

Flexibility Principles in Boolean Semantics

The interpretation of coordination, plurality and scope in natural language

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PREFACE

In his 1970 article *English as a Formal Language*, Richard Montague introduced a revolutionary theory of the interpretation of human languages. Montague showed that non-trivial semantic facts about English can be explained using precise methods that had previously been employed only for the construction of artificial mathematical languages. A fundamental principle in Montague's program is that the *meaning* of a complex linguistic expression is tightly connected to its *form*. Under this conception, knowledge of the meaning of a natural language expression is reduced to knowledge of its internal structure and the meanings of its syntactic constituents. Accordingly, the theory contains a simple recursive procedure that computes the meaning of a sentence from its syntactic representation and the meaning of the words it contains.

Because of the close relationship it assumes between syntax and semantics, Montague's paradigm carries an enormous hope for linguistic theory. If it proves correct it will allow theories of natural language syntax, with the impressive advances they have achieved since the early works of Noam Chomsky, to significantly extend their empirical coverage. Syntactic theory would not only account for well-formedness of expressions, but could also be the basis for analyzing their informational content. On the other hand, the theory of natural language semantics in the Montagovian paradigm is no longer the dull exercise of merely formalizing *what* sentences mean. Montague semantics also addresses the scientifically more exciting question of *how* the meaning of language expressions is derived.

On the basis of Montague's answer to this question, a broader framework of *Boolean Semantics* has evolved. Boolean semantics is an extension of Montague grammar that pays special attention to the mathematical nature of the semantic domains it uses. It is observed that these domains all have the structure of *Boolean Algebras*. This observation allows a remarkably elegant treatment of coordination and negation phenomena. The boolean order that underlies Montague semantics is also the basis for the analysis of the noun phrase, which is treated using the boolean domain of *generalized quantifiers*. Boolean semantics and its sub-field of generalized quantifier theory have become the foundations of a modern framework where the meaning of natural language expressions is studied in close connection to their syntactic analysis.

The main proposal in this book is that boolean semantics should be augmented by *flexibility principles*. In a flexible interpretation process, the computation of the meaning involves operation of general semantic rules that do not have any direct counterpart in phonological form and are more specialized than the elementary logical operations that are needed in order to glue meanings together (e.g. function application). One familiar strategy underlying the application of

flexibility operations is the *type-fitting* strategy. According to this strategy, flexibility operations are allowed to apply only when other composition operations fail and lead to so-called *type mismatch*. Another kind of flexibility principles are referred to in this book as *category-shifting principles*. These operations, unlike type-fitting principles, change the semantic category of an expression (e.g. from predicate to quantifier or vice versa) and are triggered by syntactic factors and not by type mismatch.

Both kinds of flexibility principles contribute to the solution of central problems in the analysis of *coordination*, *plurality* and *scope* that previous works have considered inherent to boolean semantics. Contrary to these beliefs, however, it will be shown that the flexibility paradigm in fact reveals further advantages of the boolean approach to natural language. Under the emerging new conception of flexibility, semantic theory includes a logical compositional component that is relevant for the interpretation of all languages, natural as well as artificial, in conformity of Montague's use of the term *Universal Grammar*. In addition to this logical component, the theory of natural language semantics includes an array of flexibility operations that are specific to human languages. These rules are therefore candidates for inclusion in 'Universal Grammar' in the Chomskyan sense of the term: they characterize general properties of natural language that are nonetheless not made necessary by any plausible abstract definition of language as a symbolic system.

This work is primarily intended for readers with background in theoretical linguistics who have some knowledge of formal semantics. However, many parts of the book are also of relevance for researchers and students in related disciplines that deal with natural language. The discussion throughout the book presupposes some sophistication in elementary set theory and logic, but a number of central principles and techniques in the formal semantics of natural language are reviewed in the introduction.