(3) method override, in which a new body is specified for one of the methods of an existing object. (The use of method override as a primitive means that the Object Calculus models delegation-based languages more directly than languages with classes, which must be encoded here using objects.)

The book is divided into four main sections. It opens with a long, non-technical review of object-oriented concepts, establishing intuitions and terminology for the technical sections that follow. The second section introduces the two variants of the untyped Object Calculus—one a purely functional calculus in which updating a method of an object yields a fresh object, the other an imperative calculus where method updates happen 'in place'—and develops the basic technical mechanisms of subtyping and recursive types. The third section treats second-order object calculi, using parametric polymorphism to model more advanced language features such as covariant method specialization. Finally, in the last section an object calculus with a more powerful form of polymorphism is used to model features such as 'matching' and the typing of binary methods.

The first two sections of the book should be accessible to any computer scientist with a reasonably solid mathematical background. Prior familiarity with typed lambda-calculi will make the reading easier, but the presentation is both lucid and complete: it could even be used in an introductory course on type systems. In the latter half, both the material and the writing style become much more technical, though the development remains essentially self-contained; these sections will be most useful for advanced readers.

The Object Calculus is already widely used and will be a fundamental tool in future work on the foundations of object-oriented languages. This book will be both a basic reference for established researchers and an introduction for new arrivals to this exciting field.

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JOHAN VAN BENTHEM
Exploring Logical Dynamics. CSLI Publications, distributed by Cambridge University Press. (1996) ISBN 1-57586-058-9. £14.95. 288 pp. Softbound.

Johan van Benthem's book is somehow reminiscent of a Seurat painting. You can view it from close distance, which allows you to appreciate single brushstrokes, single results in the philosophy of logic, language and computation that have been contributed by the author or by his colleagues, either in the form of new logical calculi or of new perspectives on old ones. Or you can view it from a longer distance, maybe squinting your eyes a bit, and from this distance the brushstrokes lose their individual character, thereby revealing the overall, fascinating picture of the dynamic perspective on logic.

But, what is this perspective in the first place? What is 'logical dynamics'? The book makes clear that there is no completely organic, thoroughly developed theory of logical dynamics yet, as the opposition 'dynamic' versus 'static', like the opposition 'procedural' versus 'declarative' in computer science, has immediate appeal but very elusive content' (p. 285). What van Benthem manages to convey, though, is that at the current stage logical dynamics (not to be confounded with dynamic logic *à la* Pratt, although there is a strong commonality in spirit between the two) is, more than anything, a way of looking at logical and linguistic phenomena which is somehow orthogonal to the received wisdom. Although dynamic concerns also feature within previous research in logic and language, the present paradigm is different in its clear debt to theoretical computer science.

The bottom line of logical dynamics is that there is a dual character to many entities we commonly deal with in logic and language. A sentence of natural language, or a formula of logic, should be studied not only for their 'static' properties, which is the point of view privileged by standard logic, but also in their 'dynamic' aspects. For instance, a sentence of natural language may be 'statically' seen as having truth conditions, but once uttered by a speaker may also be 'dynamically' seen as causing an information flow to the hearer, thus engendering a transition from her previous information state to a new one, much like the internal state of a machine changes after the execution of a programming language statement. Under this new light, natural language is *de facto* to be viewed as 'the programming language of cognition', and this leads in turn to the investigation of linguistic devices as operators of an imperative programming language.

This book is a powerful statement that this metaphor is far-reaching, and that the study of many phenomena in natural language and logic (anaphoric reference, belief revision, quantification, to name but a few) may benefit from this analysis. Various influences are recognisable within logical dynamics, ranging from Ramsey's test for implication, to the dynamic logic of programs, to the Alchourron-Gärdenfors-Makinson theory of belief revision, and to speech act theory. The heterogeneity of the predecessors naturally makes a vision of logical dynamics as a possible unifying paradigm in the study of logic, language and computation, linger in the distance.

The author argues that the 'dynamic stance', to which he has arguably been the major contributor since its inception, does not aim to substitute the static one, but to supplement it. This is just a reflection of the equal importance attributed within natural language to human activities and their effects: natural language terms like 'judgment' or 'move', evoke both aspects at the same time. The dual character of reality that dynamicists advocate has various surprising consequences. For instance, the analytic tools provided by the dynamic stance even allow one to shed new light on old pillars of logical analysis, e.g. revealing assumptions (Chapter 9) hidden under first order logic that, once substituted with their 'dynamically justified' equivalents, yield decidability!

The book is beautifully written. Going through it is not an easy task, as in his walk through the repercussions of the

dynamic viewpoint the author touches upon a wide range of tools and techniques, ranging from modal correspondence theory to cylindric algebras, and from dynamic logic to game theory; only a reader with a strong background in logic, mathematics and theoretical computer science may hope to understand the book in depth. However, the book will be enjoyed also by mathematically less sophisticated (or more philosophically inclined) readers, also thanks to the valiant, if concise, introduction to a number of advanced logical and mathematical tools (Chapter 3) with which the reader needs familiarity in order to understand the main points of the book.

This is an important book, and one which is bound to raise interest around logical dynamics among people that had not been previously exposed to the specialised literature of the field. Like a true Seurat painting, the contours of the picture which van Benthem gives are still fuzzy, as in a hazy morning: the agenda of dynamicists is still rich with unsolved problems, and the rich notes at the end of each chapter are there to remind researchers about this.

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COLLEEN CRANGLE AND PATRICK SUPPES
Language and Learning for Robots. CLSI Publications, distributed by Cambridge University Press. (1995) ISBN 1-881526-19-4. £16.95. 276 pp. Softbound.

This book, one of the CSLI lecture notes series, is a collection of the authors' work over the past 10 years in the field of instructible robots. Though I have not read all their published work in this field, it is indisputable that they are unique in their approach to their research. They focus on the natural language and cognitive aspects of instructing robots; their work is based on a sound theoretical foundation and it is also oriented to practical application. They straddle the disciplines of mathematical logic, philosophy, computer science, engineering and linguistics, drawing from each of these in a significant and non-superficial manner. So, it is right and fitting that they have produced a book that presents their work in the field of instructible robots in a coherent fashion.

It seems that the main intent in putting together this book is to present in one publication — cohesively — the results of many years of work on related aspects of the central theme. An additional aim is to broaden the natural language aspect of their work. To do this, the authors have used some work that has previously been published, as well as presenting unpublished work. The overall structure of the book is coherent; there is certainly no sense that the book is a collection of papers. My only reservation is that there is less in the way of conclusions and links between chapters than I would like. Certainly there is some; but the final chapter for example seems to end abruptly. There is no drawing together of the various themes through the book, but instead a summary of related work on language acquisition. This minor omission is by no means a flaw. The book is well enough written and well enough structured for such niceties to not be essential.

The book is structured into three sections, addressing (roughly) theoretical foundations, language processing and language learning. All these are oriented ultimately to their application to instructible robots, and the examples usually reflect this. That is not to say that this book is of no wider relevance than robot applications. The work is based firmly in a computational linguistics paradigm, and is of relevance to researchers working on natural language understanding (especially instruction understanding) as well as those working on language learning.

Particular topics dealt with in the book include the application of augmented phrase-structure grammars, context-fixing semantics, geometric models and language learning, from corrective instruction and from task descriptions. A chapter is devoted to the issues related to saying 'Stop' to a robot. This is a topic that I feel deserves even more attention; certainly it is connected to more general issues than instructible robots. A nice feature in the book is the use of a model for arithmetic instruction. The model itself is described in one of the earlier chapters; then in the section of the book that is about learning, the model serves as an example for discussing discourse.

I do not believe that this is the place to comment on Crangle & Suppes' particular research orientation and their results; suffice it to say that I have always found their work sound and scientifically formulated. The task of this review is to comment on this particular book — and my view is that it achieves its goal admirably. It is a pleasure to read, at the same time as presenting significant research in a non-trivial fashion. I believe that the authors have succeeded in presenting their work in this field, which has always been of a high standard, in one coherent book.

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