Nissim Francez
Ian Pratt-Hartmann

Editors' Preface

In times past, the connection between logic and natural language must have seemed too transparent to merit discussion. The forms of the Classical Syllogistic are evidently linguistically inspired; much of Mediæval logic concerns what we would now call, rather clinically, 'semantics of natural language'; and as late as the nineteenth century, logicians were still battling valiantly to understand sentences featuring more than one quantifying expression. Only with the work of such figures as Frege, Russell, Whitehead and Peirce did formal—as opposed to natural—languages take centre stage in logic. According to the new method of logical analysis in philosophy, the syntax of natural language was a millennia-old barrier to progress, to be swept aside by the brave, new syntax of the predicate calculus. This dissociation of formal logic from natural language was subsequently compounded by the rise of theoretical linguistics, which—notwithstanding its early stress on grammar formalisms and models of computation—developed in relative isolation from mathematical logic. Only towards the end of the twentieth century did work on the relationship between natural and formal languages gather pace.

Two convergent trends can be discerned. The first is a growing realization that the characteristics of natural languages which most clearly differentiate them from formal languages—oddly restricted expressive power, redundancy, vagueness, ambiguity—are themselves worthy objects of logical study. The second is an ever livelier interest among formal linguists in logical aspects of grammar—a development which is itself a manifestation of the deep connections between logic and the theory of computation. Today, researchers in Logic, Linguistics, Philosophy and Computer Science face a constellation of questions on the relationship between logic and natural language. What logical resources are required to articulate formal grammars of various sorts? How well do temporal logics model tense and aspect? What formal systems best account for logical deduction in natural language? Can such phenomena as vagueness, ambiguity and polysemy be incorporated in a logical framework? What light can formalization of natural language shed on the difficulty of language-processing tasks?

Special issue: Logic and Natural Language
Edited by **Nissim Francez and Ian Pratt-Hartmann**

Studia Logica (2012) 100: 663–665
DOI: 10.1007/s11225-012-9423-x

The following collection of papers provides a snapshot of current work at the interface between logic and natural language, and reflects the two-way traffic characteristic of research in this area: just as proof theory and model theory have opened up new avenues in linguistics, so too has the study of natural languages led to new—indeed revisionary—logical systems. All of the contributions were submitted in response to an open call for papers. Twenty-six submissions were received, and subjected to a double-blind reviewing process. The editors of this Special Issue would like to thank all those who submitted papers, and also the large team of anonymous reviewers. (These two sets of people were disjoint.) The reviewing process was rigorous: nine papers were finally accepted.

The Special Issue begins with a programmatic paper by Joachim Lambek in support of the view that natural language grammar can be formulated as deduction in a sub-structural logic. Two fundamental ideas lie at the core of such *type-logical* grammars. The first is that parsing is deduction: to determine the syntactic category of a string is to produce a derivation of that categorization in an appropriate logic of types. The second idea is that semantics is a projection of syntactic derivations: having proved that a string has a particular syntactic category, we can extract from our derivation a representation of that string's meaning. This general outlook has inspired a variety of distinct, yet related approaches to syntax and semantics. Two principal dimensions of variation present themselves. The first concerns the *syntactic types* employed. Most familiar type-logical grammars employ basic types corresponding to traditional parts-of-speech (sentences, noun-phrases, nouns etc.); however, it is equally possible to consider types enriched with 'logical' information. Thus, the paper by Lawrence S. Moss investigates how the *polarity* of constituent phrases might be extracted during the parsing of a sentence within a type-logical system. Here, a phrase has *positive* (*negative*) polarity in a sentence if replacing it with a phrase having more specific (more general) denotation preserves truth. In the terminology of traditional logic: negative polarity phrases are "distributed". That logically useful information might be extracted directly as part of the parsing process is especially attractive in view of the fact that such polarity information is so frequently explicitly marked in natural languages; and the paper by Thomas F. Icard III investigates this idea for a wider range of logical features. More ambitiously, the thrust of this research into 'natural logic' is to develop logics whose rules of deduction are formulated directly in terms of the syntax of natural languages. The second principal dimension of variation in type-logical grammars concerns the *semantic objects* employed. Thus, the paper by Scott Martin and Carl Pollard tackles the problem of how to incorporate

ideas from dynamic semantics into the type-logical framework. Here, the primary goal is not to extend the syntactic types employed by type-logical grammars, but rather, to enrich the semantic objects in their lexica. The authors thereby aim to account for phenomena not belonging strictly to truth-conditional semantics, yet long-familiar to linguists and philosophical logicians: presupposition, factivity, anaphora resolution.

Once a semantic representation—at whatever degree of detail—has been extracted from natural language, the question of course arises as to what logical and computational properties that semantic representation exhibits. This is the topic of the next two contributions to this Special Issue. The paper by Koji Mineshima, Mitsuhiro Okada and Ryo Takemura examines the proof theory of the syllogistic fragment (corresponding roughly to the logic generated by the features considered in Thomas Icard's paper); and the paper by Camilo Thorne and Diego Calvanese determines the complexity of query-answering in ontology-based systems specified by fragments of natural language. Both of these papers take a 'traditional' approach to the relationship between fragments of languages and their proof-theoretical and computational investigation: the language is first given a truth-conditional semantics, on the basis of which logical notions such as validity and satisfiability are defined in the standard way; it is then the job of any proof theory to match these semantic notions. By contrast, the paper by Bartosz Więckowski turns this idea around: the proof theory of the linguistic fragment is fundamental; the meaning of an expression resides in its contribution to the derivations in which sentences featuring it may participate.

We end on a cautionary note. We have so far been speaking as if the notion of valid inference and its cognates in the context of natural language were philosophically unproblematical. Not so, as the final two papers remind us. The paper by P. Cobreros, P. Egré, D. Ripley and R. van Rooij considers various notions of 'strict' and 'tolerant' implication with application to the *Sorites* paradox. Last but not least, the paper by Chris Fox investigates some of the delicate issues regarding logical relations involving imperatives: *Read this special issue of* Studia Logica*, and you won't regret it*!

Nissim Francez
Department of Computer Science
The Technion
Haifa 32000, Israel
francez@cs.technion.ac.il

Ian Pratt-Hartmann
School of Computer Science
Manchester University
Manchester M13 9PL, UK
ipratt@cs.man.ac.uk