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Shalom Lappin

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Do not say anything which cannot be understood in the hope that in the end it will be understood.

Hillel, *Pirkei Avot*, Perek Bet, Pasuk Hey (Chapter 2:5)

To my parents, Adah and Ben Lappin, who introduced me to natural language and inspired me to investigate it

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Notes on Contributors

Robin Cooper is Reader in Cognitive Science and Principal Investigator in the Human Communication Research Center at the University of Edinburgh. His publications are mainly in the area of natural language semantics and recently he has been concerned with computational semantics. His book *Quantification and Syntactic Theory* (Reidel) appeared in 1983. He has recently co-edited and contributed to a four-volume survey of formal and computational semantics produced for the FraCas (Framework for Computational Semantics) Consortium.

Mürvet Enç is Associate Professor of Linguistics at the University of Wisconsin, Madison. She has written articles on the semantics of tense and temporal expressions, including 'Towards a Referential Analysis of Temporal Expressions', *Linguistics and Philosophy*, 1986 and 'Anchoring Conditions for Tense', *Linguistic Inquiry*, 1987.

Robert Fiengo received his Ph.D. from MIT in 1974. He is Professor of Linguistics at Queens College and the Graduate Center, City University of New York. He is the author of *Surface Structure* (Harvard University Press, 1980) and, with Robert May, *Indices and Identity* (MIT Press, 1994).

Jean Mark Gawron is a research linguist at the Artificial Intelligence Center at SRI in Menlo Park, California. He is co-author with Stanley Peters of *Anaphora and Quantification in Situation Semantics* (CSLI, 1990) and is also a writer of fiction. His interests include lexical semantics, quantification and anaphora, indexicals, comparatives, and superlatives.

Jonathan Ginzburg is currently a research follow at the Human Communication Research Centre, University of Edinburgh. He gained a B.Sc. in mathematics from the Hebrew University of Jerusalem and a Ph.D. in linguistics from Stanford University. His interests include the syntax through pragmatics of interrogatives, propositional attitudes, and the semantics of dialogue.

Jeroen Groenendijk teaches logic and linguistics at the University of Amsterdam. He is affiliated with both the Institute for Logic, Language and Computation and the Department of Philosophy. Together with Martin Stokhof he has published papers on dynamic semantics, including 'Dynamic Montague Grammar' in L. Kalman and L. Polos (eds) *Papers from the Second Symposium on Logic and Language* (Akademiai Kiado, Budapest, 1990) and 'Dynamic Predicate Logic', *Linguistics and Philosophy*, 1991. He is also an Associate Editor of *Linguistics and Philosophy*.

Laurence R. Horn is Professor and Director of Graduate and Undergraduate Studies in the Department of Linguistics at Yale University. His publications include *A Natural History of Negation* (Chicago University Press, 1989) and numerous philosophical articles. His primary research area lies within the union (if not the intersection) of traditional logic, lexical semantics, neo-Gricean pragmatic theory, and the analysis of negation. Other research interests include functional syntax, grammatical relations, and language, sex, and gender.

James Higginbotham is Professor of General Linguistics, University of Oxford and formerly Professor of Philosophy and Linguistics, MIT. His publications include articles on syntactic and semantic theory and the philosophy of language and linguistics.

Malka Rappaport Hovav is Associate Professor in the Department of English at Bar-Ilan University, where she has worked since 1984. She has also been affiliated with the Lexicon project of the MIT Center for Cognitive Science. Her major research interests are lexical semantics and morphology, and their interaction with syntax. She is co-author with Beth Levin of *Unaccusativity: At the Syntax-Lexical Semantics Interface* (MIT Press, 1995).

Ray Jackendoff is Professor of Linguistics at Brandeis University. He is the author of *Semantics and Cognition* (MIT Press, 1983), *Consciousness and the Computational Mind* (MIT Press, 1987), *Semantic Structures* (MIT Press, 1990) and, with Fred Lordhal, *A Generative Theory of Tonal Music* (MIT Press, 1983). His most recent book, *Patterns in the Mind: Language and Human Nature* (Basic Books, 1994), presents the *Weltanschauung* of contemporary generative linguistics and psycholinguistics in a fashion accessible to the lay reader.

Pauline Jacobson is Professor of Cognitive and Linguistic Sciences at Brown University. Her research centers on the syntax/semantics interface and is carried out primarily within the tradition of Categorical Grammar. Recent publications include articles in E. Bach et al. (eds) *Quantification in Natural Language* (Kluwer, 1995) and in A. Szabolcsi and I. Sag (eds) *Lexical Matters* (CLSI, 1992).

Jerrold J. Katz received his Ph.D. in philosophy from Princeton University. Having taught at Princeton, MIT, the City University of New York, and King's College London, he is currently Distinguished Professor in the Philosophy and Linguistics Programs at The Graduate Center of the City University of New York. He has written articles and books on philosophy and linguistics, including *Semantic Theory* (Harper and Row, 1972), *Propositional Structure and Illocutionary Force* (Harvester, 1977), *Language and other Abstract Objects* (Rowman and Littlefield, 1981), *Cogitations* (OUP, 1986), and *The Metaphysics of Meaning* (MIT Press, 1990). He is currently working on a book on the philosophy of mathematics. His major research interests are philosophy of language, semantics, philosophy of linguistics, philosophy of mathematics, and metaphysics.

Edward L. Keenan received his Ph.D. from the University of Pennsylvania. He is Professor of Linguistics at UCLA, and has written a series of papers in generalized quantifier theory and Boolean semantics. He has also published, with Leonard Falz, *Boolean Semantics for Natural Language* (Reidel, 1985).

Ruth M. Kempson is Professor of Linguistics at the School of Oriental and African Studies at the University of London. She is the author of *Presupposition and the Delimitation of Semantics* (CUP, 1975), Semantic Theory (CUP, 1977) and editor of *Mental Representations* (CUP, 1988). Her research interests include the interface of syntax, semantics, and pragmatics, language and proof theory, labelled deduction and natural language interpretation.

William A. Ladusaw gained his Ph.D. from the University of Texas at Austin. He is Associate Professor of Linguistics at the University of California, Santa Cruz. His research interests are in semantics and the syntax-semantics interface, with a particular interest in negation. He has published papers on negation, negative polarity items, and logical form.

Fred Landman is Associate Professor of Semantics in the Linguistics Department at Tel Aviv University. He is the author of *Towards a Theory of Information: The Status of Partial Objects in Semantics* (Foris Publications, 1984) and *Structures for Semantics* (Kluwer, 1991), and of various articles on semantics. Unlike everyone else, he was not born in a scenic spot, but in a dump of a baby clinic in Amsterdam, which (fortunately) no longer exists.

Shalom Lappin is Professor of Linguistics at the School of Oriental and African Studies, University of London. He was formerly a Research Staff Member at IBM T. J. Watson Research Center in Hawthorne, New York. His teaching and research interests are in formal semantics, formal syntax, and computational linguistics. He is the author of *Sorts, Ontology, and Metaphor: The Semantics of Sortal Structure* (de Gruyter, 1981) and, with Asa Kasher, *Philosophical Linguistics* (Scriptor, 1977). His most recent publications include articles in *Linguistics and Philosophy* and *Computational Linguistics*.

Beth Levin is Associate Professor in the Department of Linguistics at Northwestern University. Her research investigates the lexical representation of verb

meaning, as well as the interactions between lexical semantics, syntax, and morphology. She is the author of *English Verb Classes and Alternations: A Preliminary Investigation* (University of Chicago Press, 1993) and co-author with Malka Rappaport Hovav of *Unaccusativity: At the Syntax-Lexical Semantic Interface* (MIT Press, 1995). Prior to coming to Northwestern, she had major responsibility for directing the Lexicon Project of the MIT Center for Cognitive Science.

Robert May received his Ph.D. in 1977 from MIT, and has taught at Barnard College, Columbia University and the University of California, Irvine, where he is currently Professor of Linguistics. He is the author of *Logical Form: Its Structure and Derivation* (MIT Press, 1985) and, with Robert Fiengo, *Indices and Identity* (MIT Press, 1994).

John Nerbonne is a computational linguist who has worked on inheritance-based lexicons, computational semantics, and applied linguistics. He has worked at Hewlett-Packard Laboratories and at the German Artificial Intelligence Center. He is currently Professor of Computational Linguistics and Chair of Humanities Computing at the Rijksuniversiteit Gronigen. He has published articles in a number of journals, including *Computational Linguistics, Annals of Mathematics and Artificial Intelligence, Künstliche Intelligenz* and *Machine Translation.*

Barbara H. Partee is Distinguished University Professor of Linguistics and Philosophy at the University of Massachusetts, Amherst. She has published numerous books and articles on formal semantics and mathematical linguistics. Her most recent book, co-edited with A. Ter Meulen and R. Wall, is *Mathematical Methods in Linguistics* (Kluwer, 1989).

Mats Rooth is Professor of Linguistics in the Institute for Computational Linguistics, University of Stuttgart. He has worked on focus and the semantics of noun phrases. His recent papers include 'Noun Phrase Interpretation in Montague Grammar, File Change Semantics, and Situation Semantics' in P. Gärdenfors (ed.), *Generalized Quantifier Theory* (Reidel 1987) and 'A Theory of Focus Interpretation', *Natural Language Semantics*, 1992.

Craige Roberts is Associate Professor of Linguistics at the Ohio State University, Columbus. She has published papers on anaphora, modality, and pragmatics. Among her recent articles are 'Modal Subordination and Pronominal Anaphora in Discourse', *Linguistics and Philosophy*, 1989 and 'Domain Restriction in Dynamic Interpretation' in E. Bach et al. (eds.) (1995).

Gila Y. Sher is Associate Professor of Philosophy at the University of California, San Diego. Among her publications are *The Bounds of Logic; A Generalized Veiwpoint* (MIT, 1991) and articles in *The Pacific Philosophical Quarterly, The Journal of Philosophical Logic, and Linguistics and Philosophy*. Her current research centers on the theory of truth.

Martin Stokhof teaches logic and linguistics at the University of Amsterdam. He is affiliated with both the Institute for Logic, Language and Computation and the Department of Philosophy. Together with Jeroen Groenendijk he has published papers on dynamic semantics, including 'Dynamic Montague Grammar' in L. Kalman and L. Polos (eds) *Papers from the Second Symposium on Logic and Language* (Akademiai Kiado, Budapest, 1990) and 'Dynamic Predicate Logic', *Linguistics and Philosophy*, 1991. He is also an Associate Editor of *Linguistics and Philosophy*.

Frank Veltman is Associate Professor in Logic at the Department of Philosophy of the University of Amsterdam. He has published several papers on the borderline between semantics and logic. The topics dealt with include conditionals, modalities, defaults, and vagueness.

Preface

Work on this handbook began in 1992, when I was a Research Staff Member in the Computer Science Department at IBM T.J. Watson Research Center in Hawthorne, New York. The book came along when I moved to London in the summer of 1993 to take up a position in the Linguistics Department at the School of Oriental and African Studies, University of London. That it was finished is due, in no small measure, to the help and support which I received from numerous people.

I am grateful to the contributors for their cooperation and patience during the extended process of assembling and editing the papers in the volume. Reading and discussing their articles with them has given me a wonderful perspective on the depth and range of current research at the frontiers of contemporary semantic theory. My editors at Blackwell, Philip Carpenter, Steven Smith, and Bridget Jennings, have provided much help, advice, and encouragement. I would like to thank Robert May for very useful advice on the design and structure of the Handbook. Ruth Kempson has given me invaluable support and critical discussion. I am grateful to my wife, Elena, whose love and good natured tolerance have been indispensable to the completion of this project. She carries heavy editorial responsibilities of her own, but never failed to display full understanding of the demands which the handbook involved. Finally, I must thank my children, Miriam, Yaakov, Yoni, and Shira, for being themselves, and for putting up with the long periods during which I was working on the handbook. Part of the time required for this work rightfully belongs to them, and I will now try to repay some of what I owe them.

Shalom Lappin
London, February, 1995

Introduction

In the past twenty-five years semantics has moved from a peripheral status in the theory of grammar to a central role in linguistic research. At the beginning of the 1970s most linguists working within generative grammar regarded linguistic semantics as an underdeveloped field without a clearly specified formal framework or a well-defined research programme. The following comment from Chomsky (1971) reflects this widely held view.

> In the domain of semantics there are, needless to say, problems of fact and principle that have barely been approached, and there is no reasonably concrete or well-defined "theory of semantic representation" to which one can refer. I will, however, assume here that such a system can be developed, and that it makes sense to speak of the ways in which the inherent meaning of a sentence, characterized in some still-to-be-discovered system of representation, is related to various aspects of its form. (p.183)

The situation changed soon after the publication of Chomsky's paper. The appearance of Montague's "Proper Treatment of Quantification in Ordinary English" (PTQ) in 1973 provided a model for developing a formal semantic theory of natural language. Specifically, Montague constructed a theory of semantic representation in which the model theoretic interpretations of natural language sentences (and expressions generally) are built up by rules operating in strict correspondence with the syntactic operations that generate their structural representations. Montague's work established the foundations for research in formal semantics for the next two decades. At approximately the same time, Jackendoff (1972) proposed a system for representing lexical semantic relations within generative grammar. This system (and its subsequent refinements) has provided the basis for a considerable amount of work on the relation between lexical meaning and syntax. In the past few years a variety of innovative formal developments have extended both the empirical coverage and the explanatory power of current semantic theories. Genuine progress has

been made in the analysis of difficult semantic problems which have, until now, resisted solution. Thus, for example, while classical Montague Grammar adopts an essentially static, sentence-bound view of meaning, the investigation of dynamic processes of interpretation has yielded proposals for modelling the incremental flow of information through discourse. Similarly, by extending model theory to represent the internal structure of discourse situations, situation-based theories have provided precise accounts of the respective roles played by certain aspects of extra-linguistic context and the context-independent components of sentence meaning in generating complete interpretations for sentences.

The papers in this handbook address the major areas of current semantic research. Taken together, they offer an overview of the state of the art in semantic theory. The handbook is not intended to provide an exhaustive account of the issues it deals with. Nor does it purport to be an introductory textbook. Each paper gives a brief introductory sketch of previous work on the problem addressed and includes all the relevant references. This introduction serves as a guide for readers interested in pursuing the background to the problem in greater detail. In most cases, the author devotes the greater part of the article to the presentation of his/her current work on the topic.

The book is organized thematically rather than by theoretical approach. Each chapter concerns a particular problem or area of research. This allows the reader to appreciate the issues which constitute the research domain of contemporary semantics, rather than encouraging him/her to partition the field into competing schools. Fortunately, as the papers in this volume show, paradigm boundaries in current semantic theory tend to be porous, and there is a high degree of mutual interaction among researchers across these boundaries. This indicates the existence of a significant core of shared assumptions among many semanticists concerning the objectives of semantic theory and the set of phenomena to which it applies. However, the major theoretical paradigms are well represented, and the set of contributors encompasses a broad spectrum of views. The contributors are leading figures in the field, whose research has shaped current thinking on the issues which they take up here. Therefore, the articles in the handbook present a view of the central issues and major theoretical developments which are driving work in contemporary semantic theory.

In Section I Partee provides a history of formal semantics in linguistic theory. Given the fact that she has played a key role in the introduction of Montague Grammar (MG) into generative linguistics and contributed to the subsequent emergence of this model as the dominant framework for formal semantics, she is uniquely placed to present this historical account. In her paper, Partee traces the roots of MG to ideas in logic, model theory and the philosophy of language. She discusses the development of MG and the evolution of several post-Montague approaches to formal semantics, such as Discourse Representation Theory (DRT) (Kamp (1981), Kamp and Reyle (1993), and Heim (1982)), Situation Semantics (Barwise and Perry (1983)) and Dynamic Montague Grammar (Groenendijk and Stokhof (1990a)).

Section II is concerned with Generalized Quantifier (GQ) theory, which occupies a central place in formal semantics. On the GQ approach, NPs are analyzed as belonging to a unified syntactic category and corresponding semantic type. A GQ is generally taken to denote a set of sets, and a determiner is characterized as denoting a relation between sets. Keenan gives a survey of GQ theory, and presents the results of some of his recent work on the semantics of determiners. This work develops the ideas on Boolean semantics for determiners in, for example, Keenan and Moss (1985), Keenan and Stavi (1986) and Keenan (1987b). Cooper argues for a formulation of GQ theory which employs situation-theoretic notions in specifying the interpretation of quantified NPs. This analysis involves a significant revision of the classical version of GQ theory presented in Barwise and Cooper (1981).

The papers in Section III take up the question of how to characterize the interface between syntactic structure and semantic representation. Jacobson indicates how the interface is characterized within the framework of Categorial Grammar (CG). The CG approach sustains Montague's programme for specifying a homomorphism between syntactic categories and semantic types, where both categories and types are either basic elements or functions on objects built up from these elements. Jacobson's version of CG dispenses with empty syntactic categories and semantic variables. The relations which they are intended to capture are expressed by complex syntactic functions and the semantic functions which correspond to them. Fiengo and May take up the syntax-semantics interface in the context of determining how syntactic factors contribute to the interpretation of anaphoric relations. The guiding principle which informs their investigation is that identity of syntactic structure implies identity of semantic interpretation. This principle leads them to formulate a set of criteria for recognizing when two expressions exhibit the same syntactic structure, and so stand in the relation of (syntactic) *reconstruction* to each other. In my paper, I explore the interface question from the perspective of ellipsis resolution. I consider three types of constituent fragment (only two of which are genuine instances of ellipsis), and I argue that it is not possible to apply a single strategy of either syntactic or semantic reconstruction to all of them. Each fragment type requires a distinct reconstruction procedure which generates an interpretation at a different level of representation.

Section IV is devoted to the dynamic interpretation of anaphoric elements in discourse. Groenendijk, Stokhof and Veltman propose an account of pronominal anaphora which combines aspects of the dynamic semantics proposed in Groenendijk and Stokhof (1990a) and (1991) with Veltman's (forthcoming) update semantics. The account seeks to model the way in which a speaker's assertion of a sentence can modify an information state that existed prior to the assertion. Their analysis extends their previous work in order to capture the anaphoric possibilities of pronouns in modal contexts. Craige Roberts deals with a similar range of issues. She suggests an analysis of pronominal anaphora in intensional contexts which relies on both the notions of modal subordination (Roberts (1987) and (1989)) and the accommodation of a presupposition

(Lewis (1979)). Mark Gawron is concerned with the way in which the domain of a quantified NP is specified and updated in discourse. He maintains that the setting and modification of a quantificational domain is subject to dynamic factors of a sort analogous to those which determine the interpretation of pronouns in conversation. Gawron constructs a dynamic logic to represent the processes involved in domain update.

Section V contains papers on focus, presupposition, and negation. Rooth characterizes the focus of a sentence in terms of a set of alternative propositions which are obtained by substituting different values for a variable corresponding to the focused constituent. This analysis develops the proposals of Rooth (1985) and (1992). Horn gives a history of the semantic and pragmatic concepts of presupposition and their respective connections with the pragmatic notion of conversational implicature. He relates these issues to current research on discourse processing, specifically to Sperber and Wilson's (1986) work on Relevance Theory. Ladusaw discusses the semantics of clausal negation in connection with the distribution of negative polarity items and negative concord. He extends the account of negative polarity suggested in Ladusaw (1979) to take account of the role of pragmatic factors in determining the interpretation of negative polarity structures.

Section VI addresses the semantics of tense. Enç discusses the relationship between tense and modals. She argues that in English, the past is the only genuine tense, while the future is, in fact, interpreted as a modal and the present is the absence of tense specification.

Section VII consists of two papers on the semantics of questions. Higginbotham proposes that a question is interpreted as a space of possibilities, and a relevant answer to a question is a statement which eliminates some but not all of the possibilities in this space. He uses this account of questions to define the notion of a partial answer and to characterize the presupposition of a question. The analysis is developed within the framework of intensional logic, and it extends the account given in Higginbotham (1993). Ginzburg offers a situation-theoretic analysis of interrogatives on which a question is a partially specified situation type that generates a set of information structures (states of affairs) each of which potentially resolves the question. The notion of resolvedness is, in part, discourse dependent and invokes the informational state of the questioner. Ginzburg applies this treatment of interrogatives to construct a model of question-answer dialogues.

In Section VIII Landman gives an account of plurality on which both cumulative and distributive readings of a plural NP are identified as cases in which the NP denotes a sum (a plural entity), and does not receive a thematic role in the predication determined by the verb of which the NP is an argument. By contrast, a collective reading involves the assignment of a thematic role to an NP which denotes a group (an individual entity). The theory of plurals which Landman presents here develops and significantly modifies the analysis in Landman (1989a) and (1989b).

In Section IX Nerbonne presents a computational model of semantic interpretation within the framework of a unification-based approach to grammar (he uses HPSG to illustrate this approach). He specifies the interpretation process as unification of semantic feature structures. Unification involves the generation of composite feature representations from the structures of constituent expressions, in accordance with the constraints that the constituent feature structures impose. Nerbonne argues that compositionality need not hold in this model of interpretation.

Section X is devoted to lexical semantics. Levin and Rappaport take up the problem of how to determine the linking rules which specify the correspondence between the lexical semantic representation of a verb and its syntactic argument structure. They adopt the view that the argument structure of a verb is, in general, projected from its lexical semantic representation. They explore the relation between verbs of sound and verbs of manner of motion, in connection with the syntactic property of unaccusativity, in order to provide a case study which motivates this view.

Finally, Section XI takes up the connections between semantics and related disciplines. While it is firmly anchored in the theory of grammar, semantics, more than most other areas of linguistic research, is a focus for interdisciplinary activity. Computer science, logic, philosophy, pragmatics and psychology have all contributed important ideas to linguistic semantics and have been influenced by developments in semantic theory. Sher discusses the development of first-order logic and GQ theory within the framework of Tarskian semantics. She proposes a generalized concept of logicality based upon Mostowski's idea of invariance of interpretation under permutation of the elements of a model. She specifies Tarskian interpretations for various classes of GQs within an extended first-order system. Her paper provides an interesting perspective on some of the formal issues in GQ theory raised in Keenan's paper. Jackendoff describes the framework for representing lexical conceptual structures which he has developed and refined in recent work (such as Jackendoff (1990) and (1992)). He identifies these structures as the point of interface between grammar and cognition. He maintains that they provide the level of representation at which the universal conceptual relations underlying semantically coherent lexical (specifically verb) classes are expressed. Jackendoff's theory of lexical conceptual structure relates directly to the issues which Levin and Rappaport address in their paper. Kempson considers the traditional separation of semantics and pragmatics. She argues that this distinction should be discarded in favour of a unified model of interpretation which incorporates both context-dependent and context-independent aspects of meaning. She proposes a proof theoretic system in which the interpretation of a sentence is built up incrementally through a species of natural deduction. Her approach is similar in spirit to that of the dynamic semantic theories presented in Section IV. Katz discusses the influence of extensionalist theories of meaning developed by philosophers like Carnap, Quine and Davidson on formal semantics, and he offers a critique of these theories. He suggests an alternative view of meaning on which the intension of an expression is not

characterized in denotational terms, but through decomposition into a complex of universal semantic features. Katz deals with issues that are also taken up in the papers by Partee and by Jackendoff. The non-denotational version of intensionalism which he presents develops ideas from Katz (1990b) and (1992).

The papers in this volume indicate the prominence of at least five major themes in contemporary semantic theory. First, the concern to model interpretation as a dynamic process involving the successive modification of an information state through discourse (which began with Kamp's DRT (1981)) has emerged as a primary line of research. Dynamic semantic theories are yielding increasingly sophisticated representations of the information states attributed to discourse participants, and progressively refined accounts of the procedures through which these states are modified in response to contributions to a discourse. As a result, the classical notion of interpretation as the specification of a model for a set of sentences has given way to the view that interpretation applies to a sequence of sentences, and evolves as each element of the sequence is processed.

Second, there has been a considerable expansion in the formal resources of both the type theories applied to natural language and the model theories used to specify interpretations. An example of the former development is the introduction of flexibly determined grammatical categories with corresponding types, as well as the adoption of various type shifting operations in CG. The use of n-ary ($2 \leq n$) determiner functions and resumptive quantifiers in the representation of GQs in natural language provides a second example.[1] The extension of models, in situation semantics, to include situation types is an instance of the latter phenomenon. Another case where classical models are enriched is the introduction of algebraic structure into the domain of elements to permit the definition of composite individuals in order to represent the denotations of certain plural expressions.[2] These increases in the expressive power of both instantiated type theory and model theory are intended to capture semantic properties of expressions which cannot be accommodated in more classical frameworks. To the extent that these enrichments are well motivated, they indicate that the semantic interpretation of natural languages requires a type theory and a model theory that are considerably more complex than the system of Intensional Logic that Montague employed for the PTQ fragment.

Third, two main approaches to the syntax-semantics interface have shaped discussion of the relation between syntactic structure and semantic interpretation. On the first, an abstract syntactic level of Logical Form (LF) is derived by non-overt operations of raising that apply to quantified NPs and *in situ* *wh*-phrases to generate operator-variable structures. LF is the level of syntactic representation to which rules of semantic interpretation apply.[3] The second approach identifies the interface level with a structure in which all constituents appear in their surface positions.[4] Each view represents a certain type of choice in determining the relative complexity of syntactic representation and

procedures of semantic interpretation. In general, a richer syntactic structure permits a simpler and more straightforward mapping of the interface structure onto a semantic interpretation. Conversely, a more impoverished syntactic representation which is closer to the lexically realized surface form requires more powerful semantic devices to generate an appropriate interpretation (or set of interpretations). Both empirical factors and theory-internal considerations play a role in deciding how to weight this balance.

The fourth theme concerns the question of whether there is an autonomous level of semantic representation which intervenes between the syntactic structure of a sentence and its model theoretic interpretation. Such a level has no place in MG, where interpreting a sentence consists entirely in computing its denotation relative to a model on the basis of the denotations (relative to the model) of its constituents. However, at least some dynamic approaches assign a representation to a sentence which corresponds to the informational state that it produces, and which is, in turn, mapped into a model.[5] The current emphasis on the semantic processing of sentences in a discourse sequence and the fine grained specification of context-dependent factors has given rise to theories which seek to represent the interaction of discourse participants and the states of affairs they talk about. The focus on informational processing has resulted in a strong tendency to posit independent semantic structures which are essentially models of cognitive states. This trend reflects the growing recognition of the psychological and computational dimensions of semantic interpretation.

Finally, the fifth issue is the absence of a common theoretical framework which can accommodate the sort of research currently being done in lexical semantics on one hand and in formal semantics on the other. The decompositional lexical conceptual structures which Jackendoff and other lexical semanticists employ cannot express the insights of formal semantics with respect to the properties of quantified NPs (and other scope defining elements), referential terms, and anaphoric expressions. They also seem unable to represent presuppositions. Formal theorists, for their part, have generally relied on meaning postulates to express lexical semantic relations. They have not managed to incorporate into their frameworks the systematic and subtle generalizations of lexical semanticists concerning the meaning relations which hold for different subclasses of lexical items. Some important work has been done by formal semanticists on the model theoretic treatment of the concepts and regularities that have emerged in lexical semanticists.[6] However, this is an area where much remains to be done. Specifically, what is required is a framework which will express the relationship between the "internal" semantic properties of a lexical item and its contribution to the denotation of a sentence in which it appears.

The issues connected with these five research themes will undoubtedly continue to provide focal points for much future work in semantic theory. If the papers in this handbook succeed in giving a sense of the directions which current research in semantics is pursuing and the vitality of this research, then the handbook will have achieved its purpose.

NOTES

1 See, for example, Keenan (1987b), van Benthem (1989), and May (1989) on n-ary and resumptive quantifiers.
2 See Link (1983) and (1987b), and Landman (1989a) and (1989b).
3 For the role of LF in the grammar see May (1985). Chomsky (1993) proposes a minimalist model of syntax in which LF is the only level of syntactic structure to which syntactic constraints apply, and so it is the only level of syntactic representation.
4 Variants of this view are developed in, for example, CG, HPSG (Pollard and Sag (1994)), and in Lappin (1991), (1993a), and (forthcoming).
5 This view is explicitly adopted in DRT, and it appears to be implicit in the dynamic semantics presented by Groenendijk, et al. in this volume. Moreover, the respective situation theoretic analyses which Cooper, Gawron and Ginzburg propose in this volume also suggest a representationalist approach. It should be noted that not all dynamic theories assume a level of semantic representation which is distinct from the interpretation of a sentence in a model. Thus, Lappin (1989), Lappin and Francez (1994) and Heim (1990) propose E-type accounts of donkey pronouns which are dynamic in that the domain and range of E-type functions are determined by prior expressions in discourse. However, none of these accounts posits a discourse representation apart from the model theoretic structures in terms of which the denotations of expressions are specified.
6 Carlson (1984), and Dowty (1989) and (1991) propose formal reconstructions of thematic roles and linking rules. Zwarts and Verkuyl (1994) offer a model theoretic formulation of Jackendoff's lexical conceptual structures.

I Formal Semantics in Linguistics