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LOGIC AND LANGUAGE

It has been commonly assumed for a long time and in wide circles that it is trivially true that the sentences of a language can, in principle, be translated into some logical language which provides both a semantic and a logical analysis for the sentences in question. This language of logic is essentially the system of Predicate Calculus, as we have known it since the days of Frege and Russell. Where it has so far been impossible to provide logical analyses for sentences, this was attributed to the fact that certain areas of logic (e.g. tense logic) have not been developed sufficiently to provide the means for a translation of sentences into logic.

In making this assumption, philosophers and linguists alike have never paid much attention to the problem of how precisely logical analyses and actual sentences are related to one another. Especially in philosophy, the translation problem has traditionally been left undiscussed : full reliance was placed on intuitive translation procedures. In particular, the problem of establishing *regular* correspondences between sentence forms and logical analyses was never treated seriously, due to a defective insight into the empirical nature of the problem of how speakers of a language *understand* sentences. Sometimes, the requirement of regularity in the language-logic correspondences is given great emphasis (as in Russell's "On Denoting", where he speaks of the principle of "parity of form"), but sometimes, especially when this principle gets in the way of satisfactory analyses, it is thrown to the wind.

The point I wish to make here is that, when the principle of "parity of form" is maintained, not only is the transition from language to logic not trivial, it is in fact and in principle impossible. And the "parity of form" principle has to be maintained in view of the fact that speakers do understand sentences : there must be a correspondence by rule (i.e. mapping relation) between sentences and their semantic analyses. Such a regular mapping relation is impossible if semantic analyses are to be given in terms of existing Predicate Calculus, even when this is expanded into new directions (tense).

One of the main principles of Predicate Calculus (PC) is that its variables must be bound: no unbound variables are allowed to occur. It is this principle which provides an essential stumbling block for logical analyses for sentences. It was remarked by Peter Geach ([1]) that a sentence such as:

(1) Socrates had a dog and it bit him.

cannot be simply of the logical form "$p \wedge q$", since, simply, in language, the sentence

(2) Socrates had a dog and it bit him, and Socrates had a dog and it did not bite him.

is, although somewhat biblical in its style, not contradictory: Socrates may have had two dogs. Yet, in logic, any expression of the form "$(p \wedge q) \wedge (p \wedge \sim q)$" will be irreparably contradictory. He proposes, therefore, in agreement with Quine, to analyse sentence (1) not as "$p \wedge q$", but as an expression with bound variables:

(3) $(\exists x: \text{dog})$ [(Socrates owned x) $\wedge$ (x bit Socrates)]

(where Geach uses his form of "restricted quantification": "there is an x, i.e., a dog, such that ..."). This, says Geach, provides the solution to the problem.

It is, however, easy to show that this solution cannot be regular. That is, it necessitates a number of *ad hoc* and unsystematic provisions for the translation of sentences into PC, if this is possible at all. Geach's solution seems to work well enough in first order contexts. But as soon as intensional contexts are introduced, it breaks down. Take, for example, the sentence:

(4) Socrates must have had a dog, and it may have bitten him.

As with (1), there is no contradiction, in natural language, in:

(5) Socrates must have had a dog and it may have bitten him, and Socrates must have had a dog and it cannot have bitten him.

(1) P. T. GEACH, *Logic Matters*, Blackwell, Oxford, 1972, pp. 115-127.

Yet, there is no solution in Geach's terms. If we put the existential quantifier first, we violate the meaning of the sentence:

(6) $(\exists x: \text{dog})\ [\Box\ (\text{Socrates owned } x) \wedge \Diamond\ (x \text{ bit Socrates})]$

Here, the variable x is properly bound, but the analysis does not correspond to what (4) means. The only other solution is to put the necessity operator first, but then, in order to bind the variable, the possibility operator will also have to come under the necessity operator, which, again, violates the meaning of the sentence:

(7) $\Box\ [(\exists x: \text{dog})\ [(\text{Socrates owned } x) \wedge \Diamond\ (x \text{ bit Socrates})]]$

Sentence (4) simply does not mean "it is necessary that there is a dog such that Socrates owned the dog and that it is possible that it bit Socrates". More clearly, this can be shown with the example:

(8) I know that Socrates had a dog, and I hope that it bit him.

which cannot possibly mean the same as "I know that S. had a dog and *that* I hope that it bit him". Yet, in order to bind the variable, this would be the only analysis.

It is clear, then, that the principle which excludes unbound variables in PC cannot be upheld for analyses of sentences in conjunction with the principle of the "parity of form". One way or another, we shall have to come to terms, for the purpose of semantic analysis of natural language sentences, with the phenomenon of unbound variables (which turn up in surface structure as pronouns). The logical problem raised by sentences (1) and (2) is moot again, since Geach's solution is not viable. How this problem should be solved, is a question of very far-reaching impact. Its solution would be part of a general *empirical* theory of natural language semantics.

This argument does not show any inadequacy in established logical analyses or in the logical powers of PC. What it does show is that a distinction has to be drawn between logical and semantic form, and that it is the semantic form which is instrumental in our processes of understanding sentences. The logical form would be derivative with respect to the semantic form, and would be instrumental in the exercise of our logical powers of deduction and, to some extent, induction.

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