THE METAPHYSICAL BASIS OF LOGIC

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Logic is not metaphysically neutral. For propositional logics assumptions are needed about the nature of the world as it relates to propositions. Predicate logic assumes a metaphysics of individual things. The metaphysics is reflected in the linguistic forms chosen for investigation. The scope and limitations of the logic are determined primarily by the metaphysics. The metaphysics of predicate logic precludes analysis of inferences that depend on aspects of verbs. A logic of processes is needed, for there is much more in the world than everything.

PROPOSITIONAL LOGIC

There is enough common in how people understand what a proposition is to establish propositional logic with seemingly no metaphysics. But metaphysical assumptions are needed. At the very least there must be a smallest unit of language that relates, or corresponds to what relates in some way to the "world". The relation is a dichotomy: true, false/agree, disagree/assertible, nonassertible/designated, undesignated. Then metaphysical, or more commonly epistemological assumptions are used to establish a particular propositional logic, as I have detailed in my survey *Propositional Logics*[1].

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[1] See Epstein (1995).

It is an illusion that propositional logic can be metaphysically neutral, just an axiom system in a formal language. Logic is meant to codify and/or prescribe correct reasoning, and there would be no reason to adopt any logic without some talk of a dichotomy on propositions relating to the world.

PREDICATE LOGIC

Predicate logic was developed as an alternative to Aristotelian logic. Many inferences, especially in mathematics, were seen to be about things – individual things – using propositions that related those things. Validity was to be justified on the basis of an intuition about how to reason about things. Linguistically the logic was derived from consideration of inferences that involved the following:

names	"every"
Pronouns	"some"
Predicates	phrase markers
	the connectives of propositional logic

There is a core of agreement about the nature of predicates that requires little metaphysics beyond that of propositional logic. Predicates as needed in this analysis are or correspond to parts of propositions, parts with blanks (unsaturated, if you like). They fall

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In attempting to explain truth without metaphysics, those who avow a coherence theory of truth merely conceal their metaphysical assumptions. Coherence depends on a choice of logic, and justifying the choice of logic depends on a metaphysics. Conformity with how people reason cannot be a basis of coherence, because there is not enough uniformity in that. Nor can we use conformity with how the "experts" reason, since the experts, too, do not agree on one logic, even supposing we could say who the experts are.

The idealist, too, has a "world", albeit different than the realist, which stands at the heart of his use of propositional logic.

into the dichotomy (true, false/agree, disagree/etc.), when those blanks are filled. (See Epstein (1994)).

But how do we distinguish what can be taken out of a proposition to form a blank, and what can fill a blank? Simply: words for individual things (names and pronouns). Predicate logic requires the following assumption.

THINGS, THE WORLD, AND PROPOSITIONS

1. The world is made up to some extent of individual things.
2. There are many propositions and inferences that can be understood as being about individual things.
3. We shall be concerned with propositions and inferences only insofar as they can be construed as being about individual things.

Originally the metaphysics was quite explicit. The logical positivists, however, wanted logic free of all metaphysical assumptions. Some of them still believe that predicate logic can be developed without any reference to the nature of the world, relying solely on our intuition about which forms of inferences are valid. But there are always exceptions to those forms. Consider:

> Peter is in a car.
> *Therefore:* There is a car.

This is valid. It is impossible that the premise be true and conclusion false. It is an archetypal valid inference for formalization in predicate logic. But consider:

(a) Peter is in a hurry.
   Therefore: There is a hurry.

(b) Peter is in a huff.
   Therefore: There is a huff.

What entirely syntactic intuition can justify our ignoring these apparent counterexamples? We say "Peter did it for the sake of Dick" and "Tom left Dick in the lurch", but we do not think that "sake" and "lurch", nor "hurry" nor "huff" stand for things, and that is why we do not reason with them as if they did.

Some disagree, saying we can argue about lurches and sakes just as well as about cats and dogs. All we need are that the words are meaningful and that they play the correct grammatical role. So (a) and (b) are valid.

But we cannot found a logic solely on inductive generalizations from examples of true propositions and valid inferences, especially when there are apparent counterexamples. We need assumptions about the nature of the world to justify why some general forms of inferences are valid. Once the assumptions are made and generally accepted, the logical positivists can remake predicate logic. But they cannot make predicate logic[2].

The syntactic view is supported, though, by noting what an extraordinary variety falls under the category *thing*. How can this be a category of the world? Isn't "thing" just a place-marker?

We do have some notion of what a thing is. It is not entirely precise, but in many cases of individual things we can agree: ta-

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[2] Hailperin (1997), also remakes predicate logic. He claims to have presented a first-order logic that has no ontology. However, his formal system relies on an ontology of functions (or humans following instructions). Nominalism and constructivism are not ontology-free.

But the deeper problem with his work is that which infects much of mathematical logic. Logic is about how to reason correctly. Any formal system can be called a "logic" by analogy with other systems that bear that title. But a formal system becomes a logic only when semantics are provided for it that relate it to reasoning, as I have argued in Chapter IV of Epstein (1995), and Chapter IV of Epstein (1994). Hailperin does connect his formal system to reasoning by showing how to translate inferences in first-order predicate logic to his system. Thus the ontology of predicate logic must be invoked in order to justify calling his system a "logic".

bles, chairs, people, dogs, rutabagas are individual things. In many cases we don't agree: real numbers, infinite sets, wisdom, atoms – are these things?

In establishing predicate logic we find that there is a very substantial agreement about how to reason about things, even when people disagree about whether certain words stand for things. That uniformity in our views is reflected in our being able to develop a clear logic with clear semantics that can justify many of our intuitions about the validity of certain deductions. *Predicate logic,* in its fundamental form before any particular predicate logic is adopted (intuitionist, many-valued, classical, ...), *serves to define implicitly our notion of thing.* A thing is that which can be reasoned about in predicate logic[3].

SECOND-ORDER PREDICATE LOGIC

Metaphysical disputes about the nature of predicates do not affect the basis of predicate logic, since predicates are used only to

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[3] Alternatively, one could say that a thing is that which can be counted and to which the laws of elementary arithmetic apply. So, for example, mud would not be a thing, because two muds together become one mud. But there are difficulties in this view, primarily because it does not demand as much in specifying the naming process as predicate logic does, and too much seems to be made of juxtaposition and physical contact. Morris Cohen and Earnest Nagel (1934), say:

> The vague concept of "thing" denotes, therefore, a very elementary but fundamental type of order. It denotes a certain invariable conjunction or association of properties that is different from other conjunctions.

They give as an example water. But water isn't a *thing,* as discussed in Section D below. And the properties they say water has are mostly dispositions to exhibit properties. The bigger problem, though, is that you can't take properties as more fundamental than things, because a property has to be a property (potentially at least) of a thing, thus presupposing a notion of thing.

the extent that they can be identified with pieces of language. However, in analyses of reasoning that allow for quantifying over predicates, disagreements are sufficient to generate no common logic. Whether the collection of all predicates contains objects that cannot be identified with pieces of language affects the forms of reasoning that are deemed valid[4].

ARISTOTELIAN LOGIC

Aristotelian logic considers propositions only insofar as they can be assimilated to ones in the forms:

All – are –
Some – are –
No – are –
Some – are not –

Linguistically, these seem a simple and apt collection of forms whose role in inferences can be analyzed easily. But to fit much reasoning into these forms requires a substantial and complex metaphysics. The blanks in the forms can be filled variously by words standing for qualities, substances, or categories. And talk of things is essential, too, to justify the validity of inferences such as:

All dogs bark.
All that bark are mammals.
Therefore, all dogs are mammals.

Even the rewriting of the colloquial "Everything that barks is a mammal" as "All that bark are mammals" demands metaphysical assumptions.
Or consider:

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[4] See Chapter X of Epstein (1994).

> All that is beautiful is valuable.
> Gold is beautiful.
> *Therefore:* Gold is valuable.

Routinely analyzed in Aristotelian logic, the rewriting is difficult and metaphysically suspect, requiring masses to be viewed on a par with cats and dogs.

Nonetheless, for two millennia this was the best logic available. As a result, reasoners tried to force all inferences into the forms of Aristotelian logic, with the result that the best form of reasoning determined the fundamentals of metaphysics.[5]

In predicate logic this last inference cannot be analyzed[6]. Gold is not a thing; we cannot reason about it as if it were. Arguments become nonsense or invalid if we do. We can reason in predicate logic about this *bit* of gold, this *container* of water, that *patch* of mud, seeing them as things. But gold as a substance, water as a substance that is everywhere, we cannot reason about in

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[5] A similar point was made by Bertrand Russell (1914). But he then suggests that the logic of relations, essentially classical predicate logic, is the right logic using the right metaphysics (pp. 62-63):

> Thus a proposition is the same as what may be significantly asserted or denied. A proposition which expresses what we have called a fact, i.e. which, when asserted, asserts that a certain thing has a certain quality, or that certain things have a certain relation, will be called an atomic proposition. ... If we knew all atomic facts, and also knew that there were none except those we knew, we should, theoretically, be able to infer all truths of whatever form.
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> Footnote: This perhaps requires modification in order to include such facts as beliefs and wishes, since such facts, though not strictly atomic, must be supposed included if the statement in the text is to be true.

[6] See Chapter V in Epstein (1994), or Pelletier & Schubert (1989), Chapter IV.4.

predicate logic. The story of reference and identity we need to give in order to justify the valid forms of predicate logic do not apply to words that stand for substances. The clarity of the metaphysics of predicate logic imposes limitations.

PREDICATE LOGIC AND PROCESSES

There are other kinds of inferences that cannot be analyzed in predicate logic. Compare the following:

(1)   Juney is a black dog.
       Therefore: Juney is a dog.

(2)   Juney is barking loudly.
       Therefore: Juney is barking.

Each is transparently valid: It is impossible for the premise to be true and conclusion false. The first is easy to analyze in predicate logic. We rewrite "Juney is a black dog" as "Juney is black and Juney is a dog." We do so because both " – is black" and " – is a dog" are predicates, and we can understand the proposition as composed of two predicates asserted about a single thing.

But the second inference cannot be analyzed in this fashion. "Juney is barking loudly" is not two predicates asserted about one thing. It has one predicate " – is barking loudly". We can model the deduction (2) by adding a meaning postulate:

$\forall x$ (*x* is barking loudly $\rightarrow$ *x* is barking)

That works for this deduction, but to formalize all deductions like (2) we would need to add a separate meaning postulate for each use of each adverb. But that's just to say that in predicate logic we cannot model deductions like (2) except on an *ad hoc* basis.

Yet some say we can rewrite the first claim in (2) in such a way as to make it amenable to predicate logic methods:

> There is an instance of barking and it is by Juney and it is loud.

Then the reasoning in (2) is validated in predicate logic, for the conclusion is rewritten as: "There is an instance of barking and it is by Juney."

This is nonsense. It's like trying to squeeze "The head of a man is the head of an animal" into Aristotelian logic. There is a metaphysical mismatch.

In inference (2) the focus is on the *process* of barking, though even to talk that way makes barking sound like a thing. Our language has a prejudice to make all our talk into talk about things, but that does not mean that all our talk can be made to fit into talk about things. Processes are different from things, if our language is any guide to the world. The category of the world picked out by nouns is not the same as the category picked out by verbs. Indeed, in some situations we see the world entirely in terms of processes: Someone who trains a dog uses only commands and words of approval and disapproval[7].

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[7] Hanson (1958), tried to get us to see something like this:

> That it is yellow is a passive thing to say about the sun, as if its colour were yellow as its shape is round and its distance great. Yellow inheres in the sun, as in a buttercup. 'The sun yellows', however, describes what the sun does. As its surface bums, so it yellows. Now the grass would green; it would send forth, radiate greeness – like X-ray fluorescence. Crossing a lawn would be wading through a pool of green light. Colleges would no longer be cold, lifeless stone; now they would emit greyness, disperse it into the courts. As a matter of optics this is rather like what does happen; the change of idiom is not utterly fanciful. ... Speaking of colour-words as verbs just is to think of colours as activities and of things as colouring agents.
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> What if information about colours were expressed adverbially? We would then say 'The sun glows yellowly', 'The

Our understanding of things as used in predicate logic requires us to understand naming or somehow individuating things. We cannot name processes, at least not uniformly with how we name numbers, atoms, and chairs[8].

The problem is acute with, or reflected in our trouble in analysing tensed propositions in predicate logic. Tenses are aspects of verbs, or if you like, aspects of processes. Predicate logic must deal with timelessly true or timelessly false propositions. Consider:

(3)   Richard L. Epstein will never forget Juney.
(4)   Richard L. Epstein forgot Juney.

The first was uttered in 1991. The second was uttered in 1996. These are contradictory. But not in predicate logic. To be contra-

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grass glitters greenly', 'The chapel twinkles greyly'. If everyone spoke thus how could one insist on its being a fact that the sun is yellow, that grass is green, or that the chapel is grey? Could such 'facts' be articulated at all? ...

What of primary qualities? 'The sun is round' states a fact. So too 'St John's College hall is rectangular', 'sugar lumps are cubes'.

Try 'the sun rounds', 'St John's hall rectangulates', 'sugar cubes'. Activity is suggested here. Would one who saw the round sun see the sun rounding? The college hall *is* rectangular. Would this fact be apprehended by a man for whom the hall rectangulates-holding itself in a rectangular form against gravity, wind, cold and damp? Perhaps the man for whom the sun rounds would see the sun incessantly arranging itself as a sphere. If he can say only 'The sun rounds', how else can he see it?

[8] See Epstein (1994), for a fuller discussion of this. Salmon in ((1989), pp. 108-109), points out that the projection of a beam of light on a distant object can move with velocity greater than the speed of light. He calls such projections "pseudo-processes". But what is at issue, I suspect, is that we cannot take them to be things in accord with Einstein's theory of relativity.

dictory they would need to use the same predicate. Some suggest we rewrite the first as:

$$\forall x \, (x \text{ is an instant of time} \wedge x \text{ is later than June 5, 1991} \rightarrow$$
$$\neg(\text{Richard L. Epstein forgets Juney at } x)).$$

And the second as:

$$\exists x \, ((x \text{ is an instant of time} \wedge x \text{ is July 17, 1996}) \wedge$$
$$(\text{Richard L. Epstein forgets Juney at } x)).$$

But these are still not contradictory. We need that July 17, 1996 is later than June 5, 1991. And we need that instants of time are *things*. And we need to know exactly what we mean by "an instant of time", since we will have to name those. And we need to incorporate into the foundations of predicate logic most of the theory of real numbers in order to deal with linear continuous time, or argue for time as being discrete.

These explanations and assumptions about the nature of time are not comparable to the assumptions we need in order to take, say, atoms as things to reason about them in predicate logic. Rather, these explanations must be on a par with the other assumptions generating predicate logic, such as reference, since it is claimed that this is part of the standard scope of predicate logic. But we shouldn't need to master the mathematics of real analysis in order to justify why (2) is valid.

Rather, (3) and (4) are clearly contradictory, just as (2) is clearly valid, and that is because of the nature of processes, or whatever it is that we mean when we use verbs. To try to reason with (2), (3), and (4) in predicate logic is tantamount to making a much stronger metaphysical assumption:

THINGS ONLY, THE WORLD, AND PROPOSITIONS

1. The world is made up entirely of things.
2. All propositions and deductions are about things.

That is, the metaphysics of the best available logic is taken to be the full metaphysics, the only true metaphysics, so that the logic can be applied to all arguments.

We need a logic of processes to analyze (2), and we do not have that. We need a logic where, comparable to a predicate, one of the primitives recognized by the logic is what we get when we take the verbs out of a proposition. We do not have that[9].

A logic of processes will allow us to analyze many inferences that we cannot analyze in predicate logic. It is crucial for computer science, where modal logic is often forced to do the work of a tense logic. And the use-mention confusion of modal logic is no better when working with tenses than when working with necessity and possibility. Even in mathematics we need to recognize that it was a 19th century change that saw mathematics as being about things and structures only. Viewing functions as correlations of things to things, as collections rather than processes, was a novelty that has borne some fruit, but has also led to anomalies in the foundations of the real numbers, such as everywhere discontinuous functions. Processes are not that way, they used to say – but functions conceived as collections are[10].

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[9] W. V. Quine attempted to improve on Russell's theory of descriptions by changing every name into an adjective ("Pegasus" becomes "Pegasizing"; see Epstein (1994), Chapter VII, Section D). Nicholas Rescher seizes on this to try to produce "process semantics" in Rescher ((1996), pp. 175-182). But he does not say what language the semantics are designed for-formal symbols are introduced, so it isn't ordinary language, but no formal language is presented, nor obvious.

Moreover, he uses much of the formal language of predicate logic, apparently unaware that by simply using "∀" and "∃" he has imported a metaphysics of things into his analysis.

[10] Category theory is an attempt to place processes at the heart of reasoning in mathematics. However, nothing in the literature of category theory suggests any simple analysis of inferences such as (2), or (3) and (4) above.

AN EXAMPLE: DAVIDSON ON ACTIONS AS THINGS

Davidson says that we need to speak of actions and events in order to give the logical form of causation claims[11]. By "logical form" he means a manner of representing action statements in predicate logic[12]. In short: Since predicate logic is the best logic we have, we should be able to formalize in predicate logic inferences that rely on verbs, tenses, and adverbs. This can only be if actions and events are things. Therefore, actions and events are things.

Davidson realizes that if we are to take actions as things we must individuate them. But naming and identifying actions seems to be entirely different from naming chairs and numbers. Coming full circle, Davidson says that we can only identify actions by noting their causes and effects[13]. Yet we adopted actions as things in order to better understand causes and effects.

Actions and events as commonly taken by Davidson and his successors are artefacts of the view that predicate logic must account for all reasoning. To take actions and events as things means rewriting every proposition to eliminate all verbs except "is" (the aristotelians would be happy). It ignores the possibility that processes could be a distinct metaphysical category, a possibility that better explains our reasoning, though one which is not (yet) formalized[14].

Davidson is not alone. Carl G. Hempel, Morton White, Ernest Nagel all seem to think that any law of nature can be for-

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[11] "Causal Relations", in Davidson (1980).

[12] "The Logical Form of Action Sentences", in Davidson (1980).

[13] "The Individuation of Events", Davidson (1980).

[14] But what of causation? We do not need states of affairs (nor their new incarnations actions and events, or situations) but only propositions. What is the state of affairs (situation) that makes "Juney is barking" true? Well, Juney is barking, and there's no simpler way to say it. What action is referred to by "Juney was barking"? Juney was barking. We can identify causes and effects with propositions. Causal claims can be viewed as second-order claims about a relation between propositions, as I explain in my *Five Ways of Saying "Therefore"*, (Wadsworth (forthcoming)).

malized as a universal generalization or statistical claim in predicate logic[15].

Quine apparently believes that predicate logic can formalize all reasoning when he asserts, "To be is to be the value of a variable". What other than an unjustified faith that the world is made up only of things can justify answering the question "What is there?" with "Everything"?[16]

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[15] Or perhaps Aristotelian logic. See Hempel (1965); White (1965); and Nagel ((1961), pp. 32 and 47). Philip Kitcher (1989), develops criteria for what makes one theory simpler or better than another, but never considers that the theory might not be formalizable in predicate logic.

[16] But it might be objected that Quine doesn't really "believe" in objects; as he says in Quine ((1951), pp. 49-50):

As an empiricist, I continue to think of the conceptual scheme of science as a tool, ultimately, for predicting future experience in the light of past experience. Physical objects are conceptually imported into the situation as convenient intermediaries – not by definition in terms of experience, but simply as irreducible posits comparable, epistemologically, to the gods of Homer. For my part, I do, qua lay physicist, believe in physical objects and not in Homer's gods; and I consider it a scientific error to believe otherwise. But in point of epistemological footing, the physical objects and the gods differ only in degree and not in kind. Both sorts of entities enter our conception only as cultural posits. The myth of physical objects is epistemologically superior to most in that it has proved more efficacious than other myths as a device for working manageable structure into the flux of experience.

This sounds superficially as if Quine did not really "believe" in objects. It's just the best myth around, so let's act as if we believe in it.

But there is a deep confusion here. Of course it would be a scientific error not to ascribe to the existence of objects, but not as a lay physicist, rather as a professional physicist. Physical theories at Quine's time were based on objects, though even then fields as processes were fundamental. I do not know what a "lay physicist" is, but I do know that often we analyze the "flux of experience" in terms of flux and process, too.

There is a lot more in the world than everything. There are all those substances and all those processes. And who knows how much else when we develop better and better analyses of reasoning[17].

REFERENCES

COHEN, M. & NAGEL, E. (1934). *Introduction to Logic and Scientific Method* (New York, Harcourt, Brace and Company).

DAVIDSON, D. (1980). *Essays on Actions and Events* (Oxford & New York, Oxford University Press).

EPSTEIN, R.L. (1994). *Predicate Logic,* in the series The Semantic Foundations of Logic (Oxford University Press).

————. (1995). *Propositional Logics,* in the series The Semantic Foundations of Logic (Oxford University Press), 2nd edition.

HAILPERIN, T. (1997). "Ontologically Neutral Logic", *History and Philosophy of Logic,* vol. 18, pp. 185-200.

Further, Quine's unexamined pragmatism here is no good reason to act as if objects exist. On reflection we always have the problem pointed out so clearly by Mates: Do we believe it because it works, or does it work because we believe it? The same kind of argument could be made for English being the language of experience. Being efficacious seems to have no obvious relevance for epistemology.

[17] The view of logics based on metaphysical assumptions that I have presented here has consequences for how we formalize ordinary language deductions. Viewing such formalizations as translations from ordinary language to a semi-formal language, I have given criteria for good formalizations in Epstein (1994). Those criteria yield a substantially different understanding of the nature of formalizing the notion of validity than that put forward most recently by Etchemendy or by Sher. But that is more than I can discuss in this short attempt to make clear why it seems to me that first comes metaphysics, then comes logic.

HANSON, N.R. (1958). *Patterns of Discovery* (Cambridge, Cambridge University Press).

HEMPEL, C.G. (1965). *Aspects of Scientific Explanation* (The Free Press).

KITCHER, P. (1989). "Explanatory Unification and Causal Structure". In: KITCHER, P. & SALMON, W. (eds.) *Scientific Explanation,* Minnesota Studies in the Philosophy of Science, vol. XIII (University of Minnesota Press).

NAGEL, E. (1961). *The Structure of Science* (New York, Harcourt, Brace & World).

PELLETIER, F.J. & SCHUBERT, L.K. (1989). "Mass Expressions". In: GABBAY, D. & GUENTHNER, F. (eds.) *Handbook of Philosophical Logic,* vol. 4 (Dordrecht, Reidel).

QUINE, (1951). "Two Dogmas of Empiricism", *The Philosophical Review,* vol. LX.

RESCHER, N. (1996). "Process Semantics" in *Process Metaphysics* (New York, State University of New York Press), pp. 175-182.

RUSSELL, B. (1914). "Logic as the Essence of Philosophy", in *Our Knowledge of the External World* (La Salle, Open Court).

SALMON, W. (1989). "Four Decades of Scientific Explanation". In: KITCHER, P. & SALMON, W. (eds.) *Scientific Explanation,* Minnesota Studies in the Philosophy of Science, vol. XIII (Minnesota, University of Minnesota Press).

WHITE, M. (1965). *Foundations of Historical Knowledge* (New York, Harper and Row).