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THE ONTOLOGICAL SQUARE AND MODERN TYPE THEORIES (MTTS)

The Ontological Square and Modern Type Theories (MTTs). Aristotle in *'Categories'* (and in some other treatises) suggests two fundamental metaphysical distinctions: 1) the distinction between *singular* and *universal* things and 2) the distinction between *essential* and *accidental* predication of things. A combination of these two distinctions generates a metaphysical scheme, which Ignacio Angelelli has called *'the Ontological Square'* [1], see the Table 1.

1. Universal Substances *= universal essential things* *e.g. 'Man'*	*3. Universal Accidents* *= singular accidental things* *e.g. 'Wisdom'*
2. Individual Substances *= singular essential things* *e.g. 'Socrates'*	*4. Individual Accidents* *= universal accidental things* *e.g. 'Socrates's Wisdom'*

Table 1: The Aristotle's Ontological Square

Barry Smith [6] argues that modern logic since Gottlob Frege has neglected the fundamental metaphysical distinctions of the Logical Square, especially, the distinction between universal substances and universal accidents.

As an illustration of this point let us consider two sentences:

- (1) *'John is a man'*
- (2) *'John is happy'*

According to Frege's analysis, these sentences share the similar logical form, respectively:

$$man'(j) \tag{1}$$

and

$$happy'(j) \tag{2}$$

The logical form for both sentences could be schematized as

$$F(a) \tag{3}$$

where F stands for any predicate (essential or accidental) and a – for an individual. That is why B. Smith's calls the Frege's approach 'f(a)ntology'. Smith offers a theory – 'Basic Formal Ontology' (BFO), which could express the Ontological Square's fundamental distinctions.

We argue that the standard version of Montague Grammar (MG) also cannot express the distinction between universal substances and universal accidents. Montague Grammar is based on Church's simple type theory with two basic types – e and t. Hence, predicates man' and $happy'$ share the same type: '(e, t)' (or '$e \to t$' in other notation), a type for a function, which maps entities into truth values.

Modern Type Theories (MTTs) provides an alternative to Montague Grammar [2, 3, 4, 5]. MTTs treat common nouns as types, but not as predicates. Hence, the logical form of (1) in MTTs will looks like:

$$j : \texttt{[Man]} \tag{4}$$

where `[Man]` is a basic type. Adjectives are interpreted as a predicate over the type which interprets the adjective's domain. For example, the interpretation of 'happy' in MTTs' is

$$||happy|| : \texttt{[Man]} \to Prop, \tag{5}$$

where $Prop$ is the type of propositions.

Modern type theories contain dependent types, in particular, Σ-types, which could be interpreted as types of dependent pairs.

$$\Sigma(A, B) \tag{6}$$

is a type of pairs (a, b) such that $a : A$ and $b : B(a)$, i.e. a is of type A and b is of type $B(a)$. According to MTTs the relevant interpretation of (2) should involve dependent types:

$$j : \Sigma(x \colon \texttt{[Man]}.happy'(x)) \tag{7}$$

We argue that MTTs is compatible with the metaphysical distinctions of the Ontological Square. However, many questions remain about the proper combination of semantical analysis and ontological commitments: for example, the proper semantical analysis for Individual Accidents (the corner '4.' in the Table 1) is still a problem.

References

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