Peirce's Universal Grammar:

Some Implications for Modern Linguistics

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1. Introduction

This chapter discusses ideas of Peirce's philosophy, especially his semeiotics, that bear on the development and assessment of the methods, results, and objectives of modern linguistics, especially in regard to the theme of Universal Grammar (UG). Because a single chapter must restrict its scope, I will keep to those topics which seem to me to distinguish Peirce's views, and those of any future Peircean linguistics, from current theories of language.[1] As a further narrowing of the latter subtopic, I intend to focus my discussion of UG on the ideas of Peirce and Noam Chomsky (see Chomsky (2007) for his perspective).[2]

Peirce's ideas have frequently been borrowed piecemeal in linguistics and anthropology. One theory builds around his iconicity (Perniss, Thompson, and Vigliocco (2010)), another around indexes (Silverstein 2003), and yet another on his algebraic logic (Font and Jansana (1996)). But this type of "inspiration by Peirce" as opposed to "engaging with Peircean theory" as a whole can create empirical, and conceptual problems. Thus one of the goals here is to offer a brief discussion of some of the ways that overlooking Peirce has deprived modern linguistics and philosophy of a number of insights that seem beneficial empirically and theoretically to the

objectives of that discipline, regardless of one's particular theoretical orientation, though the focus here is on formal linguistics (Tomalin (2006); cf. Everett (in progress) for a more detailed discussion of these and many other issues).

Even those superficially acquainted with C.S. Peirce's work will know that he was a brilliant polymath (Everett 2019). But many might be surprised to know that, according to Nöth (2000),

> *"Although Peirce had 'no pretension to being a linguist' (CP 2.328), the Annotated Catalog of his publications and manuscripts lists no less than 127 papers classified as 'linguistic' and contains references to many other manuscripts dealing with language ... [in Robin, 1967, p133-142] ..."* [3]

The issues distinguishing Peirce's views from much of modern formal linguistics can be seen in a series of theoretical contrasts of the latter relative to Peirce's quite different approach. Thus modern linguistics (i) takes form as the principal explanandum for linguistics, whereas Peirce takes interpretation of signs as the core of of the discipline; (ii) Some modern linguists assert that recursion in sentences is the core pre-condition for human language, whereas Peirce sees semeiotic recursion as the sine qua non of language; (iii) modern formal linguistics commonly takes unconnected sentences, rather than discourse, as its principal empirical responsibility, whereas semeiotics sees discourse as "the perfect symbol", i.e. a principal object of investigation; (iv) modern linguistics recognizes three three components as essential to its investigation - intuitions, introspection, and compositionality, whereas these are for Peirce but manifestations of inference; (v) modern linguistics misinterprets much previous use of the word "instinct" in earlier literature as a genetic endowment rather than as a set of phenomena (genetic-based, cultural, idiosyncratic apperceptional experience), each with a variety of distinct

2

implications for our understanding of the sources of human language. Thus modern linguistics has come too often to embrace an impoverished concept of "instinct."

But perhaps the most significant contrast between modern, especially Chomskyan, linguistics and Peircean semeiotics and pragmatism is the concept of Universal Grammar.

2. Peirce on Universal grammar

2.1. Terminology and Classification

Peirce first used the term Universal Grammar in 1865 - the first usage of this term by anyone in the USA so far as I can tell. He did not invent the term of course. This dates back to the thirteenth century Modistae (Covington 1983; Rosier 1983). But his was the first in the USA. Peirce being Peirce, the term did not satisfy him for long, however, and so he experimented with other terms, e.g. "pure grammar," and "formal grammar," finally settling on "speculative grammar" (CP 1.191, 559 and many other references in the Collected Papers, as well as Bellucci (2018)). This grammar was one of three branches of the study of Logic/Semeiotics, the other two being Logic proper (Critic) and Universal Rhetoric.

In his classification of the sciences (CP 5.203-283), Peirce separated universal grammar from linguistics. Thus, whereas Universal Grammar falls under Peirce's Logic (Peirce 1903), linguistics as the study of individual human languages falls farther down in his list, in the classification of Idioscopic sciences (those dedicated to making new observations). There linguistics is listed as a subtype of Classificatory Ethnology/Psychics (a classification that later linguistic anthropologists such as Franz Boas (2002) and Edward Sapir (1921) would have found congenial. As Nöth (2000) points out, Peirce wrote on both UG and individual languages.

For Noam Chomsky, on the other hand, Universal Grammar refers to the *biological* capacity that underlies its direct offshoot, Linguistics. In this scheme, linguistics is part of biology, along with psychology. Neither linguistics nor psychology has any significant connection to anthropology, the study of humans as constructors and occupants of culture. This cleavage in the sciences of humans is part of the revolution that Chomsky instituted. This separation distinguishes Chomsky's views from those of earlier figures in linguistics history such as Sapir, Boas, and Saussure (and also Peirce). By classifying linguistics as a branch of biology, Chomsky removes any possibility that logic or culture exercises major ontogenetic effects on (the "core grammar" of) a language. (Chomsky 1986)[4] And yet there is something to Chomsky's conception that, superficially at least, is reminiscent of Peirce's. According to Lasnik, Uriagereka, and Boeckx (2005) Chomsky's theory also distinguishes between the study of UG (the "language faculty") and that of individual languages.

This division echoes Peirce's similar distinction between his logical UG and individual languages. Chomsky's latest research program, Minimalism, continues the decades-old program of building a theory of how propositions become linguistic objects. Peirce's theory was also concerned with this (in his theory the subject was an index and the predicate an icon, the entire proposition being a symbol), though Peirce saw propositions as constituents of arguments and discourses. With this conceptualization of the role of UG in the study of human language, Chomsky, in a sense, then is continuing Peirce's division of UG from linguistics proper, whether consciously or not is not clear, though see 4.3.1. below..

To restate this slightly, in Chomskyan theory, arguably the most widely-known theory of Universal Grammar, all of linguistics emerges from UG, which is the "biological capacity for language." Likewise for Peirce, linguistic objects emerge from UG, though without biology.

Once the logic of signs and their arrangements are worked out, all the rest is culturally and historically constrained.

Peirce's splitting of the responsibility between Language (UG) and languages (linguistics) logically rather than biologically has a variety of healthy empirical implications, e.g. the evolution of human language from other animal forms of communication (Everett 2017 and 5.11. below). One implication of Peirce's theory that arguably broadens its interest is that *all plant* (Simard 2021, inter alia) *and animal communication* (Bradbury and Vehrencamp 2011) *must follow UG* in Peirce's sense. [5]

2.2. Animals and Universal Grammar - Two Approaches

2.2.1. Symbols vs. Indexes and Icons in Communication

Pursuing this implication of Peirce's UG in more detail, animals, like all entities (even minerals), communicate via signs. The crucial Peircean difference between animal communication and human communication according to Everett (2017) is that non-human animals do not create symbols, or at least they do not create open-ended classes of symbols. I have argued (Everett 2017) that animals tend to use icons and indexes primarily, though much more research is needed to establish such a claim. And their icons and indexes are constrained, just and human signs are. For example, an earthworm will emerge from the ground if the water index passes a certain threshhold, presumably to migrate across a slicker surface. In this sense, the moisture in the ground corresponds to the moisture on the surface and is thus an icon of the surface moisture. The earthworm's iconic interpretation is governed by Peirce's UG. Dogs use indexes to find game and they recognize icons when they bark at two-dimensional, odorless dogs on the television. Ants uses indexes and icons regularly. Etc.

It is often overlooked that for Peirce a symbol "... is a general sign, *i. e.*, *a sign that represents a general object*." (Bellucci 2021, 169) This means that if we want to attribute symbol creation or recognition to animals, the object of each of their symbols must be shown to be a general concept, a type. But how can this be determined?

We can address this question following a methodology based on upon Pikean theory, drawing upon the important *etic* vs. *emic* dichotomy. When we observe a behavior outside our own language or culture (e.g. in non-human communication), linguistic or otherwise, we observe it pre-analytically from an "etic" perspective (Pike 1967).

If we think we are viewing a symbol, i.e. a sign with a general object (at least according to Bellucci), then we must test our thinking by analysis. Our "etic" view, once analyzed, transforms from an outsider's preanalytic perspective into an insider's postanalytic perspective, or an "emic" perspective (these Pikean terms are drawn from "phonetic" and "phonemic," respectively).[6] Only by achieving this insider, post-analytic perspective, in conjunction with Peirce's semeiotics, are we able to determine whether non-humans use symbols. And this analysis relies on Peirce's predictions regarding the signs available.

If my understanding is correct, nonhumans of any species, plant or animal, are unlikely to possess symbols to the degree that they lack culture and the ability to generalise that undergird all cultures, though their communication will nevertheless entail signs and be guided by Peirce's version of UG.

This leads to the distinction between communication and grammar proposed in Everett (2017):

Communication = transfer of information by signs.

Language = transfer of information by signs, including symbols.

Thus language is a subset of communication. Human languages use icons and indexes, of course, but they uniquely use symbols as a productive, open-ended class. Thus, with no regard to grammar, it is predicted that only humans will have language.

But again we must be careful that our analysis of non-human animal communication is based on a clear semeiotic understanding of the extent of signs they use. A recent paper on symbol-recognition in bees illustrates the need for a better understanding of Peirce's semeiotics in science more generally. The article in question claims that bees can be taught symbols (Howard, et. al. 2019, 1):[7]

But the paper (as pointed out in Everett 2019) appears to confuse what are symbols for humans with what are almost certainly indexes (or indexical legisigns) for bees[8]. The paper shows that bees can match particular numerical symbols and correctly associate these human symbols with the correct quantities. However, although they can go from sign to numerosity, they cannot go from numerosity to signs (according to the authors). But this limitation follows from the fact that they index points to a quantity in some way, but the quantities are not indexical or iconic themselves. And they are not, for the bees, generalizations (symbolic objects). The index points to a quantity, but not vice-versa. A footprint points to the maker of the footprint, but the maker of the footprint does not indicate a footprint. For example, if bees learned that the symbol '7' means *seven objects* (of any kind), then they would have learned a symbol. However, while the researchers have clearly trained bees that x–>y; y–>x – ie, if you see an *x* expect a *y* – they don't seem to have taught the bees anything other than indexes, which we already know that all animals recognize (as they use smells, footprints, broken branches, etc., to track other animals).

In other words, even if *x* and *y* are symbols to humans, they need not be for bees. There is no compelling reason to believe that members of Apoidea have learned anything other than an index for an object, as with Pavlov's dogs. Bees can learn that the appearance of one sign *indicates* the presence of a particular kind of object (whether that object is another sign or simply a natural object): i.e., that the first sign is an index (not a symbol) of the latter. Symbols require culture but indexes do not.

Such (in my analysis) inaccurate understanding of symbols is also seen occasionally in computer science and elsewhere in the cognitive sciences (Everett (in progress)). This seems to underlie the difficulty pointed out by philosopher John Searle (1980) in his "Chinese room" thought-experiment about the Turing Test. In this work he argued computers cannot understand symbols semantically when they perform automatic machine translation (thus even if their behavior would otherwise pass the Turing Test, this is of little significance, according to Searle). In semeiotic terms we can restate Searle's results more economically by seeing computers as able to interpret indexes, though perhaps not symbols in the particular translation case that concerned Searle (I am not making a a global claim about AI).

Searle's experiment, simply put, states that we can express what the computer is doing translation by imagining a human as the CPU. As Chinese comes in, the human CPU takes Chinese symbols and outputs, correctly and quickly, English symbols. The question that arises is "Does the human/CPU understand Chinese?" And the answer, for Searle, is a resoundingly obvious "No." Though Searle did not use these terms, we can reinterpret Searle's "Chinese Room" gedanken experiment semeiotically. Thus the computer translator's input, say a squiggly line (unbeknownst to him/her/they a Chinese character), serves as an index of another squiggle (English) which functions as the output. If this is characterization is correct, then the computer is

not using symbolic meaning but only indexical reference, being programmed to treat one squiggly line as an index of another, like the bees in the experiment discussed earlier. So far as we know, only humans use the former (Everett 2017) , but all animals use non-symbolic signs. The computer is not interpreting signs as having general objects, but only linking one sign to another, i.e. using one sign as an index of another. Thus semeiotically, Searle's results and subsequent discussion make sense. Anyone arguing against Searle's conclusions needs to discuss the significance of the semeiotic interpretation of this experiment.

To take another example, if one could train their dog to fetch seven things when she sees the numeral '7', it would be scientifically interesting if she could distinguish seven things *as* "seven things," but since there is no dog culture, there is no presymbolic 'agreement' between dogs that the sign '7' means seven *things*, which in this sense is an abstraction (see also Everett 2005 for a quite different explanation of why the Pirahã people lack numbers in their Nominalistic culture (Everett (in progress)). The behaviour simply shows a response to the stimulus of an index to a particular referent. It is learning, of course, but with no need to invoke symbols. On the other hand, even if my dog is understanding a symbol when I ask her to get a specific toy (which I doubt), she is not creating symbols (if we restrict these to general objects). But notice that in the case of non-human animals and computers, semeiotics and therefore UG are crucial to any explanation of what they are doing in communication tasks.[9]

2.2.2. Creating Symbols

Let's explore these ideas a bit further. I think it is reasonable to investigate the hypothesis that some animals might be able to learn or create symbols. It is even possible that insects, e.g. ants and bees, can learn or create symbols. But so far the creation of open-ended symbol systems

has not been shown for any creatures other than humans. To put it another way, Pavlov's dog did not interpret the bell as a symbol of food, but as an index of food. When you see one, you anticipate the other. Pavlov's trick was to eventually take away the referent of the index from the immediate environment, while producing the same interpretant (salivation), much as Lucy does to Charlie Brown regularly in the Peanuts comic strip by Charles Shulz, when she urges him to kick the ball and then removes the ball just as he goes to kick it. She has removed the object leaving only the form, her kneeling, and the interpretant, Charlie's kicking. But symbols are more abstract. They do not require an immediate connection between an object and a form for effective use and their objects are general. Only Peirce's semeiotics captures this distinction. And so it is the most appropriate set of principles for testing claims about animal communication.

Icons and indexes, like symbols (and Peirce's 63 other types of signs) fall under UG in Peirce's theory. Once again, it is significant that Peirce's UG accounts for all signs, the full range of signs (including animal legisigns where these are found) used by both non-human animals and humans.[10] The biological UG of Chomsky does not. This would of course not bother Chomsky, since he believes that there is little or nothing in common between animal and human communication. In his theory, human linguistic communication is based on a recursive grammar while animals lack recursive communication (though this is only a claim, to be tested empirically).[11] Thus there is nothing to compare. He has said (paraphrasing from public lectures) that claiming that animals have language "is like comparing bird flight with a man flapping his arms."

Of course, animals have no biological UG (according to Samuels, Hauser, and Boeckx (2017), who address animal communication relative to Chomsky's version of UG.

But these authors' objections fail because they focus on a biological language faculty, based on grammar, rather than a logical set of constraints on signs. And this choice impedes our understanding of language evolution (as both Deacon (1997) and Everett (2017) make clear), making it appear to some that language came out of nowhere phylogenetically, whereas the Peircean semeiotic UG renders the evolutionary progression much clearer.

3. Peirce's Syntactic Depth of Analysis

3.1 Surfacey

From one perspective, Peirce's view of linguistics seems to be what modern linguists might refer to as "surfacey." Peirce tended to look at what speakers actually said, not what they might be implying covertly. For example, in a sentence like *John came in and sat down*, many linguists would propose that "sat down" has its own subject, but that the subject is covert, i.e. it is syntactically and semantically present but phonologically absent. Peirce's view was different. In CP 3.459, Peirce says that while we expect proper nouns and pronouns in all languages, the function of common nouns is less central.

So for a sentence like "John promised to go," a Peircean analysis would propose an underlying logical constraint on predicates that interprets the positions generated by their valency, but would not posit an invisible or "covert" syntactic subject[12]. The subject is inferred in the interpretant of the construction as a whole, from verb forms and context. It need not be present in the phrase (neither syntactically nor phonologically present) in any form in order to be lexically inferred.

As an "inflection of a verb" a syntactically separate common noun (Peirce here seems to almost paraphrase the hypothesis that nearly a century later would come to be known as the

"predicate argument hypothesis," the idea that the functions of noun can be manifested as verb affixes and need not actually manifest as independent words) is not necessary to grammar. For Peirce this would explain his observation that common nouns are rarer than pronouns (which have indexical meanings) in sentences cross-linguistically. That is, he these saw independent words as themselves inflections of verbs, reminscent of the theory of "pronominal arguments" proposed by Jelinek (1994), inter alia. (Nöth 2000).

3.2. Deeper - Hypostatic Abstraction and Transformations

On the other hand, Peirce's understanding of language was not based on surface forms alone. For example, in his concept of hypostatic abstraction there is evidence that Peirce's view of UG entailed a concept similar to what modern linguists, following Chomsky, once labelled "deep" vs. "surface" structures. Hypostatic abstraction is a formal operation that takes as input some predicate and outputs a relation. An example often given of this is the transformation of "Honey *is* sweet" into "Honey *has* sweetness." The original assertion of fact about a topic is turned into a property about that topic. This transformation is not merely (as in Harris's 1951 concept of transformation) a relationship between synonymous phrases with distinct discourse functions[13]. Nor is it claiming that one of these sentences is the syntactic base for the other (as in Chomsky's original theory where passive constructions are "transforms" of active constructions, e.g. *John saw Mary* (active) --> *Mary was seen by John* (passive)). Rather Peirce is claiming that semantically/semeiotically one implies the other. He does, however, leave open the possibility of a deeper analysis not unlike that of early Transformational Generative Grammar (Chomsky 1957; 1965), when he claims that "Thus, we transform the proposition, "honey is sweet," into "honey possesses sweetness." CP 4.235 But here the "transformation" is a logical one, not a

syntactic derivation. For an enlightening discussion of the concept of "transformation" in the sciences, see Stjernfelt (2011).

Peirce claims that hypostatic abstraction is not only crucial to understanding propositions and signs, but that it is vital for rational thought: "Intuition is the regarding of the abstract in a concrete form, by the realistic hypostatization of relations; that is the one sole method of valuable thought." CP 1.383[14]

The general properties of semeiotic relationships thus constrain natural language forms in order to allow for the proper evaluation or selection of interpretants as well as to provide for an understanding of and restrictions upon reasoning, characterized by Peirce as a semeiotic process. These general semeiotic constraints, UG, are thus, as mentioned earlier, a separate domain of study for Peirce from the study of actual natural languages.

3.3. Language of Thought

Another point of similarity between Peirce and modern linguistics and philosophy of language is that, like philosopher Jerry Fodor (1980), Peirce's theory requires that there be a "language of thought." At the same time, unlike Fodor and others, Peirce's language of thought is more nuanced, and he argues that the language of thought should not rely exclusively on symbolic thought, because this can lead individuals astray in their reasoning. We must also think iconically and indexically (as animals appear to do, see below). Peirce makes it clear that thinking only symbolically is a disadvantage.

The problem can be corrected by supplementing symbolic reasoning with iconic thought/reasoning.

This is not only an important distinction for philosophers. Some artists have independently arrived at this conclusion. For example, Joan Didion (2021, 50ff) recognizes this issue of thinking in images and symbols:

"The picture dictates the arrangement... The picture tells you how to arrange the words and the arrangement of the words tells you, or tells me, what's going on in the picture."

Not only was Fodor (1980) not the first to propose a language of thought, but Peirce's much earlier language of thought is more detailed, more sophisticated, and more closely predicted by theory than any other version on offer, because it is not grammar or symbol-based.

Now let us turn to what I see as an ironic echo of Peirce's triadic semantics in the architecture of modern syntactic theories.

4. Semeiotic Residue in the Architectonics of Modern Linguistics

4.1. The Overall Design of Modern Theories is Semeiotic

For example, Chomsky's tripartite division of the theory of grammar into Logical Form (interpretant), Phonological Form (representamen), and syntax (object) is a triadic semeiotic (Peircean) conception of grammar. Take a sentence like *John ordered Bill to come in the room.* Minimalism proposes that the atomic objects of this sentence (roughly the word tokens) are selected from the dictionary and then formed into syntactic objects by a recursive process of pairing units from the "bottom up." Thus we take "room" and pair it with "the" and take the result "the room" and pair it with "in" to derive "in the room," and so on until we finally pair the penultimate structure, the predicate, with "John," the subject, to form the sentence. This pairwise, recursive operation, which Chomsky calls Merge, is the "basic operation" for the formation of linguistic signs.

The phonological form of a sentence on the other hand is the analysis of the spoken, signed, etc. physical form of a sentence, its representamen (which must also include accompanying hand gestures, intonation, and so on or the absence of speech sounds in sign languages, though these are ignored in Chomsky's "syntactocentric" theory (see Culicover and Jackendoff (2005)) for further exploration of syntactocentrism.

Chomskyan theories of linguistics thus all share the ternarity one would expect of semeiotic systems, though not all theories recognize this ternarity explicitly. To see what is meant by ternarity in more detail, consider diagrams of the basic theories of Tagmemics of Kenneth L. Pike and Minimalism of Chomsky. Chomsky's theory is represented as:

Diagram One: Ternary Organization of Chomskyan Theory

Syntax

Logical Form   Phonological Form
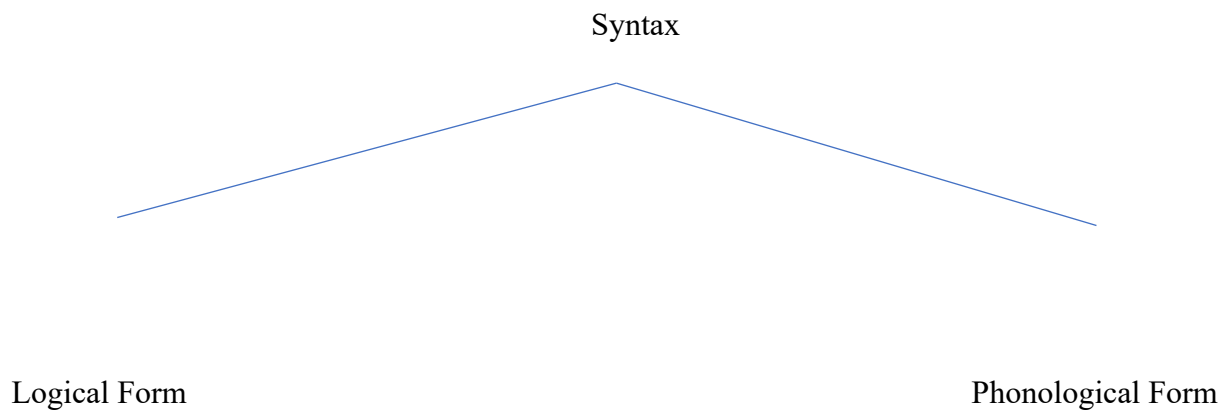
Logical Form in Diagram One produces the semantic interpretant. Phonological Form is the physical interpretant of the syntax, i.e. the representamen of the sentence. The syntax is the linguistic object to be interpreted in the linguistic semiosis (real world objects are brought in/linked through the Logical Form).

Tagmemics (Pike 1967; Pike and Pike 1976) is simlar - three hierarchies are linked, with the phonological corresponding to representamens, the grammatical corresponding to objects, and the referential corresponding to overall meaning.

Diagram Two: Ternary Organization of Pikean Theory

Phonological Hierarcy	<-->	Grammatical Hierarchy	<-->	Referential Hierarchy[15]
Ph. Discourse		Discourse		Highest meaning unit
Ph. Paragraph		Paragraph		
Breath Group/Contour		Sentence		
Ph. Phrase		Phrase		
Phonological Word		Word		
Phoneme		Morpheme		Lowest meaning unit

The ternarity in these models therefore, however inadvertently, recognizes that language is a semeiotic system, with a Peircean structure. Phonology is about the construction of Representamens; Logical Form/Referential Hierarchy is about Interpretants; Grammar/Syntax is about the production of propositions and linguistic objects (unfortunately omitting

arguments/discourses in Peirce's theory). The extra step in linguistics is that the syntactic interpretations of "objects" of linguistic structures do not merely link them to extra-linguistic objects but also to linguistic objects. In *John saw Mary* we interpret 'John' as a referring to a person in Logical Form, but in the syntax as a subject, an agent, a topic, etc. In the phonology we interpret "John" as a unit composed of prosody (stress, intonation, length) and segments (ʤ, o, n), the representamen of the sign in Logical Form of a person named "John."

4.2. Peirce as Theoretician

As part of our investigation of the significance of Peirce's for modern linguistics, it is important to note that overlooking Peirce or any other researcher does not diminish their contributions.

Peirce invented Pragmatism. He invented first and second-order logic with quantifiers (independently of Frege, with a much easier to use notation). He invented Existential Graphs (which are isomorphic to the Discourse Representation Theory (Kamp and Reyle 1993), which not only are a formal theory of discourse but also serve as a logical proof procedures.[16]

One of the most puzzling facts of modern linguistics is the near-absence of any overt role for Peircean ideas. Major current theories such as Chomsky's Minimalism (Chomsky 1995), Van Valin's Role and Reference Grammar (RRG; Van Valin and LaPolla (1997)), and the various versions of the popular theory of Construction Grammar (CG, especially in the work of Princeton linguist Adele Goldberg (1995)), as well as Hans Kamp's Discourse Representation Theory (Kamp and Reyle 1993) make no detailed references to Peirce. This is ironic because (i) Chomsky claims Peirce as a very influential source, (ii) DRT is nearly identical to Peirce's Existential Graphs (Sowa (2013)); (iii) RRG contains linking rules and constructions that are

reminiscent of Peirce's UG; (iv) CG takes linguistics utterances to be "signs" (primarily in the Saussurean sense, but Peirce's ideas are clearly related) and could thus benefit from the more formal and much more mature theory of signs in Peircean semeiotics.

Ultimately, evaluating modern linguistics against Peircean theory, the proof must be in the pudding. Comparisons between modern theories and Peirce therefore can be instructive. To take Chomsky's theory, for example, it arguably has few, if any, non-theory-internal discoveries, and even those are based on the passé idea that grammar is the center of language and that it stops/replicates once it reaches the sentence, with little concern for the causal role of meaning and culture, and paying little attention to the growing neurolinguistic evidence in favor of storage of symbols rather than grammar in the brain (Fedorenko and Schill (2013); Fedorenko et. al. (2020) Ivanova et. al. (2021)). Can such a theory survive and thrive empirically (theories long outlast their empirical utility due to professional pressures) over newer theories without such limitations? Time will tell.[17] [18]

4.3. Misinterpretation of Peirce in Modern Linguistics

4.3.1. Chomsky on Peirce

Ironically, Chomsky does cite Peirce, especially with regard to the concept of abduction, also referring to Peirce as the philosopher to whom he felt the greatest affinity. So he says in his interviews with Mitsou Ronat (1976, 71) that "In relation to the questions we have just been discussing [philosophy of language, DLE], the philosopher to whom I feel closest and whom I'm almost paraphrasing is Charles Sanders Peirce." And yet in all of his work on Peirce, including the interview with Ronat, Chomsky mistakes Peirce's ideas as rationalist and nativist, when they are realist and empiricist (with allowance, to be sure, for some nativist dispositions). This is

unfortunate and seems to result from a typical anachronistic view of the use of "instinct" and "innate" as used in philosophical literature prior to the emergence of the cognitive sciences.

Chomsky's interpretation misses/misunderstands key points of Peirce's concepts of abduction and instinct. Chomsky refers in places to Peirce's "one essay" on abduction, claiming that Peirce never pursued this further. But this is profoundly incorrect (Everett in progress). Of course, Peirce's papers are in much better shape now (largely due to Harvard's Houghton Library and the Peirce Edition Project of IUPUI) than they were in the 50s, but the Collected Papers were already available at that time (they were published in 1932 - thanks to Hartshorne and Weiss), and they include many, many references to abduction.

When Chomsky claims (ibid) that Peirce asserted that "... you can't get anywhere by association, you can't get anywhere by induction..." he is being very misleading, because for Peirce inference was key to human cognitive advancement and abduction is but one of three components of/types of inference, the others being induction and deduction. The guesses of abduction needed to be tested by induction and deduction to have value. In this sense Chomsky's remarks miss the point almost entirely, because although he mentions these in the quote above, the vital significance of inference as a ternary operation is overlooked. For Peirce abduction is always a first step of ampliative inference, to be tested via iconic reasoning, induction, deduction, scientific method, etc. As for Peirce's concept of instinct, we return to this in section 5 below.

4.3.2. Jakobson on Peirce

Roman Jakobson was one of the most important linguists of the past century. Some of his most significant work occurred during his time in Prague in the late 1920s with the Prague

Linguistics Circle and at Harvard, where his students included the late Morris Halle, who eventually would "discover" Noam Chomsky and recommend him for employment at MIT, where Halle was already established in a project directed by Victor Yngve (Yngve, p.c.). In Prague Jakobson and Prince Nikolai Trubetskoy, among others, developed the concept of "oppositions" in phonological theory that led to the theory of "distinctive features." Although I have not been able to find any direct link between the work of the Prague Circle and Peirce, their influential ideas on binary oppositions were quite similar to Peirce's perspective on "secondness."

More direct influence might one day be found between Peirce and these early phonological theorists. But in the absence of evidence of direct influence of Peirce on the Prague Circle, we can point to one prominent member of that circle taking inspiration from Peirce, Roman Jakobson. In Jakobson (1977), an attempt was made to introduce Peirce's "pathfinding" work to linguists, though arguably it failed. This is, in my view, because Jakobson, while claiming that Peirce's work was important, failed to consult the greater body of Peirce's work and so missed crucial points. (see Shapiro (1983)). Peirce has little overtly acknowledged influence in linguistics. In general Jakobson seems to have not understood Peirce's theory of signs well. On the other hand, it is likely that Chomsky heard of Peirce in part through Jakobson, since Jakobson exercised considerable influence over Chomsky directly and indirectly, through Halle.

5. Peirce and Current Linguistic Research Issues

5.1. Methodology: Intuition, Introspection, and Inference

5.1.1. Intuition

Peirce (1868), argues at length that there is no such thing as intuition, a central component of cognitive research from Descartes to the present, and vital to many linguists (e.g. Chomsky). Defining intuition as a "cognition unlinked to a previous cognition," Peirce concludes that no such cognitions exist and that all cognition is part of a chain of inference with other cognitions.[19] He claims that the only evidence for intuition is that we think we have it (CP 5.218).

In spite of potential problems, intuitions nevertheless play a significant role in modern linguistic theory and are crucial to determining the grammaticality of utterances and thus in turn also crucial not only to the goals of linguistic theory but its methdlogy as well.[20] But intuition also figures into the very goals of linguistic theory. One leading psycholinguist puts it this way:

"The goal of syntactic theory is to account for linguistic intuitions," (Slobin 1974; see also Chomsky 1986; 2006; 1980, 9; Larson and Segal (1995, 10ff); Fodor (1981, 200ff).

But there are some who express reservations. For example, that "intuitions" might be forms of inference or at least not a direct connection to an internal grammar:

"... it is an empirical hypothesis that the grammarian's formal explanation has an empirical realization in speakers." (Levin 1983, p182)

These quotes illlustrate an immense divide among those who study natural languages regarding the object of inquiry. Is linguistics about epistemology or is it about language? Some theories (e.g. Pullum (2020)) offer analyses of the data and try to understand the empirical implications of those data in relation to linguistic behavior, avoiding all talk of introspection or intuition.

But perhaps the most articulate critic of intuitions in linguistic theory apart from Peirce, is Michael Devitt (2006b, 481), who argues that intuitions are not specific to language, to the degree that they exist.

Devitt argues that intuitions could only serve as evidence for grammatical rules if they "really were the voice of competence." "These linguists" (Chomskyans), Devitt claims, are "committed to the Cartesian view that intuitions are the voice of competence... [that these speakers] simply by virtue of being competent, have information about linguistic facts..." Devitt rejects these ideas.

Peirce offered the best criticism of this type of research program, thus any theory that relies on grammatical "intuitions" or "intuitive judgements." The problem with such theories from a Peircean perspective is that whenever a speaker offers a judgement, they are *inferring* the grammaticality of a given example based on their experience (unconsciously or consciously). The issue is that if, as Peirce would have it in "Questions Concerning Certain Capacities Claimed for Man," (CP5.213-263) an intuition is a "premiss which is not itself a conclusion," then we simply cannot be sure that no premiss in a judgement/conclusion has not been previously a conclusion. That is, we have no special power to ensure that our judgements are "cognitions not determined by a previous cognition." Intuitions can thus never be proven to be intuitions in the sense of a special cognition, as opposed to inference.

All of our judgements and theories emerge from networks of knowledge and arguments and propositions and these are too complicated to sort through for any judgement of a single utterance of a given language to determine whether our acceptance of that utterance as grammatical is a direct deliverance of our grammatical competence (as Chomsky would have it) or inferring from our CPU, as Devitt argues. Given the fact that speakers' grammaticality

judgements change in different circumstances, it seems most likely that Peirce's arguments against intuitions as special forms of cognitive evaluation are correct. Certainly no one has explained what intuitions are in any deep sense, other than to claim them as the source of native speaker judgements (see the papers in Schindler, Drozdzowicz, and Brocker (2020) for more details.

What Peirce contributes in this regard to linguistic theory are strong arguments that intuitions are inference and reflect no special power or immediate connection to the "voice of competence."[21] And this holds true not only for intuitions, but also for compositionality and introspection, and other questionable tools in the arsenal of modern linguistics.

One lesson to draw from this is that if intuitions, compositionality, and introspection are not privileged linguistic tools directly tied to our competence, then we can interpret these in more general inferential terms when talking about language (and other human behaviors). In other words, quantitative data and corpora are crucial to linguistic theory. Although the standard data of "intuitions" and "introspection" can be of value, we can only evaluate these inferentially and never take them as offering a "voice of competence." This is what many cognitive scientists have been arguing for for some years now (see especially Gibson and Fedorenko (2013)).

5.1.2. Introspection

Another crucial cognitive tool for modern linguistics that Peirce calls into question is the concept of introspection. Introspection about grammaticality judgements as windows into native speaker competence go hand-in-hand with intuitions in Chomskyan (and many other theories). Schwitzgebel (2010)·is a useful discussion of this concept as it is generally accepted.

However, the problem for introspection is the same as for intuition. If we think of these as just labels for types of inference, then there is no Peircean objection. We draw information in some way about our inner life and test our judgements about this following standard forms of induction, deduction, and abduction. But if we think of introspection as a special mental ability or special access to truth, knowledge, or inner states, and not a form of inference using data and standard scientific and logical argumentation, we delude ourselves. Once again, Peirce emphasizes that all knowledge is acquired by inferential reasoning, not by special powers (into which forms of spiritual revelation would also fall).

Since we have no way to understand the world within and around us other than by inference, it is crucial that modern linguistics develop more scientific methods for evaluating theories other than intuition and introspection. The widespread reliance on intuitions and, by extension, introspection in linguistic theory is representative of the unscientific foundations of much of modern linguistics.

I now want to turn to consider another special form of inference, one that is considered a vital and special part of linguistic theory, yet distinct from inference in most work, namely compositionality.

5.2. Compositionality

There are various related concepts of compositionality in linguistics and philosophy. It is an extremely important concept in modern linguistics. And it is usually assumed to have originated with Frege, who writes that "it is enough if the sentence as whole has meaning; thereby also its parts obtain their meanings" (Frege 1884, section 60)

In more recent work, perhaps the most succinct definition of it is found in the following quote from Szabó (2000, 3; see also Pietarinen (2005)):

"Principle of Compositionality: the meaning of a complex expression is determined by meanings of its constituents and by its structure*."*

But these versions of compositionality do not offer a solution for the temporal interpretations to be discussed in this section (see also Everett (in progress)). The question is how we achieve temporal interpretations for time words, affixes, and discourses in languages like the Amazonian isolate Pirahã, which do not use either precision time words or tense morphosyntax (Everett 1986). The concept of compositionality given above do not work. The reason is that compositionality is a special form of inference and the entire resources of inference are required to arrive at appropriate semantic interpretations. This is discussed in detail in Everett (2022), in which it is argued that temporal interpretations require inference that unites logic, psychology, context, and language and that Szabó's compositionality is never suffcient and that, in fact it is simply a subtype of inference (see also Everett (in progress)), and can be dispensed with as a distinct feature of language.

People interpret and evaluate the grammaticality and meaning of their sentences inferentially, via cultural and real-world knowledge, in conjunction with knowledge of the words and structures of their languages. All of the conclusions relative to the grammaticality of sentences rely exclusively on inferential reasoning (including memory, cultural associations, apperceptions, etc (see Everett (2016)), of which compositionality is but a subtype.

The idea that there are only inferences in understanding our native tongues, not some other special capacity of the mind, obviously means that no speaker is able to make intuitive judgements about what is grammatical or not, because intuition doesn't exist. We only judge

whether something is grammatical or not just as we only judge what something means in the first place - via inference, using one or more of the three "-ductions" - induction, abduction, or deduction.

According to Peirce, speakers know how to interpret their sentences because they *infer* (however tacitly and quickly) that they are ungrammatical or grammatical, what their meanings are, etc. Of course, for Peirce the forms of inference are dependent on semeiotics (Everett (2022 and in progress)).

5.3. Transitivity, Valency, and the Reduction Theorem

Consider the following examples from English:

It is raining. (monotransitive - no arguments)

I am running. (intranstive - one argument)

He sees you. (transitive - two arguments)

Sheila gave Mary a gift/Sheila gave a gift to Mary. (ditransitive - three arguments)

Peter bet Noam two dollars that it would rain. (tritransitive - four arguments)

There are linguists who believe that such verb-argument combinations represent semantically basic verb types. There is a problem, however. Consider that in tritransitives, an argument can be omitted, but not in the others:

*Running.

*He sees.

*Sheila gave a gift

*Sheila gave Mary.

Peter bet Noam two dollars.

Peter bet Noam that it would rain.

What is interesting in these examples is that intransitives, transitives, and ditransitives require their full complement of arguments or the sentence is ungrammatical. However, this is not true for tritransitives. While there are linguists who believe that tritransitives do constitute a basic, non-derived semantic type of verb, there are no convincing answers to the paradigm above. If the fourth argument of a tritransitive were basic as the arguments of the other types are, it should not be able to be omitted.

Some linguists have long wondered why three arguments seem to be the maximum number allowed without semantic additions to the verb, e.g. adpositions, causative morphology, and so on. Interestingly, this is exactly what Peirce's theory predicts. Three is the maximum number of basic arguments a verb can have in its lexical meaning, though extra arguments can be added or indicated by prepositions, affixation, or lexical processes (Van Valin 2007). Tritransitive verbs violate Peirce's reduction theorem for valency (the lexically basic semantics of a verb). Peirce introduced the concept of "valency" into linguistics from chemistry (Peirce (1897, 170ff). The only way to produce a tritransitive verb is to superficially increase valency (i.e. a transitivity alternation) in a deviation from the verb's basic semantics, one argument at a time. See, inter alia, Atkins (2018, 71ff); Burch (2001)).

It is crucial, however, in evaluating Peirce's reduction thesis to draw a strict line between valency (this, appropriately, seems to mean "number of required lexical arguments" for most linguists) and transitivity (number of arguments of a verb in a sentence). This distinction can be overlooked in casual analyses of languages, by linguists, philosophers, and anthropologists. One superb study of the difference between transitivity and valency is Hopper and Thompson (1980).[22]

As is well-known, transitivity (the number of syntactic arguments) can be reduced or expanded while valency (the number of lexical arguments) is held constant:

John saw Mary = transitive, bivalent

Mary was seen by John = intransitive, bivalent (see Everett (1996) for detailed discussion).

All serious theories of human linguistic capacity address the interrelationship between linguistic form and meaning. This is certainly built into Peircean (and Sausurrean) Semeiotics. But arguably only Peirce in the long history of the study of human language predicts these valency facts from the building blocks of his theory, UG.

5.4. Field Research

Peirce's phenomenology (which he called "phaneroscopy") captures the task of linguistic field research well. Sakel and Everett (2011) offer a number of suggestions and guidelines for the conduct of linguistic field research. One of the things that we point out is that as the linguist moves from an etic perspective to an emic one, many sounds and structures and meanings in the language under study will go from vague impressions (tones) to clear oppositions (tokens) and finally will be related to particular emic analytical units (types). In Peircean terms we metaphorically move from firstness to secondness to thirdness in field research. In terms of specific units we notice tones, analyze tokens, and construct types.

When we arrive in a new field situation, hearing a language for the first time that we do not speak or know anything about, we begin our work with Phonetics (articulatory, acoustic, or auditory), which is the study of speech sounds from the perspective of a non-native speaker, say, a physicist or linguist. But phonetics has already been preceded by vague and unclear

perceptions we have of the language before we begin to transcribe or analyze. Once we complete

our phonetic analyses and transcriptions, we are in a better position to analyze the Phonemics

which is the study of the set of phonetic sounds that native speakers perceive as single sounds,

i.e. the sounds that are important from the perspective of a native speaker, an insider.[23] For

example, English speakers all hear one sound, /p/ in the words [park], [spark], and [carp], when

in fact there are at least three sounds, all written as 'p' in these words, namely, [p], [pʰ], and [p̄],

respectively.[24] Native speakers thus know less *explicitly* about the sounds of their language than

they tacitly know about them, since speakers in general never perceive the separate etic sounds

but only the single emic sound that an etic sound is associated with. Yet they never confuse etic

sounds in use. In just the same way, native speakers know how to use all the etic sounds of their

language appropriately, e.g. the three separate manifestions (technically, *allophones*) of /p/ in

this example: "Use [p] in syllable-medial positions, [pʰ] in (some) syllable-initial positions, and

[p̄] in phrase-final position."[25]

It is interesting that Peirce in effect predicts the order of field research in his

phenomenological categories. However, to fully utilize his insights, linguists need to be aware

not merely of his terms *type* and *token* but also of the etic, preanalytic category, *tones*, that are a

crucial part of Peirce's model. And these correspond to Peirce's basic phenomenological

categories of firstness (tones), secondness (tokens), and thirdness (types).

5.5. Recursion

In 2002, Marc Hauser, Noam Chomsky, and Tecumseh Fitch (HCF) offered the novel

idea that the "Narrow Faculty of Language" was recursion.

They discussed their evidence for this claim, which was based on the idea that there is no longest sentence in any language.

When (Everett 2005) later argued that the Pirahã language of the Brazilian Amazon lacked recursion in its sentential syntax and that it *did* have a longest sentence, this led to a sixteen-year (and counting) debate. Recently work on the implications of my claim on discourse recursion has show this idea to have positive consequences for Chomsky's theory (Maier 2021).[26]

Apart from discourse, however, had HCF and Everett (2005) adopted Peirce's perspective on recursion, universally overlooked in form-centered syntax and formal (math-based) syntax, much of this debate could have been avoided. The reason for this is that semiosis, which is as important to the Pirahãs as to English-speakers, is inherently recursive. In other words, Peirce already claimed in effect that recursion is the heart of language (because it is the heart of semiosis) and thus that all languages must have recursion, just not necessarily in their sentence structures. In Peirce's system, recursion is found in the interpretant, not the object or representamen (as HCF would have it), that is, in the semantics, since each sign must be interpreted via another sign - a recursive process. There can be, if my work on Pirahã is correct (see Futrell, et. al. (2016); Everett and Gibson (2019), etc), languages which have semeiotic recursion and discourse recursion, but which lack sentential recursion.

If Chomsky simply wants to claim that recursion somewhere in language is the FLN, there is no problem. Peirce already explained this more than a century ago. But if Chomsky wants to claim that recursion in syntax is what is crucial, that finds neither support in Peirce nor in the facts of natural languages.

One interesting proposal in more recent years within Minimalism is found in Murphy (2015). Although he gives no reference to Peirce, the proposal introduces an element of

semeiotics into Chomsky's theory, arguing that "the operation Label, not Merge, constitutes the evolutionary novelty which distinguishes human language from non-human computational systems..."

In other words, Murphy is claiming that syntax is not unique to humans but labeling of syntactic nodes is. Thus putting the words "hit" and "John" together in "... hit John" to form a verb phrase is less significant than the label "verb phrase." Other creatures put things together. Only humans label them (i.e. attach symbols to them). Murphy is absolutely correct it seems to me. And absolutely Peircean in his insight, however unknowingly.[27]

5.6. Speech Acts and Peirce

Though a full discussion of Peirce's view of speech acts is beyond the scope of this paper, it is worth noting that not only did Peirce anticipate the theory of speech acts, but that is "commitment view" of assertions also prefigures Brandom's (1983; 1998) view of inference and responsibility. (see CP 5.477-478, Brock (1981, 324))

But Peirce's theory holds the advantage over Brandom's, because Peirce's assertion theory is embedded in a logical theory of semiosis and therefore, stands as part of a larger architectonic, its principal features derived rather than stipulated.

5.7 Peircean Discourse Analysis

Longacre (1996) is one of many studies that argue for the centrality of discourse studies to understanding language. Yet, although much of modern linguistics ignored careful study of discourse until the 1950s (two of the foundational monographs from US scholars are Longacre (1991 and Grimes 1975), Peirce's pioneering work had already argued that arguments (a form of

discourse) were "perfect symbols" which could be analyzed via his system of Existential Graphs (EG). Interestingly, Chomsky's linguistic followers have never acknowleged the important differences between discourse and sentences and that a failure to recognize discourses in his theory leaves him with no account of sentences as discourse constituents (which even Chomsky's advisor Harris had done (Harris 1951).

As mentioned earlier, in the past couple of decades, a widely-respected theory of discourse has arisen, developed by Hans Kamp and others (Kamp and Reyle 1993) which is, as Sowa (2013) puts it "isomorphic" to EGs (CP 4.347ff; see also Sowa (http://www.jfsowa.com/peirce/ms514.htm)). Modern theories of linguistics that focus on sentences seem to have done so via an implicit recognition that the proposition is, as Peirce claimed, essential to understanding speech acts. Sentences are primarily the realization of propositions in linguistic form. Unfortunately, they were never intended by Peirce or any other researcher, until Chomsky, to be the principal focus of linguistic theory to the exclusion of discourse. (Hilpinen (1982) offers an interesting analysis of the proposition in Peircean theory.)

Once again, however, we see that Peirce's theory is superior to modern formal linguistics in not only having a sophisticated theory of discourses, but also embedding the study of discourses and sentences into a larger, comprehensive theory of semeiotics.

5.8. Peirce and Instinct

For Peirce, human "instincts" were derived from "feeding and breeding." (CP 1.118)[28]

When Chomsky refers to abduction (ibid) as "instinctive," he naturally interprets "instinct" as he uses it in his theory, which is an innate predisposition or knowledge. However, it is anachronistic to think that this is all Peirce could have meant by the term. Clearly Peirce did

believe that innate knowledge in humans is plausible and likely. But in a survey of all occurrences of "instinct" in the Collected Papers, there are many references that are best interpreted as cultural or another form of acquired, not innate knowledge, along the lines of what I refer to as "dark matter of the mind" in Everett (2017). And instinct at times in Peirces seems to be a label for the output of habits:

"... the study of animal and *vegetable* [emphasis mine, DLE] instinct (both of which, especially the latter throw much light on man's nature)." CP 1.266

In discussing the role of instinct in understanding the temporal relationships implied by logical relationships (CP 1.496) Peirce says that this "... instinct may, therefore, be presumed to be an obscure perception that temporal succession is a mirror of, or framework for, logical sequence." But when Peirce here uses "obscure perception" he is not claiming that this ability is of necessity innate conceptual knowledge, but that we have an innate ability to perceive types of relations (similar to Everett 2016's interpretation of instinct as "dark matter"). This is crucial because in Chomsky's theory instinct usually refers to innate conceptual knowledge (this is also the meaning of instinct/"core knowledge" that is found in Elizabeth Spelke's work (Spelke and Kinzler (2007)).

There is simply no unambiguous support in Peirce's work for the "instinct" that Chomsky uses and attributes to Peirce. Nor for Spelke's core knowledge (which goes against the definition of knowledge in pragmatism and Brandom (1998), among others, with no justification offered in Spelke's work for this notion of "knowledge" or "concepts"). Moreover, Chomsky also misses the range of meanings associated with Peirce's use of the word "instinct," in his discussion reviewed earlier. Peirce nowhere made any statements that could be construed in modern terms as a "theory construction module of the brain."

What Peirce said is that our guessing is not random and that this could be guided by instinct of some form, which in his writings could be either biological or cultural. The most one can get out of this is that children have a type of solution space - either through biology or experience in language and culture - for making guesses that are "wrong most of the time [according to Peirce]." There is thus no support in Peirce for anything but the fact that children will somehow guess at what sentences mean and how they are structured. Which of course we all know. They learn by bits and pieces, not innate theories. (I believe this latter idea would have appalled Peirce.)

5.9. Linguistic Relativity and Peirce

Since Sapir and earlier the idea that language influences our thinking has been explored and discussed heatedly by linguists (for a historical review of linguistic relativity and very careful, detailed discussion, see C. Everett (2016)).

Again, though, Peirce was there at the beginning. For Peirce, since language is a semeiotic system and since all thinking is in signs, language could not be secondary to cognition, nor could words be secondary to, or otherwise independent from, the ideas which they express. As Peirce puts it, "it is wrong to say that a good language is important to good thought, merely; for it is the essence of it" (CP 2.220).

5.10. Peirce, Language, and the Brain

In EvLab at MIT, Evelina Fedorenko and her co-researchers have been finding that syntax seems secondary to meaning - to constructions and words. This makes perfect sense from a Peircean perspective because in Peirce's Universal Grammar, the purpose of the grammar is not

to produce syntactic structures per se but to support the interpretation of symbols (e.g. words and constructions). The neurolinguistics of language is thus offering preliminary support for the superiority of the predictions of a Peircean Universal Grammar over a Chomskyan Universal Grammar (or indeed almost any theory that takes lexical meaning as basic and syntax as derivative).

In my interpretation, Fedorenko's research shows that the brain network is a set of connections in which the principal functional nodes are symbols, not syntactic rules. This is worth exploring further from a semeiotic perspective, but for now it is evidence that Peirce's theory appears to predict the findings of Fedorenko's lab about language and the brain.

5.11. Peirce, Chomsky, and Language Evolution

In Everett (2017) I argue that proposals on the evolution of human language often fail to see evidence for language in the archaeological record because they are looking for the wrong things. Thus most archaeologists are willing to count paintings, decorative ornaments, and so on as evidence for "symbolic thinking" because they fit popular understandings of the growth of culture and thought. But few studies make use of Peirce's semeiotics in their analyses of the archaeological record.

When we look exclusively for behavior reminiscent of modern Homo sapiens as evidence for the appearance of human language, rather than evidence for a full range of signs, especially symbols, we fail to understand the sophisticated behavior (boat-building, settlement divisions, tool refinement, and so on) characteristic of Homo erectus and dependent on the possession of language. Everett (2017) and Barham and Everett (2021) both argue that Homo erectus had language and that language, based on field studies of modern languages by Everett and others,

need not conform to the grammar-bias of the Chomskyan Universal Grammar because language is fully expressive so long as it has symbols and a grammar just good enough to express them (a purely linear grammar suffices).

Moreover, because Peircean Universal Grammar also applies to the signs used by non-humans, the gap between human language and non-human communication is smaller than it is in the biological model of UG (which must produce a recursive grammar from nothing, via some sort of genetic saltation) and it is thus easier to comprehend that while other primates use icons and indexes (perhaps also the occasional symbol), humans (all members of the genus Homo) have fully expressive language as soon as they are able to create symbols (culturally) without a priori limits. Thus the Peircean view of Universal Grammar, among its many advantages, also provides a richer potential explanation for the evolution of language.

6. Peirce and the mathematical foundations of modern linguistics.

During his lifetime, Peirce was considered to be one of if not the US's foremost mathematician, as was his father Benjamin before him. As mentioned earlier, he invented first and second order logic with quantification independently of Frege. His worked influenced many philosophers and mathematicians from Ramsey to Wittgenstein, Peano, Schroeder, Russell, and Whitehead, among many others.

Tomalin (2006) provides an overview of the influence of the "formal sciences" (mathematics, logic, computer science, and the like) on the development of modern formal linguistics, an outgrowth of the pioneering work of Noam Chomsky and others. It is often and incorrectly assumed that formal theoretical research on human languages began with Chomsky. Robert Lees erroneously states in his well-known 1957 review of Chomsky's first published

book, *Syntactic Structures* that Chomsky had offered the first formal theory of language, ignoring entirely Peirce's well-worked out and much more formal theory of words, propositions, and discourse (in his EGs), which together provide a comprehensive theory of language. [29]

Tomalin's book, while well-written, knowledgeable, and highly informative nonetheless commits major errors of omission regarding the history of the study of language, the history of the formal sciences, and the history of the classification and purposes of scientific theory. Peirce is a major, perhaps the most important, figure in the history of all of these ideas and is not mentioned by Tomalin.

The formal study of language began no later than Peirce's theory of signs (with honorable mention to Panini, (Kumar 2017)), continued into his discussions of UG (1865), was developed in more detail in his Speculative Grammar (Bellucci 2018), and reached its pinnacle, never surpassed for most of the intervening 120 or so years, in Peirce's Existential Graphs.

Tomalin's review of the history of the formal sciences focuses on mathematics, explaining how it was foundational for formal linguistics. Yet there are surprising misses in his history. For example, he talks about Whitehead, Russell, Frege, Peano, and Schroeder, inter alia, but fails to catch the fact that behind all of these figures except Frege stood Peirce, who influenced them all profoundly. Thus, Tomalin attributes great significance to Whitehead and Russell's *Principia Matematica* (PM) and its setting an agenda which came to influence formal sciences directly and formal linguistics indirectly. But this fails to account for Peirce's influence throughout PM. For example, although Russell and Whitehead give credit to Frege for the invention of formal logic, they use Peirce's ideas and notations (via Peirce directly (Peire and Whitehead paper) as well as indirectly from Peano and Schroeder (Putnam (1982); Eisele (1976)

7. Summary - Signs, Form, Meaning, and Cognition

Semeiotics studies the ways that meaning can be communicated (encoded and decoded). This interpretation of semeiotics is not limited to human language since meanings are encoded and decoded throughout the universe, as Peirce argued. In this sense human languages are but one system in the universal communication of meaning and linguistics as a science is a branch of semeiotics. On the other hand, many linguists would argue to the contrary that linguistics, far from being a subdiscipline of semeiotics is a completely independent entity, because it is governed by different principles and because language emerged from a different evolutionary trajectory than semeiotics. To these researchers, semeiotics connects with linguistics from time-to-time, but it is a distinct discipline.

Chomsky has argued for over sixty years that the best theory of language takes form to be the principal explanandum and that the explanada are independent of meaning. (Hence one sense of the label "formal linguistics," i.e. "centered on form;" though most agree that the central definition of formal linguistics is "based on mathematical formalisms," a task which occupied much of Peirce's energy during his entire life). Additionally, there is, as of Chomsky's work in the 21st century, just one faculty that is crucial to having language, recursion. Not meaning. Not symbols. Not nouns. Not verbs. Just recursion. Therefore any discussion of the relationship between Peirce's work and modern formal linguistics must discuss the opposing theses about what is central to human language, symbols or grammar.

According to Tomalin (2006) Chomsky has been keenly interested in recursion's role in grammar at least since his interactions with Yehoshua Bar-Hillel in 1950. But Peircean recursion is much older, applicable throughout semeiotics (not merely language), and, arguably, more rigorous in its theoretical development and presentation.

What follows are just a few of the points we have seen above in which Peirce's UG appears to enjoy advantages over Chomsky's:[30]

1. For Chomsky data are selected and evaluated largely based on intuition, or what Michael Devitt refers to as the "Voice of Competence." But for Peirce, all interpretation and learning are inferential semeiotics. Inference generalizes more and fits cognitive sscience better than separate categories of intuition, which do not stand up to Peircean analysis.

2. Form, not meaning, is central to linguistic analysis and understanding for Chomsky. But signs are central for Peirce.

3. Universal structural principles in Chomsky's theories are biological in nature, but logical in nature for Peirce. This extends the empirical reach of Peirce's beyond human cognition and communication in necessary ways.

4. For Peirce discourse, arguments, and propositions (sentences) can be recursive, but need not be. Since recursion is semeiotic rather than syntactic, Peirce has ready analyses for languages like Pirahã, though there is no unproblematic analysis in Chomskyan theory.

5. Peirce predicts semeiotic storage in the brain, whether specifically symbolic or, potentially with images, and this is supported by Fedorenko's "language network" in the brain.

6. Peirce captures similarities between human and non-human communication but most theories of linguistics, especially those that attribute linguistic principles to biology rather than logic or function cannot.

8. Conclusion: Peirce and the Nature of Cognition

One thing that emerges from detailed examination of Peirce's work is that it underlies a good deal of work in modern linguistics and that the latter would profit from a deeper

understanding of the ideas that it has used so widely, an understanding that requires a return to Peirce's own writings. Peirce's own work on evaluating theories is found in two important theses (Atkins 2018, p33):

> Function Thesis: The function of conceptions is to reduce sense impressions to a unity.

> Validity Thesis: A conception is valid just in case we cannot reduce the content of consciousness to unity without it.

The idea that all humans are born with an innate UG. UG clearly satisfies the Function Thesis because its purpose is to unify many observations about humans' linguistic behavior under a single concept. But does UG satisfy the Validity Thesis? Is it crucial to understand humans' use and reducing all the observations about human language behavior to unity?

If the answer is yes, UG stands as a valid concept. If no, it does not. These theses apply to any concept, e.g. linguistic rules, religious beliefs, electronic components, Homo erectus tools, and so on. The purpose of our reasoning is in part to deal with the phaneron - our conscious and unconscious experiences. Thus Peirce's phaneroscopy not only provides the best model for evaluating the simplicity of theories, focusing on the semantics rather than the syntax of theories, but it also contributes to our understanding of individual inferential operations. A child learning their first language, for example, can be expected to regularly winnow their inferential conclusions, e.g. rules of grammar learned, in light of the prerequisites of the Function and Validity Theses. These theses do not fall exclusively within the domain of philosophers but desireable for successful reason in science and daily life. Human reasoning must succeed by and large or we would go extinct.

By selecting its particular philosophies and objectives, any science's course of research is set for the future. This is what I call the "gyroscope issue." Two theories beginning with slightly different assumptions and goals will eventually be separated by large empirical and conceptual differences. And the wider the divergence in the initial settings of their gyroscopes, the greater the distance between the theories as time progresses. Their gyroscopes are leading them apart because they are set for different stars. We see this today in the contrast between Peirce's theory and Chomsky's, as representative of much of modern linguistics.

References

Anderson, Benedict. 2016. Frameworks of Comparison: Benedict Anderson Reflects on His Intellectual Formation. London Review of Books, vol. 38, no. 2. 21 January.

Atkins, Richard Kenneth. 2018. Charles S. Peirce's Phenomenology: Analysis and Consciousness. Oxford University Press. Oxford UK

Bellucci, Francesco. 2018. Peirce's Speculative Grammar: Logic as Semeiotics. Routledge. New York.

Barham, Larry and Daniel Everett. 2020. "Semeiotics and the Origin of Language in the Lower Paleolithic,"Journal of Archaeological Method and Theory (online).

Boas, Franz, ed. 2002. *Handbook of American Indian languages.* Bristol, UK: Thoemmes.

Bradbury, Jack W. and Sandra L. Vehrencamp. 2011. Principles of Animal Communication, Oxford University Press. New York.

Brandom, Robert B. 1983. Asserting. Noûs , Nov., 1983, Vol. 17, No. 4 (Nov., 1983), pp. 637-650

Brandom, Robert B. 1998. Making It Explicit: Reasoning, Representing, and Discursive Commitment. Harvard University Press. Cambridge, MA.

Burch, R. 2001. Charles Sanders Peirce. Stanford Encyclopedia of Philosophy.

Buzzetti, Dino and Maurizio Ferriani. 1987. Speculative Grammar, Universal Grammar, and Philosophical Analysis of Language. John Benjamins Publishing Company. Philadelphia.

Chomsky, Noam. 1957. Syntactic Structures. Mouton. The Hague.

Chomsky, Noam. 1965. Aspects of the Theory of Syntax. MIT Press. Cambridge, MA.

Chomsky, Noam. 1980. Rules and Representations. Columbia University Press. New York.

Chomsky, Noam 1986. Knowledge of language: its nature, origin and use. Praeger, New York.

Chomsky, Noam. 1995. A Minimalist Program. MIT Press. Cambridge, MA.

Chomsky, Noam. 1994. Michael C. Haley and Ronald F. Lunsford, eds. *Noam Chomsky*.
    Twayne. pp. 182-1966

Chomsky, Noam. 2006. Language and Mind. Cambridge University Press. New York.

Chomsky, Noam (2007). "Approaching UG from Below". In Hans-Martin Gärtner; Uli
    Sauerland (eds.). *Interfaces + Recursion = Language? Chomsky's Minimalism and the*
    View from Syntax-Semantics. Studies in Generative Grammar. Berlin: Mouton de
    Gruyter. ISBN 978-3-11-018872-1.

Covington, Michael A. 1984. Syntactic Theory in the High Middle Ages. Cambridge University
    Press, Cambridge, UK.

Culicover, Peter W. and Ray Jackendoff. 2005. Simpler Syntax. Oxford University Press. New
    York.

Deacon, Terrence W. 1998. The Symbolic Species: The Co-Evolution of Language and the
    Brain. W.W. Norton. New York.

Devitt, Michael. 2006a. Ignorance of Language. Oxford University Press. New York.

Devitt, Michael. 2006b. Intuitions in Linguistics. Brit. J. Phil. Sci. 57 (2006), 481-513

Didion, Joan. 2021. Let Me Tell You What I Mean. Knopf. New York.

Duhem, Pierre. 1954. The Aim and Structure of Physical Theory. Princeton University Press.
    Princeton, NJ.

Eisele, Carol ed. 1976. The New Elements of Mathematics, volumes 1-4. Mouton. The Hague.
    (Collection of Peirce's mathematical writings.)

Everett, Caleb D. 2016. Linguistic Relativity. De Gruyter Mouton. The Hague.

Everett, Daniel L. 2019. "The American Aristotle," Aeon Magazine,

    https://aeon.co/essays/charles-sanders-peirce-was-americas-greatest-thinker.

Everett, Daniel L. 2017. How Language Began. The Story of Humanity's Greatest Invention,

    Liveright. New York.

Everett, Daniel L. 2016. Dark Matter of the Mind: The Culturally Articulated Unconscious.

    University of Chicago Press. Chicago.

Everett, Daniel L. 2005. "Cultural Constraints on Grammar and Cognition in Pirahã: Another

    Look at the Design Features of Human Language." **Current Anthropology**, 76: 621-646.

Everett, Daniel L. 1996. Why There Are No Clitics. SIL-UTA, Arlington, TX.

Everett, Daniel L. 1986. Pirahã. In: Desmond Derbyshire and Geoffrey Pullum (eds.) Handbook

    of Amazonian Languages I, Mouton DeGruyter, Berlin, pp200-326.

Everett, Daniel L. in progress. Peircean Linguistics: A Chapter in the History of Realist Thought,

    Oxford University Press.

Everett, Daniel L. and Edward Gibson. 2019, Review of Recursion Across Domains, Language,

    Journal of the Linguistic Society of America.

Fedorenko, Evelina, Idan Asher Blank, Matthew Siegelman, and Zachary Mineroff. 2020. Lack

    of selectivity for syntax relative to word meanings throughout the language network.

    Cognition 203.

Fedorenko, Evelina and Sharon L. Thompson-Schill. 2014. Reworking the Language Network.

    Trends in Cognitive Science, 2014 Mar;18(3):120-6.

Fodor, Jerry A. 1980. The Language of Thought. Harvard University Press. Cambridge, MA.

Fodor, Jerry A. 1981. Representations: Philosophical Essays on the Foundations of Cognitive

    Science. MIT Press. Cambridge, MA.

Font, Josep Maria and Ramón Jansana. 1996. A general algebraic semantics for sentential logics.

  Springer-Verlag. *ISBN* *9783540616993*.)

Forster, Paul. 2011. Peirce and the Threat of Nominalism. Cambridge University Press,

  Cambridge.

Frege, Gottlob. Die Grundlagen der Arithmetik. Breslau: Verlag von Wilhelm Koebner.

Futrell, Richard, Laura Stearns, Steven T. Piantadosi, Daniel Everett and Edward Gibson 2016.

  A Corpus Investigation of Syntactic Embedding in Pirahã, PLOS One., March 2.

Gibson, Edward A.F. and Evelina Fedorenko. 2013. The need for quantitative methods in syntax

  and semantics research, Language and Cognitive Processes, Vol. 28, pp: 88-124

Gillies, Donald. "The Duhem Thesis and the Quine Thesis", in Martin Curd and J.A. Cover

  ed. *Philosophy of Science: The Central Issues*, (New York: Norton, 1998), 302-319.

Goldberg, Adele. 1995. Constructions: A Construction Grammar Approach to Argument

  Structure. University of Chicago Press. Chicago.

Graves, C., Katz, J. J., Nishiyama, Y., Soames, S., Stecker, R. and Tovey, P. [1973]: 'Tacit

  Knowledge', Journal of Philosophy, 70, pp. 318-30.

Grimes, Joseph E. 1975. The Thread of Discourse. Mouton, The Hague.

Gvoždiak, Vit and Martin Švantner (eds). 2018. How to Make Our Signs Clear: C.S. Peirce and

  Semeiotics. Brill. Leiden.

Harding, Sandra G., ed. 1976. Can Theories be Refuted?: Essays on the Duhem-Quine Thesis.

  Reidel Publishing Co. New York.

Harman, Gilbert. 1973. Thought. Princeton University Press. Princeton, NJ.

Harris, Zellig. 1951. Methods in Structural Linguistics. University of Chicago Press, Chicago.

Hartshorne, Charles and Paul Weiss, eds. 1974 [1932]. Collected Papers of Charles Sanders Peirce, vols I-VIII. The Belknap Press of the Harvard University Press. Cambridge, MA.

Hengeveld, Kees and J. Lachlan MacKenzie. 2008. Functional Discourse Grammar: A Typologically-Based Theory of Language Structure. Oxford University Press, Oxford.

Hilpinen, Risto. 1982. On C. S. Peirce's Theory of the Proposition: Peirce as a Precursor of Game-Theoretical Semantics. *The Monist*, Volume 65, Issue 2, 1 April 1982, Pages 182–188, https://doi.org/10.5840/monist198265213

Hopper, Paul. and Sandra Thompson. 1980. Transitivity in Grammar and Discourse. Lg. 56,2, pp251-299.

Howard SR, Avarguès-Weber A, Garcia JE, Greentree AD, Dyer AG. 2019. Symbolic representation of numerosity by honeybees (Apis mellifera): matching characters to small quantities. Proc. R. Soc. B 286:20190238. http://dx.doi.org/10.1098/rspb.2019.0238

Ivanova, A. A., Mineroff, Z., Zimmerer, V., Kanwisher, N., Varley, R., & Fedorenko, E. (2021). The language network is recruited but not required for nonverbal event semantics. Neurobiology of Language, 2(2), 176–201. https://doi.org/10.1162 /nol_a_00030

Jakobson, Roman. 1977. . A Few Remarks on Peirce, Pathfinder in the Science of Language. MLN, Vol. 92, No. 5, Comparative Literature (Dec 1977),pp. 1026-1032. The Johns Hopkins University Press

Kamp, Hans and Uwe Reyle. 1993. From Discourse to Logic: Introduction to Modeltheoretic Semantics of Natural Language, Formal Logic, and Discourse Representation Theory. Springer, Boston.

Kumar, Vinod. 2017. The Astadhyayi of Panini - A Treatise on Sanskrit Grammar,. Parimal Publication. Delhi.

Larson, Richard. 2017. On Shell Structure. Routledge, London.

Larson, Richard and Gabriel Segal. 1995. Knowledge of Meaning: Introduction to Semantic
Theory. MIT Press. Cambridge, MA.

Lasnik, Howard, Juan Uriagereka and Cedrik Boeckx. 2005. A Course in Minimalist Syntax:
Foundations and Prospects, Wiley, New York.

Levin, Michael. 1983. Explanation and Prediction in Grammar (and Semantics). In: Peter A.
French, Theodore E. Uehling Jr., Howard Wettstein, eds. 1983. Contemporary
Perspectives in the Philosophy of Language. University of Minnesota Press. pp.179-188.

Longacre, Robert E. 1996. The Grammar of Discourse. Plenum Press, New York.

Maier, Ernst. 2021. Reporting With Clausal Embedding and Without: Another Look at the Pirahã
Controversy. https://ling.auf.net/lingbuzz/006292

Morris, Charles W. 1971. Writings on the General Theory of Signs. Mouton, The Hague.

Murphy, Elliot. 2015. Labels, cognomes, and cyclic computation: an ethological perspective.
Front. Psychol., 03 June 2015 | https://doi.org/10.3389/fpsyg.2015.00715

Nöth, Winfried. 2000. Charles Sanders Peirce, Pathfinder in Linguistics. *The Commens
Encyclopedia: The Digital Encyclopedia of Peirce Studies* (2000)

Paterson, Don. 2018. The Poem: Lyric, Sign, Metre. Princeton University Press. Princeton, NJ.

Perniss, Pamela, Robin L. Thompson, and Gabriella Vigliocco. 2010. Iconicity as a general
property of language: evidence from spoken and signed languages. Frontiers in
Psychology. https://www.frontiersin.org/articles/10.3389/fpsyg.2010.00227/full

Peirce, Charles Sanders. 1897. The Logic of Relatives. The Monist, Vol. 7, No. 2, pp. 161-217

Peirce, Charles Sanders. 1903. A Syllabus of Certain Topics of Logic, Alfred Mudge & Son,
Boston.

Pietarinen, Ahti. 2005. Compositionality, Relevance, and Peirce's Logic of Existential Graphs. Axiomathes. December 2005 DOI: 10.1007/s10516-004-7683-4

Pike, Kenneth L. 1967. *Language in relation to a unified theory of the structure of human behavior*. Janua Linguarum, series maior, 24. The Hague: Mouton. 762 pp. [second rev. ed.]

Pike, Kenneth L. and Evelyn G. Pike. 1976. Grammatical Analysis. SIL International. Dallas, Tx.

Pullum, Geoffrey Keith. 2020. Theorizing About The Syntax of Human Language: A Radical Alternative to Generative Formalisms. DOI: 10.25189/2675-4916.2020.V1.N1.ID279

Putnam, Hilary. 1982. Peirce the Logician. Historia Mathematica 9, pp290-301.

Quine, W. V. O. (1951). Two Dogmas of Empiricism. The Philosophical Review. **60** (1): 20–43.

Rosier, Irène. 1983. La Grammaire Speculative des Modistes. Presses Universitaires de Lille, France.

Sakel, Jeanette and Daniel Everett. 2011. Linguistic Field Work: A Student Guide, Cambridge University Press Red Series in Introductory Textbooks in Linguistics

Samuels Bridget D,. Marc Hauser, and Cedric Boeckx. 2016. Looking for UG in Animals: A Case Study in Phonology. In: Ian Roberts, ed., 2016. The Oxford Handbook of Universal Grammar. Oxford University Press. New York.

Sapir, Edward. 1921. Language. Harcourt, Brace, and Jovanovich. New York.

Saussure, Ferdinand de. 1959. Course in general linguistics. Eds. Charles Bally & Albert Sechehaye. Trans. Wade Baskin. NY: The Philosophical Society.

Schindler, Samuel, Anna Drożdżowicz, and Karen Brøker, eds. 2020. Linguistic Intuitions. Oxford University Press, New York.

Schwitzgebel, E. 2010. Introspection. Stanford Encyclopedia of Philosophy.

Searle, John. 1980. Minds, Brains, and Programs. Behavioral and Brain Sciences, 3 (3):417-57.

Shapiro, Michael. 1983. A Sense of Grammar: Language as Semeiotic. Indiana University Press.
    Bloomington.

Short, T.L. 2007. Peirce's Theory of Signs. Cambridge University Press, New York.

Silverstein, 2003 Indexical order and the dialectics of sociolinguistic life. Language &
    Communication. Volume 23, Issues 3–4, July–October 2003, Pages 193-229

Simard, Suzanne. 2021. Finding the Mother Tree: Discovering the Wisdom of the Forest. Knopf.
    New York.

Sowa, John. 2013. From Existential Graphs to Conceptual Graphs. International Journal of
    Conceptual Structures and Smart Applications, 1:1.

Spelke, Elizabeth S. and Katherine D. Kinzler. 2007. Core knowledge. Developmental Science
    10:1 (2007), pp 89–96

Stjernfelt, Frederik. 2011. Diagrammatology: An Investigation on the Borderlines of
    Phenomenology, Ontology, and Semeiotics. Springer, New York.

Szabó, Zoltán Gendler. 2000. Problems of Compositionality. Routledge. New York.

Thomason, Sarah and Everett, Daniel. 1993. Transitivity in Flathead. In Seaburg, William (ed.),
    Papers for the 28th International Conference on Salish and Neighboring Languages,
    August 19-21, 1993, 317-343. Seattle: University of Washington.

Tomalin, Marcus. 2006. Linguistics and the Formal Sciences: The Origins of Generative
    Grammar, Cambridge University Press. New York.

Townsend, Simon W., Maria Rasmussen, Tim Clutton-Brock, and Marta B. Manser. 2012.
    Flexible alarm calling in meerkats: the role of the social environment and predation

urgency. Behavioral Ecology. doi:10.1093/beheco/ars129. Advance Access publication 17 September 2012

Van Valin, Robert D. 2007. The Role and Reference Grammar Analysis of Three-Place Predicates, unpublished ms. SUNY Buffalo.

Van Valin, Robert D. and Randy J. LaPolla. 1998. Syntax: Structure, Meaning, and Function. Cambridge University Press. New York.

Werning, Markus, Wolfram Hinzen, and Edouard Machery, eds. 2012. The Oxford Handbook of Compositionality. Oxford University Press. Oxford.

Notes

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[1] In Everett (in progress), I am developing a much more detailed exposition of Peirce's relevance to modern linguistics.

[2] There is no attempt in this review to offer an au courant introduction to Chomsky's work, though the basic concepts addressed continue to be relevant.

[3] By convention, all papers in Peirce's Collected Papers are referred to by CP + volume number + paragraph number. So CP 1.1 refers to these papers, volume 1, paragraph 1.The chonological edition of his papers, published by Indiana University Press, are referred to by W + volume number + page number.

[4] Saussure (1959) divided the study of language into two parts, parole and langue, where the latter is a social concept/application of the mental component/knowledge of language. Sapir placed psychology and linguistics both in anthropology. As we will see, Peirce's view separates out the logical components of sign representations usually located in linguistics and moves them into logic. The study of actual languages and their variation he considers to be a separate field. On the other hand languages are constrained by the logic of his UG, though his notion places these constraints outside of the nature-nurture debate.

[5] Though UG has no such applications in Chomsky's theory, since from Chomsky's Cartesian perspective, non-human and human communication are unrelated in any significant way. But they *are* related in Peirce's theory because for Peirce non-human communication and human languages are all semeiotic systems, subject to the logical constraints of UG (discussed in more detail in Everett (in progress)).

[6] Pike's theory treats all human behavior, including language, as a kind of semiosis (though Pike does not use this term) in which watching a football game or speaking a sentence can both be broken down into "-emes" (e.g. phonemes and behavioremes) which include form, meaning, and referential link to object.

[7] The next several paragraphs on bees paraphrase Everett (2019).

[8] For an introduction to Peirce's semeiotics, see Short (2007).

[9] My assertion that animals do not use symbols so far as we know might seem strange to some. So take a common example purportedly showing symbol use by animals in the wild, meerkat calls, these seem to fit the semeiotic definition of indexes (but also show reasoning). (Townsend, et. al. 2012).

[10] In Everett (forthcoming) I argue that the warning signs of many animals, e.g. vervet monkeys, chimpanzees, meerkats, dolphins, and others are indexical legisigns, rather than symbols. But even if it turned out that other animals could invent and use symbols, this would not alter the basic point that no animal other than those of the genus Homo invents open-ended symbols to apply to any new situation or interest.

[11] S(ign) --> S (one sign is interpreted by another)

[12] This is quite different from the Chomskyan analytic strategy known as "pro-drop" (Chomsky 1981), in which a missing pronoun is only missing in the phonology, but present in the syntax.

This is analyzed as a "parameter" in Chomsky's theory For example, Portuguese has the pro-drop (pronominal dropping) parameter, while English does not:

Está chovendo 'It is raining'

It is raining vs. **Is raining*

The Portuguese example is fine, because it is pro-drop, so it does not require a subject. But the English example is ungrammatical because it does require subjects. Peirce might simply have said that the subject is known from the verb inflection in Portuguese, but cannot be so recovered from the much more impoverished verb conjugations of English. In any case, Peirce was aware of such examples and took them quite seriously.

[13] Harris's transformations would simply state the relationship between, say, *John saw Mary* and *Mary was seen by John* is a discourse relationship, where a proposition has more than one possible form to better fit discourse structure. In this case, if we want "John" as the topic, we choose the active "transform" (or "allosentence" in some theories) and if we want "Mary" as topic, we choose the passive.

[14] It should be noted that hypostatic abstraction in itself, however important as a mental operation, is not a major grammatical operation or device in most of the world's languages.

[15] Although Pike and Pike (1976) refer to a "referential hierarchy" as part of the triadic structure of linguistic theory - Pike saw most topics as triadic in structure, though he never to my knowledge cites Peirce as a source for this approach - it is not sufficiently worked out to include much detail here.

[16] It is also in harmony with Antoine Meillet who, in his *Introduction à l'étude comparative des langues indo-européennes* (1903: p. 407) wrote "que chaque langue forme un systeme on tout se tient."

[17] In the academic climate of Chomsky's early years as a junior fellow at Harvard (when he developed the basics of his Transformational-Generative Grammar), major concerns involved the proper analysis of propositions and sentences and how such analyses could be incorporated into computer science. His theory reflects these concerns, has never really moved beyond them. Peirce on the other hand always saw propositions as constituents of larger units, i.e. arguments, including what we would today call discourse.

[18] For example, the shell structure hypothesis of Larson (2017) makes a series of valuable predictions within Chomsky's theory, but it is largely ignored outside of the literature of that theory. The reason is not because the other theories are inferior but rather than this kind of form-only analysis is less desireable for theories in which the principal causative power lies in meaning rather than form.

[19] Peirce allows that indexes, by simply pointing out an object in the real or imagined world, may halt this recursive process or begin it. Infinite regress is thus avoided. In general, however, there is no need to restrict "infinite semeiosis."

[20] Peirce was a hard-working scientist who left copious documentation of his working methods, such as his analysis of Tagalog grammar - see Everett (in progress) for analysis.

[21] Harman (1973) argues, as Peirce would, that inferences can be fast, instantaneous perhaps, and need not be conscious.

[22] This issue of tritransitives is further discussed competently in this piece written for a general audience: https://slate.com/human-interest/2014/04/does-english-have-any-tritransitive-verbs.html. See Thomason and Everett (1993) for a discussion of transitivity and valency along these lines in Flathead/Montana Salish.

[23] These are both idealizations. Our understanding of "phonetics" seen, for example, in something so erstwhile objective or etic as the International Phonetic Alphabet, is shaped by our emic perspectives and most etic categories are already idealized in cultural ways. So there is no truly objective vantage point, just ones less contaminated in ways we know of.

[24] The standard convention in linguistics is that //s are used to enclose phonemic sounds and []s to enclose phonetic sounds.

[25] For Generative Phonology, phonemics is not a theoretically recognized level of analysis. Nothing hangs on this debate here, however. So where I have written "phonemics" one can read "phonology" without any change in intended meaning.

[26] Maier states:

> "*This paper explores the relation between the syntax of clausal embedding and the ability to represent what others are saying, thinking etc.. I'm using the Pirahã controversy as a lens through which to study this relationship because, supposedly, the Pirahã language has no clausal embedding and hence no analogue of English indirect discourse ('Katy said/thought/dreamed that she was rich'). I first show how hearsay evidentiality and direct quotation, both of which are attested in Pirahã, differ semantically from each other and from indirect discourse. However, together, these two arguably embedding-free report strategies could cover two of the most common uses of indirect discourse in English, viz. efficient communication that keeps track of speaker's evidential sources through a not-at-issue information channel, and vivid description of speech and thought in narratives. I also argue that reporting in general is best understood as a discourse phenomenon, only optionally encoded in the grammar. Spelling this out in a formally explicit and independently motivated general model of discourse structure and coherence relations (including a non-veridical relation of Attribution) we actually derive Dan Everett's own diagnosis of the situation, viz. that "there can be recursive discourses in the absence of recursive sentences.""*

[27] We might call this "Semeiotic Minimalism" in which, in accordance with Peirce, semeiotics is basic, grammar is secondary, though I realize this is not at all what Murphy intends.

[28] I would have preferred the alliterative "fucking and feeding," but that would have been even more offensive in Peirce's day.

[29] Lees was Chomsky's PhD student. It is questionable whether publishing such a review is even in good taste, given the personal connection.

[30] The principal developers of Construction Grammar were the late Charles Fillmore and his colleague at the University of California at Berkeley, Paul Kay. Currently among the many names associated with this theory perhaps the two most prominent are that of Adele Goldberg (Princeton) and William Croft (University of New Mexico).