2020 WINTER MEETING
OF THE ASSOCIATION FOR SYMBOLIC LOGIC

The Westin St. Francis on Union Square
San Francisco, California
April 8–11, 2020

Program committee: Gillian Russell, Gil Sagi (Chair) and Sean Walsh.

The 2020 Winter Meeting will be held as part of the meeting of the Pacific Division of the American Philosophical Association. Registration and hotel information for the APA meeting is available on the website of the APA at `apaonline.org`. All ASL participants are required to register.

The APA meeting includes talks and sessions of interest to logicians. For a complete program see `www.apaonline.org/page/2019P_program`. This schedule is based on the APA draft schedule and is subject to change. In particular, the rooms for the ASL sessions are not yet scheduled. See the official APA Program for final time and room assignments.

Wednesday Morning, April 8, 9:00 A.M.– 12:00 P.M.

Invited Speaker Session I

Chair: William Stafford and Sean Walsh

9:00 – 9:50 **Melissa Fusco** (Columbia) *A two-dimensional logic for paradoxes of deontic modality*

10:00 – 10:50 **Hanti Lin** (University of California, Davis) *Despite our death in the long run*

11:00 – 11:50 **Eleonora Cresto** (National Council for Scientific and Technical Research/CONICET-SADAF-Universidad Torcuato Di Tella) *The logic of relative altruism*

Wednesday Early Evening, April 8, 4:00 P.M.–6:00 P.M.

Contributed Talks Session

4:00 – 4:20 **Katalin Bimbó** (University of Alberta) *Reverse computation in push-down automata*

4:25 – 4:45 **Michael Tomasz Godziszewski** (University of Lodz) *Learnability, measurability, and applications of set theory in machine learning*

4:50 – 5:10 **Michael Tomasz Godziszewski** (University of Lodz) *Potentialism, semantics and ontology - a case study of Yablo's paradox*

5:15 – 5:35 **Iarloslav Petik** (Independent Scholar) *Abstract complexity algebra for first order predicate logic*

5:40 – 6:00 **Joachim Mueller-Theys** (Independent Scholar) *First order concept logic*

Thursday morning, April 9, 9:00 A.M.– 12:00 P.M.

Invited Speaker Session II

9:00 – 9:50 **Sanford Shieh** (Wesleyan University) *Form-series, predicativity & induction in Wittgenstein's Tractatus*

10:00 – 10:50 **Rohan French** (University of California, Davis) *Non-classical metatheory*

11:00 – 11:50 **Andrew Bacon** (University of Southern California) *Fundamentality: A logical framework*

Abstracts of invited papers in Special Session I

► ELEONORA CRESTO, *The logic of reflective altruism*.
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Higher order likes and desires sometimes lead agents to have ungrounded or paradoxical preferences. In this talk I develop a dynamic logic of preferences that can help us gain insight into this phenomenon, in the context of games. In particular, I examine cases in which payoffs are interdependent and cannot be fixed, and hence the overall assessment of particular courses of action becomes ungrounded. Paradigmatic examples of this situation occur when players are 'reflective altruists' or 'reflective haters', in a sense to be explained.

I begin by describing the nature of interactions between reflective altruists and haters. In previous work I offered a framework to model such interactions successfully; I recall some of its main results here. I've argued that ungrounded payoffs cannot be captured by standard games with incomplete information. Rather, we need to rely on the concept of an *underspecified game*, in which the matrix of the game is radically under-determined. Players can then provide the necessary specifications through a second order coordination game for subjective probabilities. Players locked into ungrounded, but not paradoxical, preferences, may (but need not) succeed at the time of fixing a unique matrix for the first order game; players locked into paradoxical preferences, by contrast, can never fix a matrix.

Next, I propose a dynamic preference logic that can mimic the search for a suitable matrix. Updates are triggered by conjectures on other players' utilities, which can in turn be based on behavioral cues. We can prove that pairs of agents with paradoxical preferences eventually come to believe that they are not able to interact in a game. As a result I hope to provide a better understanding of game-theoretic ungroundedness, and, more generally, of the structure of higher order preferences and desires.

► MELISSA FUSCO, *A two-dimensional logic for the paradoxes of deontic modality*.
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In this paper, I take steps towards axiomatizing the two dimensional deontic logic in Fusco [1], which validates a form of free choice permission (von Wright [4], Kamp [2]; (1) below) and witnesses the nonentailment known as Ross's Puzzle (Ross [3]; (2) below).

(1) You may have an apple or a pear $\Rightarrow$ You may have an apple, and you may have a pear.
(2) You ought to post the letter $\not\Rightarrow$ You ought to post the letter or burn it.

Since $\Diamond(p \text{ or } q) = (\Diamond p \vee \Diamond q)$ and $\Box(p) \Rightarrow \Box(p \vee q)$ are valid in any normal modal logic—including standard deontic logic—the negations of (1)–(2) are entrenched in modal proof systems. To reverse them without explosion will entail excavating the foundations of the propositional tautologies. The resulting system pursues the intuition that classical tautologies involving disjunctions are *truths of meaning* rather than *propositional necessities*. This marks a departure from the commitments the propositional fragment of a modal proof system is standardly taken to embody.

[1] M. FUSCO, *Deontic modality and the semantics of choice*, ***Philosophers'Imprint***, vol. 15 (2015), no. 28, pp. 1–27.

[2] H. KAMP, *Free choice permission*, ***Proceedings of the Aristotelian Society***, New Series, vol. 74 (1973), pp. 57–74.

[3] A. ROSS, *Imperatives in logic*, ***Theoria***, vol. 7 (1941), no. 1, pp. 53–71.

[4] G.H. VON WRIGHT, ***An essay on deontic logic and the general theory of action***, North Holland, Amsterdam, 1969.

▸ HANTI LIN, *Despite our death in the long run*.
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There is a long epistemological tradition in which inductive methods are evaluated in terms of some concepts about convergence to the truth. This convergentist tradition can be traced back to Reichenbach and Peirce, and has become very influential in data science—it has even been incorporated into the textbook standards in machine learning. But this convergentist tradition receives little attention in today's philosophy, for two reasons. First, this tradition still faces a longstanding worry, the Keynesian worry: we are all dead in the long run, so who cares about convergence to the truth? Second (and worse), if I am right, the convergence lovers have not clearly formulated the core thesis of their beloved tradition, so it is even not clear what should be the intended target of the Keynesian worry. I will address those problems in favor of the convergentist tradition, defended against at least four sharpened versions of the Keynesian worry.

Abstracts of invited papers in Special Session II

▸ ANDREW BACON, *Fundamentality: A logical framework*.
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In explaining the notion of a fundamental property or relation, metaphysicians will often draw an analogy with languages. According to this analogy, the fundamental properties and relations stand to reality as the primitive predicates and relations stand to a language: the smallest set of vocabulary God would need in order to write the 'book of the world'. However this metaphor, if taken too literally, is fraught with paradoxes. In this talk I shall outline a general model theoretic framework for generating theories of fundamentality that draws on the abstract properties of languages as left adjoints of forgetful functors in categories of typed structures. I will then summarize some results on the consistency of higher-order theories of fundamentality that capture some of the abstract analogies between language and reality.

▸ ROHAN FRENCH, *Non-classical metatheory*.
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According to a common line of thought, clearly articulated in [1, p. 740], non-classical logicians who claim that their preferred non-classical logic L gives the correct account of validity, while at the same time giving proofs of theorems about L in classical logic, are in some sense being insincere in their claim that L is the correct logic. This line of thought suggests a requirement on the correctness of a given account of validity: that it be able provide internally acceptable proofs of its main metatheorems, particularly soundness and completeness results.

This turns out to be a more ill-defined requirement than one might have first thought. To be able to even assess whether a given logic can give such internally acceptable proofs of soundness and completeness, we need to know what such results should look like. In an attempt to get clearer on this issue, in the present paper we look at three different soundness and completeness results for Intuitionistic propositional logic, looking at the extent to which they are internally acceptable.

[1] J. P. Burgess, *No requirement of relevance*, ***Oxford Handbook of Philosophy of Mathematics and Logic*** (Steward Shapiro, editor), Oxford University Press, Oxford, 2005, pp. 727–750

▸ SANFORD SHIEH, *Predicativity, form-series, and bilateralism in Wittgenstein's* Tractatus.
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It is now generally accepted that some version of standard first-order logic with identity may be formulated with fairly minimal extensions of the notational resources of Wittgenstein's *Tractatus Logico-Philosophicus*, especially in remarks 5.2522 & 5.501 (see in particular [5]). It is not at all clear, however, whether the *Tractatus* provides the means for formulating other systems of logic. In this talk, I survey some recent proposals for Tractarian logic(s) different from or beyond first-order logic. First, I discuss the suggestion of [8] and [3] that impredicative second-order quantification is consistent with the *Tractatus*, and the contrary position of [9] that only predicative quantification is allowed by Wittgenstein's commitments. Second, I discuss the suggestion first advanced in [2] and developed in [4] that the device of "form-series," introduced at 4.1252, is used by Wittgenstein to provide an alternative to Frege's definition of the ancestral of a dyadic relation. Form-series provides the means of expressing certain infinitary disjunctions whose disjuncts are "constructed" according to a "formal law" (5.501). I survey conceptions of this notion of "formal law" advanced in [4], [1], and [9]. I explore the formulation of a tableau procedure for the minimalist reconstruction of form-series in [9]. Finally, I discuss the relationship between the well-known apparently proto-semantic account in 4.26-4.462 of what we would call the "logical truth (and falsity)" of tautologies and contradictions and Wittgenstein's move, starting in 5.124, to a terminology of propositions "affirming" and "denying" other propositions. I explore the possibility of reconstructing this in terms of the "bilateral" logic of [7] and [6].

[1] David Fisher and Charles McCarty, *Reconstructing a logic from* Tractatus*: WittgensteinŠs variables and formulae*, ***Early analytic philosophy: new perspectives on the tradition***, (Sorin Costreie, editor) Springer, Berlin, 2016, pp. 301–324.

[2] P. T. Geach, *Wittgenstein's operator N*, ***Analysis***, vol. 41 (1981), no. 4, pp. 168–171.

[3] Michael Potter, *The logic of the* Tractatus, ***Handbook of the history of logic***, volume 5 (D. M. Gabbay and J. Woods, editors), Elsevier, Amsterdam, 2009, pp. 255–304.

[4] Thomas G. Ricketts, *Logical segmentation and generality in WittgensteinŠs* Tractatus, ***Wittgenstein's* Tractatus*: history and interpretation*** (Michael Potter and Peter Sullivan, editors), Oxford University Press, Oxford, 2012, pp. 125–142.

[5] Brian Rogers and Kai F. Wehmeier, *Tractarian first-order logic: Identity and the N-operator*, ***The Review of Symbolic Logic***, vol. 5 (2012), no. 4, pp. 538–573.

[6] Ian Rumfitt, *'Yes' and 'no'*, ***Mind***, vol. 109 (2000), no. 436, pp. 781–823.

[7] Timothy Smiley, *Rejection*, ***Analysis***, vol. 56 (1996), no. 1, pp. 1–9.

[8] Scott Soames, ***The analytic tradition in philosophy***, volume 2, Princeton University Press, 2017.

[9] Max Weiss, *Logic in the* Tractatus, ***The Review of Symbolic Logic***, vol. 10 (2017), no. 1, pp. 1–50.

Abstract of contributed papers

▸ KATALIN BIMBÓ, *Reverse computation in push-down automata*.

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Proofs in various logical systems can be linked to steps in one or another model of computation. Deterministic and non-deterministic push-down automata are models of computation in a restricted sense. In this talk, I will consider what reverse computation can mean in these machines, what sorts of machines can model the reverse computation, and what the result of the reverse computation is.

▸ MICHAŁ TOMASZ GODZISZEWSKI, *Learnability, measurability and applications of set theoretic independence in machine learning*.
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In a recent paper *Learnability can be undecidable* by S. Ben-David, et al., published in *Nature Machine Intelligence* the authors argue that certain abstract learnability questions are undecidable by ZFC axioms. The general learning problem considered there is to find a way of choosing a finite set that maximizes a particular expected value (within a certain range of error) with an obstacle that the probability distribution is unknown, or more formally: *given a family of functions $\mathcal{F}$ from some fixed domain X to the real numbers and an unknown probability distribution μ over X, find, based on a finite sample generated by μ, a function in $\mathcal{F}$ whose expectation with respect to μ is (close to) maximal.* The authors then provide a translation from this statistical framework to infinite comibnatorics: namely, they prove that existence of certain learning functions corresponding to the problem above (the so-called *estimating the maximum* learners, or EMX-learners) translates into the existence of the so-called monotone compression schemes, which in turn is equivalent to a statement in cardinal arithmetic that is indeed independent of ZFC. Specifically, let X be an infinite set, $Fin(X)$ be the family of its finite subsets, and let $m > k$ be natural nubers. A *monotone compressions scheme* for (X, m, k) is a function $f\colon [X]^k \to Fin(X)$ such that

$$\forall A \in [X]^m \, \exists B \in [X]^k \, (B \subseteq A \subseteq f(B)).$$

The main result of the paper then is that there exists a monotone compressions scheme for $([0, 1], m + 1, m)$ for some m if and only if $2^{\aleph}_0 < \aleph_\omega$. It is now well known that the results are related to Kuratowski's theorem on decompositions of finite powers of sets and that the monotone compression functions on the unit interval cannot be Borel measurable. During the talk I will introduce the subject of the paper in question, present the set-theoretic aspects of the main results, including some remarks concerning the formulation of existence of the monotone compressions schemes in terms of determinacy for certain collaborative compression-reconstruction games and discuss what these theorems tell us about the nature of the way set theory (and set-theoretic independence in particular) is being applied in other fields of mathematics. Time permitting, I want also to elaborate on how the monotone compression schemes could be expressed in large cardinal terms.

▸ MICHAŁ TOMASZ GODZISZEWSKI AND RAFAL URBANIAK, *Potentialism, semantics, and ontology—a case study of Yablo's Paradox*.
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When properly arithmetized, formal version of Yablo's paradox results in a set of formulas which, if considered in first-order logic with the only assumptions about the notion of truth being local disquotation (i.e., when formalized without certain (strong) assumptions imposed either on logic behind our arithmetized theories or on the axioms governing the properties of the truth predicate involved in the formulas from the Yablo sequence) turns out consistent and only ω-inconsistent, contrary to natural-lanugage interpretation of it. One has to add either uniform disquotation or the ω-rule to obtain an (expected) inconsistency. Since the paradox involves an infinite sequence of sentences, one might think that it also doesn't arise in finitary contexts. We study whether it does. It turns out that the issue turns on how the finitistic approach is formalized.

On one of them, proposed by M. Mostowski, all paradoxical sentences simply fail to hold. This happens at a price: the underlying finitistic arithmetic itself is ω-inconsistent. Finally, when studied in the context of a finitistic approach which preserves the truth of standard arithmetic (developed by one of the authors), the paradox strikes back—it does so with double force, for now inconsistency can be obtained without the use of uniform disquotation or the ω-rule.

Apart from a finitistic formalization of the Yablo paradox and giving out the modal semantics for potentially infinite domains of Mostowski, we conclude with a discussion of the difference between semantics and ontology of arithmetical potentialism. We claim that the difference is hidden in the choice of the order of logic used to determine arithmetical formulas. Although the modal first-order theory theory of potentially infinite domain of finite models approximating the natural numbers is simply (infinitistic) True Arithmetic, the finitary nature of the models serving as universes of potentialist discourse is revealed on the level of the second-order interpretations of quantifiers in this potenialist setting.

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▸ JOACHIM MUELLER-THEYS, *First-order concept logic*.
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We developed *Basic Concept Logic*, intentionally considering only juxtaposition (as with rational creature), thereby enabling a special intensional characterization of implication (cf. BSL 24 (2018), pp. 370–1). By adding conceptual negation, a level comparable to that of PL can be reached. However, concepts like prime cannot be further analyzed.

I. Let L be some first-order language, $L_n := \{\phi \in L : \mathrm{fv}(\phi) = \{x_1, \ldots, x_n\}\}$ $(n \geq 0)$. Any formula $\phi(x) \in L_1$ can be regarded a *concept expression* having the *extension* $\phi(x)^{\mathcal{M}} := \{a \in |\mathcal{M}| : \mathcal{M} \models \phi[a]\}$ with respect to the given L-model $\mathcal{M}$. There is a close relationship to *definable sets* $A = \phi(x)^{\mathcal{M}}$, and the approach is in line with Buchholz's determination: *concepts are named sets*.

In general, we consider *predicate expressions* $\phi(\vec{x}) = \phi(x_1, \ldots, x_n) \in L_n$, which we *compare by extent* as follows. *Particularly*: $\phi(\vec{x}) \preceq_{\mathcal{M}} \psi(\vec{x})$:iff $\phi(\vec{x})^{\mathcal{M}} \subseteq (\leq)\ \psi(\vec{x})^{\mathcal{M}}$, and *universally*: $\phi(\vec{x}) \preceq_{\Sigma} \psi(\vec{x})$:iff $\phi(\vec{x}) \preceq_{\mathcal{M}} \psi(\vec{x})$ for all $\mathcal{M} \models \Sigma$, where $\Sigma \subseteq L_0$ is some set of sentences ("axioms"). Notice that $\phi(\vec{x}) \preceq_{\Sigma} \psi(\vec{x})$ *implies* $\phi(\vec{x}) \preceq_{\mathcal{M}_{\Sigma}} \psi(\vec{x})$, whereas the converse is *not* true obviously.

We have formulated and proved the *Universally-Less-Extent Implication Theorem*: $\phi(\vec{x}) \preceq_{\Sigma} \psi(\vec{x})$ *if and only if* $\phi(\vec{x}) \Rightarrow_{\Sigma} \psi(\vec{x})$, where $\phi \Rightarrow_{\Sigma} \psi$:iff $\Sigma \models \phi \to \psi$.

II. Odd is an attribute of prime > 2, since prime > 2 implies uneven. In general, we call $\phi(\vec{x})$ Σ-*attribute* of $\psi(\vec{x})$:iff $\psi(\vec{x}) \Rightarrow_{\Sigma} \phi(\vec{x})$. Traditionally, *conceptual content* has been considered the "sum" of attributes: $\big(\phi(\vec{x})\big)_{\Sigma} := \{\psi(\vec{x}) \in L_n : \psi(\vec{x})\ \mathrm{attr}_{\Sigma}\ \phi(\vec{x})\}$. For $n = 0$, $(\sigma)_{\Sigma}$ amazingly becomes *propositional content*, which we have considered the set of implicates

$\{\tau : \sigma \ \Rightarrow_\Sigma \tau\}$ evidently.

We can now *compare by content*: $\phi(\vec{x}) =)_\Sigma \psi(\vec{x})$:iff $\big(\phi(\vec{x})\big)_\Sigma \supseteq \big(\psi(\vec{x})\big)_\Sigma$, and we get the *More-Content Implication Theorem*: $\phi(\vec{x}) =)_\Sigma \psi(\vec{x})$ *if and only if* $\phi(\vec{x}) \Rightarrow_\Sigma \psi(\vec{x})$, which we can reconstruct in any quasi-ordering.

III. Traditional logic has claimed that more content corresponds to less extent. The More-Content Implication and the Universally-Less-Extent Implication Theorem yield the *Logical Reciprocity Theorem*: $\phi(\vec{x}) =)_\Sigma \psi(\vec{x})$ *if and only if* $\phi(\vec{x}) \preceq_\Sigma \psi(\vec{x})$. The concrete *Reciprocity Theorem* follows: $\phi(\vec{x}) =)_\Sigma \psi(\vec{x})$ *implies* $\phi(\vec{x}) \preceq_{\mathcal{M}_\Sigma} \psi(\vec{x})$, but, on the other hand, we have *Failure of Converse Reciprocity*—as with BCL.

Acknowledgments. Many of my original ideas were resolved by Wilfried Buchholz. My work has been closely connected to “Peana Pesen”.

► IAROSLAV PETIK, *Abstract complexity algebra for first order predicate logic*.
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This thesis proposes to modify the model of first order predicate theory so as to present the levels of abstract complexity to any given statement of the logic which is useful for purposes of studying the complexity properties of a variety of formal systems.

The signature of a first order predicate logic is $\Sigma = (\Omega, \Pi)$ where Ω is a set of functional symbols and Π is a set of predicate symbols. The next elements are added $\{\mathrm{A}, \mathrm{D}\}$ where A is a set of abstract complexity indicators, D is a graph of which nodes represent individual terms of FOPL and lines represent logical operators. Thus the growth of graph *D* represents the semantics for A-indicators.

Examples. P(X) is a term which will have the basic abstract complexity represented by P(X)[$*$1]. Complex formula P(X) $\wedge$ Q(X) will be calculated basing on the complexity of its nodes and their algebraic sum (P(X)[$*$1] $\wedge$ Q(X)[$*$1])[$*$2].

Complexity in this case is abstract because it gives the opportunity to view FOPL without being bounded to existing technical hierarchies of decision problems. In most of the cases the abstract complexity can be translated to time or memory complexity hierarchy (being in direct ratio to it). Exceptions include “hard” places of decision problem theory like problems which evaluation differs in time and memory systems.