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Syraya Chin-Mu Yang, Duen-Min Deng, Hanti Lin (eds.), *Structural Analysis of Non-Classical Logics: The Proceedings of the Second Taiwan Philosophical Logic Colloquium* (Berlin/Heidelberg: Springer Verlag, 2016), 278 pp.

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Many of the most interesting advancements in logic in the last century have occurred in the areas of extending and narrowing of the classical logic. In the case of narrowing its scope and creating a new system, the well-known cases include e.g. *intuitionistic logic* (rejects the law of the excluded middle and the double negation elimination), *many-valued logics* (reject bivalence of truth values), *paraconsistent logic* (rejects the *ex falso quodlibet*), *relevance logic* (rejects monotonicity of entailment), *linear logic* (rejects idempotency of entailment), and *free logic* (allows for terms that do not denote any object).

The most famous case of extension of classical logic is represented by the *modal logic*, which expands the classical logic with modal operators ( $\Box p$ : it is necessary that  $p$ ,  $\Diamond p$ : it is possible that  $p$ ), and its branches include various interpretations of modal operators in e.g. cases of knowledge (*epistemic logic* has  $Kp$ : agent  $K$  knows that  $p$ , *justification logic* has  $t:p$  where  $t$  is a proof/justification for  $p$ ), time (*temporal logic* has  $Gp$  – it will always be the case that  $p$  or  $Hp$  – it has always been the case that  $p$ ), or we have various interpretations of modal operators in doxastic or deontic sense.

However, even if a logic rejects or restricts some classical axioms, it may extend the system as well, so the division is not always as clear as it may seem. As for semantics, the main technique is usually *possible-world semantics*, first introduced by Saul Kripke: a statement that is e.g. *possible* in modal logic is true in at least one possible world, while a statement that is *necessary* is true in all possible worlds.

The flourishing of non-classical logics has produced the movement known as *philosophical logic*, which sees logic fundamental to philosophy, and it addresses extensions and alternatives to classical logic. As a result, more attention has been paid to the philosophical aspect and conceptual analyses in logic, which has been established mostly as a mathematical discipline. Asian researchers have engaged in this movement as well, and the *Taiwan Philosophical Logic Colloquium* (TPLC) was based at the Department of Philosophy at the National Taiwan University, for the sake of connecting Asian logicians, mathematicians, and philosophers, and engage them to rethink, reevaluate and extend the conceptual framework of their work, in order to emphasize the philosophical aspects of these non-classical systems. *Structural Analysis of Non-Classical Logics* is derived from the proceedings of the *Second TPLC* (October 24 and 25, 2014) and consists of twelve papers, united by

the common theme of structural analysis, since all the authors constructed or reconstructed models for various non-classical logics.

The opening chapter *Semantical Approach to Cut Elimination and Subformula Property in Modal Logic* is a work of a Japanese logician Hiroakira Ono, in which he tries to combine algebraic approaches to cut elimination with model-theoretical ones, giving a philosophical aspect to generally strictly mathematical methods. In the following chapter, Robert Goldblatt in *Ultraproducts of Admissible Models for Quantified Modal Logic* takes into account first-order modal logic which has a restriction on which sets of possible worlds are admissible as propositions. In Kripkean models he uses an actualistic interpretation of the universal quantifier, which ranges over individuals that exist in the *actual* world, and states that one can show that for every propositional modal logic, there is a naturally axiomatized quantified logic that is complete for validity in the built models.

In chapter 3, *Logic and/of Truthmaking*, Jamin Assay addresses the question of how truthmaker theories relate to logic and philosophy. *Truthmakers* are the objects in reality in virtue of which truths are true, and truthmaker theorists disagree over which truths have truthmakers, what these are, and what is the nature of the relation between a truth and its truthmaker. He defends the view that logic has no immediate implications for the theory of truthmaking, but addresses some questions regarding the theory that can help us to better understand the conceptual framework and metaphysics that motivate the truthmaker theorists.

Duen-Min Deng examines Williamson's counterfactual account of modal epistemology in chapter 4, *Structural Models for Williamson's Modal Epistemology*. Williamson offers the view that our cognitive capacity to handle counterfactual conditionals provides us with what we need to handle moral claims. This account gives rise to two problems, and the first one is the cotenability problem: it is not entirely clear *which* background facts we should hold fixed and *when*. The second problem is the *gap problem*: even granted the legitimacy of holding scientific constitutive and nomic facts fixed, it does not justify the knowledge of metaphysical modality. Deng invokes *structural semantics* (as developed by Pearl and Halpern), and resolves the cotenability problem with a causal model, that is complicated because of vast background conditions and scientific knowledge. Regarding the gap problem, we know that not all modal knowledge can be treated in terms of causal counterfactuals, so Deng takes into account *metaphysical* necessity, where we do not have to hold fixed actual laws and background factors, unlike with something that is *naturally* necessary. Deng asserts that our knowledge of metaphysical modality is grounded in knowledge of counterfactuals, not because of Williamson's equivalence, but because our capacity to handle counterfactuals provides us with what we need to handle metaphysical modalities.

Kok Yong Lee in chapter 5 titled *Motivating the Causal Modeling Semantics of Counterfactuals, or, Why We Should Favor the Causal Modeling Semantics*

*over the Possible-Worlds Semantics* argues that the causal modeling semantics, used in the previous chapter, is more plausible than the Lewis-Stalnaker possible-world semantics. Lewis-Stalnaker's semantics suffers from a specific type of counterexamples which fail to take into account the notion of causal dependence. Causal modeling semantics can describe these examples with ease, and has enough resources for *forward-tracking* (counterfactuals with antecedents that are about events which take place before the events their consequents refer to) and *back-tracking* (counterfactuals whose antecedents deal with events that overlap the events in the consequents or that happen after these events) of counterfactual conditionals, while Lewis-Stalnaker's semantics does not track back-tracking counterfactuals. The author constructs a causal model, where in the case of reasoning forwardly, we focus on the causal effect and ignore the causal ancestors of the antecedent. On the other hand, in the case of back-tracking, we rationalize how the antecedent could have happened, all things considered, and we exploit our knowledge of its causal ancestors, descendants and causal relations to determine under what conditions the content of the antecedent would have happened.

The sixth paper by Hanti Lin – *The Meaning of Epistemic Modality and the Absence of Truth* – proposes the first semantics to explain the conjunctive *or* as a semantic phenomenon in the case of epistemic modality *might*, e.g. “the keys *might* be in the drawer, *or* they *might* be in the car”. Lin uses not truth conditions, but *acceptability conditions*. In the set of possible worlds, information states are a subset of it that leave the open possibilities inside. Each sentence is evaluated at each information state as *acceptable*, *deniable*, or *undecided*. A sentence's acceptability condition determines whether the sentence has a truth condition or not. Lin shows the following: if a sentence has a truth condition, it has a unique truth condition; all classical sentences have truth conditions; no epistemic modal has a truth condition.

Shoshin Nomura, Katsuhiko Sano and Satoshi Tojo in the paper titled *Revising a Labelled Sequent Calculus for Public Announcement Logic* in chapter 7 have devised labeled sequent calculus for *public announcement logic*, and have shown it to be sound for Kripke semantics. In chapter 8 – *Logics for Dynamic Epistemic Behavioral Strategies* – Joshua Sack shows that the probabilistic logic of communication and change can be used to reason about finite *extensive-form games* (games that allow explicit representation of players' possible moves, choices, imperfect information agents possess, payoffs etc.).

Satoru Suzuki's paper titled *Measurement-Theoretic Foundations of Observational-Predicate Logic* in chapter 9 emphasizes vagueness that can invite serious problems and paradoxes, so the aim of this paper is to propose a new version of logic for the so-called observational predicates – *observational predicate logic* – which makes it possible to reason about observational predicates without inviting the sorites paradox. Chapter 10 provides us with Tomoyuki

Yamada's paper *Channel Theoretic Reflections on Dynamic Logics of Speech Acts*. In linguistics, Austin differentiates between *locution* (what was said), from *perlocution* (what happened as a result), and *illocution* (what was meant). Yamada claims that illocutionary acts may fail to take effect (e.g. one might issue a command, and fail because of one's non-suitable authority), so the purpose of his paper is to show how the background conditions supporting these acts and regularities in performing them can be captured in logical terms.

Sakiko Yamasaki's and Katsuhiko Sano's paper *Constructive Embedding from Extensions of Logics of Strict Implication into Modal Logics* in chapter 11 is devoted to a proof-theoretic approach to the embedding from intuitionistic logic to modal logic **S4** (characterized by axioms  $\Box p \rightarrow p$  and  $\Box p \rightarrow \Box \Box p$ ). Syraya Chin-Mu Yang is the author of the last chapter's paper titled *Common Knowledge and the Knowledge. Account of Assertion*. The author uses epistemic logic with multi-agent systems at the propositional level. The author argues that *common knowledge* in a group arises from communication that is itself the result from observable interactions between agents in the group, and therefore *assertion* plays a substantial role in communication and knowledge acquisition.

To conclude, this volume has brought together a group of philosophers, mathematicians and logicians united under the common goal of rethinking the concepts usually taken for granted, and addressing a diversity of topics on non-classical logics. The papers mainly deal with building models for various non-classical logics, not only for new applications, but to solve current issues and reanalyze the existing conceptual framework. Researchers have modeled the philosophical issues in non-classical logics and/or analyzed the conceptual issues and strategies in existing ones.

However, the structural analysis is not its only merit, its main achievement is to make western researchers acquainted with the astonishing development of philosophical and mathematical logic in Asia, an effort that will help not only graduate students and experts in philosophy, logic and mathematics, but researchers in a wide range of disciplines, such as cognitive science, computer science, linguistics, sociology, economics, game theory and many more. Personally, as a PhD student of logic, I am intrigued by novelties in Asian approaches that I have not been familiar with, and this book bridges the gap between western and eastern traditions, which do not seem that different after all. Therefore, I would recommend it to scholars eager to broaden their perspectives and pursue new challenges in old traditions.

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