
LETTERS TO THE EDITOR

Genetic Epistemology

Editor:

In his recent article in AI Magazine, "AI prepares for 2001," Nils Nilsson put forward a paradigm of AI based on a declarative representation of knowledge with semantic attachments to problem-specific procedures and data structures. The author discussed various research strategies for AI and specifically a computer-individual project was introduced as an efficient way of stimulating research and advances in the basic science of AI. The undertaking of such a project immediately raises some classical psychological questions. Besides the deductive versus inductive or declarative versus procedural controversies, problems related to knowledge representation and evolution in an interactive environment must be considered. I would like to present some ideas and concepts stemming from current research in Genetic Epistemology (GE), initiated by Jean Piaget, as possible contributions to AI research fields.

Knowledge is a common preoccupation for GE and AI. Although AI deals with such topics as knowledge representation, knowledge exploitation, and knowledge acquisition, as is reflected in the new developing Knowledge Engineering science, few research works consider the following question: How is Knowledge made possible?

This interrogation is precisely the core of the Piagetian doctrine of GE [Piaget (1970)].

GE is concerned with knowledge considered as a process, [Piaget (1964)]. The obvious point of convergence of AI and GE is precisely this concept of knowledge as a process. AI provides programming languages for pattern process and might yield the formal linguistic requirements Piaget had sought with difficulties in algebraic structures. The GE distinction between operative and figurative knowledge can be mapped into the distinction between program and data, procedural and declarative, or even inference engine and knowledge base. Formal languages provide precision for statement and power of deduction. Nevertheless programming languages might contain suppositions regarding the phenomena they are supposed to model; programs depend on representations of knowledge and would not explain it.

Moreover AI is concerned with sufficiency in knowledge considerations, and is still alien to the concerns of necessity in GE. The basic test of AI remains the Turing test. Such an experiment discriminates programs with insufficient capability for acting as a human subject, although AI insists that a winning program should be faithful to the actual way this capability is realised in human beings. The three following points emerge from AI research and applications:

- "Sufficiency" is extremely difficult.
- Efficiency and sufficiency are the only relevant considerations from the practical perspective of programming.
- Sufficiency implies finding a guide to investigate the case of human beings.

The same assumptions are implicit in the actual design of rule-based expert systems, which follows a kind of stimulus/response model. The rule-based expert system is provided a set of production rules, figuring the mathematico-logical frame in the previous piagetian analysis, allowing processing of inputs and problem solving. The experiments with AM and EURISKO have shown that applying syntactic mutation operators to design new heuristics, involving no revisions of the logical rule-frame, in order to improve problem-solving performances succeeds only because syntax mirrors semantics in the domains where the programs were applied. The revision of representations occurring in the active assimilation model suggested by GE is deeper than syntactic mutations guided by meta-rules provided by the operator [Michalski, *et al.* (1983)].

If we are willing to consider a computer-individual, as suggested by Nilsson, as an epistemic subject, following Piaget, there is then no need for any distinction between rules and meta-rules or knowledge-base and inference engines. The "epistemic program" should undergo by itself a series of revisions of representations, and thus experiment different schemes of perceptions—or inference engines—as the mathematico-logical structure underlying the dynamic assimilation process undergoes alterations. As we can obviously not trace this assimilation process down to a biological, or genetic, level in the case of computers (in the current state of the art of computer technology), such "epistemic programs" should start running with some "inherited" structure set up by the operator. The overall process of learning, and knowledge acquisition, could then be characterized as skills refinement. The Piagetian assimilation process and revision mechanisms were actually implemented in a domain-specific application for feasibility demonstration. The behavior of this particular "epistemic program" yields interesting convergences with the novice-to-expert knowledge acquisition process as well as drastic divergences from probabilistic models for revision of a given corpus of knowledge [Rappaport & Chauvet (1984)].

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On Defining "Knowledge"

Editor:

Kosko's enthusiasm over his proposed definition of "knowledge" (Letters to the Editor, *The AI Magazine* (Fall 1984), p. 5) invites critical assessment of its theoretical adequacy. Since "facts" appear to be neither more nor less than true statements themselves, it creates circularity to maintain that statement *S* is true when *S* is "a factual truth (a correspondence with fact)", which impairs the significance of Kosko's truth condition. Since an agent *x* may believe that *S* is true whether or not "if verbally stimulated, the agent emits an assent response to *S*, a dissent response to not-*S*", as a function of pragmatic circumstances, Kosko's belief condition likewise requires qualifications. And, since an agent *x* might be justified in the belief that *S* is true without being able to "justify its belief that *S* is true" by providing the grounds, reasons, or evidence upon which that belief rests, Kosko's justification condition cannot be quite right. These complaints, however, are objections to detail, and they certainly do not demonstrate that Kosko's conception is completely wrong.

Indeed, philosophers have displayed an enduring infatuation with the conception of knowledge as justified true belief for perhaps 2000 years (roughly, since the time of Socrates). Yet there are excellent grounds to suspect that, even if these questions of detail could all be ironed out, the analysis which would remain might not be entirely satisfactory. As Russell observed in 1912, "If a man believes that the (then) late Prime Minister's last name began with a B, he believes what is true, since the (then) late Prime Minister was Sir Henry Campbell Bannerman. But if he believes that Mr. Balfour was the (then) late Prime Minister, he will still believe that the late Prime Minister's name began with a B, yet this belief, thought true, would not be thought to constitute knowledge" (Russell 1959, pp. 131-2). Examples of this kind have preoccupied theoreticians of knowledge since Gettier's article of 1963, and now whole books have been devoted to "the Gettier problem", namely: whether or not justified true belief is sufficient for knowledge (see, for example, Shope 1983).

My purpose in writing, let me add, is not to suggest that "knowledge" is impossible to define or that this project should be abandoned, but instead to emphasize what some of your readers no doubt already realize, i.e., an enormous amount of work has previously been done on problems such as these, especially within the theory of knowledge. The nature of knowledge is regularly addressed in lectures, articles and books, research within epistemology that AI can utilize without the agony of rediscovery. An accessible introduction to the theory of knowledge, in general, may be found in Scheffler (1965); a less accessible investigation of the nature of scientific knowledge, in particular, may be found in Fetzer (1981). Indeed, as

my former student, Terry L. Rankin, has convinced me, it is illuminating to entertain AI itself as (the principal domain of) applied epistemology. This assertion, I believe, is justified and supports the expectation that the theory of knowledge might provide an access route whereby AI itself could be better understood as a theoretical endeavor.

References

- Fetzer, J. H. (1981) *Scientific Knowledge: Causation, Explanation, and Corroboration*. Dordrecht, Holland: D. Reidel.
- Gettier, E. (1963) Is Justified True Belief Knowledge? *Analysis* 23: pp. 121-123.
- Russell, B. (1959) *The Problems of Philosophy*. New York: Oxford University Press.
- Scheffler, I. (1965) *Conditions of Knowledge*. Glenview, Illinois: Scott, Foresman and Company.
- Shope, R. K. (1983) *The Analysis of Knowing: A Decade of Research*. Princeton: Princeton University Press.

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AAAI-84 Profile

Editor:

Perhaps readers of the AI Magazine would be interested in some eyeball demographic impressions of AAAI-84, from a new AAAI member attending his first such meeting.

The typical attendees were young, white males who were slim, quiet, cool, polite, informal and nonsmoking. In slightly more detail:

- Men seemed to outnumber women by some five to one. Many attendees seemed in their twenties and thirties, some in their forties, few (including me) in their fifties, and none older. Almost everyone was white. I saw very few orientals and only a handful of blacks.
- Most seemed slim, even athletic, while very few were much overweight.
- Quiet: I was able to converse at normal volume immediately before a session in a room containing five to eight hundred people.
- Polite: "Please" and "thank you" were the rule, and "After you" prevailed at elevator doors. Queuing up seemed automatic.
- Cool: There were no emotions in sight, no shouts, no tears, no hugs, few laughs.
- Informal: Roughly one man in ten wore a coat and tie. The women all seemed to dress casually except for the manufacturers representatives.

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• Non-smoking: What few smokers I saw were again mostly manufacturers representatives.

For the most part the women also seemed young, white, slim, etc. Some half of them wore no wedding ring.

Sincerely yours,
Stan Franklin
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P.S. Great meeting!

(*Maybe the slim ones know about meta-ravioli. See next letter. —Ed.*)

Meta-Ravioli

Editor:

One of my colleagues at Teknowledge, David King, saw the following item on the menu in an Italian restaurant:

meta-ravioli

In passing he asked me if I happened to know anything about this particular use of the *meta-* prefix. I promised I would look into it. I would like to share the results of my research with you.

In Italian, the word *metá* means *half* or *middle*. So in this case the menu was probably advertising a half order of ravioli. It is interesting to note that the Italian word *méta* means *goal* or *aim*. Similarly, the Latin word *mēta* (with a long *e*) means *goal*, as does the Spanish word *meta*. So much for Romance linguistics. However, all of this has nothing to do with the origin of the *meta-* that we have all come to know and love!

The following two extracts from the Oxford English Dictionary explain how the *erroneous* use of the Greek *metá* was introduced into English:

The supposed analogy of *Metaphysics* (misapprehended as meaning *the science of that which transcends* has been followed in the practice of prefixing *meta-* to the name of a science, to form a designation for a higher science (actual or hypothetical) of the same nature but dealing with ulterior or more fundamental problems.

The second extract explains how the misapprehension started. The word *metaphysics* comes from the medieval Greek word *metafisiká* "...which is an alteration of the older *tá metá tá fisiká* ..." (Note that *tá* is just the definite article.) In this context the word *meta* simply means *after!* Thus, the Greek phrase

...literally means *the (works) after the Physics*, the title applied to the thirteen books of Aristotle dealing with questions of "first philosophy" or

ontology. This title doubtless originally referred (as some of the early commentators state) to the position which the books so designated occupied in the received arrangement of Aristotle's writings (*tá fisiká* being used to signify, not the particular treatise so called, but the whole collection of treatises referring to natural science.) It was, however, from an early period used as a name for the branch of study treated in these books, and hence came to be misinterpreted as meaning *the science of things transcending what is physical or natural*. The misinterpretation is found, though rarely, in Greek writers, notwithstanding the fact the word *metá* does not admit of any such sense as "beyond" or "transcending"

Among scholastic Latin writers the error was general (being helped, perhaps, by the known equivalence of *meta* and *trans-* in various compounds)...

And so folks, that's the way it was...

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