ABSTRACTS

C1.9 Philosophy of the Formal Sciences

Philosophy of logical practice: a case study in formal semantics Nikhil Maddirala, Strategy and Operations, Deloitte, Hyderabad, INDIA

This paper seeks to advance a nascent domain of inquiry known as "philosophy of logical practice" and to provide a concrete example of original research in this domain by way of a case study in formal semantics. Over the past few decades, logic has spawned a lively scientific community with its own social norms, rules of behavior and procedures for generating new results; consequently, I believe that an adequate philosophy of logic needs to account for logical practice and provide an explanation for the practices and procedures of the logical community. Philosophy of logical practice seeks to do so by combining historical, philosophical and social scientific studies of logic. In this paper I demonstrate one possible approach to philosophy of logical practice by way of a case study in formal semantics, which is a particular form of logical practice. In 2011, Martin Stokhof and Michiel van Lambalgen (two prominent formal semanticists) provocatively raised the question: "is formal semantics a failed discipline?" The question sparked an intense debate among leading researchers in the field in a special issue of the journal "Theoretical Linguistics." My case study discusses this question by drawing primarily on the methodological framework of qualitative research in the social sciences — in particular, this case study is structured as an interview study featuring interviews with critics, insiders and outsiders of formal semantics. Major themes that emerge from the case study are: (1) the tension between the scientific and philosophical aspirations of formal semantics as a discipline, (2) the tension between the narratives and the everyday practice of formal semantics, and (3) the trend towards empirical, data-driven research in the larger field of linguistics. Hopefully such research will encourage more formal semanticists, logicians, philosophers and mathematicians to reflect critically upon the goals, methods and narratives of their respective disciplines.

Philosophy of Operator Algebra: Understanding of Infinite through Algebraic Structure and Dynamics

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This presentation attempts to apply to modern mathematics "Philosophy of Concepts" developed by, among others, J. Vuillemin. Utilizing the method of Vuillemin’s "La Philosophie de l’algebre" (1962), which philosophically analyzes the birth of Galois group and its extension to many domains of mathematics, I hope to clarify how some concepts in von Neumann algebra, one of operator algebras, were born and generated.

Since usual Analysis cannot appropriately treat the points of zero measure, such
pathological phenomena as Cantor set and Banach-Tarski theorem appear. They issue from the measure of “infinitesimal”. Instead of considering space as a set of points of measure zero, operator algebras take their algebraic structure as points of departure. The analytical definition of von Neumann algebra as closed by strong topology is equivalent to its algebraic definition as equal to its double commutant algebra. For this reason, the projection operators of von Neumann algebra have a structure of complete orthomodular lattice. Based on this fact, von Neumann algebra is classified according to the density of its projection operators. Moreover, M. Tomita, M. Takesaki and other mathematicians introduce modular automorphism groups, i.e. time development as dynamics, into von Neumann algebra and understand them as crossed products with topological groups. As ergodic theory and KMS condition issued from equilibrium system of quantum statistical dynamics are also integrated, von Neumann algebra develops as dynamical system. Analogically to the fact that commutative von Neumann algebra is isomorph to usual Lebesgue measurable space, noncommutative measurable space is constructed as dual to von Neumann algebra, which is noncommutative in general.

This presentation clarifies how Leibniz' differential and integral, which depend on infinitesimal calculus, as well as Newton's method of fluxions, which depend on dynamics, come down to modern operator algebras, which circumvent pathological phenomena that issue from “infinitesimal” through algebraic structure and dynamics.

**Set existence principles in reverse mathematics**  Benedict Eastaugh, Philosophy, University of Bristol, Bristol, UNITED KINGDOM

What axioms are necessary to prove theorems of ordinary mathematics? The research programme formed to answer this question, reverse mathematics, has enjoyed great success since its inception in the 1970s. Connections were drawn early on between the Big Five systems to which most theorems of ordinary (countable) mathematics were proved to be equivalent, and foundational programmes motivated by philosophical concerns such as Hilbert’s programme and Weyl’s predicativism. But do reversals have a significance that goes beyond their usefulness in analysing the mathematical strength of proposed foundations? And if so, in what does this significance lie? The standard view in the field is that reversals track the set existence principles necessary to prove theorems of ordinary mathematics. The Big Five systems of reverse mathematics are all held to express set existence principles. While this view has intuitive appeal, the central concept of a set existence principle is unclear. One obvious way of spelling it out would be to identify set existence principles with comprehension principles, or more broadly, with separation principles. However, there are mathematically natural systems such as weak weak König’s lemma which cannot be thus characterised. To save the standard view we thus need a new account of what set existence principles are. I propose understanding them as closure conditions on the powerset of the natural numbers. Such an account readily incorporates examples such as WWKL0, but it also seems to suffer from an obvious problem, namely that it makes all Pi^1_2 statements express set existence principles. So we need to find a way to restrict the account. One such restriction would be to invoke the notion of a natural theory: on this modified view, reversals track natural
I want to argue in favor of a kind of logical pluralism: I claim that both classical and relevant logic are correct logics, as natural language is ambiguous between classical and relevant interpretation of the connectives.

To illustrate my claim I focus on the discussion between Greg Restall and Stephen Read about the validity of Disjunctive Syllogism. The rejection of Ex Falso Quodlibet by relevantists implies the rejection of Disjunctive Syllogism, which seems to be a valid argument. Relevant logicians, as Read (monist relevant logician) and Restall (pluralist relevant logician) have to explain this counterintuitive result. Both Read and Restall accept the invalidity of DS in relevant logic, however, their justification differs as a result of their background theories: Read argues that there is an intensional version of the DS which is valid, in which the disjunction that is used is the intensional disjunction `+', while Restall denies its relevant validity, while accepts it in classical logic.

My argument for pluralism has two parts: first, I identify the circularity in which they fail when they argue in favor and against the validity of this principle: in order the accept/reject the validity of DS one has to accept/reject it on the metalanguage that uses for arguing about logic. Classical extensional connectives support the validity of DS, while relevant intensional connectives reject it. Second, once the circularity is identified, I want to claim that both intensional and extensional connectives are legitimate formalizations of natural language connectives. That is, there is more than one logic as there is more than one legitimate formalization of natural language, and the validity of some inferences, as DS, is relative to the logic and language one chooses.