Formal Semantics of Natural Language

Edited by

EDWARD L. KEENAN

FORMAL SEMANTICS OF NATURAL LANGUAGE

Papers from a colloquium sponsored by the
King's College Research Centre, Cambridge

EDITED BY
EDWARD L. KEENAN
Senior Research Fellow, King's College, Cambridge
(now Associate Professor, Department of Linguistics, UCLA)

NOTES ON THE CONTRIBUTORS

DAVID LEWIS is Professor of Philosophy at Princeton University. He is the author of *Convention* (1969), of *Counterfactuals* (1973), and of articles on metaphysics, semantics, and philosophy of science.

BARBARA HALL PARTEE is Professor of Linguistics and Philosophy at the University of Massachusetts at Amherst. She is co-author with Robert P. Stockwell and Paul Schachter of *The Major Syntactic Structures of English* (1973) and editor of *Montague Grammar* (1975). Her main research interests are syntactic and semantic theory, structure of English, and Montague grammar.

R. D. HULL is currently researching at the University of Cambridge for a Ph.D. thesis entitled 'A Logical Analysis of Questions and Answers'. He is the joint author, with Edward Keenan, of 'The logical presupposition of questions and answers', in *Präsuppositionen in der Philosophie und der Linguistik* (1973).

NEIL W. TENNANT is Lecturer in Logic at the University of Edinburgh. His Ph.D. research was on the semantics of knowledge and belief.

J. E. J. ALTHAM is Assistant Lecturer in Philosophy at the University of Cambridge. He is the author of *The Logic of Plurality* (1971). His main research interests are in philosophical logic and in ethics.

JOHN LYONS is Professor of General Linguistics at the University of Edinburgh. He was the first editor of the *Journal of Linguistics* (1965-9); and his publications include *Structural Semantics* (1963), *Introduction to Theoretical Linguistics* (1968), *Chomsky* (1970), and, as editor, *New Horizons in Linguistics* (1970).

PIETER SEUREN is Reader in the Philosophy of Language at Nijmegen University, Holland. He is the author of *Operators and Nucleus: A Contribution to the Theory of Grammar* (1969), and the editor of *Generative*

Semantik: Semantische Syntax (1973), *Semantic Syntax* (1974). His research interests are in syntax and semantics, theory of reference, prelexical syntax.

ÖSTEN DAHL is Docent in General Linguistics at the University of Göteborg. He is the author of *Topic and Comment: A Study in Russian and General Transformational Grammar* (1969), and has written articles for *Language, Scando-Slavica*, and *Synthese* as well as textbooks in linguistics. His research interests are in semantics, theory of grammar, logic and language.

COLIN BIGGS is a Research Student in Linguistics at the University of Cambridge. His principal research interests are in linguistic theory and philosophy of language.

J. A. W. KAMP has held teaching posts at the University of California Los Angeles, Cornell University, the University of Amersterdam and the University of London. His research and publications have been primarily concerned with tense logic, modal logic, intensional logic, and the formal semantics and pragmatics of natural languages.

FRANTZ VON KUTSCHERA is Professor of Philosophy at the University of Regensburg. He is the author of *Die Antinomien der Logik* (1964), *Elementare Logik* (1967), *Einführung in die moderne Logik* (1971) with A. Breitkopf, *Wissenschaftstheorie-Grundzüge der allgemeinen Methodologie der empirischen Wissenschaften* (1972), and *Einführung in die Logik der Normen, Werte und Entscheidungen* (1973). His principal research interests are in philosophical logic, philosophy of language, philosophy of science, epistemology.

RENATE BARTSCH is Professor of the Philosophy of Language at the University of Amsterdam. Her publications include *Adverbialsemantik* (1972), and, together with Theo Vennemann, *Semantic Structures: A study in the Relation between Semantics and Syntax*.

CARL H. HEIDRICH is at present leading a research group on formal linguistics at the University of Bonn. His publications include 'Eine Einbettung von generativen Chomsky-Grammatiken in den Prädikaten-kalkül', in *Forschungsberichte des IKP* (1974), *Vorlesungen über Montague-Grammatiken und Linguistische Logik* (forthcoming), and, as editor, *Formale Betrachtungen in Sprachtheorien* (1975). His principal research

interests are in logic, model theory and semantics of natural languages, algebraic linguistics.

ARNIM VON STECHOW is Professor of Linguistics at the University of Konstanz (Germany). His publications include *Einführung in Theorie und Anwendung der generative Syntax* (1973–4) with A. Kratzer and E. Pause and 'ε-λ-kontextfreie Sprachen. Ein Beitrag zu einer natürlichen formalen Semantik', *Linguistische Berichte*, 34.

NICHOLAS JARDINE is Lecturer in History and Philosophy of Science and Senior Research Fellow, King's College, Cambridge. His publications include *Mathematical Taxonomy* (1971) and papers on the mathematical theory of classification and its applications. His main research interests are in philosophy of language, the role of natural kinds in scientific theories and renaissance concepts of method in mathematics and natural philosophy.

TIMOTHY C. POTTS is Lecturer in Philosophy at the University of Leeds. His publications include 'Fregean categorial grammar', in *Logic, Language and Probability* (1973), 'Modal logic and auxiliary verbs', in *Semantics and Communication* (1974), and 'Montague's semiotic: a syllabus of errors', in *Proceedings of the Logic Conferences at the University of York, 1973 and 1974*. His research interests are in formal linguistics, medieval philosophy, philosophy of mind, speculative theology, aesthetics.

GEORGE LAKOFF is Professor of Linguistics at the University of California at Berkeley. He is one of the founders of the Generative Semantics movement in American Linguistics. His principal research has been devoted to showing why semantics, pragmatics and psychological processing need to be integrated into a theory of syntax, and how that might be done. He is the author of *Irregularity in Syntax* and numerous articles, especially, 'On generative semantics', 'Linguistics and natural logic', 'Conversational postulates' (with David Gordon), ' "Hedges": a study in meaning criteria and the logic of fuzzy concepts', and 'Introducing cognitive grammar' (with Henry Thompson).

STEPHEN ISARD is at present with the Laboratory of Experimental Psychology at the University of Sussex. His publications include 'Free recall of self-embedded sentences' with G. A. Miller, 'Computability over arbitrary fields' with G. T. Herman, and 'Utterances as programs' with D. J. M. Davies.

PETR SGALL is a Professor at Charles University, Prague. His publications on general linguistics and generative grammar include *Vývoj flexe v indoevropských jazycích* (*The Development of Inflection in IE Languages*) (1958), *Die Infinitive im Rigveda* (1958), *Generativní popis jazyka a česká deklinace* (*Generative Description of Language and the Czech Declension*) (1967), and, as the main author, *A Functional Approach to Syntax* (1969), *Topic, Focus and Generative Semantics* (1973), and *Functional Generative Grammar in Prague* (1974).

THEO VENNEMANN is Professor of Linguistics at the University of California, Los Angeles and Professor-elect at the University of Munich. His publications include 'Explanation in syntax', in *Syntax and Semantics* (1973), 'An explanation of drift', in *Word Order and Word Order Change, Schuchardt, the Neogrammarians, and the Transformational Theory of Phonological Change* (1972) with Terence H. Wilbur, and *Semantic Structures: A Study in the Relation between Semantics and Syntax*. His research interests are in the theory of grammar and of grammar change.

YORICK WILKS has worked at Cambridge, Stanford, and now in Switzerland, on the analysis of the structure of natural language within the Artificial Intelligence paradigm. He has written numerous articles and is the author of *Grammar, Meaning and the Machine Analysis of Language* (1972).

JOSEPH EMONDS is an Assistant Professor at the University of California, Los Angeles. His publications include 'The place of linguistics in American Society', in *Papers from the 7th Meeting of the Chicago Linguistic Society*, and 'A reformulation of Grimm's Law', in *Contributions to Generative Phonology*. His principle research interest is in the development of the extended standard theory of generative syntax, and the results of most of this work will be collected in his forthcoming book, *Transformational Approach to English Syntax: Root, Structure-Preserving, and Local Transformations*.

CATHERINE FUCHS is at present a Lecturer in Formal Linguistics at the University of Paris, and is engaged on research on the formal semantics of natural language at the Centre National de la Recherche Scientifique. She is the author of *Considérations théoriques à propos du traitement formel du language* (1970), *Théorie de l'énonciation et problèmes de prédication* (1972), *Ordinateurs, programmation et langues naturelles* (1974), *Analyse*

du discours et linguistique (1975), and *Initiation aux linguistiques contemporaines*.

JACQUES ROUAULT is Professor at the Social Sciences University of Grenoble, Institute for Computer Sciences, and Head of the Laboratory of Computational Linguistics and Applications. His publications include 'Etude formelle de l'opposition Situation/Propriété et des phénomènes de Voix et de Thématisation', International Conference on Computational Linguistics, Pisa (1973), 'Sémantique et traitement automatique des langues', Journées d'Etude sur la Parole, Orsay (1974), 'Les modèles logiques existants sont surtout un obstacle à la formalisation des théories linguistiques', Colloque Logique et Linguistique, Metz, and 'Vers une linguistique expérimentale des textes' (1975). His research interests are in the formalization of linguistic theories, computational linguistics.

MAURICE GROSS is Professor of Linguistics at the University of Paris and Director of the Laboratoire d'Automatique Documentaire et Linguistique. His major publications include *Notions sur les grammaires formelles* (1966) with A. Lentin, *Grammaire transformationnelle du français* (1968), *Mathematical Models in Linguistics* (1972) and *Méthodes en syntaxe* (1974). His research interest are in the problems in the foundation of syntax, formalization of syntactic rules and of generative transformational grammars.

EDWARD L. KEENAN is Associate Professor in the Department of Linguistics at the University of California, Los Angeles. His publications include 'Two kinds of presupposition in natural language', in *Studies in Semantics* (1970), 'Quantifier structures in English', *Foundations of Language* (1971), 'The logical presuppositions of questions and answers', in *Präsuppositionen in der Philosophie und der Linguistik*, 'Linguistics and logic', in *Linguistik und Nachbarwissenschaften* (forthcoming), articles in *Linguistic Inquiry* and papers presented to the Chicago Linguistic Society. He is an Associate Editor of *Linguistic Inquiry* and on the Advisory Board of Scriptor Verlag, Linguistics Series.

JOHN R. ROSS is Professor of Linguistics at the Massachusetts Institute of Technology. His Ph.D. thesis was entitled 'Constraints on Variables in Syntax'. His research interests are in universal grammar and the relationship of syntax and semantics.

ACKNOWLEDGEMENTS

INTRODUCTION

The papers in this volume are those given at the Cambridge Colloquium on Formal Semantics of Natural Language, April 1973. The purpose of that colloquium was twofold: to stimulate work in natural language semantics and to bring together linguists, philosophers, and logicians working in different countries and, often, from different points of view. Both purposes were, it seems to us, achieved, though of course it was not feasible to represent all countries and all points of view at a single conference.

The questions treated in the colloquium papers represent the following current areas of interest: problems of quantification and reference in natural language, the application of formal logic to natural language semantics, the formal semantics of non-declarative sentences, the relation between natural language semantics and that of programming languages, formal pragmatics and the relation between sentences and their contexts of use, discourse meaning, and the relation between surface syntax and logical meaning.

The papers have been loosely grouped under the six rubrics given in the table of contents. These rubrics were not given to the authors in advance and are intended only as a rough guide to the reader.　　　　　E.L.K.

CONTENTS

V PRAGMATICS AND SENTENCES IN CONTEXT

VI SEMANTICS AND SURFACE SYNTAX

I QUANTIFICATION IN NATURAL LANGUAGE

Adverbs of quantification

DAVID LEWIS

Cast of characters

The adverbs I wish to consider fall into six groups of near-synonyms, as follows.

(1) Always, invariably, universally, without exception
(2) Sometimes, occasionally, [once]
(3) Never
(4) Usually, mostly, generally, almost always, with few exceptions, [ordinarily], [normally]
(5) Often, frequently, commonly
(6) Seldom, infrequently, rarely, almost never

Bracketed items differ semantically from their list-mates in ways I shall not consider here; omit them if you prefer.

First guess: quantifiers over times?

It may seem plausible, especially if we stop with the first word on each list, that these adverbs function as quantifiers over times. That is to say that *always*, for instance, is a modifier that combines with a sentence Φ to make a sentence *Always* Φ that is true iff the modified sentence Φ is true at all times. Likewise, we might guess that *Sometimes* Φ, *Never* Φ, *Usually* Φ, *Often* Φ, and *Seldom* Φ are true, respectively, iff Φ is true at some times, none, most, many, or few. But it is easy to find various reasons why this first guess is too simple.

First, we may note that the times quantified over need not be moments of time. They can be suitable stretches of time instead. For instance,

(7) The fog usually lifts before noon here

means that the sentence modified by *usually* is true on most days, not at most moments. Indeed, what is it for that sentence to be true at a moment?

Second, we may note that the range of quantification is often restricted For instance,

(8) Caesar seldom awoke before dawn

is not made true by the mere fact that few of all times (past, present, or future) are times when Caesar was even alive, wherefore fewer still are times when he awoke before dawn. Rather it means that few of all the times when Caesar awoke are times before dawn; or perhaps that on few of all the days of his life did he awake before dawn.

Third, we may note that the entities we are quantifying over, unlike times,[1] may be distinct although simultaneous. For instance,

(9) Riders on the Thirteenth Avenue line seldom find seats

may be true even though for 22 hours out of every 24 – all but the two peak hours when 86% of the daily riders show up – there are plenty of seats for all.

Second guess: quantifiers over events?

It may seem at this point that our adverbs are quantifiers, suitably restricted over events; and that times enter the picture only because events occur at times. Thus (7) could mean that most of the daily fog-liftings occurred before noon; (8) could mean that few of Caesar's awakenings occurred before dawn; and (9) could mean that most riders on the Thirteenth Avenue line are seatless. So far, so good; but further difficulties work both against our first guess and against this alternative.

Sometimes it seems that we quantify not over single events but over enduring states of affairs. For instance,

(10) A man who owns a donkey always beats it now and then

means that every continuing relationship between a man and his donkey is punctuated by beatings; but these continuing relationships, unlike the beatings, are not events in any commonplace sense. Note also that if *always* were a quantifier over times, the sentence would be inconsistent: it would say that the donkey-beatings are incessant and that they only happen now and then. (This sentence poses other problems that we shall consider later.)

---

[1] Unlike genuine moments or stretches of time, that is. But we may truly say that Miles the war hero has been wounded 100 times if he has suffered 100 woundings, even if he has been wounded at only 99 distinct moments (or stretches) of time because two of his woundings were simultaneous.

We come last to a sweeping objection to both of our first two guesses: the adverbs of quantification may be used in speaking of abstract entities that have no location in time and do not participate in events. For instance,

(11) A quadratic equation never has more than two solutions

(12) A quadratic equation usually has two different solutions

mean, respectively, that no quadratic equation has more than two solutions and that most – more precisely, all but a set of measure zero under the natural measure on the set of triples of coefficients – have two different solutions. These sentences have nothing at all to do with times or events.

Or do they? This imagery comes to mind: someone is contemplating quadratic equations, one after another, drawing at random from all the quadratic equations there are. Each one takes one unit of time. In no unit of time does he contemplate a quadratic equation with more than two solutions. In most units of time he contemplates quadratic equations with two different solutions.

For all I know, such imagery may sustain the usage illustrated by (11) and (12), but it offers no hope of a serious analysis. There can be no such contemplator. To be more realistic, call a quadratic equation *simple* iff each of its coefficients could be specified somehow in less than 10,000 pages; then we may be quite sure that the only quadratic equations that are ever contemplated are simple ones. Yet

(13) Quadratic equations are always simple

is false, and in fact they are almost never simple.

Third guess: quantifiers over cases

What we can say, safely and with full generality, is that our adverbs of quantification are quantifiers over cases. What holds always, sometimes, never, usually, often, or seldom is what holds in, respectively, all, some, no, most, many, or few cases.

But we have gained safety by saying next to nothing. What is a case? It seems that sometimes we have a case corresponding to each moment or stretch of time, or to each in some restricted class. But sometimes we have a case for each event of some sort; or for each continuing relationship between a man and his donkey; or for each quadratic equation; or – as in the case of this very sentence – for each sentence that contains one of our adverbs of quantification.