Type-Logical Syntax

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Foreword

This book represents the culmination of a research project on which we have collaborated for close to a decade, developing a "type-logical" version of categorial grammar as a viable alternative model of natural language syntax and semantics. Our collaboration originated in our realization that some of the thorniest problems presented by the syntax-semantics interface for natural language, first in the domain of coordination and then in ellipsis, have remained problematic across a wide range of seemingly quite different theoretical frameworks for syntax. It gradually became clear to us that these problems, addressed in the following chapters, have deep connections with each other, and that their intractability reflects a foundational problem shared by these approaches—commitment to the strategy of licensing linguistic expressions via well-formedness conditions on hierarchically organized objects. Despite the fact that the strategy has become ingrained in the practice of linguistic theorizing to the point where the vast majority of researchers in the field regard it as the only conceivable approach, a look back at the early history of the field makes it clear that there never was any sense in which this hierarchical model of representation was found to be necessary, on either logical or empirical grounds, as we discuss below (and in greater detail in chapter 1).

It is by now a truism that, with the advent of generative grammar in Chomsky (1957), the middle of the twentieth century saw the emergence of a radically new view of the fundamental questions a scientific perspective on human languages should seek answers to. This turn in the field, representing as it does the full adoption of a nomological-deductive paradigm, is arguably one of the great watersheds in the history of ideas. The results of this development in the theoretical foundations of linguistics as a field include an explosive growth in both the domain of knowledge that it claims as its own and the size of the field as an academic enterprise. What is not generally recognized is that the methodological/conceptual toolkit used to implement this new approach was brought over, largely intact, from the previous taxonomic era, commonly referred to as American Structuralism. The syntactic representation of natural language stringsets that provided the basis for contemporary mainstream grammatical frameworks—derivational

and monostratal alike—was a reflection, ultimately, of the analytic practice of American Structuralists, in particular, the Boasian tradition in descriptive linguistics. This tradition in turn has its roots in the challenges posed by the extreme morphological complexity of indigenous North American languages. In particular, the phrase markers that became the lingua franca of theoretical syntax build into linguistic representations an enduring hierarchical relationship among the parts of sentences, in principle allowing for the accessibility of the entire compositional history of those parts for reference in the statement of grammatical operations.

From the very outset, however, there was a genuinely alternative perspective on the fundamental architecture of grammar. Lambek (1958), building on Ajdukiewicz (1935) and Bar-Hillel (1953), outlined a very different system, one in which the well-formedness of sentences is determined not by constructing hierarchically organized objects but via proofs formally homologous to proofs of theorems in various familiar logics. In Lambek's deductive calculus, all vocabulary items are associated with syntactic types, and the complete set of such types is defined by type constructors whose behavior mirrors that of the implication connective in intuitionistic propositional logic (IPL). Specifically, Lambek's rules in his 1958 calculus, recast in so-called natural deduction format, introduce and eliminate these connectives in a fashion which mirrors the rules of implication elimination and introduction, and—just as in logical proofs—the history of the deduction is not in general uniquely recoverable from the final line of the proof. In effect, this architecture, which forms the core of more modern versions of (type-logical variants of) categorial grammar, entails that there is no internal structure to the representation of sentences, at least in its simplest form as formulated in Lambek (1958) (one of the central issues in the later extensions of this system as a theory of natural language was actually to partially reintroduce the notion of hierarchical constituency in a controlled manner).

However, as Moortgat (2014, 2) observes, "[a]t the time of their publication, these ideas did not resonate." There seem to be a couple of factors involved in the initial failure of this logical perspective on syntax pioneered by Lambek to enter contemporary theoretical debates. In the first place, Lambek's calculus embodied a level of technical rigor that few linguists at the time, or subsequently, were in a position to apply. Its fundamental character—which, as a true logic of residuation, gives it remarkable expressive power relative to its basic simplicity—made it largely inaccessible to working linguists at the time of its appearance. A second factor, at least equally important in this context, was the lack of precedence for a deductive (as opposed to an implicitly configurational) model in American linguistic practice. As noted above, the rapidly developing field of generative grammar relied on data structures which had their original applications in the working practice of the field linguists trained by Leonard Bloom-

field and his students. Given this background, Lambek's approach was conceptually too alien for ordinary working linguists.

There was, however, a third contributing factor. As noted by both Pollard (1988) and van Benthem (1988a), in the first decades of theoretical syntax, the inadequacy of phrase structure grammars as accounts of natural languages was, in Pollard's (1988, 392) words, "an article of faith." Combined with the strong suspicion that pure Lambek systems had exactly the weak generative capacity of context-free grammars, researchers in the field saw little incentive to explore what was, supposedly, a notational variant of an inadequate syntactic framework. It was not until the early 1980s that research in Generalized Phrase Structure Grammar was able to demonstrate that the standard arguments against phrase structure grammars failed empirically, despite the fact that repeated efforts to adduce such data typically overlooked counterexamples and/or critical semantic factors bearing on the interpretation of the evidence.[1] Moreover, phenomena which most severely challenged phrase structure–based grammatical frameworks—so-called nonconstituent coordination and ellipsis—were not widely studied, nor their difficulties fully appreciated, until decades after Lambek's early papers. The first detailed transformational treatment of coordination, Dougherty (1970, 1971), spanning nearly one hundred pages in the journal *Language*, did not once mention any constructions in which apparent nonconstituents were conjoined, while major syntax textbooks have occasionally cited coordination as a standard test for constituency (e.g., Baker 1978; Radford 1981). Ellipsis phenomena such as sluicing and pseudogapping, while recognized as anomalies, did not attract the kind of attention that was paid to *wh* extraction or to passive, raising, and control constructions until much later in the development of grammatical theory.

Interest in categorial grammar was thus largely confined, up until the early 1980s, to work on the borders of metalogic and the theory of formal languages. The major work on categorial grammar during this period—Bar-Hillel et al. (1960), Cohen (1967), Zielonka (1978), among a few others—mostly focused on purely formal aspects such as generative capacity.[2] When the (psycho)linguistically attractive aspects of categorial grammar began to be exploited for empirical applications a quarter of a century after Lambek's 1958 paper, it was a somewhat different version which did not make use of the proof-theoretic architecture of Lambek's original system. Nonetheless, this version of categorial grammar, now known as Combinatory Categorial Grammar (CCG), was

1. See Pullum and Gazdar (1982) for details. Pullum (1985) provides an entertaining critique of one such effort, representative of the kinds of arguments that were made at the time in response to claims that natural languages were indeed context-free.

2. Despite much earlier conjecture and important partial results, the complete proof of weak equivalence of the Lambek calculus and context-free phrase structure grammars was not established until the appearance of Pentus (1993).

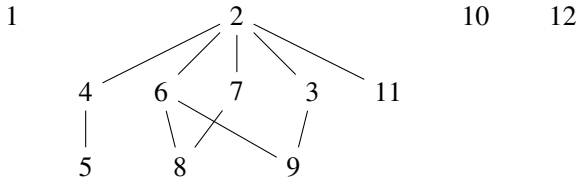
applied to some of the most difficult syntactic problems under discussion at the time. In particular, it was shown by Steedman (1985) and Dowty (1988) that varieties of "nonconstituent coordination" that could only find phrase structure–based solutions involving considerable arbitrary stipulation receive elegant and simple accounts with essentially no extra machinery in categorial grammar by exploiting an architecture that de-emphasizes the notion of hierarchical constituency (it was shown later [cf. Morrill 1994; Carpenter 1997] that these empirical results carry over straightforwardly to the original Lambek system).

During the past two decades, there has been further work showcasing the insights obtainable from the logic-based approach (see, e.g., Moortgat 1988; Morrill 1994; Bernardi 2002; Jäger 2005). Our goal in this book is to further extend this line of research and demonstrate that Type-Logical Categorial Grammar (TLCG) is a strong candidate for the optimal theory of the compositional syntax-semantics interface for natural languages.[3] For this purpose, we propose a new version of TLCG that extends the Lambek calculus with a mode of implication that is dissociated from surface word order by building on the proposal outlined in Oehrle (1994, 1995) to model the prosodic component of linguistic signs via a lambda calculus. TLCG embodies a particularly satisfying framework from the point of view of explanatory capability in the following two respects. In the first place, as a true implicative logic of types, the system we explore and apply in this volume offers little or no room for the importation of special machinery or add-on devices: one has the lexicon and the rules of proof, and the claims and predictions of any given analysis are in very large part the forced consequences of these two components of the system. This kind of architecture amounts to a very strict accounting in reckoning up the pros and cons of specific analyses. Second, categorial grammar in general and TLCG in particular is known for an elegant and systematic interface between syntax and semantics—as van Benthem (1988a, 36) puts it, the calculus of syntactic types "wears its semantics upon its sleeves." This is an especially important property of the theory we propose in this book since the central target of our investigations is a set of complex (yet systematic) interactions between phenomena in natural language (specifically, scopal operators and noncanonical varieties of coordination and ellipsis) each of which itself exhibits considerable complexity in the mapping between form and meaning. These phenomena illustrate the power of logic-based theory in uncovering the systematicity underlying the surface observations, which initially tend to look just messy and complicated.

3. The term *Type-Logical Grammar* is more standard in the literature, but we stick to the terminology *Type-Logical Categorial Grammar* (TLCG) throughout this book in order to underscore the fact that Type-Logical Grammar is a version of categorial grammar.

The present volume consists of twelve chapters. The following diagram indicates the dependencies among the individual chapters:

(1)



Chapter 1 lays out the general background of the ensuing discussion, tracing the history of contemporary syntactic theory, with special attention to what (on hindsight) seem to be largely accidental choices made at various points in the development of generative grammar that ultimately led to the central role that the notion of phrase structural constituency plays in practically all variants of contemporary generative grammar. As the discussion in this chapter provides the key motivation for the theory we present in this book, we recommend the reader at least skim through it. However, since this is not a technical chapter, the material in the following chapters does not directly depend on its content.

Chapter 2 presents the theory that is used (with only slight extensions in a couple of places) throughout the rest of the book for the analysis of various empirical phenomena. The theory we present, Hybrid Type-Logical Categorial Grammar (Hybrid TLCG), is a version of Type-Logical Categorial Grammar and builds on a large body of research in the literature of TLCG over the past thirty years. Though TLCG is a mathematically sophisticated formalism, we have tried to make the presentation in this chapter maximally accessible to ordinary linguists. We do not assume any background knowledge beyond solid understanding of the basics of formal semantics, especially the use of the lambda calculus (to write higher-order functions) as a "glue" language for meaning composition. Familiarity with standard propositional logic (especially the natural deduction system for it), versions of categorial grammar (such as CCG) and techniques in mathematical logic and computer science (such as type theory) would be useful but are not really required. The chapter is a self-contained introduction for the theory and prepares the reader for the technical analysis presented in the ensuing chapters.

The rest of the book up to chapter 9 deals with various empirical phenomena in English, mostly in the domains of coordination and ellipsis. Our empirical investigation starts with two types of "noncanonical" coordination phenomena, Gapping (chapter 3) and nonconstituent coordination (Right-Node Raising and Dependent Cluster Coordination; chapter 4). A central issue in these two chapters is the scopal interactions between coordination and scope-taking expressions such as generalized quantifiers

and modal auxiliaries. As we discuss in detail in these chapters, the systematic linkages among complex empirical patterns found in such interactions crucially distinguish the predictions of competing analyses of these phenomena. We show that two key properties of Hybrid TLCG—the flexible notion of constituency and the systematic mapping between syntax and semantics, both of which are direct consequences of the logic-based architecture of the theory in the sense outlined above—enable particularly simple analyses of these phenomena, which pose considerable difficulties for phrase structure–based theories of syntax (including both transformational and nontransformational variants). This discussion of the interactions between coordination and scopal expressions is followed by an in-depth analysis of more complex types of scope-taking expressions (symmetrical predicates such as *same* and *different*, so-called respective readings of conjoined and plural expressions, and summative predicates such as *a total of ten books*) in chapter 5. We show that the basic analysis of nonconstituent coordination from chapter 4 interacts with independently motivated analyses of these scopal phenomena to automatically make the right predictions for a wide range of complex phenomena involving these constructions.

In the latter half of the empirical investigations, we turn our attention to ellipsis phenomena, another major empirical domain which has been the target of extensive research in the contemporary syntactic literature. We start our investigations into ellipsis phenomena with an analysis of pseudogapping in chapter 6. Pseudogapping is a peculiar type of ellipsis phenomenon in English that is closely related to VP ellipsis. We formulate an analysis of this construction, which exploits the flexible notion of constituency that is at the heart of Hybrid TLCG. This is then followed by a brief chapter sketching the analysis of extraction in Hybrid TLCG (chapter 7), which provides the basis for a detailed analysis of the interactions between extraction and ellipsis in chapter 8. One of the central issues in the literature on ellipsis is whether covert structural representations are needed. Arguments for covert structural representations typically invoke interactions between ellipsis and extraction, where the latter is taken as a probe for covert structure, for example, by exhibiting sensitivity to island constraints. In chapter 8, we examine in detail the validity of this type of argument advocated by Kennedy (2003) by formulating an alternative analysis of the range of facts adduced by Kennedy which dispenses with covert structural representations.

The final chapter in the main part of the book (chapter 9) examines the syntax of auxiliary verbs in English (especially its interaction with scope of negation), a topic that is relevant for both coordination (in its relation to Gapping; chapter 3) and ellipsis (VP ellipsis; chapters 6 and 8). We show in this chapter that in Hybrid TLCG, we can formulate an analysis of English modal auxiliaries that offers a unifying perspective on the major types of analyses advocated in the literature of transformational and nontransformational variants of generative grammar respectively. Specifically, our analy-

sis posits a higher-order entry for auxiliaries that mimics a movement-based analysis in the transformational literature, from which a sign corresponding to the "lexicalist" analyses of auxiliaries standardly adopted in the nontransformational theories can be derived as a theorem. This relationship between higher- and lower-order forms leads to an interesting synthesis of ideas from transformational and nontransformational variants of generative grammar. A broader implication that follows from this is that TLCG may be viewed as a common unifying framework for making explicit the hidden connections between analytic ideas explored in different strands of research in syntax and thereby clarifying the nature of the combinatoric system underlying human linguistic competence.

The remaining chapters (chapters 10–12) deal with some residual (but important) issues that have been left unaddressed in the main body of the book. Chapter 10 examines the issue of island constraints. Analyses of coordination and ellipsis phenomena in the transformational literature often invoke movement operations of various sorts, and such analyses are typically motivated by the (alleged) fact that they induce syntactic island effects. Though this type of argumentation has been standard practice in the syntactic literature over the last fifty years since Ross (1967) first discovered syntactic islands, recent reconsiderations of island effects call for fundamental rethinking of this research practice. In chapter 10, we first review the recent rethinking of island effects and alternative extragrammatical accounts of major types of syntactic islands. This part can be independently read as an up-to-date summary of the actively growing literature on this topic. This review of recent rethinking of island effects is followed by our own reassessment of various proposals about island sensitivity of the major types of coordination and ellipsis phenomena we have analyzed in the preceding chapters. The overall conclusion we reach is that the island-based arguments for the analyses of coordination and ellipsis phenomena in the transformational literature are uniformly untenable. In most cases, the reported data are neither robust nor representative enough to support the particular conclusions the authors draw based on such data.

Chapter 11 deals with another potential issue one may find with the type of theory advocated in this book. The key claim of the present book essentially amounts to the proposal to do away with the notion of constituency, or, to put it in a more nuanced way, to give it a much less central role than it happens to receive in most contemporary syntactic theories. But denying the relevance of syntactic constituency completely is also an extreme idea that is unlikely to be tenable. In this chapter, we sketch an extension of our theory, just to make it clear that we are in fact not advocating such an extreme position. The extended system is equipped with a mechanism for explicitly representing "grouping of words" and handling reordering of constituents in the morpho-phonological representation. (This type of architecture receives motivation mostly from languages other than English that display complex morpho-syntactic phenomena, which are beyond the

scope of the present book.) We illustrate the workings of this system by formulating an analysis of a certain puzzling pattern in Right-Node Raising in English and other languages (here we take Japanese as an example) called Right-Node Wrapping.

Finally, in chapter 12, we provide a brief comparison between Hybrid TLCG and other variants of categorial grammar. The categorial grammar research community entertains a rather varied range of perspectives represented by a host of related yet distinct approaches (including our own), and it is sometimes difficult for outsiders to grasp the relationship between different variants and the different "philosophies" underlying coexisting alternative approaches. Putting our own approach in perspective helps clarify its primary goals and those respects in which it has made progress as well as respects in which it is underdeveloped relative to other related approaches. We hope to remind the reader through this comparison that categorial grammar research—just like any other scientific research in any other domain—is a collaborative endeavor in which related yet distinct approaches coexist and in which different perspectives mutually inform each other in a fruitful manner.

The present work itself has indeed benefited greatly from collaborations and interactions with our colleagues, and we would like to take this occasion to thank them. First and foremost, we'd like to thank our colleagues at Ohio State University, in particular, Carl Pollard. He was the first author's co-advisor (the second author being the other co-advisor) on the dissertation project (Kubota 2010) leading to the earliest version of the framework explored in the present book. Carl's critical feedback and constant engagement with the development of our approach has been invaluable in the refinement of our proposals, and our thinking in general. We are likewise indebted to current and former students at OSU, in particular, Noah Diewald, Scott Martin, Jordan Needle, Daniel Puthawala, Symon Stevens-Guille, Elena Vaiksnoraite, and Chris Worth.

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volume. We hope they would have been gratified at seeing how much analytic power and empirical reach follow from the combination of their brilliant contributions to the rigorously formal study of human language.