TOWARD A SEMANTIC APPROACH IN EPISTEMOLOGY

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ABSTRACT: Philosophers have recognized for some time the usefulness of semantic conceptions of truth and belief. That the third member of the knowledge triad, evidence, might also have a useful semantic version seems to have been overlooked. This paper corrects that omission by defining a semantic conception of evidence for science and mathematics and then developing a semantic conception of knowledge for these fields, arguably mankind's most important knowledge repository. The goal is to demonstrate the advantages of having an answer to the more modest question "What is necessary and sufficient for introducing a knowledge predicate into scientific and mathematical languages?" – as contrasted with the ambitious Platonic question "What is knowledge?" After presenting the theory, the paper responds to a wide range of objections stemming from traditional philosophical concerns.

KEYWORDS: semantic evidence, scientific knowledge, mathematical knowledge, Gettier problem, skepticism, positivism

Philosophers have recognized for some time the usefulness of semantic conceptions of truth and belief. That the third member of the traditional triad, evidence, might also have a useful semantic version seems to have been overlooked. This paper corrects that omission by defining a semantic conception of evidence for science and mathematics and then developing a semantic conception of knowledge for these fields, arguably mankind's most important knowledge repository. The goal is to demonstrate the advantages of having an answer to the more modest question "What is necessary and sufficient for introducing a knowledge predicate into scientific and mathematical languages?" – as contrasted with the ambitious Platonic question "What is knowledge?" After presenting the theory, the paper responds to a wide range of objections stemming from traditional philosophical concerns.

1. Preliminaries

In a letter to the author, Alonzo Church expressed the following view on the importance of semantic conceptions of truth and belief:

> There is the notion of belief in a *sentence* relative to a *language*. I am not at the moment inclined to think this is a notion of great importance, but I am prepared to agree that someone might well be able to change my mind on this point by

> citing reasons for the importance of this notion. Carnap undertook to use this notion to provide a definition of the different notion of belief in a *proposition*, where this latter notion is understood as language-independent. (I might well know that Columbus believed the world to be round in a way that is completely independent of reference to any particular language.) My criticism of Carnap was to the effect that his attempt to provide such a definition failed in a rather obvious way. Analogously, there is the notion of truth of a *sentence* relative to a language. It is to Tarski's credit that he was able to supply a definition of this notion, and he himself provides quite sufficient reasons for the importance of this notion. I only ask Tarski and others not to confuse this notion with the language-independent notion of truth of a *proposition*.[1]

Surprisingly, philosophers sympathetic to the semantic approaches of Tarski[2] regarding truth and Carnap[3] regarding belief, such as Goodman,[4] Hempel,[5] Quine,[6] Sellars[7] and Davidson,[8] seem not to have considered the possibility of a semantic approach in epistemology. That is, while these philosophers have been sympathetic to replacing the concepts of truth and belief linked to propositions with concepts of truth and belief linked to sentences of a language,[9] there has not been a recognition that the same can be done for the third leg of the knowledge triad, the concept of evidence.

Be that as it may, I will pursue Church's challenge in an epistemic direction and provide "quite sufficient reasons for the importance" of a semantic analysis of the concept of evidence. I will show that such an analysis for science and mathematics has intuitive appeal and is relatively straightforward to formulate, at least in outline, and that the payoffs are significant. Coupled with already available semantic conceptions of truth and belief, a semantic conception of evidence leads to a semantic conception of knowledge that captures what is arguably mankind's most important knowledge repository.

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[1] Alonzo Church, letter to the author, August 6, 1982.

[2] Alfred Tarski, "The Semantic Conception of Truth" *Philosophy and Phenomenological Research* 4 (1944): 341-376. Reprinted in his *Logic, Semantics, Metamathematics* (Oxford: Oxford University Press, 1956).

[3] Rudolf Carnap, *Meaning and Necessity* (Chicago: University of Chicago Press, 1947).

[4] Nelson Goodman, *Structure of Appearance* (Cambridge: Harvard University Press, 1951).

[5] Carl G. Hempel, *Aspects of Scientific Explanation* (New York: Macmillan, 1965).

[6] W.V.O. Quine, "Epistemology Naturalized," in his *Ontological Relativity and Other Essays* (New York: Columbia University Press, 1969).

[7] Wilfrid Sellars, *Science, Perception and Reality* (London: Routledge & Kegan Paul, 1963).

[8] Donald Davidson, *Subjective, Intersubjective, Objective* (Oxford: Clarendon Press, 2001).

[9] I should add right away that on the present view it is sentence-types, i.e., abstract objects that exemplify epistemic properties and not inscriptions. My semantic conception of evidence is not committed to Nominalism.

2. Semantic Epistemology in Mathematics

2.1. Evidence-in-Mathematical-Languages

A semantic conception of evidence for mathematical languages entails the introduction of an evidence predicate for all and only (closed) wffs of the mathematical language to which they belong. While there's nothing wrong with introducing such a predicate into mathematical languages one at a time, it is clearly preferable to do so in a way that is necessary and sufficient for all mathematical languages.

The task is considerably less daunting than it sounds because mathematics is a formal system with deduction as the only basing relationship, hence we can count as semantically evident all and only wffs that are axioms or theorems:

> (SEM) Where *z* is a wff of a mathematical language *ML*, <u>*z* is evident-in-*ML*</u> =Df There is a derivation-in-*ML* of *z*.

At the working level, derivations occur in a specific mathematical language such as set theory, plane geometry, algebra, calculus, arithmetic, and so on. The Herculean efforts of Russell and Whitehead have made it possible to speak of a unified language of mathematics, so that in the final analysis we can let ML be *Principia Mathematica* and achieve the desired level of generality.

2.2. Knowledge-in-Mathematical-Languages

According to SEM, a mathematical wff could be semantically evident without being evident for anyone, thus SEM is not sufficient for the formulation of a semantic conception of mathematical knowledge.

> (SEM1) Where *z* is a wff of a mathematical language *ML*, <u>*z* is evident-in-*ML* for a person S</u> =Df (i) There is a derivation-in-*ML* of *z*, and (ii) the derivation-in-*ML* of *z* is believed-in-*ML* by S.

A small adjustment yields a semantic conception of mathematical knowledge:

> (SKM) <u>*z* is known-in-*ML* by S</u> =Df (i) *z* is true-in-*ML*, (ii) *z* is believed-in-*ML* by S, (iii) *z* is evident-in-*ML* for S.

3. Semantic Epistemology in Science

3.1. Evidence-in-Scientific-Languages

It would be ideal, as well as something of a philosophical coup, if a semantic evidence predicate could be introduced into science along deductivist lines. Familiar objections stand in the way of such a project: Mathematics truths are necessary, a priori, and analytic, those of science are contingent, a posteriori, and synthetic (pace Kant); mathematics is deductive, science is inductive; mathematics means reason, science means experience; mathematics is axiomatic, science is not; and so on.

Thus, Williams:

> Today, the demonstrative conception of knowledge is thought to apply at most to knowledge that is strictly *a priori*, the sort of knowledge that, if it exists at all, is exemplified by logic and pure mathematics. No one thinks that the demonstrative ideal can plausibly be invoked in connection with empirical knowledge, which includes all of natural science.[10]

Well and good, but consider the epistemic status of a simple (but paradigmatic) observation sentence in the language of meteorology (ultimately, physics) such as,

> (A) Air temperature on Earth at (x,y,z,t) = *n.m* degrees Fahrenheit.

A semantic evidence predicate defined for observation sentences of a scientific language should be compatible with the fact that scientific justification derives from the result of an experiment or use of a suitable sensor or measuring device, e.g.,

> (B) A working thermometer placed at spatio-temporal location (x,y,z,t) showed a reading of *n.m* degrees Fahrenheit.[11]

Preanalytically, then, (B) is the right sort of scientific epistemic ground for (A). Defining a semantic evidence predicate on the model of SEM, however, requires the availability of a valid derivation of (A) in the language of meteorology, but (B) by itself is clearly not sufficient for that purpose. In this case, a valid derivation requires only the assumption that measuring instruments provide accurate information about the world – an 'instrumental accuracy law' – something without which science and engineering would come to a complete standstill:

> (C) Whenever a working thermometer placed at a location near the surface of the Earth shows a reading of *n.m* degrees Fahrenheit, the temperature at that location is *n.m* degrees Fahrenheit.

[10] Michael Williams, *Problems of Knowledge* (London: Oxford University Press, 2001).

[11] I am not assuming that to every observation predicate there can correspond one and only one measuring device or method. Thus, "the temperature of *X* is 150,000 degree Fahrenheit" might well be semantically evident even though no thermometer could measure such high temperatures, since there are other devices and methods for doing so.

I could multiply this example many times over by replacing thermometers with clocks, telescopes, microscopes, oscilloscopes, angioscopes, spectrographs, manometers, anemometers, barometers, galvanometers, and so on. The reasoning pattern exemplified by all these examples is the same, namely:

1. $(x)(Fx \rightarrow Gx)$	An instrumental accuracy law
2. $Fa \rightarrow Ga$	(From 1 by Universal Instantiation)
3. Fa	The antecedent of 2 (an instrumental "initial condition")
————	
4. Ga	The observation sentence (from 2 and 3 by *Modus Ponens*.)

More generally, then, for observation sentences such as (A), the basic structure of the deductive-nomological model of explanation yields an analysis of evidence-in-a-scientific-language that is formally similar to the analysis of evidence-in-a-mathematical-language, thereby skirting traditional objections noted above. This time, however, we must proceed one scientific language at a time (chemistry, biology, physics, geology and so on) because as yet there is no unified 'language of science' similar to *Principia Mathematica* (or, alternatively, Zermelo-Fraenkel set theory with the Axiom of Choice (ZFC).)

> (SES) Where *z* is an observation sentence[12] of a scientific language *SL*, <u>*z*-is-evident-in-*SL*</u> =Df There is a derivation-in-*SL* of *z* from true-in-*SL* instrumental-accuracy-law-sentences-of-*SL* and instrumental initial-condition-sentences-of-*SL*.

3.2 Knowledge-in-Scientific-Languages

Once again, we must first formulate a semantic concept of evidence-in-a-scientific-language for a person:

> (SES1) Where *z* is a wff of a scientific language *SL*, <u>*z*-is-evident-in-*SL* for S</u> =Df (i) There is a derivation-in-*SL* of *z* from true-in-*SL* instrumental-accuracy-law-sentences-of-*SL* and initial-condition-sentences-of-*SL*, (ii) this derivation-in-*SL* of *z* is believed-in-*SL* by S.

Finally, here is my semantic conception of scientific knowledge:

[12] I am aware that a scientific language will need a semantic predicate that can, at least in principle, apply to the full range of sentence-types that can be considered well-formed relative to the language's rules of formation, including universally quantified sentences and sentences that contain theoretical terms. I restrict the definition to observation sentences, i.e., those whose non-logical expressions are all observational, because at the moment I am only interested in outlining the foundations of my theory.

(SKS) <u>*z* is known-in-*SL* by S</u> =Df (i) *z* is true-in-*SL*, (ii) *z* is believed-in-*SL* by S, (iii) *z* is evident-in-*SL* for S.

4. Objections and Replies

4.1. *Your version of semantic epistemology is unnecessary because traditional epistemology can easily accomplish the same goal by assigning epistemic properties to sentences or semantic beliefs, leaving existing details unchanged.*

This is not the case. First, I note that a semantic conception of knowledge entails a semantic conception of truth, which Tarski makes quite clear applies only to formalized languages – one semantic concept of truth for a propositional calculus and another for a predicate calculus. Traditional epistemology wishing to go the semantic route would therefore have to be limited to a semantic conception of knowledge for formalized languages, a limitation unacceptable to traditional epistemologists. Second, given that a general semantic analysis of knowledge is not an option for traditional epistemologies, it would serve no purpose for foundationalism, coherentism, reliabilism and so on to develop only semantic conceptions of evidence unique to their respective approaches. Finally, it's unclear that all non-semantic epistemologies would be happy with assigning epistemic properties to sentences or semantic beliefs. Foundationalism, for example, is inextricably tried to propositions or non-semantic beliefs as the bearers of epistemic properties. Reliabilism would have to do a great deal of work to connect reliable cognitive processes to semantic beliefs to define a semantic reliabilist concept of evidence. Other epistemologies would also face daunting tasks – again, to no clear purpose.

4.2. *A semantic conception of knowledge is unnecessary because traditional epistemology already has a conception of knowledge that is adequate for science and mathematics.*

This argument is inconclusive because I too can make it; namely, if semantic epistemology is sufficient to account for scientific and mathematical knowledge, then non-semantic epistemology is not necessary. But this is not the best reply. The best reply is to meet the argument head on and challenge the general adequacy of the traditional conception of knowledge.

An analogy will help make my case. Consider the naïve conception of a set held by Cantor and Frege, which contained a comprehension schema that creates sets all at once by specifying a common attribute. In his famous paradox, Bertrand Russell produced a derivation in the language of naïve set theory proving this axiom was inconsistent. To solve the problem he had discovered, Russell pondered the naïve conception of a set itself and asked whether more than just a single axiom was at fault. As a result, the iterative conception of a set was developed, with a separation axiom that generates sets not all at once but rather in stages.[13] In true scientific fashion, a concept that seemed perfectly adequate initially had to be rejected because it led to paradox.

The traditional definition of knowledge seems to me to be in a similar bind. My argument for this claim is the Gettier Problem,[14] which I see as a paradox with the same force as Russell's. With a bit of work, Gettier's insight can be converted into a formally adequate argument to prove that the traditional definition of knowledge is inconsistent.

1. P is evident for a person S ……………………………..Premise
2. S believes P ……………………………………...........Premise
3. P logically implies P v Q ………..…………….…...........By Addition
4. Q is true entirely by luck, accident or coincidence ....Premise
5. P is false …………………………………………….......Premise
6. P v Q is true …..……………………..….....................5, 4, definition of "v"
7. S recognizes the inference from P to P v Q ……………Premise
8. S believes P v Q on the basis of recognizing the inference from P to P v Q ………………………...Premise
9. For any X and Y, if X is evident for a person S, X logically implies Y, S recognizes the inferences from X to Y, and S believes Y on the basis of recognizing this inference, then Y is evident for S ………………….……………………………………………Premise
10. P v Q is evident for S ……….……………….....................From 1, 3, 7, 8, 9
11. For any X, if X is true, S believes X, and X is evident for S, then S knows X …………………………..…..……….……………………Premise
12. *S knows P v Q* ………….………………...........................From 6, 8, 10, 11
13. For any X and Y, if X is true entirely by luck, accident or coincidence and Y is false, then X v Y is true entirely by luck, accident or coincidence ……………………………………………………………Premise
14. P v Q is true entirely by luck, accident or coincidence …..From 4, 5, 13
15. For any X and Y, if S believes X and X is true entirely by luck, accident or coincidence, then it is not the case that S knows X …………………………………………………….......Premise
16. *It is not the case that S knows P v Q*.………………..........From 8, 14, 15
17. S knows P v Q *and* it is not the case that S knows P v Q …………………………………………….....................From 12, 16, Q.E.D.

[13] An excellent discussion of these issues is George Boolos, "The Iterative Conception of Set," *Journal of Philosophy* 68, 8 (1971): 215-231.

[14] Edmund L Gettier, "Is Justified True Belief Knowledge?" *Analysis* 23 (1963): 121-23.

To be sure, this argument by itself does not prove that the traditional definition of knowledge is hopeless, nor that the non-semantic conception of knowledge is in principle indefinable. However, the sheer number, variety, and complexity of solutions for dealing with the Gettier Paradox, many of which are open to increasingly convoluted counterexamples, is suggestive.[15] By comparison, the iterative conception of a set was formalized six years after Russell's famous 1902 letter to Frege announcing the paradox,[16] and the mathematical world moved on, with Frege himself as the lone holdout, still trying to save the naïve conception of a set by imposing restrictions on his comprehension schema, Axiom V.

4.3. *What is your way out of Gettier's Paradox?*

As with any argument that is logically correct, the remaining option is to reject a premise.

First, because SKM and SKS rule out evident falsehoods, my semantic conception of knowledge rejects the joint assertion of steps 1 and 5 of the argument. Second, for me, deduction does not carry epistemic value from one sentence to another as simply as step 9 suggests.

> 9. For any X and Y, if X is evident for a person S, X logically implies Y, S recognizes the inferences from X to Y, and S believes Y on the basis of recognizing this inference, then Y is evident for S.

Under SES, Y can be a semantically evident observation sentence of a scientific language only if Y is entailed by a sentence X that is a conjunction of two sentences of that language (that need not be semantically evident): an instrumental accuracy law and an initial condition. For example,

> (A1) The temperature is 74.6 degrees Fahrenheit

can be semantically evident for S, and yet a sentence it logically implies such as

> (A2) The temperature is above freezing

can fail to be semantically evident for S even though S may believe (A2) on the basis of an inference from (A1) and

> (A3) If the temperature is 74.6 degrees Fahrenheit, then the temperature is above freezing

[15] See Robert K. Shope, *The Analysis of Knowing: A Decade of Research* (Princeton: Princeton University Press, 1983).

[16] The letter is reprinted in Jean van Heijnoort, *From Frege to Gödel* (Cambridge: Harvard University Press, 1967), 124-5.

because (A3) is true by definition and not an instrumental accuracy law. Thus, I reject step 9 of the (reconstructed) Gettier argument.

4.4. *Abandoning a distinction as old as Plato between 'the true' and 'the evident' to solve the Gettier problem seems conveniently ad hoc.*

I am only abandoning half of the distinction. There are two questions at issue: whether 'true' entails 'evident' and whether 'evident' entails 'true.' Along with everyone else, I reject the first entailment – not because intuition so directs it but rather because of modern mathematical and scientific discoveries. Thus, Gödel proved that a (non-axiomatic) sentence-of-ML (e.g., arithmetic) could be a tautology-in-ML even though there is no derivation-in-ML of it – thus the sentence is neither evident-in-ML nor known-in-ML.[17] And quantum mechanics has the phenomenon of incompleteness in the form indeterminacy, though only as a matter of contingent fact. My view is compatible with modern discoveries about the limits of knowledge.

I accept the second entailment for a reason that is independent of my semantic theory of evidence: Occam's Razor. Science and mathematics do not need a semantic evidence predicate that allows for the possibility of sentences being both evident and false because we can make room for this possibility another way, namely, by means of the concept of 'ostensible evidence.' This option is already available for other epistemic concepts (semantic or otherwise) such as memory and even knowledge itself, as well as non-epistemic concepts such as ontological commitment. Moreover, there is non-philosophical precedent for disallowing the possibility of evident falsehoods as well: The concept of evidence in jurisprudence does not allow for it,[18] and if it did, serious harm to judicial practices and reasoning – indeed, to justice itself – would result.

4.5. *What do you propose to put in place of a principle such as step 9? After all, unless a theory allows deduction to carry both truth and epistemic value from one sentence to another, it will be impossible to explain the growth of knowledge.*

Observation sentences that are semantically evident according to SES form a foundation of sorts and might be said to be directly or instrumentally evident in the sense that their epistemic status is based on a sensor or measuring device conveying information about the world. At the same time, semantically evident

[17] Pursuing the implication of Gödel's celebrated results for semantic mathematical knowledge is also beyond the scope of this paper.

[18] The language of law is an example of a language that is neither scientific nor mathematical into which the introduction of a semantic predicate of the sort sketched here might realistically be expected. This would entail showing that a legal system could be put on an axiomatic footing and that the required logical machinery could be developed within those confines.

observation sentences do indeed logically imply all manner of other sentences and I agree this fact should count toward their epistemic status. The simplest solution is to consider such sentences as 'inferentially evident.' Thus,

(A2) The temperature is above freezing

is inferentially evident because it is a deductive consequence from an instrumentally evident sentence such as

(A1) The temperature is 74.6 degrees Fahrenheit,

together with an appropriate definition,

(A3) If the temperature is 74.6 degrees Fahrenheit, then the temperature is above freezing.

This sketch of the 'inferentially evident' will have to suffice for now. The precise manner in which my theory explains how old knowledge can generate new knowledge is another issue that will have to wait its turn.

4.6. *Explanation and justification are different concepts, so a theory should not confuse them. Show that your use of the D-N model structure does not do so.*

I agree that using the D-N model of explanation as a theory of justification is a mistake. "Iron bars expand when heated" and "This iron bar was heated" logically imply and explain but do not justify "This iron bar expanded." According to SES, however, the justification of a sentence about the length l2 of an iron bar at t2 consists of deduction from an instrumental accuracy law about length measurements coupled with a sentence about the length l1 of the iron bar at some earlier time t1 such that l2 > l1. Laws of nature are not part of the definition of my semantic conception of scientific evidence. The relation between laws of nature and instrumental accuracy laws is another area of further inquiry.

4.7. *Your definitions are too narrow because they rule out knowledge based on testimony. For example, scientists must be allowed to have knowledge in areas of their own field even if (a) they were not present in the lab when a discovery was made and only heard about it from a colleague who was present, or (b) a description of the discovery in a scientific journal does not say anything about the instruments or measurements involved.*

I agree that what Russell called 'knowledge by description'[19] is genuine and needs to be captured by semantic epistemology. In regard to (a), semantic knowledge should be 'transmissible' from expert A, who has it by satisfying SKS,

[19] Bertrand Russell, "Knowledge by acquaintance and knowledge by description," *Proceedings of the Aristotelian Society*, 1910-1911. Reprinted in his *Mysticism and Logic* (Totowa: Barnes & Noble Books, 1951), 152-167.

to expert B, who would have it based on A's 'say-so.' Intuitively, what is needed here is a concept of indirect semantic evidence that entails a true counterfactual of the form "If expert B had been in the lab when the discovery was made, then B would have had semantic knowledge." Case (b) strikes me as an example of what might be called 'provisional' knowledge, spelling out which would also require a counterfactual, but of the form, "If the scientific journal had mentioned instruments or measurements used in making the discovery, then an expert reader would have had semantic knowledge." How to make these intuitions precise within my theory is also an issue that will have to wait its turn.

4.8. *"Derivation" is ambiguous between a proof sketch of the sort that is customary in mathematics – e.g., Euclid's reductio argument showing that the square root of 2 is irrational – and a formal proof of validity listing each step in the inference chain along with the rules used. Which concept is intended in SEM1 and SES1?*

This ambiguity has no practical significance for the belief clause of SES1. Believing-in-SL the derivation of some z is a simple matter even in the stronger sense of formal proof of validity, because the reasoning involves only the universal instantiation of an instrumental law-sentence-of-SL, followed by detachment of z from this instantiation and an initial condition sentence of SL by means of modus ponens. The complexity of the premises of this short argument, which can be considerable in some cases, does not measurably increase the formal doxastic burden.

The situation changes dramatically when we turn to mathematics, where even the simplest and most intuitive of proof sketches can take dozens of steps to express as a formal proof of validity. For example, stating Euclid's argument that $\sqrt{2}$ is irrational as a formal proof of validity in first-order logic with identity took me over 50 lines! The formal doxastic burden may well turn out to be excessive if SEM1 were to require that derivation mean formal proof of validity. There is no reason, however, why I must depart from normal mathematical practice and insist on a stronger requirement.

4.9. *Defining evidence in terms of deduction may be fine for mathematics but it is not sufficient for purposes of empirical science, which requires induction to arrive at laws of nature in general and instrumental ones in particular. Once induction is allowed a role, however, we are back to square one having to face old Humean and other skeptical worries.*

I qualified my title to indicate that my purpose here was only to introduce what is a radically new and different conception of epistemology, and not necessarily spell out all its major implications, which would require book-length treatment. That said, I'm inclined to see what is called inductive inference as the deduction of probabilities, which would make induction a part of the mathematical theory of probability and thus not a special type of inference after all. The real issue, to my mind, is not the nature or limitations of inductive inference but rather which interpretation of probability is necessary and sufficient for scientific purposes, a problem that cannot be pursued here.

4.10. *What does semantic epistemology have to say about distinctions in philosophy such as a priori/a posteriori, analytic/synthetic, and necessary/ contingent?*

Only the first of these is an epistemic distinction. My view is that the difference between the two types of knowledge concerns the types of premises used to deduce a sentence that is semantically evident. A sentence semantically evident a priori is derived from axioms that are known a priori, so I can say that such a sentence owes its epistemic status to sentences already known a priori. Everything in the chain that leads by deduction to a sentence that is semantically evident a posteriori is known a posteriori, so once again I get to say that such a sentence owes its status to sentences known a posteriori. Intuitions behind the a priori/a posteriori distinction remain where they are.

4.11. *Instrumental accuracy laws are few and far between once we move away from the 'hard' sciences such as physics, chemistry, and biology. By comparison, your semantic epistemic predicate would do little work in psychology, anthropology, and sociology, for example.*

The problem goes much deeper than that. I am skeptical that languages of the 'soft' sciences can even be built with the level of rigor required to give meaning to the concept of derivation common to SEM and SES. The exception might be certain parts of experimental psychology or anthropology but those languages already behave very much like the language of physics in the way observation predicates are introduced and should have available instrumental laws, hence SES would indeed apply. The rest …

4.12. *How does semantic epistemology respond to traditional skeptical arguments?*

Many of these arguments rely on the assumption that a belief can be evident and false, and then use the assumption in various ingenious ways to create an unbridgeable gulf to knowledge. Semantic epistemology does not allow for the possibility that a sentence is both evident and false. As noted earlier, a sentence can be ostensibly evident and false; however, a skeptical argument against the ostensibly evident would not have any force against the possibility of semantic knowledge, empirical or mathematical.

4.13. *The vast majority of people spend their lives thinking and communicating largely in a native vernacular, holding few if any semantic beliefs in scientific or* *mathematical languages. Have you anything to offer in the way of a theory of evidence-in-L, where L is a natural language?*

To pick up where the previous reply left off, natural languages are in an even worse position than those of 'soft' sciences, where at least a modicum of formal rigor is an attainable goal. For example, 'sentence of English' does not have a status in English equivalent to 'well-formed formula,' nor does it make sense to speak in English of recursive application of rules of inference. The standard concept of consistency, without which derivability could not even gain a foothold, is not clear at all for natural languages, because it's not obvious what it means to prove the consistency of English by showing that there is a sentence of English that is not a theorem of English, where this is not merely a reference to the grammar or syntax of English. Finally, let us recall that the vernacular is semantically closed, which leads immediately to the Liar Paradox.

Solving these problems is a rather tall order. It amounts to a kind of skepticism about the ordinary concept of knowledge that Descartes never considered and may well be the real reason why philosophers have never even considered having a hard look at a semantic conception of evidence that essentially turns its back on familiar intuitions. Perhaps the best we can do is to translate sentences of epistemic interest from a natural language into a scientific or mathematical one and then try to resolve evidentiary issues there via the semantic route I have proposed. This paper is hardly the place, however, to even begin suggesting how such translations might be effected.

Finally, I am aware of widely held, cherished, and in a broad sense valuable beliefs – God exists, life has meaning, we are morally responsible for our actions – that are by no means easily translatable into a scientific or mathematical language. I agree it would be a mistake to regard such beliefs either as falling outside the realm of rationality or as being cognitively defective somehow; I am not a positivist. How such beliefs would fit within the scheme I have proposed is also a matter for another occasion.[20]

[20] Paul Moser, Gary Rosenkrantz, and the late Philip Quinn provided helpful comments on earlier versions of this paper.