the contradictions (Collected Works, p. 384). But perhaps
here at least the Soviets got something right: rejection of this concept outside of
the Soviet sphere may have been premature since it has no inherent link to the
limits of behaviorism, and appears now to be quite plausible considering the
neurological structures of the mind as we can begin to identify them with the
aid of new technologies. Piaget concludes in fact, per Weeks (p. 67), that the
child up to an age as yet undetermined, but probably somewhere about 7, is
“incapable of keeping to himself the thoughts which enter his mind.” Piaget
says thoughts, but what he observes is the inability in the immature child to
think without speech or vocalization, which of course indicates yet again that
speech is the genesis of thought rather than vice versa.

24 Alberto Manguel, reviewing the history of silent reading, notes that it was still a
very new phenomenon when reported by St. Augustine as he observed St.
Ambrose:

"When he read," said Augustine, "his eyes scanned the page and his heart
sought out the meaning, but his voice was silent and his tongue was still."
Anyone could approach him freely and guests were not commonly announced, so that often, when we came to visit him, we found him reading like this in silence, for he never read aloud."

The silent reading of Ambrose is the first definite instance of the phenomenon recorded in Western literature. Other early records, however, documented by Manguel indicate that silent reading probably occurred – still as an exceptional phenomenon – in the Greek world as early as the 5th century B.C. Acoustical reading in the time of Augustine and Ambrose (386 AD) was still the norm.

The optimum and limiting size, rather than a family group, would more likely be a hunting group, perhaps somewhat larger than an individual family. Chimpanzees, as a point of reference, typically move in what might be relatively larger population clusters of about 40 to 60 animals.


Chomsky’s most careful description of the analytical process leading to the UG concept comes very close to identifying the nature of language as a two-tier cognitive system (*Reflections*, p. 12-13), but he is locked into a language-is-an-abstraction perspective which has no reason to investigate a cross-domain biological process. In describing the function of the grammar, however, he does point to their outcome as sentences, and observes that “These sentences, each with its particular structure, constitute the language generated by the grammar.” In noting that “language” is only realized at the level of sentences, he does not however identify a biological system of hierarchy but only states what Harold Coward (p. 66) identifies, in reviewing language seen through the different historical framework of Indian culture, as the *sphota* theory, which asks the question, “what constitutes the meaning-unit of language” and comes up with the same answer: the sentence. Chomsky, later in the same work (*Reflections*, p. 33), is able to demonstrate, on the basis of the logical scientific consideration that sentences are structure-dependent, that “UG contains the principle that all such rules must be structure-dependent. That is, the child’s mind (specifically, its component LT(H,L)) contains the instruction: Construct a structure-dependent
rule, ignoring all structure-independent rules. The principle of structure-dependence is not learned, but forms part of the conditions for language learning.” But what he avoids with this premature conclusion is the search for a cognitive structural system which would permit a child to learn grammar as easily as its specific lexical contents. Chomsky’s analysis does direct him to the conclusion that “a grammar is not a structure of higher-order concepts and principles constructed from simpler elements by ‘abstraction’ or ‘generalization’ or ‘induction’.” It is not, in other words, a “build-up” process occurring as a result of higher orders of abstraction within referents themselves. And Chomsky further posits that “In principle, we should be able to account for it [UG] in terms of human biology,” (p. 34) which of course is our endeavor here.

An empiricist description that predicts the possibility of a “learned” grammar even a two-tier cognitive language structure goes back to the observations of Vygotsky who, per Wood (p. 95), concluded that “children acquire meaning by chaining situations with words,” a process that clearly must include objects and their perceived relationships, perhaps through cognitive functions in the visual domain, with other objects, with close appositive qualities and characteristics, with location and with actions.


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Henry Schwarz
1 (562) 438-7400
zrawhcs@post.harvard.edu
henry@hallerschwarz.com