

ALESSANDRA PALMIGIANO  
MARCUS PIVATO

## Logics for Social Behaviour: An Editorial

*Logics for Social Behaviour* made its first appearance as the title for the general public of a grant proposal submitted to the Dutch Research Council (NWO) in 2012. This title, and the accompanying 40-word abstract, was hastily written down and reluctantly surrendered to an NWO officer—way past its submission deadline—by one of the co-editors of the present volume, who at the time was privately (or maybe not so privately) skeptical about the chances of success of this grant proposal, and—more fundamentally—of the research program therein, promising to develop general and uniform methods to strengthen and inter-connect the algebraic, topological, duality-theoretic, category-theoretic, and proof-theoretic foundations of nonclassical logics, and use the resulting improved formal tools to advance our understanding of issues such as collective decision-making and categorization. The brazen ambition of this project laid not only in its promise of methodological unification and connection of families of logics very different in their origins, motivations and mathematical properties, but also in the promise that the very same tools, techniques and insights that were originally developed to study foundational problems could be effective for a meaningful analysis of social interaction.

Persuading valiant researchers to address these incautious promises became paramount to extricate said co-editor from the predicament generated by the unexpected award of this grant in 2013. Thus, starting from 2014, a series of workshops, conferences, and courses at summer schools ensued in close succession, among which Trends XV, held in Delft in July 2015. These events were enthusiastically received and became the agora of a novel interdisciplinary community in which challenging issues in theoretical economics, political philosophy and social sciences are addressed by and inspire groundbreaking research in the mathematical foundations of nonclassical logics. The present volume collects some of these results, which attest what has been achieved and, more importantly, project forward to what can still be achieved.

The diversity of topics covered in these papers—and the diversity in the academic backgrounds of their authors—is indicative of the diversity in the

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emerging field at the intersection of logic and social science. In “The Birth of Social Choice Theory from the Spirit of Mathematical Logic”, Daniel Eckert and Frederik Herzberg observe that Arrow’s Impossibility Theorem anticipates certain key ideas in model theory that developed around the same time in the 1950s, and speculate that Arrow was influenced by his interactions with Alfred Tarski while he was a student in New York. One advantage of the model-theoretic approach to Arrovian aggregation is that it applies to infinite populations as well as to finite populations of agents.

In “Convex MV-algebras: Many-valued Logics Meet Decision Theory”, Tommaso Flaminio, Hykel Hosni, and Serafina Lapenta define a notion of convexity in Łukasiewicz logic, and use this to make interesting connections between many-valued (MV) logics, probability theory, and decision theory. Using convex operators on MV-algebras, they present a new proof of a classic theorem of Anscombe and Aumann (1963) [1], which yields a *subjective expected utility* representation for the decisions of an agent confronted with uncertainty.

A more general model of decision-making uncertainty is the *Monotonic Bernoullian Archimedean* (MBA) model, introduced by Cerreia-Vioglio, Ghirardato, Maccheroni, Marinacci and Siniscalchi (2011) [2]. In “Arrovian Aggregation of Generalised Expected-utility Preferences: (Im)possibility Results by Means of Model Theory”, Frederik Herzberg considers the Arrovian aggregation of MBA preferences, and derives impossibility theorems using model-theoretic techniques. As in his joint paper with Eckert, Herzberg considers both finite and infinite populations.

Infinite populations arise in models of intertemporal social choice with an infinite time horizon. But many intuitions and techniques which work for finite populations break down for infinite populations, leading to paradoxes and pathologies. The economic theory literature contains many analyses of these issues. However, in “Infinite Populations, Choice and Determinacy”, Tadeusz Litak objects that many of these papers make inappropriate use of nonconstructive methods—specifically, the Axiom of Choice. He argues that for many of these applications, the Axiom of Choice can be replaced with the less objectionable Axiom of Determinacy.

Finally, in “The Category of Node-and-Choice Preforms for Extensive-Form Games”, Peter Streufert proposes a new category-theoretic formalism for representing and analysing extensive form games. This paper is the first step in a larger project to build category-theoretic foundations for much of game theory.

## References

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- [2] CERREIA-VIOGLIO, S., P. GHIRARDATO, F. MACCHERONI, M. MARINACCI, and M. SINISCALCHI, Rational preferences under ambiguity, *Economic Theory* 48(2-3): 341–375, 2011.

A. PALMIGIANO  
Department of Values, Technology and Innovation  
TU Delft  
Delft  
The Netherlands  
[a.palmigiano@tudelft.nl](mailto:a.palmigiano@tudelft.nl)

M. PIVATO  
Department of Economics  
THEMA, Université de Cergy-Pontoise  
Cergy-Pontoise  
France  
[marcus.pivato@u-cergy.fr](mailto:marcus.pivato@u-cergy.fr)