(In)flexibility of Constituency in Japanese in Multi-Modal Categorial Grammar with Structured Phonology

Dissertation

Presented in Partial Fulfillment of the Requirements for

the Degree Doctor of Philosophy in the

Graduate School of The Ohio State University

By

Yusuke Kubota, M.A.

Graduate Program in Linguistics

The Ohio State University

2010

Dissertation Committee:

Carl Pollard, Advisor

Robert Levine

Etsuyo Yuasa

ABSTRACT

This dissertation proposes a theory of categorial grammar called Multi-Modal Categorial Grammar with Structured Phonology. The central feature that distinguishes this theory from the majority of contemporary syntactic theories is that it decouples (without completely segregating) two aspects of syntax—hierarchical organization (reflecting semantic combinatorics) and surface morpho-syntactic realization—which are conflated in the single notion of phrase structure in theories of syntax that take this notion as a primitive.

In Chapter 2, I review three phenomena in Japanese—nonconstituent coordination, nonconstituent clefting and four kinds of complementation constructions—that present serious empirical challenges to previous models of generative syntax, whether transformational or nontransformational, and argue that all existing analyses of these constructions in these theories are inadequate. The problems of these previous approaches all stem from the fact that the empirical phenomena considered here constitute cases that deviate from what one might call the 'canonical' mode of phrasal composition, implicitly built into the notion of phrase structure, wherein the surface syntactic constituency transparently reflects the semantically-oriented combinatoric structure. In theories that take the notion of phrase structure as a primitive, such deviations can only be accommodated by means of some kind of extensions to the basic phrase structural component. However, such extensions are often

ad hoc and fail to capture the systematic patterns that the empirical phenomena in question exhibit, especially when they interact with one another and with other aspects of the grammar of the language.

This motivates us to abandon the phrase structure-based perspective and instead adopt an architecture in which the combinatoric component and the surface morpho-syntactic component are separated, yet interact closely with one another. Chapter 3 presents the theory of Multi-Modal Categorial Grammar with Structured Phonology, a formal theory of syntax that embodies this architecture. The proposed theory emerges as a result of unifying and integrating two most notable features of categorial grammar as a linguistic theory, namely, flexibility of constituency and the separation of semantic combinatorics from surface morpho-syntax. The resulting theory resembles and borrows many ideas from related recent variants of categorial grammar, all of which attempt to achieve a similar synthesis in one way or another, but it achieves this goal in the conceptually simplest and technically most explicit way. Most importantly, recognizing an interface component between syntax and phonology called 'structured phonology' and working out its formal details precisely is the major contribution of the present work.

Chapter 4 demonstrates that the present theory enables straightforward analyses of the phenomena from Chapter 2. Specifically, different degrees of flexibility in constituency and linear order found in different phenomena receive a natural account, with the component of structured phonology governing the properties of different modes of morpho-syntactic composition. Moreover, not only does the present approach account for the individual phenomena adequately, the analyses of these phenomena interact with one another (and with other aspects of Japanese syntax) to automatically make correct predictions. This result provides strong confirmation for the present approach.

ACKNOWLEDGMENTS

This project would not have been possible without the help of many people. First and foremost, I would like to express my deep gratitude to my advisor Carl Pollard. His insistence on formal rigor and explicitness has been literally indispensable for working out the foundations of the theory presented in this dissertation in the right way. The other committee members, Bob Levine and Etsuyo Yuasa, have also been extremely helpful. I'd like to thank Bob for his guidance at earlier stages of my graduate study as well: it was from him that I learned how to do syntax, how to think like a syntactician. I was very lucky to have Yuasa-sensei on my committee. She gave me the much needed comments on my dissertation from the viewpoint of an 'ordinary Japanese linguist', not specializing in categorial grammar (or logic or math). If this dissertation succeeds in introducing categorial grammar to (the majority of) syntacticians working in other theories and making them think that there might at least be some merit in studying it, it is thoroughly thanks to her pointed and uncompromising comments. And all of the three committee members pushed me and pointed me toward the right direction when I was either confused, at a loss, or wrongheaded (or when all of these were simultaneously true of me).

I would like to thank my teachers as well, both here at OSU and back in Japan. At OSU: David Dowty, Bob Levine, Brian Joseph, Detmar Meurers, Carl Pollard, Craige Roberts, Judith Tonhauser and Mike White. (Brian might be surprised that I'm mentioning him here since the only class I took from him was his introduction to historical linguistics, but it was from Brian and Craige that I learned most the importance of having a perspective when doing research in linguistics.) And back in Japan: Takane Ito, Tsuneko Nakazawa, Chris Tancredi and Shûichi Yatabe. I still remember vividly the embarrassment that I felt when I was looking for a topic for my undergraduate thesis with Nakazawa-sensei, after taking Ito-sensei's (as an undergraduate course) fairly intensive introduction to syntax: I had already learned how to do syntax, but I couldn't work on Japanese since I didn't *even* know how to determine the basic phrase structure of the language (or, that was what I thought then). I hope I have made some progress since then.

And thanks to my friends and colleagues: Jungmee Lee, Ai Matsui, Osamu Sawada, Anastasia Smirnova, E. Allyn Smith and Wataru Uegaki. I have enjoyed interacting with them and have learned a lot from working with them. Among them all, I am especially indebted to Wataru Uegaki. I just can't believe that, as of writing this, I know him only for a year and a half. We've talked about so many things and I've learned from him so much. Uegaki-kun, thanks for being a fantastic friend, colleague, *koohai* and role model (and thanks also for reading and commenting on drafts of this dissertation).

In addition to those mentioned above, conversations and correspondences with the following people have influenced my thinking about theoretical linguistics, syntax and categorial grammar and I would like to thank them here: Jason Baldridge, Chris Barker, Fred Hoyt, Polly Jacobson, Chris Kennedy, Glyn Morrill, Mark Steedman, Neal Whitman and Masaya Yoshida.

Finally, I would like to thank my parents and my sister for their support (both moral and otherwise), especially for encouraging me lightly and teasing me mildly about my preoccupation with linguistics. Without their warm (but somewhat detached) attitude toward me and what I am doing, I would not have been able to come thus far.

VITA

2002 . . . . B.A. The University of Tokyo

2004 . . . . M.A. The University of Tokyo

2004, 2008 . . . . Distinguished University Fellow, The Ohio State University

2005-7,2009 . . . . Graduate Teaching Associate, Department of Linguistics, The Ohio State University

PUBLICATIONS

Kubota, Yusuke, Jungmee Lee, Anastasia Smirnova, and Judith Tonhauser. 2009. The cross-linguistic interpretation of embedded tenses. In A. Riester and T. Solstad, eds., *Proceedings of SuB13*. Stuttgart.

Kubota, Yusuke. 2008. Solving the morpho-syntactic puzzle of the Japanese *-te* form complex predicate: A Multi-Modal Combinatory Categorial Grammar analysis. In O. Bonami and P. C. Hofherr, eds., *Empirical Issues in Syntax and Semantics*, vol. 7.

Kubota, Yusuke and Jungmee Lee. 2008. Reconsidering the Coordinate Structure Constraint in Japanese and Korean: Syntactic constraint or pragmatic principle? In S. Müller, ed., *Proceedings of the 15th International Conference on Head-Driven Phrase Structure Grammar*, 417–435. Stanford: CSLI Publications.

Kubota, Yusuke. 2007. The scope interpretation of complex predicates in Japanese: A unified lexicalist analysis. *Journal of Linguistics* 43(3):489–530.

Kubota, Yusuke and E. Allyn Smith. 2007a. The Japanese internally headed relative clause is *not* an E-type pronoun. In *Proceedings of Formal Approaches to Japanese Linguistics 4*, vol. 55 of *MIT Working Papers in Linguistics*, 149–160. Cambridge, MA: MITWPL.

Kubota, Yusuke and E. Allyn Smith. 2007b. A Multi-Modal Combinatory Categorial Grammar analysis of Japanese nonconstituent clefting. In V. Nurmi and D. Sustretov, eds., *Proceedings of the Twelfth ESSLLI Student Session*, 161–172.

Kubota, Yusuke and E. Allyn Smith. 2006. Syntax and semantics of Japanese nonconstituent clefting in Combinatory Categorial Grammar. In C. Davis, A. R. Deal, and Y. Zabbal, eds., *Proceedings of the Thirty-Sixth Annual Meeting of the North East Linguistic Society*, 413–426. Amherst, MA: GLSA Publications.

Kubota, Yusuke. 2005. Toward a unified analysis of the scope interpretation of complex predicates in Japanese: Evidence from the light verb construction. In S. Müller, ed., *Proceedings of the 12th International Conference on Head-Driven Phrase Structure Grammar*, 232–252. Stanford: CSLI Publications.

Kubota, Yusuke. 2003a. A constraint-based analysis of association with focus in Japanese. In D. H. Ji and K. T. Lua, eds., *Proceedings of the 17th Pacific Asia Conference on Language, Information and Computation*, 16–27. Singapore: COLIPS Publications.

Kubota, Yusuke. 2003b. Yet another HPSG-analysis for free relative clauses in German. In J.-B. Kim and S. Wechsler, eds., *Proceedings of the 9th International Conference on Head-Driven Phrase Structure Grammar*, 147–167. Stanford: CSLI.

FIELDS OF STUDY

Major Field: Linguistics

TABLE OF CONTENTS

Page

Abstract ii

Acknowledgments iv

Vita vi

Chapters:

1. Introduction 1

2. Empirical domain 10

    2.1 Nonconstituent coordination 11
        2.1.1 (Apparent) arguments for deletion-based analyses 13
        2.1.2 (Apparent) arguments for movement-based analyses 15
        2.1.3 Problems for both deletion-based and movement-based analyses . 19
        2.1.4 Summary 26
    2.2 Nonconstituent clefting 28
        2.2.1 Basic patterns of the cleft construction in Japanese 28
        2.2.2 Patterns of nonconstituent clefting 30
        2.2.3 Impossible cases of clefting 32
        2.2.4 Movement-based analyses 33
            2.2.4.1 Koizumi (1995, 2000) 34
            2.2.4.2 Takano (2002) 37
            2.2.4.3 Fukui and Sakai (2003) 39
        2.2.5 Other possible analyses in PS-based theories 45
    2.3 Complementation constructions 47
        2.3.1 Morpho-syntactic properties of complementation constructions . 50
            2.3.1.1 Interclausal scrambling 51

2.3.1.2 Scrambling of the embedded clause 53
2.3.1.3 The cleft construction 55
2.3.1.4 Nonconstituent coordination 56
2.3.1.5 Embedded VP coordination 58
2.3.1.6 Focus particle insertion 60
2.3.1.7 Reduplication 60
2.3.2 Previous analyses 62
2.3.2.1 Matsumoto's (1996) analysis of complementation constructions 63
2.3.2.2 Analyses of the *-te* form complex predicate in other PS-based theories 67
2.3.3 Summary 75

3. Multi-Modal Categorial Grammar with Structured Phonology 76

3.1 Multi-Modal Categorial Grammar with Structured Phonology 80
3.1.1 Basic assumptions 82
3.1.1.1 General assumptions about linguistic expressions 82
3.1.1.2 Basics of the combinatoric component: The syntactic calculus 89
3.1.2 Extending the combinatoric component: Modelling C-flexible CG 92
3.1.3 Structured phonology: Modelling L-flexible CG 111
3.1.3.1 Conceptual underpinnings of structured phonology . . . 112
3.1.3.2 Formalizing structured phonology in terms of a preordered algebra 114
3.1.3.3 Some linguistic illustrations 124
3.1.4 Putting the two components together 128
3.2 Comparison with related approaches 135
3.2.1 (Purely) L-flexible CG 136
3.2.2 Variants that unify C-flexible CG and L-flexible CG 145
3.2.2.1 Multi-Modal Type-Logical Grammar with prosodic labelling (Morrill and Solias 1993; Morrill 1994) 146
3.2.2.2 Multi-Modal Categorial Type Logics (Moortgat 1997; Bernardi 2002) 149
3.2.2.3 Multi-Modal Combinatory Categorial Grammar (Baldridge 2002; Steedman and Baldridge 2007) 153

4. Analysis 158

4.1 Nonconstituent coordination 158
4.1.1 The basic analysis 160

4.1.2 Cases that are problematic for all previous analyses 162
4.1.2.1 Parasitic scope and nonconstituent coordination 162
4.1.2.2 Binding 169
4.1.3 Cases that are problematic for deletion-based analyses 175
4.1.4 Cases that apparently provide evidence for deletion-based analyses 175
4.1.5 Summary 182
4.2 Nonconstituent clefting 183
4.2.1 Syntax of the cleft construction in Japanese 184
4.2.2 Analyzing nonconstituent clefting 189
4.2.3 Impossible cases of clefting 194
4.3 Complementation constructions 197
4.3.1 Sentential complementation and VP complementation 198
4.3.2 Compound verbs 211
4.3.2.1 Morpho-syntactic properties of the compound verb construction 212
4.3.2.2 Semantic properties of the compound verb construction . 223
4.3.3 *-te* form complex predicate 236
4.3.3.1 Basic cases 236
4.3.3.2 Interactions with coordination and clefting 243

5. Conclusion 251

Appendix:

A. A formal fragment of Japanese 257

A.1 Syntactic Calculus 257
A.2 φ-calculus 258
A.2.1 Inequational logic for φ-terms 259
A.3 Model-theoretic interpretation of φ-terms 261
A.4 Lexicon 262

CHAPTER 1: INTRODUCTION

This dissertation investigates phenomena in Japanese syntax that pose problems for theories of syntax in which the notion of constituency (or phrase structure) is understood in a more or less traditional sense. As I will discuss below, most variants of contemporary syntactic theory—whether transformational or non-transformational—fall under this category. I will call such theories **phrase structure (PS)-based theories**. [1] The three empirical problems that will be examined—nonconstituent coordination, nonconstituent clefting, and the morpho-syntax of complementation constructions—motivate a radical departure from the PS-based model; the ideal design architecture of syntactic theory that emerges from the empirical investigations of these phenomena is one that admits a considerable degree of flexibility in syntactic composition while at the same time being equipped with a systematic way of constraining that flexibility—something along the lines of contemporary multi-modal categorial grammar.

The first goal of this dissertation is thus to demonstrate that the phenomena taken up here pose fundamental problems for PS-based theories of syntax. The three empirical phenomena have all been extensively discussed in the literature, but there does not yet exist a completely successful analysis for any of them in any of the PS-based theories. In Chapter 2, I review the relevant empirical facts and previous literature, and argue that, in each case,

[1] Note that this is different from the standard use of the term 'phrase structure-based', where the term is used to distinguish non-transformational theories with a phrase structural component (such as G/HPSG and (possibly) LFG) from transformational ones (i.e. classical transformational grammar, GB theory and the current Minimalist approach).

the problem essentially lies in the fact that the notion of constituency (in the traditional sense) is inherently unsuitable for capturing the relevant empirical generalizations.

The second goal is to work out an explicit theory of syntax that provides better solutions for these empirical problems. I will develop such a theory in Chapter 3 and apply it to the specific phenomena in Chapter 4. As we will see, the proposed theory emerges as a synthesis of different variants of contemporary categorial grammar (CG). To preview the conclusion, the proposed theory solves the problems in question by capturing the relevant empirical generalizations in terms of notions other than syntactic constituency. The success of the proposed theory as opposed to the failure of the more traditional PS-based model leads us to the broader conclusion of the dissertation. Namely, the empirical problems taken up here, which constitute an important subset of syntactic phenomena in Japanese, call into question the utility of the notion of constituency as it is traditionally conceived of and call for a reformulation of the basic architecture of syntactic theory along the lines articulated in the proposed theory.

In what follows, I sketch an outline of the issues investigated in this dissertation. To put it briefly, what the three phenomena investigated in this dissertation have in common is that they represent cases in which phrasal composition deviates from the 'canonical' ways of syntactic composition presupposed in PS-based theories. In order to see what this exactly means, we need to be a bit clearer about what we mean by 'PS-based theories' and 'canonical' ways of syntactic composition. By PS-based theories, I refer to theories of syntax in which the notion of phrase structure (of the kind conventionally represented in tree diagrams of the familiar sort) is taken to be a primitive and is used to encode a certain kind of information, as I will explain immediately below. This includes virtually all variants of transformational theories[2] as well as most non-transformational theories of syntax such as GPSG (Gazdar et al. 1985), HPSG (Pollard and Sag 1994) and LFG (Kaplan and Bresnan 1982).[3]

In PS-based theories of syntax, the primary (or only) way in which larger linguistic expressions are built from smaller ones is by means of PS rules. In most PS-based theories, the set of available PS rules is constrained in a certain way; in particular, all contemporary syntactic theories are 'lexicalized' in the sense that most of the relevant syntactic information (such as agreement features) is projected from the lexicon and PS rules are highly generalized and schematized. Lexicalization of syntactic theory makes the role of the PS component within the overall theory significantly smaller. In a certain sense, however, this impoverishment of the PS component makes its fundamental role within PS-based theories much clearer. In contemporary lexicalized PS-based theories, PS rules essentially encode two kinds of information: (i) the head-dependent relationship among component expressions (via the hierarchical structure)[4] and (ii) the surface morpho-syntactic realization of linguistic expressions (via the linear order of the leaves).[5]

[2]I.e., the Standard Theory (Chomsky 1965), subsequent extensions to it, GB theory (Chomsky 1981), and the Minimalist program (Chomsky 1995).

[3]An important exception to this is the linearization-based variant of HPSG (Reape 1994; Kathol 2000), which dissociates semantically-oriented combinatorics from surface morpho-syntax with the use of word order domains. A comparison of the theory proposed in this dissertation and an approach of the kind represented by linearization-based HPSG will be given in section 3.2.1 of Chapter 3.

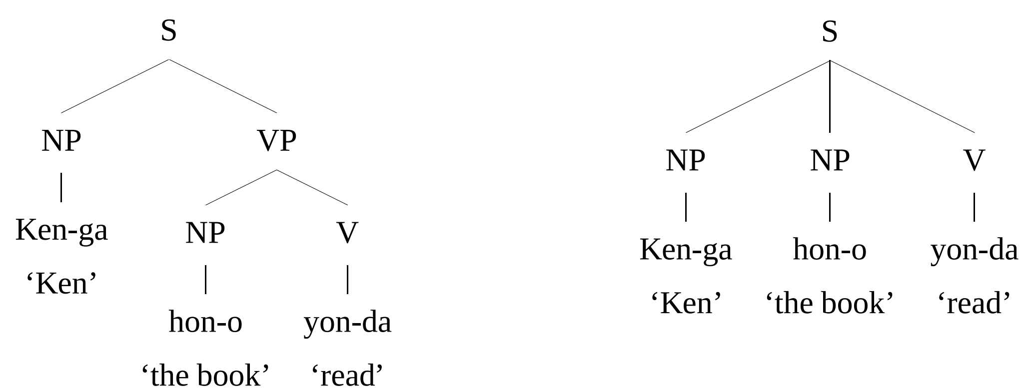
[4]This is clearly the case in HPSG. Except for a few idiosyncratic 'exocentric' rules, all of the PS rules in HPSG are 'headed', in the sense that they all combine the head with its dependent(s) (i.e. complements, adjuncts, etc.). The idea is in a sense even more strictly enforced in the X-bar theory of GB syntax. By adhering to the X-bar theory, all syntactic projections are headed and there can never be any exocentric structure.

[5]This characterization is a bit too crude given the existence of PS-based models in which ID and LP rules are separated (which includes GPSG, HPSG, and GB theory). However, given that the LP rules in such

It is important to realize here that the two kinds of information simultaneously represented in PS trees this way do not have any logical or inherent connection to one another. They are represented together just because of convention: this has been the way in which the notion of phrase structure has been put to use in the history of syntactic theory at least since Chomsky (1955).[6]

Since the notion of phrase structure and the way in which it is put to use is so familiar, it might initially be difficult to see what commitment is (implicitly) made by accepting this conception. To see what this conflation of two distinct aspects of syntax entails, consider for example the phrase structure of a sentence involving a transitive verb and its arguments. In the PS-based setup, due to the fact that the verb is the head and the subject and object NPs are its arguments, it follows that the whole sentence inevitably ends up being 'built around' the head verb. That is, regardless of whether one assumes a hierarchical structure or a flat structure for Japanese, the subject and the object cannot form a constituent by themselves in a simple transitive sentence:

(1) hierarchical structure flat structure



models only specify the relative orders among sisters within a local tree, the point discussed here that the notion of phrase structure conflates two distinct kinds of syntactic information applies to these models as well.

[6]Alternative ideas have been proposed from time to time in the literature, at least within non-transformational approaches; see, for example, Dowty (1982, 1996); Reape (1994); Kathol (2000).

We can clearly see from the pictures in (1) that the two argument NPs form a constituent only together with the verb that subcategorizes for them, since the 'basic' phrase structure transparently reflects the head-dependent relationships among the components in its hierarchical structure. By the 'canonical' way of syntactic composition, I mean syntactic composition that results in this kind of basic constituent structure where the surface morpho-syntactic constituency transparently reflects the (semantically-oriented) head-dependent relationships.

It turns out, however, that there are cases in natural language in which phrasal composition deviates from this 'canonical' mode. Here, I illustrate the essential problems posed by such cases by taking two cross-linguistically widely found types of constructions that fall under this category: **nonconstituent coordination** and **complex predicate constructions**.[7] First, nonconstituent coordination is a representative case that deviates from the 'canonical' ways of syntactic composition. Consider, for example, the following sentence:

(2) John gave [Sue a book] and [Bill a record].

As discussed above, strings of words such as *Sue a book* in (2) do not form a constituent in any standard PS-based theory of syntax, yet such strings can be coordinated, suggesting that the grammar needs to treat them as 'units' in some way or other. Nonconstituent coordination has always been a problem in PS-based theories of syntax precisely for this reason.[8]

[7] These two phenomena (in Japanese) are among the problems that will be dealt with in this dissertation. The detailed properties of the specific Japanese constructions will be discussed in Chapter 2.

[8] See Beavers and Sag (2004) and Ito and Chaves (2008) for recent attempts at analyzing nonconstituent coordination in English and Japanese, respectively, in terms of phonological deletion in the linearization variant of HPSG. At least for Japanese, this kind of analysis is implausible and there is evidence that the apparent nonconstituents should really be analyzed as real constituents, as I will discuss in Chapter 2.

Second, the mismatch between predicate-argument structure and surface morpho-syntax in complex predicate constructions is another case that deviates from the canonical mode of syntactic composition. Recall from above that we have defined the 'canonical' ways of syntactic composition as ones that reflect the head-dependent relationships among linguistic expressions transparently. A typical feature of complex predicate constructions is the morpho-syntactic clustering of the higher and lower predicates, which gives rise to a mismatch between the 'deep' predicate-argument structure and surface constituency. For example, in the following example of the *-te* form complex predicate in Japanese, the lower verb *hii-te* combines with the higher verb *morat-ta* to form a morpho-syntactic unit (the facts are actually much more complex; for a detailed exposition, see Chapter 2).

(3) Ken-ga ***piano-o*** Mari-ni [**hii-te** morat-ta].
Ken-NOM piano-ACC Mari-DAT play-TE BENEF-PAST
'Ken had Mari play the piano for her.'

One piece of evidence that the higher and lower verbs form a unit comes from the properties of scrambling of arguments. In (3), the accusative object *piano-o* of the lower verb is scrambled with matrix arguments and linearly precedes the matrix dative argument *Mari-ni*. This should not be possible if all the linguistic expressions were combined in a manner that strictly adhered to the local predicate-argument structures (or head-dependent relationships), in which case the accusative argument should appear linearly adjacent to the lower verb. This, then, is another case in which syntactic composition deviates from what is expected to be the case: the lower verb combines with the higher verb without saturating its own argument structure, and the accusative object, even though semantically an argument of the lower verb, does not directly form a syntactic constituent with it.

In PS-based theories, phenomena like the above two have been accommodated by means of various extensions to the PS-based architecture such as the following:

- in transformational frameworks, syntactic movement operations that relate surface constituent structure to deep structure (or LF) (where the latter is supposed to transparently represent the (semantically-oriented) head-dependent relationships among component expressions)

- (mostly in HPSG), enrichment of the data structure representing syntactic categories so that non-local head-dependent relationships are mediated by means of successive transmission of local information (e.g., via the slash feature and argument composition)[9]

- setting up a separate level of grammatical representation for representing predicate-argument structure and relaxing the mapping from surface constituent structure to that level in a certain way (typically in LFG, by introducing ‘non-local’ modes of mapping between f-structure and c-structure with mechanisms such as functional uncertainty)

As might be expected, the three empirical problems dealt with in this dissertation have also been analyzed in terms of these mechanisms in the previous literature. I will review these previous approaches in the next chapter.

Some of these extensions to the PS-based architecture have actually turned out to be highly successful in dealing with some of the specific empirical problems. For example,

[9]As mentioned above, the linearization-based variant of HPSG departs more radically from the PS-based perspective, and, for this reason, I will not regard it as an ‘extension’ to the PS-based architecture. In a way, the theory that I will ultimately be arguing for shares the spirit of the linearization-based architecture in dissociating semantically-oriented combinatorics and surface morpho-syntax. But see the discussion in section 3.2.1 in Chapter 3 (especially footnote 101) for an important difference between the two.

the mechanism of argument composition,[10] originally developed for the analysis of German complex predicates (Hinrichs and Nakazawa 1994), has entertained a wide cross-linguistic application and is regarded as a standard technique in the analysis of complex predicate constructions in the literature of HPSG. Nevertheless, despite the successes of particular techniques (in specific theories) for some of these empirical problems, it seems difficult for these extensions to provide a general framework in which to formulate a uniform analysis of the class of phenomena taken up in this dissertation. This is essentially because the flexibility introduced by these mechanisms are all in some sense *ad hoc* extensions to the PS-based backbone.

In particular, the three empirical problems investigated in this dissertation exemplify two somewhat different kinds of problems for PS-based theories (see Chapter 2 for a more detailed discussion on this point), and, for this reason, a completely general treatment of all of the relevant facts seems to be difficult to obtain within the PS-based setup. To put it very briefly and crudely, such an attempt would face the following challenges:

- In PS-based theories, there is no general and flexible enough mechanism for handling the kind of 'deviant' constituent structures found in nonconstituent coordination. The problem cannot be explained away as an idiosyncrasy of coordination, since, as we will see in Chapter 2, essentially the same problem arises with the cleft construction in Japanese.

[10] 'Argument composition' refers to a mechanism in HPSG whereby the argument structures of two predicates are merged into one. In a sense, the idea can be thought of as being prefigured by the 'clause union' analysis of complex predicates in Relational Grammar (cf., e.g., Aissen and Perlmutter (1983)) wherein the grammatical relations of the governing and governed predicates are represented together at a non-initial stratum (i.e. a level of representation closer to surface realization than the initial stratum, which represents the underlying predicate argument structures and roughly corresponds to the deep structure of classical transformational grammar).

- Descriptively speaking, the complementation constructions in Japanese exhibit what might be called different ‘degrees’ of flexibility in morpho-syntactic composition. The design architecture of PS-based theories, however, necessarily entails a binary distinction between morphological composition and syntactic composition and is thus inherently unsuitable for capturing such a generalization.

In fact, previous approaches to these problems within PS-based theories that I will review in Chapter 2 all fail precisely due to these problems. Based on these considerations, I will conclude that theories that take the notion of phrase structure (or constituency) as a primitive are not optimal for capturing the empirical generalizations that characterize these phenomena. This calls for a reconsideration of the basic architecture of syntactic theory in some fundamental way. In particular, I will argue that the relevant generalizations can be accounted for much more straightforwardly by relaxing the notion of constituency and by recognizing different degrees of flexibility at the level of morpho-syntactic composition of linguistic expressions. This motivates us to investigate and further articulate a perspective that certain variants of contemporary CG have recently come to share, as I will discuss in greater detail in Chapter 3.

CHAPTER 2: EMPIRICAL DOMAIN

This chapter discusses in detail the empirical problems dealt with in this dissertation. [11] The goal of this chapter is two-fold: first, to review the relevant empirical facts, and, second, to establish the point that these facts pose two different kinds of fundamental problems for PS-based theories of syntax. The phenomena taken up here are among the central problems of Japanese syntax that have been extensively discussed in the previous literature. Moreover, as we will see below, the patterns they exhibit and the ways in which they interact with other aspects of Japanese syntax are highly systematic. In this sense, these phenomena can be thought to constitute a certain core aspect of Japanese syntax and should be taken to serve as a benchmark for any adequate theory of syntax. Thus, the fact that these phenomena pose problems for PS-based theories of syntax calls into question some of the fundamental assumptions of PS-based theories and calls for a substantial reformulation of the basic architecture of syntactic theory.

In the first two sections, we will look at two phenomena that exhibit what might be called ‘flexibility of constituency’, namely, **nonconstituent coordination** (section 2.1) and **nonconstituent clefting** (section 2.2). The distributional patterns of these constructions are entirely unexpected in PS-based theories of syntax and turn out to be extremely problematic for them. Then, in section 2.3, we consider a somewhat different case: the morpho-syntax of **complementation constructions**. These constructions exhibit what might be called

[11] Section 2.2 draws on the material that has appeared in Kubota and Smith (2006). Part of section 2.3 (the data and discussion of the previous literature of the *-te* form complex predicate) is based on Kubota (2008).

different ‘degrees’ of flexibility in morpho-syntactic composition. I will argue that the fact that these constructions coexist within a single language poses a significant challenge to PS-based theories of syntax by calling into question the binary (i.e. lexical vs. syntactic) distinction in morpho-syntactic composition that PS-based theories presuppose.

2.1 Nonconstituent coordination

Like English, Japanese allows for strings of words that do not apparently form constituents to be coordinated. I refer to this phenomenon as **nonconstituent coordination**. [12] A typical example is given in (4): [13]

---

[12]This construction in Japanese has also (and more commonly) been called ‘gapping’ and ‘right-node raising’. However, I will not use these terms since this construction does not completely share properties with either gapping or right-node raising in English.

[13]There is another construction superficially similar to sentences like (4) but which involves the conjunction *to* instead of *sosite* (or an absence of a conjunction), such as the following:

(i) Taroo-ga [Hanako-ni ringo-o mit-tu]-to [Mitiko-ni banana-o huta-tu] age-ta.
Taro-NOM Hanako-DAT apple-ACC three-CL-and Michiko-DAT banana-ACC two-CL give-PAST
‘Taro gave three apples to Hanako and two bananas to Michiko.’

I call this construction ***-to* coordination**. This construction most naturally occurs with the help of numerals at the end of each conjunct, such as *mit-tu* and *huta-tu* in (i). To the best of my knowledge, Koizumi (1995) was the first to discuss sentences of this kind. As noted by Koizumi (2000), *-to* coordination differs from ordinary nonconstituent coordination in that it does not allow for postposition stranding. That is, sentences analogous to (8) (see below) with *-to* coordination is ungrammatical (island violation also seems impossible). Based on this fact, Koizumi proposes to analyze the two constructions differently. Takano (2002), countering Koizumi (2000), argues that the two constructions should be analyzed in the same way, based on the fact that the internal readings of *onazi* (discussed below) is found with both constructions (but he does not address the question of why postposition stranding and island violation are impossible in *-to* coordination). Other subsequent researchers (Fukui and Sakai 2003; Ito and Chaves 2008; Sato 2009) do not explicitly address this point. However, Fukui and Sakai (2003) and Ito and Chaves (2008) seem to be assuming that their analyses are primarily applicable to *-to* coordination whereas Sato (2009) seems to be dealing primarily with the ordinary nonconstituent coordination exemplified by (4). In what follows, I will focus on the ordinary nonconstituent coordination and leave a detailed study of *-to* coordination for future research.

(4) [Taroo-ga Hanako-o], (sosite) [Ziroo-ga Mitiko-o] mi-ta.
Taro-NOM Hanako-ACC and Jiro-NOM Michiko-ACC see-PAST
'Taro saw Hanako and Jiro saw Michiko.'

In (4), strings of words consisting of the subject and the object of the verb are coordinated. The conjunction *sosite* is optional. I call the rightmost element of the sentence shared by the conjuncts the **pivot**.[14]

Nonconstituent coordination is not limited to argument clusters. (5) is an example in which sequences of two adjuncts are coordinated and (6) is an example in which sequences of an argument and an adjunct are coordinated.

(5) Taroo-wa [kinoo eki-de], (sosite) [kyoo gakkoo-de] Hanako-ni at-ta.
Taro-TOP yesterday station-at and today school-at Hanako-DAT meet-PAST
'Taro met Hanako at the station yesterday and at school today.'

(6) [Taroo-wa kinoo], (sosite) [Ziroo-wa kyoo] Hanako-ni at-ta.
Taro-TOP yesterday and Jiro-TOP today Hanako-DAT meet-PAST
'Taro met Hanako yesterday and Jiro met her today.'

The proper treatment of nonconstituent coordination in Japanese has been a controversial issue that has been extensively discussed in the literature (cf. Kuno (1978); Saito (1987); Kageyama (1993); Abe and Hoshi (1997); Koizumi (2000); Takano (2002); Mukai (2003); Fukui and Sakai (2003); Fujino (2008); Ito and Chaves (2008); Sato (2009) for different proposals and remarks). Roughly speaking, previous proposals can be classified into two types: **deletion-based** approaches and **movement-based** approaches.[15]

[14] A term borrowed from Sabbagh (2007).

[15] Some of the proposals do not lend themselves neatly to this classification. For example, although I have classified Sato (2009) as a deletion-based analysis below, it is different from other analyses grouped in the same category in that, unlike other deletion-based analyses (all of which assume that the deletion operation is

In what follows, I will first review arguments for deletion-based approaches and movement-based approaches, respectively, and then point out two pieces of evidence that pose problems for all existing analyses of nonconstituent coordination, whether deletion-based or movement-based. As we will see, the general pattern is that morpho-syntactic evidence such as island (in)sensitivity favor deletion-based approaches while purely semantic evidence such as the construal of polysemous or idiomatic expressions favor movement-based approaches. And it turns out that the problems for both kinds of approaches—specifically, those involving the binding of the reflexive *zibun* and the scope-taking behaviors of the symmetric predicates *onazi* 'same' and *betu-no* 'different'—come from phenomena pertaining to the syntax-semantics interface.

2.1.1 (Apparent) arguments for deletion-based analyses

Kageyama (1993), Mukai (2003) Fukui and Sakai (2003), Ito and Chaves (2008) and Sato (2009)[16] argue for deletion-based analyses of nonconstituent coordination. On this view, example (4) is analyzed in terms of some kind of deletion operation, which all authors except for Sato (2009) assume to take place in the phonological component (that is, in GB/Minimalist theory, at PF), as in (7):

(7) [Taroo-ga Hanako-o ~~**mi-ta**~~], (sosite) [Ziroo-ga Mitiko-o **mi-ta**].

a phonological process), Sato's analysis assumes that the deletion operation in question applies within narrow syntax. Specifically, Sato's analysis is based on an analysis of ellipsis constructions by Williams (1997) by means of two processes called 'Coordinate Ellipsis' and 'Dependent Ellipsis', which take place in narrow syntax, and, for this reason, is more similar to movement-based approaches in some respects.

[16] It should be noted that Fukui and Sakai (2003) and Ito and Chaves (2008) might not have intended their analyses to be applicable to the construction under consideration (cf. footnote 13). I nevertheless include their proposals here, since, given the similarity between *-to* coordination and ordinary nonconstituent coordination, the kinds of analyses they propose are potentially applicable to what I am here calling nonconstituent coordination as well, even if the authors might not have intended such applications.

The condition for this deletion is typically assumed to be phonological identity of the deleted material and the pivot in the second conjunct. Some authors instead (Ito and Chaves 2008; Sato 2009) or additionally (Mukai 2003) require semantic identity.

The strongest piece of evidence for the deletion-based analyses comes from the fact that this construction does not seem to respect surface constituency. First, as can be seen in (8), the postposition can be left stranded for the final element for a nonfinal conjunct:

(8) [Taroo-wa *hon*], (sosite) [Ziroo-wa *zassi*]***-o*** **kat-ta**.
Taro-TOP book and Jiro-TOP magazine-ACC buy-PAST
'Taro bought a book and Jiro bought a magazine.'

Second, again, for a nonfinal conjunct, the nominal head can be left stranded from a prenominal adjective that modifies it:

(9) [Taroo-wa *ookina*], (sosite) [Hanako-wa *tiisana*] ***hako*-o** **mot-te** **i-ru**.
Taro-TOP large and Hanako-TOP small box-ACC hold-TE PROG-NPST
'Taro is holding a large box and Hanako is holding a small box.'

Finally, there are even cases where a relative clause is split apart in the middle, partly belonging to the coordinated string and partly belonging to the pivot (this would be a violation of the complex NP constraint if nonconstituent coordination were derived by movement):

(10) [Mike-ga *raion-ni*], (sosite) [Tom-ga *kuma-ni*] ***osow-are-ta*** ***otoko*-o**
Mike-NOM lion-DAT and Tom-NOM bear-DAT attack-PASS-PAST man-ACC
tasuke-ta.
save-PAST
'Mike saved a man who was attacked by a lion and Tom saved a man who was attacked by a bear.' (Mukai 2003)

Importantly, cases of leftward scrambling corresponding to (8)–(10) are all strictly ungrammatical, as shown in (11)–(13):

(11) *Hon$_i$, Taroo-wa t_i-o kat-ta.
book Taro-TOP -ACC buy-PAST
intended: 'Taro bought a book.'

(12) *Ookina$_i$, Taroo-wa [t_i hako-o] mot-te iru.
large Taro-TOP box-ACC hold-TE PROG
intended: 'Taro is holding a large box.'

(13) *Raion-ni$_i$ Mike-ga [t_i osow-are-ta] otoko-o tasuke-ta.
Lion-DAT Mike-NOM attack-PASS-PAST man-ACC save-PAST
intended: 'Mike saved a man who was attacked by a lion.'

As argued by proponents of deletion-based analyses, these facts would be mysterious if nonconstituent coordination were derived by movement—especially given the clear contrast with the corresponding leftward scrambling cases. By contrast, they are totally unproblematic for deletion-based analyses. If the relevant process is phonological deletion, then it would not be particularly surprising if surface syntactic constituency were not relevant.

2.1.2 (Apparent) arguments for movement-based analyses

The data that we have seen above seem to strongly support deletion-based analyses of nonconstituent coordination. However, there is a systematic set of data that suggest that deletion-based analyses—at least ones in which the condition for deletion is stated purely in terms of phonological identity—are insufficient. These cases all involve expressions in the pivot whose interpretations are ambiguous; in all such cases, the pivot cannot be construed differently with respect to different conjuncts—a fact that remains mysterious if the construction is licensed by means of pure phonological deletion. Thus, these cases seem to favor movement-based analyses. Various possibilities have been advocated in the literature for the relevant syntactic movement (or copying operation), for example: Kuno's (1978) and Saito's (1987) right-node raising analysis (in terms of ATB rightward extraction), Abe and Hoshi's (1997) LF-copying analysis, Takano's (2002) NP adjunction analysis and the analysis involving verb raising that Koizumi (2000) proposes for *-to* coordination. [17]

The first piece of evidence against deletion-based analyses and for movement-based analyses involves a lexically polysemous word. The word *kumo* is ambiguous between two meanings 'cloud' and 'spider'. As pointed out by Mukai (2003), when this word appears in the pivot of nonconstituent coordination, it cannot be understood in the two different meanings in different conjuncts:

(14)	John-ga	Mary-ni,	(sosite)	Bill-ga	Susan-ni	kumo-o	mise-ta.
	John-NOM	Mary-DAT	and	Bill-NOM	Susan-DAT	cloud/spider-ACC	show-PAST

'John showed a cloud to Mary and Bill showed a cloud to Susan.'
'John showed a spider to Mary and Bill showed a spider to Susan.'
Not: 'John showed a cloud to Mary and Bill showed a spider to Susan.'
Not: 'John showed a spider to Mary and Bill showed a cloud to Susan.'

In other words, the sentence is ambiguous only in two ways, rather than in four ways. If phonological identity is all that matters, it is puzzling why the sentence does not have the readings that it lacks. [18]

[17] As noted in footnote 13, Koizumi (2000) clearly does *not* intend his analysis to be applicable to ordinary nonconstituent coordination. I have nevertheless included his analysis here for the same reason that I have included Fukui and Sakai (2003) and Ito and Chaves (2008) in deletion-based analyses.

[18] It might be argued that examples like the following would provide evidence for deletion-based approaches, countering the argument involving (14) (Shûichi Yatabe, p.c.):

(i)	Taroo-wa	musi-no,	(sosite)	Hanako-wa	sora-no	**kumo-o**	mi-ta.
	Taro-TOP	insect-GEN	and	Hanako-TOP	sky-GEN	spider/cloud-ACC	see-PAST

'Taro saw a spider and Hanako saw a cloud.'

Second, Fujino (2008) gives a similar example involving an idiom, which establishes basically the same point. The phrase *sazi-o nage* (lit.) 'throw a spoon' has an idiomatic meaning 'give up'. As shown in (15), if the sentence does not involve nonconstituent coordination, it is ambiguous between the idiomatic and the literal interpretations:

(15) Isya-wa **sazi-o** **nage-ta**. Kanzya-wa sara-o nage-ta.
doctor-TOP spoon-ACC throw-PAST patient-TOP plate-ACC throw-PAST
'The doctor gave up. The patient threw a plate.' (idiomatic)
'The doctor threw a spoon. The patient threw a plate.' (literal)

However, when parts of the idiom are split over to one of the conjuncts and to the pivot, as in (16), the idiomatic interpretation is lost:

(16) [Isya-wa **sazi-o**], (sosite) [kanzya-wa sara-o] **nage-ta**.
doctor-TOP spoon-ACC and patient-TOP plate-ACC throw-PAST
'The doctor threw a spoon and the patient threw a plate.'

Again, a pure phonological deletion analysis fails to explain this fact.

Here, (at least superficially) it does seem that the word *kumo* is interpreted in the different meanings in the two conjuncts.

However, (i) is arguably a case in which the string *kumo* is given some kind of metalinguistic interpretation, along the lines of 'referent of a word pronounced as *kumo*', and hence does not provide any argument either for or against deletion-based approaches. Note that utterances like the following are highly marked unless the speaker specifically intends to forestall a potential confusion due to the existence of the homophonous word (and in such a case, the disambiguating expression *musi-no* receives a contrastive pitch accent):

(ii) ??Taroo-wa musi-no kumo-o mi-ta.
Taro-TOP insect-GEN spider/cloud-ACC see-PAST
intended: 'Taro saw a spider.'

The kind of zeugmatic interpretation exemplified in (i) seems to become possible in the related examples in (15) and (17) as well, but, crucially, only when the expression in the pivot is understood as being quoted (which requires a quotation mark in written language and a special kind of intonational cue in speech).

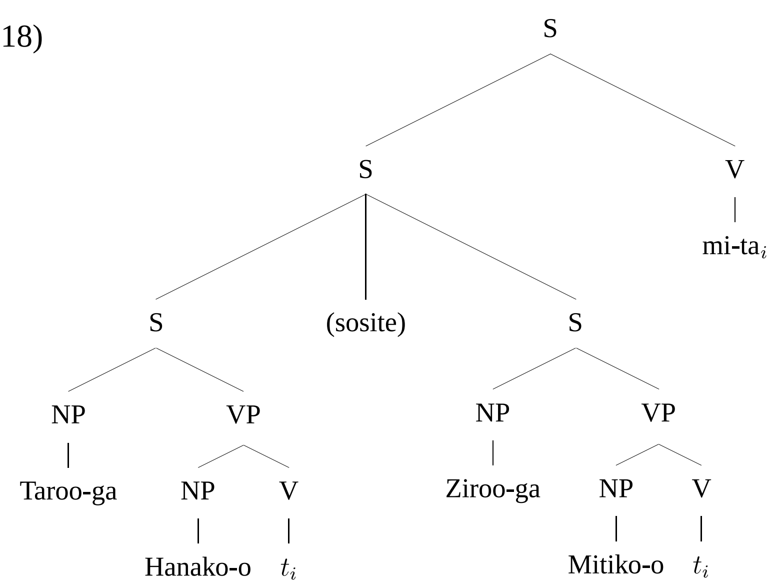
Finally, Sato (2009) notes cases like (17), where one and the same verb is used as a semantically semi-bleached light verb combining with different arguments to produce different meanings in the two conjuncts:

(17) *[John-ga kono kikaku-o], (sosite) [Bill-ga ano mokuhyoo-o]
John-NOM this plan-ACC and Bill-NOM that goal-ACC
tate-ta.
make/set.up-PAST
intended: 'John made this plan and Bill set up that goal.'

Kikaku-o tate and *mokuhyoo-o tate* each mean 'make up a plan' and 'set up a goal'. They involve the same verb *tate* (lit.) 'stand', but, as shown by the ungrammaticality of (17), nonconstituent coordination cannot be formed where the two collocational expressions share the same morphological verb in the pivot, again, a fact that remains mysterious in a deletion-based account.

Examples like (14), (16) and (17) are not problematic for movement-based analyses. For example, in Saito's (1987) right-node raising analysis, a structure like the following is assigned to (4), where the pivot undergoes an across-the-board (ATB) rightward movement:

(18)



Assuming that such a movement takes place before the structure is mapped to the phonological component, merely sharing the phonological form would not count as being identical in licensing the ATB movement. Thus, the ungrammaticality of examples like (14), (16) and (17) falls out straightforwardly in such an account.

I hasten to add here that examples like (14), (16) and (17) do not constitute knockdown arguments for deletion-based approaches: if one takes semantic identity in addition to (or instead of) phonological identity as the licensing condition for deletion (which is actually what some authors have proposed), cases like above cease to pose problems for deletion-based analyses. However, as pointed out by Sato (2009), if one takes the relevant deletion process to take place at the phonological component (as do most of the proponents of deletion-based analyses), such an assumption (i.e. reference to a semantic property in a process that is taken to be inherently phonological in nature) is evidently *ad hoc* and is not illuminating as a solution for the problem. In any event, a repair of deletion-based analyses along these lines would not be viable after all since (like all other previous approaches) they suffer from the two problems that I will discuss immediately below.

2.1.3 Problems for both deletion-based and movement-based analyses

In this section, I present two pieces of data that turn out to pose problems for all previous analyses of nonconstituent coordination—whether deletion-based or movement-based. One of them is Takano's (2002) much neglected observation about the interaction of nonconstituent coordination with the interpretation of the word *onazi* 'same'. The other involves the interpretation of the reflexive pronoun *zibun*.

Takano (2002) notes that the word *onazi* 'same', when it appears in the pivot of nonconstituent coordination, can induce the so-called **internal reading** (Carlson 1987). The same holds true of the word *betu-no* 'different' as well. The relevant data are shown in (19):

(19) a. Taroo-wa Hanako-ni, (sosite) Ziroo-wa Mitiko-ni **onazi hon-o**
Taro-TOP Hanako-DAT and Jiro-TOP Michiko-DAT same book-ACC
kasi-ta.
lend-PAST
'Taro lent Hanako and Jiro lent Michiko, the same book.'

b. Taroo-wa Hanako-ni, (sosite) Ziroo-wa Mitiko-ni (sorezore) **betu-no**
Taro-TOP Hanako-DAT and Jiro-TOP Michiko-DAT respectively different
hon-o kasi-ta.
book-ACC lend-PAST
'Taro lent Hanako and Jiro lent Michiko, different books.'

This is problematic for deletion-based analyses since the same interpretation is not available in sentences in which the alleged deletion process does not take place:

(20) Taroo-wa Hanako-ni onazi hon-o kasi-te, Ziroo-wa Mitiko-ni onazi
Taro-TOP Hanako-DAT same book-ACC lend-TE Jiro-TOP Mitiko-DAT same
hon-o kasi-ta.
book-ACC lend-PAST
'Taro lent the same book to Hanako and Jiro lent the same book to Michiko.'
(external reading only)

Movement-based analyses do not fare any better. All movement-based analyses except for Takano (2002) analyze nonconstituent coordination as coordination of constituents larger than VPs from which the pivot moves out across the board to the right to form the surface string. Assuming that such structures are interpreted at LF by reconstructing the moved material back into the extraction site in each conjunct,[19] essentially the same problem arises as for deletion-based approaches: reconstruction creates LFs that are identical to sentences that do not involve the relevant movement process. But if so, it remains a mystery why sentences involving nonconstituent coordination are not always synonymous with their counterparts that do not involve the relevant movement process.

Two remarks are in order here. First, it needs to be acknowledged that the above argument against movement-based analyses only goes through on the condition that, in movement-based analyses, the NP containing *onazi* is obligatorily reconstructed to its extraction sites in the two conjuncts at LF.[20] Thus, if one assumes that such reconstruction does not take place and that the ATB-extracted NP *onazi hon-o* is interpreted at some higher position by binding the traces that it has left in each of the conjuncts, then, the scope-taking behavior of *onazi* might be explicable much along the same lines as my proposal in Chapter 4.[21] In order to see whether such an alternative analysis is plausible, one needs to work

[19] After entertaining a couple of alternatives, Saito (1987) seems to conclude that the right-node raising movement in his analysis takes place at PF (or somewhere towards PF), rather than within narrow syntax. This makes his analysis exempt from the general criticism for movement-based analyses that I am giving in the main text. However, if one assumes that the movement takes place at PF, the analysis then suffers from the same problem as deletion-based analyses, since the problematic consequence that nonconstituent coordination sentences are semantically equivalent to their counterparts with coordination of full-fledged VPs (or clauses) is still entailed.

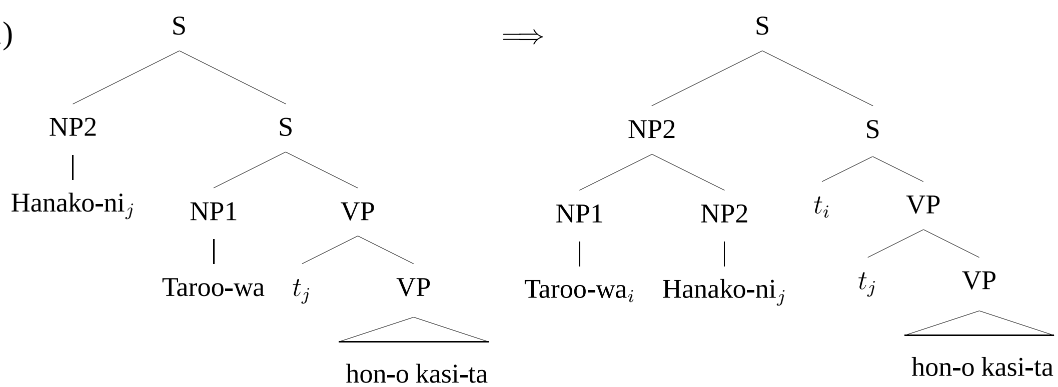
[20] But note that this assumption is a fairly standard one within the general theoretical setup of transformational/GB/Minimalist syntax: Takano's (2002) original argument against Koizumi (2000) involves the same logic, which is in turn based on a point made by Carlson (1987) against a classical transformational analysis of right-node raising in English with an example like *Bill reviewed and Ann read the same book,* where the word *same* appears in the pivot of a right-node raising sentence.

[21] See Sabbagh (2007) for a proposal about right-node raising in English along these lines. I will not attempt here to determine whether (an application of) Sabbagh's (2007) proposal (to Japanese nonconstituent coordination) makes fully equivalent predictions as my analysis since there are many details about compositional semantics and syntax-semantics interface that are left unspecified in his analysis. A complication that

out the relevant details explicitly. However, I will not explore this issue further here since, as Koizumi (2000) points out (cf. footnote 13), given the data discussed in section 2.1.1, movement-based analyses of Japanese nonconstituent coordination are highly problematic on totally independent grounds.

Second, Takano's (2002) own analysis requires some discussion here, since it does not involve coordination of constituents larger than VPs (and, hence, presumably no reconstruction back into the extraction sites at LF) and one might thus think that it is not vulnerable to the criticism of movement-based analyses that I have given above. (In fact, Takano himself takes the data in (19a) as support for his proposal.) In Takano's analysis, strings of words such as *Taroo-wa Hanako-ni* in (19a) are analyzed as derived NPs via an adjunction of one NP to another along the following lines:

(21)



arises in such an approach (which, incidentally, does not arise in the CG analysis that I formulate below) is that one will then need to assume that covert ATB movement is not possible, since, if it were, then (20) (or its English analog) would be predicted to have the same range of interpretations that (19a) (or its English analog) does. Sabbagh (2007) (his footnote 13 on p. 366), building on Citko (2000) and Bošković and Franks (2000), speculates that the ban on covert ATB movement can be made to fall out in the Minimalist framework by making certain assumptions about the identity of constituents and constraints on linearization, but he does not work out the relevant details.

This *does* allow one to analyze the argument cluster as a (non-verbal) constituent, but, as Takano himself acknowledges, the problem that then arises is that it is not clear how such argument clusters can be coordinated. That is, the dilemma is the following:

- The coordinate structure should be present in the underlying structure with the conjunction (either overt or null) coordinating the two conjuncts.
- But the argument cluster becomes a constituent *only after* the adjunction operation takes place (so, the nodes to be coordinated do not yet exist in the underlying structure).

In order to overcome this problem, Takano goes on to assume that derived constituents (such as the argument cluster constituent created by the NP adjunction operation) are conjoinable. However, the formal details of how such a mechanism can be formulated are left unspecified. In particular, in order to determine whether the internal readings of sentences like those in (19) can really be derived in such an account, what crucially needs to be worked out is how the semantic interpretations are assigned for such coordinate structures involving derived constituents. Given that Takano does not make any concrete proposal about how this might be worked out, it seems to be difficult to maintain that his analysis has any empirical edge over other previous approaches with respect to the empirical point in question (i.e. the internal readings of sentences like those in (19)).

The second case that poses a problem for both kinds of previous approaches comes from the interaction of the interpretation of the reflexive *zibun* and nonconstituent coordination. It is well-known that the subject-oriented reflexive *zibun* exhibits ambiguous interpretations in causative sentences like (22). In (22), in addition to the matrix subject, the logical subject of the embedded verb can be the binder of the reflexive.

(22) Taroo-wa$_i$ Hanako-ni$_j$ **zibun-no**$_{i/j}$ heya-de odor-ase-ta.
Taro-TOP Hanako-DAT self-GEN room-in dance-cause-PAST
'Taro$_i$ made Hanako$_j$ dance in his$_i$/her$_j$ room.'

However, when nonconstituent coordination is formed out of (22), not all logically conceivable interpretations are available. Specifically, readings in which the 'structural positions' of the binders do not match in the two conjuncts are unacceptable:

(23) Taroo-wa Hanako-ni, (sosite) Ziroo-wa Mitiko-ni **zibun-no** heya-de
Taro-TOP Hanako-DAT and Jiro-TOP Michiko-DAT self-GEN room-in
odor-ase-ta.
dance-cause-PAST
'Taro$_i$ made Hanako dance in his$_i$ room and Jiro$_j$ made Michiko dance in his$_j$ room.'
'Taro made Hanako$_i$ dance in her$_i$ room and Jiro made Michiko$_j$ dance in her$_j$ room.'
Not: 'Taro$_i$ made Hanako dance in his$_i$ room and Jiro made Michiko$_j$ dance in her$_j$ room.'
Not: 'Taro made Hanako$_i$ dance in her$_i$ room and Jiro$_j$ made Michiko dance in his$_j$ room.'

This fact remains mysterious in pure phonological deletion analyses, since the counterpart of (23) in which the alleged deletion operation does not take place is ambiguous in all of the four ways. And, again, movement-based analyses fare no better. In movement-based analyses, the surface structure cannot be taken to be the structure at which binding conditions apply, since, with the pivot displaced from the conjuncts, the potential binders do not even c-command the reflexive there.[22,23] Thus, binding conditions need to be stated either at the structure before the relevant movement takes place or at LF. In either case, the relevant binding conditions—whatever are the exact details—need to be stated in such a way as to account for the ambiguity of (22). But if that is the case, it is difficult to see how the unavailable readings for (23) can be blocked. If both NPs are possible binders when nonconstituent coordination is not involved (and they *are* possible binders in the nonconstituent coordination cases as well, as long as the structural positions of the binders match in each conjunct), it remains mysterious why (22) lacks the readings that it does.

Finally, let us consider the predictions of deletion-based analyses that take into account semantic factors as well, such as the ones proposed by Mukai (2003), Ito and Chaves (2008) and Sato (2009). It seems that these approaches face essentially the same difficulty as movement-based analyses. Note first that taking complete semantic identity to be the relevant condition is too strong, since that would incorrectly rule out the possible readings of (23) as well; in these readings, *zibun* is bound by different NPs that refer to different individuals in the two conjuncts and hence they need to be construed as referring to different individuals with respect to each conjunct, a situation similar to the impossible construals of

[22]This is easiest to see in the right-node raising analysis along the lines of Saito (1987) (cf. the tree in (18)), assuming that the relevant movement operation takes place somewhere between the deep structure and the surface structure (but see footnote 19 for what seems to be Saito's (1987) actual assumption; again, assuming that the RNR movement takes place at PF would not solve the problem for Saito (1987) since such an assumption would merely lead to the same predictions as deletion-based analyses). The same point holds of other movement-based analyses as well.

[23]It is not possible to explain away examples like (23) as cases involving logophoric anaphora (cf., e.g., Kameyama (1985)), which is thought to fall outside the scope of syntactic binding conditions; sentences like (23) do not involve any of the typical features of logophoricity such as sensitivity to the 'point of view' of some agent holding a certain mental attitude. Moreover, such a treatment would not explain the sharp contrast between the available and unavailable readings of (23).

(14), (16) and (17) that these approaches correctly rule out. [24] The only way to rule in only the acceptable readings of (23), then, seems to be to somehow stipulate that bearing the same numerical index satisfies the semantic identity condition for deletion and to further ensure that matrix subjects and embedded subjects bear the same numerical indices in the two conjuncts respectively. The problem for such an account, of course, is that it is not clear how such an identity condition for numerical indices can be imposed (and even if it were technically possible to do so, such a constraint does not seem to have any independent empirical motivation).

To summarize, the problems posed by the two cases considered in this section for deletion-based and movement-based analyses seem to stem from the fact that, despite the superficial differences between the two kinds of approaches and specific points of divergence among the different proposals within each, both of these types of approaches essentially equate nonconstituent coordination with paraphrases with full-fledged clauses for the purpose of interpretive processes (such as scope of operators and binding). But, as we have seen above, the facts considered in this section show that such an assumption is untenable.

2.1.4 Summary

As discussed in Chapter 1, the reason that nonconstituent coordination poses a problem for PS-based theories of syntax is that the strings of words that are coordinated are not constituents in any usual sense under the assumptions of these theories. The idea behind deletion-based approaches is that this is not a problem since the phenomenon in question should be treated in the phonological component rather than in narrow syntax. By contrast,

[24] Given this, under the standard account of binding in terms of syntactic indices, it is all the more puzzling why (23) exhibits the pattern that it does. In the semantically-oriented approach to binding in CG that I sketch in Chapter 4, this fact falls out straightforwardly.

movement-based approaches attempt to solve the problem inside syntax, accommodating the deviant constituents within the PS-based setup in terms of syntactic transformations that manipulate constituent structures. However, we have seen above that neither of these solutions is completely successful given the two problematic phenomena identified in the last section (in addition to the problems for each of the two approaches). As I have pointed out above, these two cases argue against analyses that equate nonconstituent coordination with coordination of full-fledged clauses for the purpose of semantic interpretation (of which virtually all variants of deletion-based and movement-based analyses are instances). This suggests that we need to analyze nonconstituent coordination as a case of surface constituent coordination and recognize the apparent nonconstituents as syntactic units having their own semantic values. In Chapter 4, I will propose an analysis of nonconstituent coordination along these lines within the CG-based theory developed in Chapter 3 and show that all of the properties reviewed in this section are accounted for naturally in this analysis. In particular, following the well-established tradition in CG, the apparent nonconstituents are analyzed as full-fledged constituents that are assigned well-formed semantic interpretations. I will show that this assumption immediately provides straightforward solutions for the two problems that both deletion-based and movement-based analyses suffer from. Thus, the case of nonconstituent coordination in Japanese provides one piece of evidence against the PS-based model of syntax and for an alternative architecture in which the notion of constituency is made significantly more flexible.

2.2 Nonconstituent clefting

Coordination is not the only construction that exhibits flexibility of constituency in Japanese. The cleft construction also treats apparent nonconstituents as if they were constituents, although the flexibility of constituency found with clefts is somewhat more restricted than with coordination. The problem has attracted attention of several researchers in the literature (cf., e.g., Koizumi (1995), Takano (2002) and Fukui and Sakai (2003)).

2.2.1 Basic patterns of the cleft construction in Japanese

In Japanese, cleft sentences are formed by combining a topicalized sentence [25] containing a gap with its 'filler' (the missing element) by means of a copular construction as in (24):[26,27]

(24) [Ken-ga t_i kat-ta]-no-wa *sono hon-(o)*$_i$ da.
Ken-NOM buy-PAST-NMLZ-TOP that book-ACC COP
'It is that book that Ken bought.'

Schematically, this can be represented as:

(25) **A** wa **B** da.

In (24), the object *sono hon o* 'that book' of the transitive verb *kat-ta* 'bought' is missing from the topicalized sentence (i.e. **A** in the schema in (25)), and that object appears in the

[25] To be topicalizable, a sentence first has to be nominalized. Hence the presence of the nominalizer *no*.

[26] Adjuncts can also be clefted. In that case, there is no gap in the topicalized sentence, at least in the ordinary sense of this term.

[27] Generally, I give translations of examples of cleft sentences in Japanese by using *it*-clefts in English, but in cases where that is impossible because of the syntactic constraints of English, I use pseudo-clefts instead. Semantic or pragmatic differences between *it*-clefts and pseudo-clefts in English have nothing to do with my choices between the two constructions in these translations.

position immediately preceding the copula (i.e. **B** in the schema in (25)). Semantically and pragmatically, the element that appears in the position immediately before the copula is the focus (in the sense that it conveys new information) and the gapped sentence marked by the topic marker is, as expected, the topic (in the sense that it is old information) (cf., e.g., Martin 1975/1983). Thus, (24) can be an answer to the question *Ken-wa nani-o kat-ta no?* 'What did Ken buy?', but not to *Dare-ga sono hon-o kat-ta no?* 'Who bought that book?', nor *Ken-wa nani-o si-ta no?* 'What did Ken do?'.

The following are examples in which the subject (26), the indirect object (27), a post-positional phrase (28) and an adverb (29) are clefted.[28]

(26) [t_i Sono hon-o kat-ta]-no-wa *Ken-(*ga)*$_i$ da.
that book-ACC buy-PAST-NMLZ-TOP Ken-NOM COP
'It is Ken that bought that book.'

(27) [Ken-ga sono hon-o t_i mise-ta]-no-wa *Mari-ni*$_i$ da.
Ken-NOM that book-ACC show-PAST-NMLZ-TOP Mari-DAT COP
'It is to Mari that Ken showed that book.'

(28) [Ken-ga sono hon-o t_i toriyose-ta]-no-wa *Huransu-kara*$_i$ da.
Ken-NOM that book-ACC order-PAST-NMLZ-TOP France-from COP
'It is from France that Ken ordered that book.'

(29) [Ken-ga t_i ki-ta]-no-wa *kinoo*$_i$ da.
Ken-NOM come-PAST-NMLZ-TOP yesterday COP

[28] As shown in (26), when the subject of the sentence appears in the focus position, the nominative marker is obligatorily omitted (Takano 2002). The accusative marker is optional as in (24) and other (more oblique) markers are obligatory as in (27) and (28). Similar (but not identical) patterns of deletion of case markers are found in other constructions such as topicalization or syntactic environments that require genitive marking. I will not attempt to account for this obligatory/optional omission of nominative and accusative case markers in the cleft construction in the analysis I present in Chapter 4 since I assume that the distribution of the case markers in the cleft focus position observed here can and should be accounted for by independently motivated principles governing other case marker deletion patterns as well.

‘It is yesterday that Ken came.’

2.2.2 Patterns of nonconstituent clefting

As noted by Koizumi (1995), strings apparently not forming constituents can occupy the focus position in the cleft construction in Japanese. I call this phenomenon **nonconstituent clefting**. (30b)–(30e) exemplify some patterns of nonconstituent clefting from the source sentence (30a):[29,30,31]

(30) a. Ken-ga Mari-ni sono himitu-o barasi-te simat-ta.
Ken-NOM Mari-DAT that secret-ACC disclose-TE EMPH-PAST
‘Ken (inadvertently) disclosed that secret to Mari.’

b. [Ken-ga t_i t_j barasi-te simat-ta]-no-wa ⟨*Mari-ni*⟩$_i$ ⟨*sono himitu-o*⟩$_j$ da.
Ken-NOM disclose-TE EMPH-PAST-NMLZ-TOP Mari-DAT that secret-ACC COP
lit. ‘It is to Mari that secret that Ken (inadvertently) disclosed.’

c. [t_i t_j Mari-ni barasi-te simat-ta]-no-wa ⟨*Ken-ga*⟩$_i$ ⟨*sono himitu-o*⟩$_j$ da.
Mari-DAT disclose-TE EMPH-PAST-NMLZ-TOP Ken-NOM that secret-ACC COP
lit. ‘It is Ken that secret that (inadvertently) disclosed to Mari.’

[29] I call a non-clefted counterpart of a cleft sentence with the same verb and arguments the ‘source sentence’ of the cleft sentence.

[30] In the following examples, each phrase that appears in the focus position is identified by angle brackets.

[31] I personally find sentences like (30b)–(30e) to be perfectly acceptable, especially given appropriate contexts. However, it is reported in the literature that not all native speakers accept such sentences readily (cf., e.g., Kizu 2005). I do not have anything to say about this inter-speaker variation.

d. [t_i Sono himitu-o t_j barasi-te simat-ta]-no-wa ⟨*Ken-ga*⟩$_i$
that secret-ACC disclose-TE EMPH-PAST-NMLZ-TOP Ken-NOM
⟨*Mari-ni*⟩$_j$ da.
Mari-DAT COP
lit. 'It is Ken to Mari that (inadvertently) disclosed that secret.'

e. [t_i t_j t_k Barasi-te simat-ta]-no-wa ⟨*Ken-ga*⟩$_i$ ⟨*Mari-ni*⟩$_j$ ⟨*sono*
disclose-TE EMPH-PAST-NMLZ-TOP Ken-NOM Mari-DAT that
himitu-o⟩$_k$ da.
secret-ACC COP
lit. 'It is Ken that secret to Mari that (inadvertently) disclosed.'

In these examples (whose English analogs are ungrammatical), the clefted elements convey new information, just as with single constituent clefting. Thus, (30b), for example, can be an answer to the question *Ken-wa dare-ni nani-o barasi-te simat-ta no?* 'What did Ken disclose to whom?', but not to *Ken-wa Mari-ni nani-o barasi-te simat-ta no?* 'What did Ken disclose to Mari?' or *Ken-wa dare-ni sono himitu-o barasi-te simat-ta no?* 'Who did Ken disclose that secret to?'.

When multiple phrases are clefted, the order of elements is generally free within the focus position, just as the relative order of arguments and adjuncts is generally free within a single clause in Japanese. For example, the following sentence, in which the order of the clefted arguments are switched from (30b), is grammatical and is truth-conditionally equivalent to (30b):[32]

[32] However, there is at least one limitation on the possible order of elements in multiple constituent clefting. That is, the nominative argument cannot appear directly before the copula. This situation comes about as a result of an interplay of two constraints. As we have already seen, the presence of a nominative marker right before the copula makes a sentence unacceptable (cf. (26)). In addition, there is another constraint peculiar to multiple constituent clefting such that omission of the case marker is not possible for any of the arguments that appear in the focus position. Because of these two restrictions, there is no way to put a nominative

(31) [Ken-ga t_i t_j barasi-te simat-ta]-no-wa ⟨*sono himitu-o*⟩$_j$ ⟨*Mari-ni*⟩$_i$ da.
Ken-NOM disclose EMPH-PAST-NMLZ-TOP that secret-ACC Mari-DAT COP
lit. 'It is that secret to Mari that Ken (inadvertently) disclosed.'

Clefting of multiple phrases is not limited to arguments. The following are examples in which multiple adjuncts are clefted:

(32) a. [Ken-ga t_i t_j happyoo-si-ta]-no-wa ⟨*kyonen*⟩$_i$ ⟨*NELS-de*⟩$_j$ da.
Ken-NOM present-do-PAST-NMLZ-TOP last-year NELS-at COP
'It is last year at NELS that Ken presented (a paper).'

b. [Ken-ga t_i t_j happyoo-si-ta]-no-wa ⟨*NELS-de*⟩$_i$ ⟨*itido-dake*⟩$_j$ da.
Ken-NOM present-do-PAST-NMLZ-TOP NELS-at once-only COP
'It is only once at NELS that Ken presented (a paper).'

Combinations of arguments and adjuncts are also possible, as in the following example, where the adjunct *kinoo* 'yesterday' and the object *sono hon-o* 'that book' are clefted together.

(33) [Ken-ga t_i t_j kat-ta]-no-wa ⟨*kinoo*⟩$_i$ ⟨*sono hon-o*⟩$_j$ da.
Ken-NOM buy-PAST-NMLZ-TOP yesterday that book-ACC COP
lit. 'It was yesterday that book that Ken bought.'

2.2.3 Impossible cases of clefting

As seen above, the Japanese cleft construction exhibits a fairly flexible pattern in terms of what can appear in its focus position. However, the flexibility is significantly more restricted than is the case with (nonconstituent) coordination, which we have seen in the

argument right before the copula in the case of multiple constituent clefting. The presence of the nominative marker would violate the first constraint, whereas its omission would violate the second constraint. Thus, a counterpart for (30c) in which the indirect object precedes the subject is not acceptable either with or without the case marker on the precopular nominative argument.

previous section. The following examples show that postposition stranding, 'extraction' of adjectives out of NPs and 'extraction' of NPs out of relative clauses are all unacceptable, just as leftward scrambling is prohibited in all of these environments.

(34) *[Ken-ga t_i-o kat-ta]-no-wa *sono hon*$_i$ da.
Ken-NOM -ACC buy-PAST-NMLZ-TOP that book COP
intended: 'It was that book that Ken bought.'

(35) *[Ken-ga [t_i hon-o] yon-da]-no-wa *nagai*$_i$ da.
Ken-NOM book-ACC read-PAST-NMLZ-TOP long COP
intended: lit. 'It is long that Ken read a book.' (where the adjective 'long' modifies the noun 'book')

(36) *[Ken-ga [t_i osow-are-ta] otoko-o tasuke-ta]-no-wa *raion-ni* da.
Ken-NOM attack-PASS-PAST man-ACC save-PAST-NMLZ-TOP lion-DAT COP
intended: lit. 'It was by a lion that Ken saved a man who was attacked.'

In sections 2.3 I will present further cases involving the *-te* form complex predicate construction and the compound verb construction where clefting some expression results in ungrammaticality. As we will see, in both of these constructions, higher and lower verbs form a morpho-syntactic unit and splitting that sequence by clefting is impossible. Thus, even though the cleft construction exhibits flexibility of constituency to a somewhat remarkable extent, it is also constrained by certain morpho-syntactic regularities in the grammar of Japanese in a way that is tighter than nonconstituent coordination.

2.2.4 Movement-based analyses

I review here three previous analyses of nonconstituent clefting in Japanese (Koizumi 1995, 2000; Takano 2002; Fukui and Sakai 2003). All of these analyses are formulated in the Minimalist framework and they attempt to derive the apparent nonconstituent found in the focus position as a constituent in terms of some syntactic transformation or other. [33]

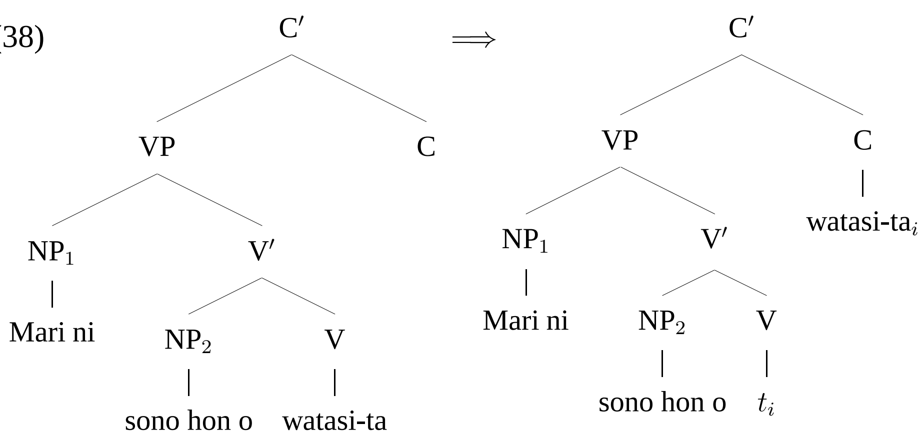
2.2.4.1 Koizumi (1995, 2000)

Koizumi (1995, 2000) analyzes examples of nonconstituent clefting like the following in terms of string vacuous **verb raising**.

(37) [Ken-ga t_i t_j watasi-ta]-no-wa $\langle$*Mari-ni*$\rangle_i$ $\langle$*sono hon-o*$\rangle_j$ da.
Ken-NOM give-PAST-NMLZ-TOP Mari-DAT that book-ACC COP
lit. 'It is that book to Mari that Ken gave.'

Roughly speaking, in his analysis, a verb is first raised up to a higher position c-commanding the VP (or S) as in (38), and then, the null-headed remnant VP, now being a constituent, moves to the focus position.

(38)



There are several theory-internal and empirical problems for this analysis pointed out in the literature (Takano 2002; Fukui and Sakai 2003; Fukushima 2003). I will not reproduce

[33] There is one nontransformational approach by Fukushima (2003). Although Fukushima presents many interesting observations, his analysis crucially rests on the assumption that nonconstituent clefting is possible only in the presence of numeral expressions (of the kind found in *-to* coordination; cf. footnote 13 above) immediately preceding the copula. I take this assumption to be empirically incorrect and will not review his analysis below since due to this dubious assumption, Fukushima's analysis does not generalize to all relevant cases of nonconstituent clefting.

these criticisms here. The interested readers are referred to the references cited above. Instead, I note two simpler problems for Koizumi's analysis, which, to the best of my knowledge, have not been addressed in the previous literature.

First, given the possibility of remnant VP movement, and assuming that local scrambling is accounted for as movement out of VP, it remains a mystery that completely empty VPs cannot move to the focus position. That is, for a source sentence like *Hon-o Taroo-ga yon-da* 'Taro read a book', which involves a completely empty VP node in his analysis, it is not clear why an example such as (39), in which no overt string moves out of the topicalized source sentence, is ruled out.[34]

(39) * [Hon-o]$_k$ Taroo-ga t_i yon-da$_j$-no-wa [$_{\mathrm{VP}}$ t_k t_j]$_i$ da.
book-ACC Taro-NOM read-PAST-NMLZ-TOP COP
intended: 'It is that Taro read the book.'

A second point is related to the status of verb raising. As Koizumi acknowledges, ordinary (non-null-headed) VPs cannot move to positions that remnant VPs can move to. For example, clefting of an ordinary VP is ungrammatical as shown in (40):

(40) * [Taroo-ga t_i]-no-wa [$_{\mathrm{VP}}$ kono hon-o yon-da]$_i$ da.
Taro-NOM -NMLZ-TOP this book-acc read-PAST COP
intended: 'What Taro did was read this book.'

[34]Of course, one could make recourse to semantic/pragmatic infelicity to account for the unacceptability of such sentences: if (39) has no focused element, then it does not convey new information; hence there would be no context in which such a sentence would serve any useful function. But it is somewhat doubtful that this would be the right characterization of the unacceptability of sentences like (39). The use of copular sentences is not limited to the cleft construction, and, in all other instances of the copular construction, there is not a single case in which the precopular position can be made totally empty. Thus, it seems very likely (although there is no direct evidence for it) that (39) is syntactically defective, independently of the question of whether it is semantically or pragmatically felicitous.

For the sake of concreteness, let us assume, following Koizumi (2000), that the verb raises to C by overt verb raising. The ungrammaticality of (40) by itself does not directly pose a problem for his analysis, since it can be accounted for by making the following three assumptions:

- Verb raising is obligatory.
- Clefting (i.e. movement of some phrase to the focus position) takes place after verb raising.
- VPs can undergo clefting but CPs cannot.

That is, clefting of VPs is still possible, licensing cases of nonconstituent clefting, but it does not give rise to the surface string identical to (40) since it always occurs after the verb is moved out of the VP.

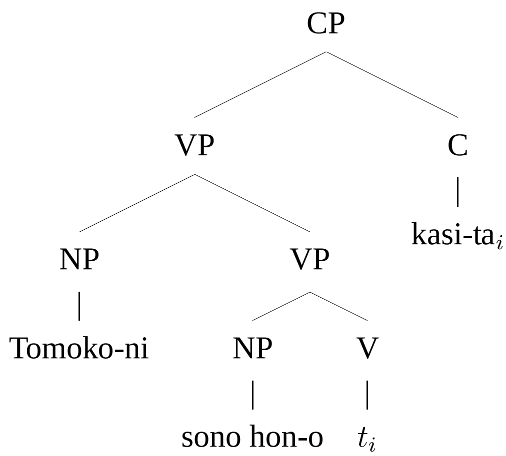
Given this, though, a problem arises as to how to account for the coordination of constituents containing both ditransitive verbs and their direct objects, as in the following: [35]

(41) Ken-wa Tomoko-ni [sono hon-o kasi-ta]-ka, [kono zassi-o
Ken-TOP Tomoko-DAT that book-ACC lend-PAST-or this magazine-ACC
age-ta].
give-PAST
'Ken either lent that book to Tomoko or gave that magazine to her.'

Assuming obligatory verb raising, there is no node that directly dominates the direct object and the verb that subcategorizes for it in sentences like (41), since the verb raises to a position that c-commands the indirect object as in (42).

[35] I use here the disjunctive coordinator *-ka* since the (semantically) conjunctive morpheme *-te* attaches to untensed clauses and thus it is not clear whether it is syntactically a coordinator or subordinator (see Tokashiki (1989), Yuasa and Sadock (2002) and Kubota and Lee (2008) for some discussions pertaining to this issue). *-ka* introduces a syntactically coordinate structure since it attaches to a tensed clause.

(42)



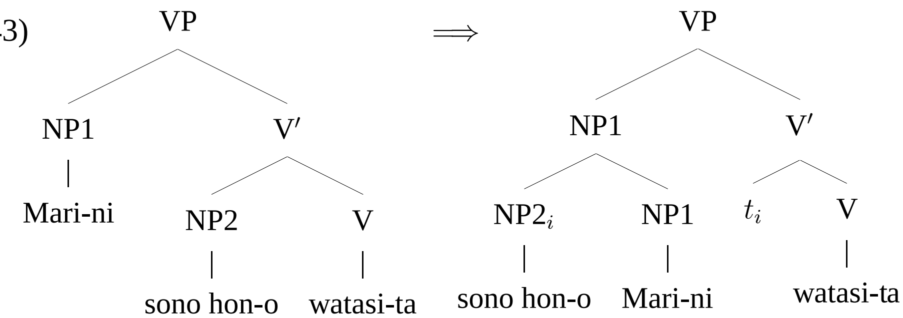
Given this, it is not clear how sentences like (41) are licensed in Koizumi's analysis, for the bracketed strings do not form constituents by themselves. Of course, one could make recourse to additional movement operations[36] to create a syntactic node exclusively containing the relevant elements, but without independent motivation, such a solution would simply be *ad hoc*.

2.2.4.2 Takano (2002)

Takano (2002) criticizes Koizumi's (1995, 2000) analysis of nonconstituent clefting in terms of verb raising and proposes an alternative that crucially relies on an NP adjunction operation called **oblique movement**. In Takano's analysis, (37) is derived by first adjoining the direct object to the indirect object and then moving that derived composite NP to the focus position.

[36]For example, it might be argued that (41) is licensed as a case of across-the-board left-node raising of the indirect object. However, for that account to be plausible, the operation of left-node raising has to be independently motivated in the grammar of Japanese.

(43)



In effect, this amounts to saying that the apparent nonconstituent that appears in the focus position is actually a constituent, and, moreover, that it is (at least when all of the elements involved are NPs) an NP (in what follows, I call such NPs **bipartite NPs**).

Oblique movement is so named since it is not the standard kind of movement where the moved material c-commands its trace. Aside from the somewhat dubious status of this movement operation,[37] there are at least two problems with this approach. The first problem is already discussed in the previous section (p. 22): his analysis runs into problems accounting for nonconstituent coordination, and Takano does not attempt to work out any solution for the technical problem that it faces, especially regarding semantic interpretation.

The other problem concerns the 'NP-ness' of the purported bipartite NPs. Contrary to the prediction of his analysis, these bipartite NPs do not behave like ordinary NPs. As shown by the following data, ordinary NPs in Japanese can be topicalized as in (44a) but bipartite NPs cannot as in (44b).[38]

[37]This kind of movement was originally introduced to account for a problem of a quite different nature: certain amelioration effects found with adjunct *wh*-phrases that originate in syntactic islands (Sohn 1994; Saito 1994). Thus, extending the applicability of this non-standard movement to *non-wh-arguments* is a rather radical move, but Takano does not give any justification for it other than the fact that it apparently provides an account of the phenomenon that he deals with.

[38]The examples in the text involve coordinated (bipartite) NPs. Simpler examples like the following (in which two NPs appear before the topic marker) do not show the relevant point clearly due to an irrelevant factor.

(44) a. [Rika-ni to Mari-ni]$_i$-wa Ken-ga t_i kono zassi-o watasi-ta.
Rika-DAT and Mari-DAT-TOP Ken-NOM this magazine-ACC give-PAST
'To Rika and to Mari, Ken gave this magazine.'

b. * [[Sono hon-o Rika-ni] to [kono zassi-o Mari-ni]]$_i$-wa
that book-ACC Rika-DAT and this magazine-ACC Mari-DAT-TOP
Ken-ga t_i watasi-ta.
Ken-NOM give-PAST
intended: lit. 'That book to Rika and this magazine to Mari, Ken gave.'

The contrast between (44a) and (44b) is not predicted by Takano's analysis, which assigns exactly the same categorial status to the topicalized phrases in these examples.

2.2.4.3 Fukui and Sakai (2003)

Fukui and Sakai (2003) propose yet another analysis of nonconstituent clefting in Japanese within Minimalist syntax. According to them, cleft sentences in Japanese are generated not by moving elements from the topicalized sentence to the focus position but by moving a gapped nominalized sentence to the topic position. Thus, (37) is licensed by first scrambling the two NPs to be clefted to the sentence-initial position and then by moving the whole sentence from which these two elements were extracted to the topic position:

(45) [$_S$ Ken-ga t_i t_j watasi-ta]$_k$-no-wa [sono hon-o]$_j$ [Mari-ni]$_i$ t_k da.
Ken-NOM give-PAST-NMLZ-TOP that book-ACC Mari-DAT COP
lit. 'It was that book to Mari that Ken gave.'

(i) Sono hon-o Rika-ni-wa Ken-ga watasi-ta.
that book-ACC Rika-DAT-TOP Ken-NOM give-PAST
intended: lit. 'That book to Rika and this magazine to Mari, Ken gave.'

Example (i) is acceptable but this cannot be taken as supporting evidence for Takano's analysis, since there is an alternative parse for this sentence in which the accusative NP precedes the topicalized dative NP without forming a bipartite constituent with it. With examples like (44) in the main text, this alternative possibility is ruled out and the ungrammaticality of such examples clearly poses a problem for Takano's analysis.

There are at least four problems with this approach. First, like Koizumi's analysis, this analysis does not account for the fact that sentences like the following, in which no element occupies the focus position, are ungrammatical:

(46) * [Taroo-ga hon-o yon-da]$_i$-no-wa t_i da.
Taro-NOM book-ACC read-PAST-NMLZ-TOP COP
intended: lit. 'It is that Taro read the book.'

This sentence would be generated in Fukui and Sakai's analysis by topicalizing the whole sentence without first scrambling anything out of it.[39]

Other problems are essentially due to Fukui and Sakai's assumption that the movement operation involved in cleft formation is not movement *into* the focus position but movement *out of* it. The first such problem is that this analysis makes an incorrect prediction regarding the binding connectivity effect of null pronouns in the cleft construction. In Japanese cleft sentences, null pronouns functioning as bound anaphors exhibit a connectivity effect where they behave as if they were in the positions that they occupied before moving to the focus position. However, the scrambling construction, from which cleft sentences are derived under Fukui and Sakai's account, do not pattern with the cleft construction in this respect. Relevant examples are as follows:

(47) a. #Hitome mi-ta otoko-ga dono zyosi-gakusei-ni-mo
glance look-PAST man-NOM which female-student-DAT-also
puropoozu-si-ta.
propose-do-PAST
intended: 'For each female student, the man who glanced at her proposed marriage.'

[39] Again, this argument is potentially weak given the possibility of a pragmatic account for the unacceptability of such sentences.

b. *Dono zyosi-gakusei-ni-mo* hitome mi-ta otoko-ga
which female-student-DAT-also glance look-PAST man-NOM
puropoozu-si-ta.
propose-do-PAST
'For each female student, the man who glanced at her proposed marriage.'

c. #[[Hitome mi-ta otoko-ga] puropoozu-si-ta]-no-wa *dono*
glance look-PAST man-NOM propose-do-PAST-NMLZ-TOP which
zyosi-gakusei-ni-mo da.
female-student-DAT-also COP
intended: 'For each female student, it is the man who glanced at her that proposed marriage.'

As shown in (47a), in the basic SOV word order, a null pronoun contained in the subject cannot be bound by the object quantifier. By scrambling the object over the subject, such a binding pattern becomes acceptable, as in (47b). However, in the cleft construction, the binding of the null pronoun by the object is again impossible, as in (47c).

In order to account for this contrast between scrambling and the cleft construction in Fukui and Sakai's analysis, one needs to assume a very elaborate formulation of reconstruction. Recall that, in Fukui and Sakai's analysis, the derivation of a cleft sentence always involves an intermediate stage at which whatever argument(s) that will ultimately end up in the focus position are scrambled out of the source sentence. That is, (47c) is derived from (47a) via (47b). Given this, in order to account for the above contrast in the interpretation of null pronouns, it needs to be somehow ensured that reconstruction of moved elements all the way down to the their original positions in the underlying structure obligatorily takes place in the cleft sentence (47c), but not in the scrambling sentence (47b). [40]

[40] By looking at the paradigm in (47) alone, one might think that an alternative explanation is available. That is, in all of the sentences in (47), the quantifier can bind the null pronoun just in case the former c-commands the latter in the surface form. Thus, it might be argued that the pattern is explicable by simply

The other problem for this approach stemming from the reversal of the moved vs. *in situ* statuses of the focus and topic phrases is that scrambling and the cleft construction do not line up with one another in terms of the sensitivity to the Coordinate Structure Constraint (CSC). As noted by Yatabe (2003), in NP coordination in Japanese involving the conjunction -*to* attached to each conjunct, it is possible to scramble a single conjunct to the sentence-initial position:

(48) a. [Kyoodai-to] kanozyo-ga [Toodai-to]-o kurabe-te i-ru-tte
Kyoto.U.-and she-NOM Tokyo.U.-and-ACC compare-TE be-NPST-COMP
sit-te i-ta?
know be-PAST
'Did you know that she is comparing Kyoto University and Tokyo University?'

b. [Kyoodai-to] kanozyo-wa [Toodai-to]-o kurabe-te i-ru-no
Kyoto.U.-and she-NOM Tokyo.U.-and-acc compare-TE be-NPST-NMLZ
da.
COP
'She is comparing Kyoto University and Tokyo University.'

---

assuming that reconstruction does not take place at all in either (47b) or (47c). However, the following example shows that such an alternative is untenable:

(i) [[Hitome mi-ta] zyosi-gakusei-ni puropoozu-si-ta]-no-wa dono otoko-mo da.
glance look-PAST female-student-dat propose-do-PAST-NMLZ-TOP which man-also COP
'It is every man that proposed marriage to the female student he glanced at.'

In Fukui and Sakai's analysis, the subject quantifier does not c-command the null pronoun contained in the object at the surface structure in this sentence. Thus, in order to account for the availability of the bound variable reading of (i) in Fukui and Sakai's analysis, one needs to assume that reconstruction is possible for cleft sentences.

However, in sharp contrast to this, the cleft construction does not allow for this kind of phrase to appear in the focus position. (49a) is an attempted case of clefting a conjunct of a coordinate structure, but this sentence is ungrammatical. [41,42]

(49) * Kanozyo-ga [Toodai-to]-o kurabe-te i-ru-no-wa
she-NOM Tokyo.U.-and-ACC compare-TE be-NPST-NMLZ-TOP
[Kyoodai-to] da.
Kyoto.U.-and COP

---

[41]The badness of (49a) cannot be ascribed to a morphological/phonological incompatibility of the conjunction *-to* and the copula *da*. The following example, in which the whole coordinate structure is clefted, is perfectly acceptable even though the morpheme *-to* is immediately followed by the copula *da*, just as in (48).

(i) Kanozyo-ga kurabe-te i-ru-no-wa [Kyoodai-to Toodai-to] da.
she-NOM compare-TE be-NPST-NMLZ-TOP Kyoto.U.-and Tokyo.U.-and COP
'It is Kyoto University and Tokyo University that she is comparing.'

[42]The CSC is known to be influenced by pragmatic factors (see, for example, Kehler (2002) for English and Kubota and Lee (2008) for Japanese for relevant discussion). Thus, if the unacceptability of (49) were to receive a pragmatic explanation, that would nullify this particular piece of argument against Fukui and Sakai (2003) based on CSC patterns. However, such a pragmatic account seems to be difficult to maintain in this particular case. Note first that the pragmatic accounts of the CSC in the literature deal specifically with the element constraint (i.e. the prohibition of extraction of an element *from* a conjunct) whereas the examples in (48) and (49) involve the conjunct constraint (i.e. the prohibition of extraction *of* a conjunct) of the CSC. This makes the possibility of a pragmatic account somewhat dubious. (Note further that, for English, the conjunct constraint is purely syntactic and inviolable. But for Japanese, at least in the form of conjunction considered here, it *is* violable at least in some cases, as exemplified by (48). This fact suggests that we are dealing here with a phenomenon for which the CSC—whether it is a syntactic constraint or a pragmatic one—is not relevant.) Second, what needs to be explained is the contrast in acceptability in the two cases (48) and (49)—one involving scrambling and the other involving clefting. However, given that both clefting and scrambling arguably involve assigning some information-structurally marked status to the displaced element, a pragmatic approach is not likely to be of any help, since, whatever other assumptions are made, it will most likely be predicted either that both sentences are felicitous or that both are infelicitous, which fails to explain the contrast in question. Thus, given the absence of any plausible pragmatic account, I take the relevant contrast to be syntactic in nature.

intended: '*It is Kyoto University$_i$ that she is comparing t_i and Tokyo University.'

The last argument against the approach of nonconstituent clefting by Fukui and Sakai (2003) involves topicalization of embedded clauses. The problem is that their analysis overgenerates sentences such as (50b).

(50) a. [Ken-ga Tookyoo-ni iru-no]$_i$-wa Mari-ga t_i sit-te i-ru.
Ken-NOM Tokyo-LOC be-NMLZ-TOP Mari-NOM know-TE PROG-NPST
'Mari knows that Ken is in Tokyo.'

b. * [Ken-ga iru-no]$_i$-wa Mari-ga [Tookyoo-ni t_i] sit-te i-ru.
Ken-NOM be-NMLZ-TOP Mari-NOM Tokyo-LOC know-TE PROG-NPST
intended: 'Mari knows that Ken is in Tokyo.'

As in (50a), topicalization of an embedded clause is possible in Japanese. (50b) is similar to (50a) except that the locative phrase of the embedded clause is scrambled and left stranded when the rest of the clause is topicalized. Since topicalization of a clause from which an element is scrambled out should be possible in Fukui and Sakai's (2003) analysis (in order to derive well-formed cleft sentences), it is not clear how sentences like (50b) are ruled out.

In sum, we have seen that all of the approaches to nonconstituent clefting reviewed in this section, that is, Koizumi (2000), Takano (2002) and Fukui and Sakai (2003), are empirically inadequate. Although the specific details are very different, these approaches have in common that they all introduce some syntactic movement operation(s) that distort the original constituent structure so that strings of words that are not constituents are reanalyzed as constituents. However, we have seen that, in each case, the introduction of such a movement operation gives rise to several undesirable consequences. At the purely descriptive level, the patterns of nonconstituent clefting in Japanese is fairly simple and systematic. Thus, the fact that none of the movement-based approaches considered above handles the problem successfully seems to suggest that an attempt to account for the relevant patterns in terms of syntactic movement is on the wrong track. In the next section, I will briefly discuss some possible alternative analyses of nonconstituent clefting that do not treat the elements in the focus position as syntactic constituents and show that such analyses are also inadequate. This brings us to the conclusion that the focused elements in nonconstituent clefting need to be recognized as constituents, but *not* by means of syntactic movement operations.

2.2.5 Other possible analyses in PS-based theories

The foregoing discussion implicitly assumes that the string of words that appears in the focus position forms a constituent. But one might doubt this assumption and instead propose a structure like the following in which the copula combines with the elements that appear in the focus position one by one:

(51)	Ken-ga	t_i t_j watasi-ta-no-wa	[sono	hon-o$_j$	[Mari-ni$_i$ da]].
	Ken-NOM	give-PAST-NMLZ-TOP	that	book-ACC	Mari-DAT COP

lit. 'It is this book to Mari that Ken gave.'

As compared to an analysis that treats the string *sono hon-o Mari-ni* as a constituent, this kind of alternative analysis has at least two problems. First, since the number of arguments and adjuncts that can appear in the focus position (and their order) is not fixed, it is not clear how the lexical entry for the copula can be specified so that it can mediate the combinatoric properties of the elements that appear in the focus position and the topicalized sentence. More specifically, the generalization governing the pattern of well-formed cleft sentences in Japanese (which distinguishes them from the ill-formed ones discussed in section 2.2.3) is that all the grammatical sentences have the property that, if the material that appears in the focus position were concatenated to the left of the topicalized sentence, that would yield a well-formed sentence. The analysis that I present in Chapter 4 directly captures this generalization by treating the whole material in the focus position as a single constituent that would correspond to the 'missing left periphery' of the topicalized sentence. (In such an analysis, working out the syntax-semantics interface will also be straightforward, as shown by Kubota and Smith (2006).) However, it is not clear how such a generalization can be captured in an alternative analysis along the lines sketched above.

Another obstacle for this kind of analysis comes from an interaction between nonconstituent coordination and nonconstituent clefting (Koizumi (2000) gives similar examples involving the *-to* coordination construction (cf. footnote 13) rather than nonconstituent coordination), such as the following:[43]

(52) a. [Ken-ga t_i t_j watasi-ta]-no-wa [[Mari-ni$_i$ kono hon-o$_j$] sosite
Ken-NOM give-PAST-NMLZ-TOP Mari-DAT this book-ACC and
[Rika-ni$_i$ ano hon-o$_j$]] da.
Rika-DAT that book-ACC COP
lit. 'It is this book to Mari and that book to Rika that Ken gave.'

b. [Ken-ga t_i t_j watasi-ta]-no-wa [[Mari-ni$_i$ kono hon-o$_j$]-de-wa-naku
Ken-NOM give-PAST-NMLZ-TOP Mari-DAT this book-ACC-DE-TOP-NEG
[Rika-ni$_i$ ano hon-o$_j$]] da.
Rika-DAT that book-ACC COP
lit. 'It is not this book to Mari but that book to Rika that Ken gave.'

In an analysis in which strings such as *Mari-ni kono hon-o* do not form constituents, it is not clear how to account for the fact that coordination of such strings can be formed in

[43]The expression *A-de-wa-naku B* translates as 'not A but B'; given the pragmatic function of the cleft construction, it is easier to imagine a context in which the sentence is felicitous for (52b) than for (52a), but that is orthogonal to the syntactic well-formedness of these examples.

the focus position of a cleft sentence. By contrast, the interaction between nonconstituent coordination and nonconstituent clefting exemplified above falls out straightforwardly in the analysis of the two constructions that I formulate in Chapter 4.

2.3 Complementation constructions

In this section, I review the morpho-syntactic properties of four kinds of **complementation constructions** in Japanese.[44] By complementation constructions, I mean the kinds of sentences in which the main verb semantically subcategorizes for some verbally-headed expression, where the morpho-syntactic realization of the embedded 'constituent' differs from one construction to another.

The following sentences exemplify the four constructions to be dealt with below.

(53) a. Mari-ga piano-o hiki-hazime-ta.
Mari-NOM piano-ACC play-begin-PAST
'Mari started playing the piano.'

b. Mari-ga Ken-ni [piano-o hii-te] morat-ta.
Mari-NOM Ken-DAT piano-ACC play-TE BENEF-PAST
'Mari had Ken play the piano for her.'

c. Mari-ga Ken-ni [piano-o hiku]-yooni tanon-da.
Mari-NOM Ken-DAT piano-ACC play-COMP ask-PAST
'Mari asked Ken to play the piano.'

d. Mari-ga Ken-ni [Akira-ga piano-o hii-ta]-to it-ta.
Mari-NOM Ken-DAT Akira-NOM piano-ACC play-PAST-COMP say-PAST
'Mari told Ken that Akira played the piano.'

[44] See Nakau (1973) for a detailed study of different kinds of complementation constructions in Japanese in the classical transformational framework.

Here, I just provide rough characterizations of the four constructions; the actual empirical data that support these characterizations and that provide evidence for the particular syntactic analyses I formulate in Chapter 4 will be given below. (53a) is an instance of the **compound verb** construction. In this construction, the embedded verb *hiki* 'play' forms a morphological cluster with the embedding verb *hazime* 'begin'. [45] The construction in (53b) is similar to (53a) except that there is less evidence for the morphological wordhood of the sequence of V1 and V2. The distinguishing characteristic of this construction is that the embedded verb is marked by the morpheme *-te* (with the allomorph *-de* in post-nasal environments). I call this construction the ***-te* form complex predicate** construction. [46] (53c) and (53d) represent cases for which there is clear evidence that an embedded VP or sentential complement is involved. I call the former the **VP complementation** construction and the latter the **sentential complementation** construction. The difference between the two is whether the embedded constituent realizes the subject overtly (i.e. the nominative NP *Akira-ga* in (53d)) and this difference correlates with a difference in the possibility of interclausal scrambling, as we will see below. In VP and sentential complementation constructions, different predicates require different markings on the embedded clause (or

[45]Throughout the rest of this dissertation, I call the embedded verb V1 and the embedding verb V2, given their linear order. (Since Japanese is a head final language, the embedded verb always precedes the embedding verb.) I adopt this terminology not just for compound verbs but for other kinds of complementation constructions as well.

[46]The set of verbs that take *-te* marked complements can be roughly classified into two types: benefactive predicates (such as *-te morau* 'have somebody V for the benefit of oneself', *-te kureru* 'V for the benefit of the speaker' and *-te yaru/ageru* 'V for the benefit of somebody else'), and modal/aspectual predicates (such as *-te iru* (progressive), *-te oku* (perfect) and *-te simau* (perfect)).

VP),[47] but the syntactic properties (at least the ones that we consider below) do not differ depending on the morphological marking.

These four constructions are representative of different kinds of complementation constructions in Japanese that exhibit different morpho-syntactic properties. As we will see, the four constructions can be considered to form a continuum with respect to the degree of tightness of the morpho-syntactic bond between V1 and V2, and, concomitantly, the degree to which the 'embedded constituent' headed by V1 has the status of a full-fledged clause. These two properties are inversely correlated: the tighter the morpho-syntactic bond between V1 and V2 is, the weaker the evidence is for the clausal status of the embedded constituent. Thus, sentential complementation, for which there is clear evidence for a full-fledged embedded clause, occupies one end of the continuum and the compound verb construction, for which there is clear evidence that the higher verb and the lower verb form a morphological cluster, occupies the other end. The two other constructions exhibit mixed properties and are located somewhere between the two ends, in a sense which we will make precise in due course.

Such a continuum poses an interesting challenge for PS-based theories of syntax, since PS-based theories draw a sharp distinction between morphological composition (which takes place in the lexicon) and phrasal composition (which takes place in the syntax). These respectively correspond to the two ends of the continuum, and, there is thus no straightforward way to capture different 'degrees' of flexibility of composition that lie between these

[47] Some examples (where the boldfaced parts are the complementizers (or markers) that the higher verb requires): *V-**to** omou* ('believe that … V'), *V-**no-o** siru* ('know that … V'), *V-**koto-o** meiziru* ('order (someone) to V'), *V-**yooni** tanomu* ('ask (someone) to V').

two ends within the PS-based setup. After reviewing the relevant data, I discuss the problems that these constructions pose for PS-based theories by first examining the most comprehensive and explicit previous analysis, namely, Matsumoto's (1996) proposal in LFG, and then by discussing the problem posed by the *-te* form complex predicate for PS-based theories somewhat more generally through an examination of possible analyses of it in two other PS-based theories, specifically, GB theory and HPSG.

2.3.1 Morpho-syntactic properties of complementation constructions

The following table summarizes the relevant empirical patterns. [48]

(54)

	CV	*-te* form	VPC	SC
leftward interclausal scrambling of embedded elements	✓	✓	✓	∗
scrambling of embedded clause with matrix elements	∗	∗	✓	✓
clefting of embedded clause/VP	∗	∗	✓	✓
nonconstituent coordination involving V1	∗	∗	✓	✓
coordination of VP headed by V1	∗	✓	✓	✓
focus particle between V1 and V2	∗	✓	✓	✓
reduplication of V2 alone	∗	✓	✓	✓

Roughly speaking, for any given construction, ✓ in the first row and ∗ in the other rows suggest a tight morphological bond between V1 and V2 and the corresponding lack of a syntactic clausal constituent headed by V1. Conversely, ∗ in the first row and ✓ in other

[48]CV, VPC and SC stand for 'compound verb', 'VP complementation' and 'sentential complementation', respectively. '✓' in a column means that the pattern in question is possible. '∗' means that the pattern results in ungrammaticality.

rows suggest the existence of a syntactic clausal constituent headed by V1 and the corresponding lack of tight morpho-syntactic bond between V1 and V2. From this table, we can see that the degree of 'clausality' of the embedded constituent is highest with sentential complementation and lowest with compound verbs. Correspondingly, the morpho-syntactic bond between the higher and lower predicates is tightest with compound verbs and loosest with sentential complementation. While the forces of the specific pieces of evidence differ, taken together, they form a reliable test set for probing into the syntactic properties of different kinds of complementation constructions.

2.3.1.1 Interclausal scrambling

Japanese allows for scrambling of arguments fairly freely within a single clause. Interclausal scrambling (i.e. scrambling of arguments and adjuncts of V1 with those of V2) is also allowed with all complementation constructions except for sentential complementation. The relevant data are given in (55); scrambling the accusative object *piano-o* of the embedded verb over the matrix dative argument *Ken-ni* results in ungrammaticality only in (55d).[49]

(55) a. Mari-ga *piano-o* hui-ni hiki-hazime-ta.
Mari-NOM piano-ACC suddenly play-begin-PAST
'Mari suddenly started playing the piano.'

b. Mari-ga *piano-o* Ken-ni hii-te morat-ta.
Mari-NOM piano-ACC Ken-DAT play-TE BENEF-PAST

[49] Strictly speaking, (55a) is not completely parallel to (55b)–(55d) since the embedded NP scrambles over an adjunct that modifies V2 rather than its argument. This is because all instances of compound verb constructions are either subject raising or subject control predicates and a parallel example (involving a matrix non-subject argument) cannot be constructed. However, the grammaticality of (55a) suffices to establish the relevant point that the compound verb construction allows for scrambling of arguments and adjuncts of V1 with those of V2 freely.

‘Mari had Ken play the piano for her.’

c. Mari-ga *piano-o*$_i$ Ken-ni [t_i hiku]-yooni tanon-da.
Mari-NOM piano-ACC Ken-DAT play-COMP ask-PAST
‘Mari asked Ken to play the piano.’

d. *Mari-ga *piano-o*$_i$ Ken-ni [Akira-ga t_i hii-ta]-to it-ta.
Mari-NOM piano-ACC Ken-DAT Akira-NOM play-PAST-COMP say-PAST
intended: ‘Mari told Ken that Akira played the piano.’

Essentially the same pattern is observed with adverb placement. The adverb *anpu-de* ‘without music’ in the examples in (56) semantically modifies the embedded verb. Scrambling this embedded adverb over the matrix dative argument *Ken-ni* results in ungrammaticality only in the case of sentential complementation (i.e. (56d)). [50]

(56) a. Mari-ga *anpu-de* hui-ni piano-o hiki-hazime-ta.
Mari-NOM without music suddenly piano-ACC play-begin-PAST
‘Mari suddenly started playing the piano without music.’

b. Mari-ga *anpu-de* Ken-ni piano-o hii-te morat-ta.
Mari-NOM without music Ken-DAT piano-ACC play-TE BENEF-PAST
‘Mari had Ken play the piano for her without music.’

c. Mari-ga *anpu-de*$_i$ Ken-ni [t_i piano-o hiku]-yooni tanon-da.
Mari-NOM without music Ken-DAT piano-ACC play-COMP ask-PAST
‘Mari asked Ken to play the piano without music.’

d. *Mari-ga *anpu-de*$_i$ Ken-ni [Akira-ga t_i piano-o
Mari-NOM without music Ken-DAT Akira-NOM piano-ACC
hii-ta]-to it-ta.
play-PAST-COMP say-PAST
intended: ‘Mari told Ken that Akira played the piano without music.’

[50] Again, (56a) is not completely parallel to the other examples. But this does not affect the main point for the same reason as above.

2.3.1.2 Scrambling of the embedded clause

The above pattern of leftward scrambling of arguments and adjuncts suggests a classification in which sentential complementation is treated as an exceptional case contrasting with the other three constructions that behave in parallel to one another. However, as can be seen from the table above, this pattern is somewhat anomalous and in all other cases sentential complementation and VP complementation behave in the same way, contrasting with the other two constructions (or with the compound verb construction alone). The first such case is scrambling of the 'embedded clause' with matrix arguments or adjuncts. As can be seen in (57) and (58), in the compound verb construction and the *-te* form complex predicate, the sequence of V1 and V2 cannot be split from one another by putting a matrix argument (as in (57)) or adjunct (as in (58)) between them, in sharp contrast to the VP and sentential complementation constructions for which such a word order is perfectly acceptable.[51]

(57) a. *Piano-o hiki *Mari-ga* hazime-ta.
piano-ACC play Mari-NOM begin-PAST
intended: 'Mari started playing the piano.'

b. *Mari-ga piano-o hii-te *Ken-ni* morat-ta.
Mari-NOM piano-ACC play-TE Ken-DAT BENEF-PAST
intended: 'Mari had Ken play the piano for her.'

c. Mari-ga [piano-o hiku]-yooni *Ken-ni* tanon-da.
Mari-NOM piano-ACC play-COMP Ken-DAT ask-PAST
'Mari asked Ken to play the piano.'

[51] Again, (57a) is not completely parallel to (57b)–(57d) in that the subject rather than the dative argument splits the sequence of V1 and V2, but this does not affect the main point.

d. Mari-ga [Akira-ga piano-o hii-ta]-to *Ken-ni* it-ta.
Mari-NOM Akira-NOM piano-ACC play-PAST-COMP Ken-DAT say-PAST
'Mari told Ken that Akira played the piano.'

(58) a. *Mari-ga piano-o hiki *hui-ni* hazime-ta.
Mari-NOM piano-ACC play suddenly begin-PAST
intended: 'Mari suddenly started playing the piano.'

b. *Mari-ga Ken-ni piano-o hii-te *murini* morat-ta.
Mari-NOM Ken-DAT piano-ACC play-TE forcibly BENEF-PAST
intended: 'Mari forcibly had Ken play the piano for her.'

c. Mari-ga Ken-ni [piano-o hiku]-yooni *murini* tanon-da.
Mari-NOM Ken-DAT piano-ACC play-COMP forcibly ask-PAST
'Mari forcibly asked Ken to play the piano.'

d. Mari-ga Ken-ni [Akira-ga piano-o hii-ta]-to *ukkari*
Mari-NOM Ken-DAT Akira-NOM piano-ACC play-PAST-COMP unthinkingly
it-ta.
say-PAST
'Mari unthinkingly told Ken that Akira played the piano.'

A further fact that should be noted about scrambling is that, in VP complementation, even though an embedded element can scramble leftward into the higher clause (as we have seen in the previous subsection) and even though the embedded VP can scramble with (matrix) arguments and adjuncts (as we have just seen), scrambling an embedded element to the right of the embedded clause results in ungrammatical sentences, as shown in (59) and (60) (descriptively speaking, this is so because of the head-finality of Japanese).

(59) *Mari-ga Ken-ni [t_i hiku]-yooni *piano-o*$_i$ tanon-da.
Mari-NOM Ken-DAT play-COMP piano-ACC ask-PAST
intended: 'Mari asked Ken to play the piano.'

(60) *Mari-ga Ken-ni [t_i piano-o hiku]-yooni *anpu-de*$_i$ tanon-da.
Mari-NOM Ken-DAT piano-ACC play-COMP without music ask-PAST
'Mari asked Ken to play the piano without music.'

As we will see below, this fact turns out to be important when accounting for the scrambling properties of VP complementation (and differentiating it properly from the behavior of sentential complementation).

2.3.1.3 The cleft construction

The cleft construction also suggests a tight morpho-syntactic bond between V1 and V2 in the compound verb construction and the *-te* form complex predicate as opposed to the other two constructions. The data in (61) show that it is possible to cleft the whole embedded VP or sentential complement in VP and sentential complementation constructions whereas the same pattern results in ungrammaticality with the compound verb construction and the *-te* form complex predicate. The ungrammaticality of the latter is due to the fact that the displacement of V1 in the focus position splits the sequence of V1 and V2.

(61) a. *[Mari-ga hazime-ta]-no-wa *sono hon-o* *yomi* da.
Mari-NOM begin-PAST-NMLZ-TOP that book-ACC read COP
intended: 'What Mari began to do was to read that book.'

b. *[Mari-ga Ken-ni morat-ta]-no-wa *sono hon-o* *yon-de* da.
Mari-NOM Ken-DAT BENEF-PAST-NMLZ-TOP that book-ACC read-TE COP
intended: lit. 'What Mari had Ken do for her was read that book.'

c. [Mari-ga Ken-ni tanon-da]-no-wa *sono hon-o* *yomu-yooni* da.
Mari-NOM Ken-DAT ask-PAST-NMLZ-TOP that book-ACC read-COMP COP
'What Mari asked Ken to do was to read that book.'

d. [Mari-ga Ken-ni it-ta]-no-wa *Akira-ga* *sono hon-o*
Mari-NOM Ken-DAT say-PAST-NMLZ-TOP Akira-NOM that book-ACC
yon-da-to da.
read-PAST-COMP COP
'What Mari told Ken was that Akira read that book.'

However, in both the compound verb construction and the *-te* form complex predicate, as long as the sequence of V1 and V2 is not split apart, multiple constituents can be clefted as shown by the following examples (examples parallel to these are also grammatical in the other two constructions):

(62) a. [Mari-ga okuri-oe-ta]-no-wa *sidoo kyookan-ni hakuron-o* da.
Mari-NOM send-finish-PAST-NMLZ-TOP supervisor-DAT thesis-ACC COP
lit. 'What Mari finished sending was her thesis to her supervisor.'

b. [Ken-ga yon-de morat-ta]-no-wa Mari-ni *sono hon-o* da.
Ken-NOM read-TE BENEF-PAST-NMLZ-TOP Mari-DAT that book-ACC COP
lit. 'What Ken had read for him was Mari that book.'

2.3.1.4 Nonconstituent coordination

The patterns of nonconstituent coordination are consistent with the phenomena that we have seen above in that the *-te* form complex predicate behaves like the compound verb construction. That is, as shown in the contrast in acceptability between (63a,b) and (64a,b), in the compound verb construction and the *-te* form complex predicate, nonconstituent coordination in which the cluster of V1 and V2 form a pivot (i.e. the rightmost material shared by the conjuncts) is grammatical whereas V2 alone cannot serve as the pivot. This pattern contrasts with the behavior of VP and sentential complementation for which V2 alone can serve as the pivot of nonconstituent coordination, as can be seen in (64c,d).

(63) a. [Ken-ga piano-o], (sosite) [Akira-ga gitaa-o] hiki-hazime-ta.
Ken-NOM piano-ACC and Akira-NOM guitar-ACC play-begin-PAST
'Ken started playing the piano and Akira started playing the guitar.'

b. Mari-ga [Ken-ni piano-o], (sosite) [Akira-ni gitaa-o] hii-te
Mari-NOM Ken-DAT piano-ACC and Akira-DAT guitar-ACC play-TE
morat-ta.
BENEF-PAST
'Mari had Ken play the piano and Akira play the guitar for her.'

c. Mari-ga [Ken-ni piano-o], (sosite) [Akira-ni gitaa-o] hiku-yooni
Mari-NOM Ken-DAT piano-ACC and Akira-DAT guitar-ACC play-COMP
tanon-da.
ask-PAST
'Mari asked Ken to play the piano and Akira to play the guitar.'

d. Mari-ga [Tomoko-ni Ken-ga piano-o], (sosite) [Kumiko-ni
Mari-NOM Tomoko-DAT Ken-NOM piano-ACC and Kumiko-DAT
Akira-ga gitaa-o] hii-ta-to it-ta.
Akira-NOM guitar-ACC play-PAST-COMP say-PAST
'Mari told Tomoko that Ken played the piano and told Kumiko that Akira played the guitar.'

(64) a. *[Ken-ga piano-o hiki], (sosite) [Akira-ga uta-o utai]-oe-ta.
Ken-NOM piano-ACC play and Akira-NOM song-ACC sing-finish-PAST
intended: 'Ken finished playing the piano and Akira finished singing a song.'

b. *Mari-ga [Ken-ni piano-o hii-te], (sosite) [Akira-ni uta-o utat-te]
Mari-NOM Ken-DAT piano-ACC play-TE and Akira-DAT song-ACC sing-TE
morat-ta.
BENEF-PAST
intended: 'Mari had Ken play the piano for her and Akira sing a song for her.'

c. Mari-ga [Ken-ni piano-o hiku-yooni], (sosite) [Akira-ni uta-o
Mari-NOM Ken-DAT piano-ACC play-COMP and Akira-DAT song-ACC
utau-yooni] tanon-da.
sing-COMP ask-PAST
'Mari asked Ken to play the piano and Akira to sing a song.'

d. Mari-ga Tomoko-ni [Ken-ga piano-o hii-ta]-to, sosite
Mari-NOM Tomoko-DAT Ken-NOM piano-ACC play-PAST-COMP and
Kumiko-ni [Akira-ni uta-o utat-ta]-to it-ta.
Kumiko-DAT Akira-NOM song-ACC sing-PAST-COMP say-PAST
'Mari told Tomoko that Ken played the piano and told Kumiko that Akira sang a song.'

This contrast, again, suggests that V1 and V2 form a morphological cluster in the former two (but not in the latter two) constructions.

2.3.1.5 Embedded VP coordination

The phenomena we have examined above all suggest that the *-te* form complex predicate has a structure similar to compound verbs in that V1 and V2 form a morphological cluster. However, there are also phenomena that go against this generalization. The pattern of embedded VP coordination is one such case.[52] As in (65c) and (65d), it is possible to coordinate embedded VPs or clauses in the VP and sentential complementation constructions. By contrast, as in (65a), a corresponding example with the compound verb construction results in ungrammaticality. Now, it turns out (perhaps somewhat surprisingly)

[52] I use here disjunctive coordination with *matawa* 'or' in order to avoid an issue that arises with simple coordination involving the *-te* form. That is, with the *-te* form, due to the accidental homophony of the marker for the *-te* form complex predicate and the marker *-te* for clausal coordination, when two clauses ending with the morpheme *-te* are juxtaposed, it becomes impossible to distinguish which form of *-te* is involved in the first conjunct.

that embedded VP coordination is possible in the *-te* form complex predicate, as shown in (65b).

(65) a. *Dono gakusei-mo [piano-o hiki] matawa [uta-o utai]-oe-ta.
which student-also piano-ACC play or song-ACC sing-finish-PAST
intended: 'Every student finished playing the piano or singing a song.'

b. Mari-ga dono gakusei-ni-mo [piano-o hii-te] matawa [uta-o
Mari-NOM which student-DAT-also piano-ACC play-TE or song-ACC
utat-te] morat-ta.
sing-TE BENEF-PAST
'Mari had every student play the piano or sing a song for her.'

c. Mari-ga dono gakusei-ni-mo [piano-o hiku-yooni] matawa [uta-o
Mari-NOM which student-DAT-also piano-ACC play-COMP or song-ACC
utau]-yooni tanon-da.
sing-COMP ask-PAST
'Mari asked every student to play the piano or sing a song.'

d. Mari-ga dono gakusei-ni-mo [Ken-ga piano-o hii-ta]-to
Mari-NOM which student-DAT-also Ken-NOM piano-ACC play-PAST-COMP
matawa [Akira-ga uta-o utat-ta]-to it-ta.
or Akira-NOM song-ACC sing-PAST-COMP tell-PAST
'Mari told every student either that Ken played the piano or that Akira sang a song.'

The pattern we see here is different from the other cases we have seen above in that the *-te* form now behaves in line with VP and sentential complementation rather than with compound verbs. This means that the *-te* form complex predicate cannot simply be analyzed in the same way as compound verbs, that is, morphologically complex but syntactically monoclausal predicates. In what follows, we will see more phenomena that pattern in the same way as VP coordination.

2.3.1.6 Focus particle insertion

Focus particles are generally known to be unable to appear inside a word boundary in Japanese (cf., e.g., Kageyama 1993). In particular, as shown in (66a), they cannot split the sequence of V1 and V2 in the compound verb construction. However, (66b) shows that the *-te* form complex predicate behaves differently from the compound verb construction and patterns like the VP and sentential complementation constructions (as in (66c) and (66d)) in allowing focus particles to appear between V1 and V2.

(66) a. *Ken-wa piano-o hiki-*sae*-hazime-ta.
Ken-TOP piano-ACC play-even-begin-PAST
intended: 'Ken started to even play the piano.'

b. Mari-ga Ken-ni piano-o hii-te-*sae* morat-ta.
Mari-NOM Ken-DAT piano-ACC play-TE-even BENEF-PAST
'Mari asked Ken even the favor of playing the piano for me.'

c. Mari-ga Ken-ni piano-o hiku-yooni-*sae* tanon-da.
Mari-NOM Ken-DAT piano-ACC play-COMP-*even* ask-PAST
'Mari asked Ken even to play the piano.'

d. Mari-ga Akira-ni Ken-ga piano-o hii-ta-to-*sae* it-ta.
Mari-NOM Akira-DAT Ken-NOM piano-ACC play-PAST-COMP-even say-PAST
'Mari told Akira even that Ken play the piano.'

2.3.1.7 Reduplication

The patterns of reduplication are similar. Generally, targets of reduplication are restricted to full-fledged words (again, see, e.g., Kageyama 1993 for some discussion). Indeed, as shown in (67a), reduplication of V2 alone is not possible in the compound verb construction. This is not surprising given the tight morpho-syntactic bond between V1 and

V2 in this construction. What is surprising is that the *-te* form (67b) once again behaves like VP and sentential complementation constructions (67c,d) in this respect, allowing for reduplication of V2 alone.

(67) a. *Ken-ga piano-o hiki-hazime-ta koto-wa hazime-ta ga, ...
Ken-NOM piano-ACC play-begin-PAST begin-PAST though
intended: 'Though Ken did started to play the piano, ...'

b. Mari-ga Ken-ni piano-o hii-te morat-ta koto-wa morat-ta
Mari-NOM Ken-DAT piano-ACC play-TE BENEF-PAST BENEF-PAST
ga, ...
though
'Though Mari did have Ken play the piano for her, ...'

c. Mari-ga Ken-ni piano-o hiku-yooni tanon-da koto-wa tanon-da
Mari-NOM Ken-DAT piano-ACC play-COMP ask-PAST ask-PAST
ga, ...
though
'Though Mari did ask Ken to play the piano, ...'

d. Mari-ga Akira-ni Ken-ga piano-o hii-ta-to it-ta
Mari-NOM Akira-DAT Ken-NOM piano-ACC play-PAST-COMP tell-PAST
koto-wa it-ta ga, ...
tell-PAST though
'Though Mari did tell Akira that Ken played the piano, ...'

To summarize the empirical patterns reviewed in this section, sentential complementation and compound verbs consistently contrast with one another in that all of the evidence suggests that the former involves a full-fledged embedded clause while the latter involves morphological clustering of V1 and V2. VP complementation exhibits a pattern that is identical to sentential complementation except that interclausal scrambling is allowed, which makes the boundary between matrix and embedded clauses in this construction somewhat obscure as compared to sentential complementation. The *-te* form complex predicate is the most problematic construction in that it exhibits an apparently contradictory distributional properties: for some of the tests it behaves like compound verbs, suggesting a tight morpho-syntactic bond between V1 and V2, whereas for other tests it behaves like VP and sentential complementation, suggesting a structure in which V1 projects its own phrasal constituent.

2.3.2 Previous analyses

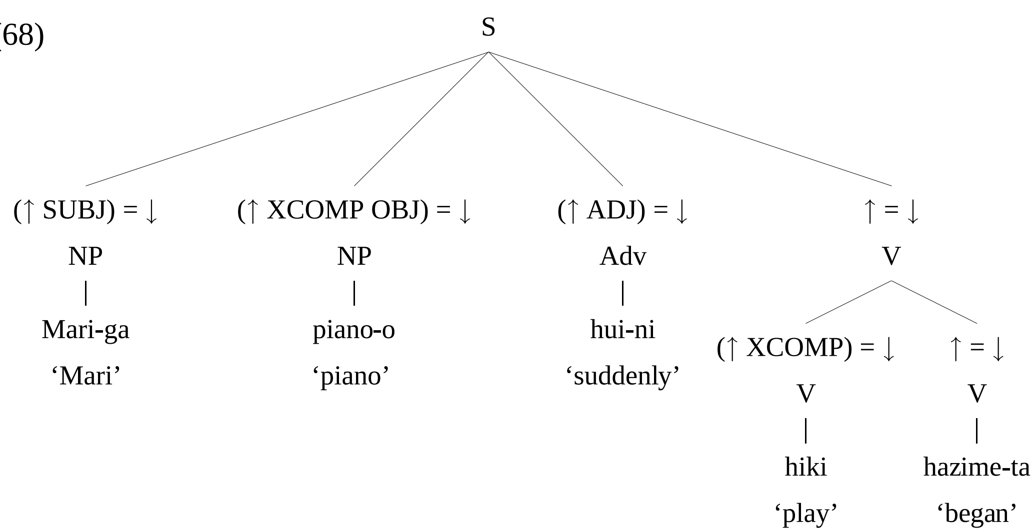
In this section, I first review Matsumoto's (1996) analysis of the complementation constructions in LFG, which, given the degree of explicitness and the breadth of empirical coverage, can be regarded as a representative analysis of the complementation constructions in Japanese within PS-based approaches. As we will see, Matsumoto's analysis captures many of the important properties of these constructions in an attractively simple and uniform manner. However, a closer examination of his approach reveals some fundamental limitations of PS-based theories in accounting for the relevant empirical facts. After reviewing Matsumoto's analysis of the whole range of constructions, I examine the issue from a somewhat different angle. That is, rather than focusing on one specific analysis, I focus on one specific construction, namely, the *-te* form complex predicate, and examine possible analyses in a wider range of PS-based theories, specifically, GB theory and HPSG. This latter discussion will make it clear that it is not the particular idiosyncrasies of Matsumoto's approach (or of LFG) that prevents a successful analysis of the empirical problem under consideration, but that the problem has to do with some more fundamental limitation that all PS-based theories share.

2.3.2.1 Matsumoto's (1996) analysis of complementation constructions

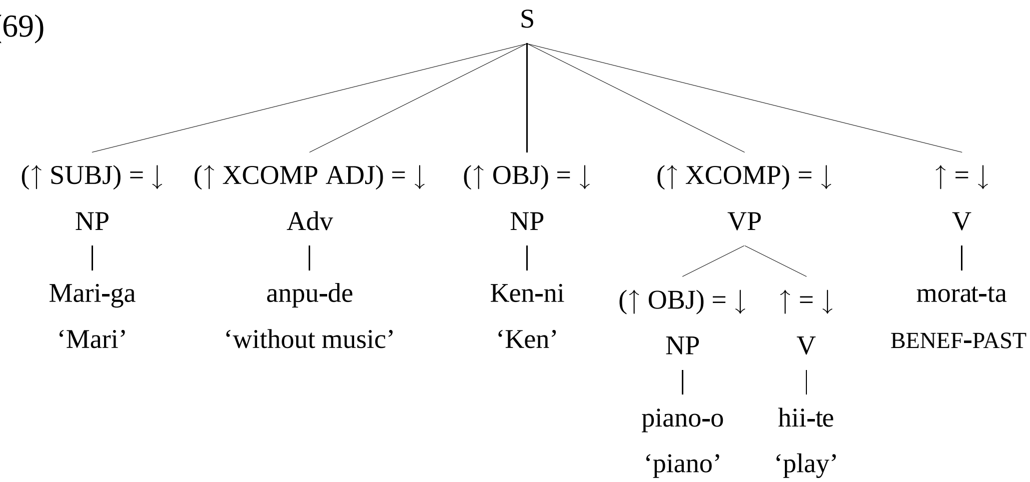
Matsumoto's (1996) analysis of complementation constructions is formulated in the framework of Lexical Functional Grammar (LFG) (Kaplan and Bresnan 1982). A notable feature of his analysis is that it exploits the different levels of grammatical representation available in LFG in capturing the relevant linguistic generalizations. Specifically, since the (semantically oriented) predicate-argument structure is represented at f-structure in LFG, the constituent structure (which is represented at c-structure in LFG) is simplified considerably, having minimum structures that more or less directly reflect surface morpho-syntactic properties. This makes it possible to analyze interclausal scrambling of embedded arguments and adjuncts with matrix elements in compound verbs, the *-te* form and VP complementation by means of a uniform mechanism known as **functional uncertainty** (Kaplan and Zaenen 1989), a technique originally introduced in LFG for the treatment of long-distance dependencies.

The following pictures illustrate Matsumoto's (1996) analysis. (68) and (69) are the c-structures assigned to the compound verb construction and the *-te* form complex predicate, respectively.

(68)



(69)



In (68), the accusative NP *piano-o* 'piano' is semantically an argument of V1 *hiki* 'play' rather than V2 *hazime* 'begin'. In Matsumoto's analysis, this fact is captured by the mechanism of functional uncertainty, which allows for a nonlocal mode of mapping from c-structure to f-structure. Specifically, the annotation (↑ XCOMP OBJ) = ↓ on this accusative NP says that its f-structure is identified with the value of the OBJ slot of the XCOMP ('open', i.e., subjectless, complement) of the local head. Since the local head is V2 and its XCOMP is V1, this means that the accusative NP fills in the embedded object slot at f-structure, which in turn is further mapped onto a semantically interpretable structure. In (69), the adverb *anpu-de* 'without music' is similarly mapped to the f-structure of the embedded verb, again via functional uncertainty, despite the fact that it is syntactically a sister of V2. Thus, the fact that this adverb semantically modifies V1 rather than V2 is correctly accounted for.

The difference between compound verbs on the one hand and other complementation constructions on the other can be captured in this setup by assuming that the higher and lower verbs in (68) are combined in the lexicon (or via a morphological process) rather than in the syntax.[53] This explains the fact that the compound verb construction does not undergo any of the syntactic operations available for VP and sentential complementation.

Thus, Matsumoto's analysis exploits the multi-dimensional architecture of LFG wherein the predicate-argument structure is dissociated from surface constituent structure to achieve a simple and uniform treatment of complementation constructions in Japanese. The separation of predicate-argument structure from the surface constituent structure is in some sense similar in spirit to the architecture of the theory I will develop in Chapter 3. However, as Matsumoto's analysis is couched in LFG, it crucially recognizes the c-structure as a theoretically significant level of representation, and, for this reason, it is not perfectly suitable for analyzing the different morpho-syntactic properties of the four constructions in question. As should be clear from the discussion of the empirical generalizations from the previous subsection, these constructions exhibit different 'degrees' of morpho-syntactic flexibility, which calls for a more fine-grained treatment than is available by simply separating predicate-argument structure from surface syntax within the PS-based setup.

The problem becomes most evident in the treatment of the *-te* form complex predicate. In order to differentiate it from the compound verb construction (especially, to account for the possibility of embedded VP coordination), one needs to assume a c-structure along the lines of (69) in which V1 projects its own VP in the syntax (rather than forming a morphological cluster with V2). However, this makes it difficult to account for those phenomena for which the *-te* form behaves in line with the compound verb construction. While interclausal scrambling can be dealt with in terms of functional uncertainty as explained above,

[53]The representation in (68) where V1 and V2 seem to occupy independent syntactic nodes makes this point somewhat obscure and Matsumoto (1996) does not make his position regarding this point entirely clear. However, if the two verbs were not combined in the lexicon, the contrast between the compound verb construction and other constructions would fails to be explained (unless one were to introduce additional assumptions about syntactic constituency and word order).

the impossibility of nonconstituent coordination involving V1 and clefting of embedded VP does not follow from anything if V1 and V2 occupy independent nodes in the syntax and the ungrammaticality of the examples involving these constructions (i.e. (61b) and (64b)) can at best be ruled out by means of *ad hoc* stipulations.

Similarly, the contrast among sentential complementation, VP complementation and the *-te* form in terms of the scrambling properties is also difficult to account for. Matsumoto proposes to draw a line between sentential complementation on the one hand and VP complementation and the *-te* form on the other. The fact that the latter two constructions but not the former allow for interclausal scrambling is accounted for by assuming that functional uncertainty is available only for cases involving embedding of XCOMP (XCOMPs are embedded predicates whose subjects are not overtly realized). This, however, still leaves unexplained the contrast between VP complementation and the *-te* form complex predicate such that only the former allows for (matrix) arguments and adjuncts to split the sequence of V1 and V2. Matsumoto suggests ruling out the impossible word order for the *-te* form (e.g. (57b) and (58b)) by stipulating a linear order constraint to the effect that all (non-verbal) arguments and adjuncts precede verbal complements. This constraint, however, is too strong for VP complementation, given examples such as (57c) and (58c). Matsumoto is aware of this fact and suggests the possibility that the linear order constraint in question can be overridden in some cases to rule in such examples. However, it is not entirely clear how to characterize the relevant condition under which the linear order constraint can be overridden so as to rule in examples like (57c) and (58c) while at the same time ruling out those like (59) and (60) (such an attempt seems to require formulating a linear order constraint that makes reference to the original head-argument relationships between NPs and verbs). In any event, Matsumoto leaves this problem unresolved and it remains unclear how the entire range of scrambling patterns exhibited by the different kinds of complementation constructions is accounted for in his approach.

2.3.2.2 Analyses of the *-te* form complex predicate in other PS-based theories

We have seen above that Matsumoto's (1996) analysis, while capturing many important properties of complementation constructions in Japanese in a simple and uniform manner, is not entirely successful. In this section, I continue my critical examination of approaches to complementation constructions within PS-based theories, taking a somewhat different angle. Having reviewed the limitations of the most comprehensive and explicit proposal in the literature, we now need to examine to what extent the problems identified above for Matsumoto's approach is general. That is, the question is whether the failure of Matsumoto's analysis is due to some idiosyncratic assumption of his particular proposal (or some theory-internal assumption in LFG) or is instead due to some fundamental assumption that all PS-based theories share. I will argue in this section that the problem is essentially of the latter character. For this purpose, I examine some previously proposed and theoretically conceivable analyses of the *-te* form complex predicate in other PS-based theories, specifically, GB theory and HPSG.[54] Considering and comparing multiple approaches to the same construction helps clarify the fundamental nature of the problem: in PS-based theories, there is simply no completely successful way of resolving the conflict between

[54]The reason that I focus on the *-te* form in this section is to keep the discussion short. This does not affect the main conclusion, since the failure (or a nearly insurmountable difficulty) in accounting for one of the four constructions is sufficient to establish that the approach in question is not a plausible candidate for a comprehensive treatment of the whole range of data.

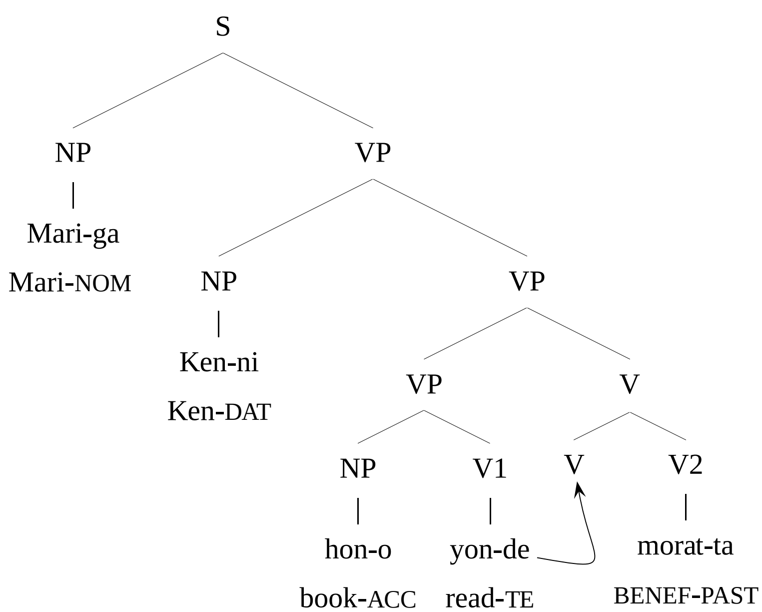
The problematic nature of the *-te* form complex predicate has long been known in the literature of Japanese generative grammar. See, e.g., Shibatani (1978), McCawley and Momoi (1986), Sells (1990) and Kageyama (1993).

the two opposing sets of distributional properties of the *-te* form complex predicate, since the phrase structures that these sets of data suggest are mutually inconsistent.

Head movement analysis in GB theory

Kageyama (1993) sketches an analysis of the *-te* form complex predicate within GB theory in terms of **head movement** (or, more specifically, 'verb incorporation' in the sense of Baker (1988)). In his suggested analysis (which is not worked out in full detail), the duality of the *-te* form is captured by means of rule ordering. That is, Kageyama assumes a biclausal deep structure for this construction and further introduces a head movement operation that raises V1 from its base position to a position where it adjoins to V2 to form a morphological cluster as in (70):

(70)

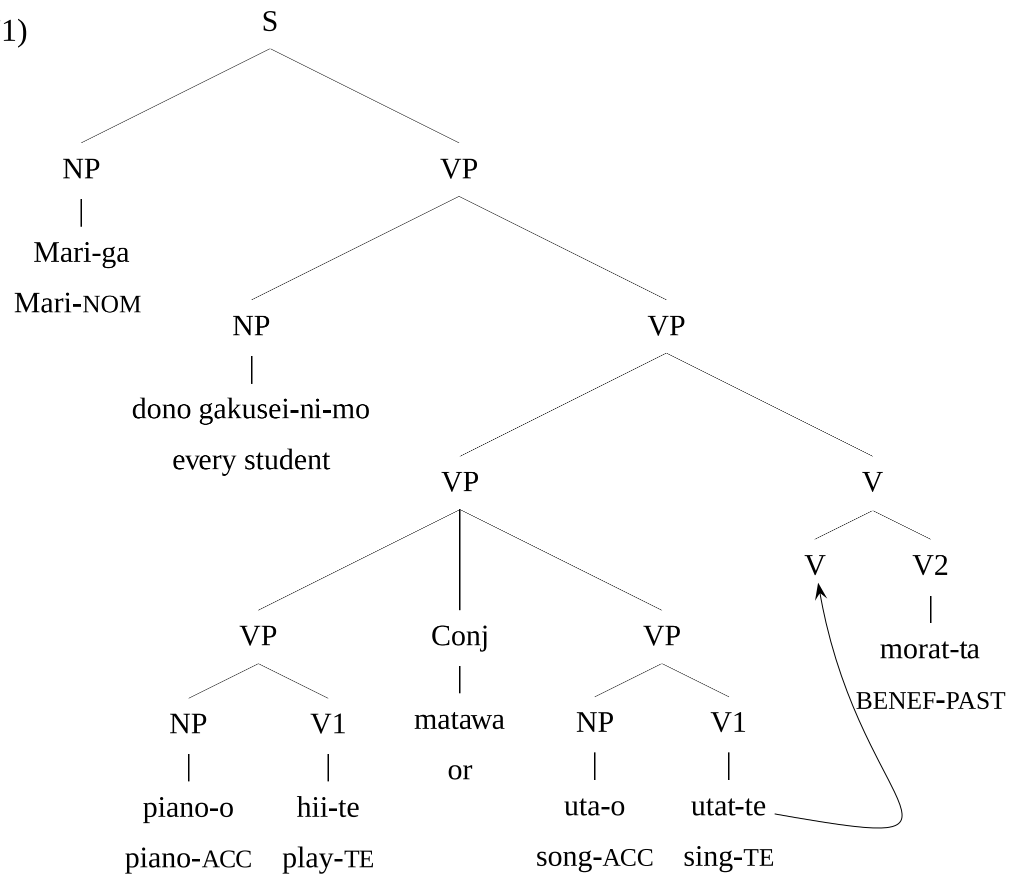


In this analysis, phenomena for which the *-te* form behaves as if it had a complex embedded structure are sensitive to the structure before the head movement takes place and phenomena for which V1 and V2 behave like a lexical unit are sensitive to the structure after the head movement.

Kageyama's analysis is in effect an attempt, within a transformational framework, to reconcile the two conflicting structures that different sets of data call for by positing them at different stages of derivation and relating them by a movement operation. The analysis seems to account for the puzzling property of this construction quite nicely. However, upon closer inspection, it turns out that this approach runs into problems in regulating the interactions of relevant movement operations properly. I point out two problems for Kageyama's analysis below.

The first problem comes from embedded VP coordination. In Kageyama's analysis, the fact that arguments and adjuncts cannot split the sequence of V1 and V2 is accounted for by assuming that the head movement operation is obligatory in the *-te* form complex predicate construction and that, once the head movement operation takes place, the unit of V1 and V2 forms a morphologically inseparable cluster. Given this, V1 of the final conjunct alone has to move to adjoin to V2 in a structure involving embedded VP coordination in order to satisfy the requirement of obligatory head movement. Thus, the structure for (65b) will look like the following:

(71)



This movement operation is somewhat dubious since it violates the Coordinate Structure Constraint (CSC); an element (i.e. V1) is moved out of the second conjunct alone.[55] This

---

[55]Note that scrambling of arguments out of coordinate structures obeys the CSC (and the ATB exception to it), as illustrated by the following examples from Sells (1990, 326):

(i) a. * Taroo-wa *daidokoro-o*$_i$ Tanaka-san-ni [$_{\mathrm{VP}}$[$_{\mathrm{VP}}$ t_i soozi-si-te] [$_{\mathrm{VP}}$ kaet-te]]
Taro-TOP kitchen-ACC Tanaka-HON-DAT clean-do-TE go.home-TE
morat-ta.
BENEF-PAST
intended: ‘Taro had Tanaka clean the kitchen and go home.’

b. Taroo-wa *zitensya-o*$_i$ Tanaka-san-ni [$_{\mathrm{VP}}$[$_{\mathrm{VP}}$ t_i syuuzen-si-te] [$_{\mathrm{VP}}$ t_i ut-te]] morat-ta.
Taro-TOP bike-ACC Tanaka-HON-DAT repair-do-TE sell-TE BENEF-PAST
‘Taro had Tanaka repair and sell the bike.’

itself, however, is not a knockdown argument, since the CSC might be a pragmatically-oriented principle rather than a syntactic constraint, as argued, for example, by Lakoff (1986) and Kehler (2002) for English and Kubota and Lee (2008) for Japanese. If one accepts this pragmatically-oriented view of the CSC, there should not be any problem with the syntactic structure of (71), and, moreover, since the verb raising in (71) is a purely syntactic operation having no pragmatic effect, no pragmatic infelicity would result either. Hence, there would be no problem at all with the head movement in (71).

Even so, the assumption that embedded VP coordination involves the structure given in (71) is problematic since it incorrectly predicts that sentences like the following are also acceptable:

(72) *Mari-ga dono gakusei-ni-mo [piano-o t_i] matawa [uta-o utat-te] hii-te$_i$ morat-ta.
Mari-NOM which student-DAT-also piano-ACC or song-ACC sing-TE play-TE BENEF-PAST
intended: 'Mari had every student either play the piano or sing a song for her.'

In coordinate structures, the two conjuncts have exactly the same syntactic status. But then, if movement of V1 out of the second conjunct alone satisfies the requirement of obligatory head movement as in (71), the movement of V1 out of the first conjunct alone should be able to do so as well. However, as shown in (72), this is not the case. I do not see any principled way to rule out (72) while at the same time maintaining the analysis of embedded VP coordination (65b) along the lines of (71).

The second problem for Kageyama's analysis is that it fails to account for a pattern of reduplication available when the *-te* form complex predicate is embedded under another predicate.

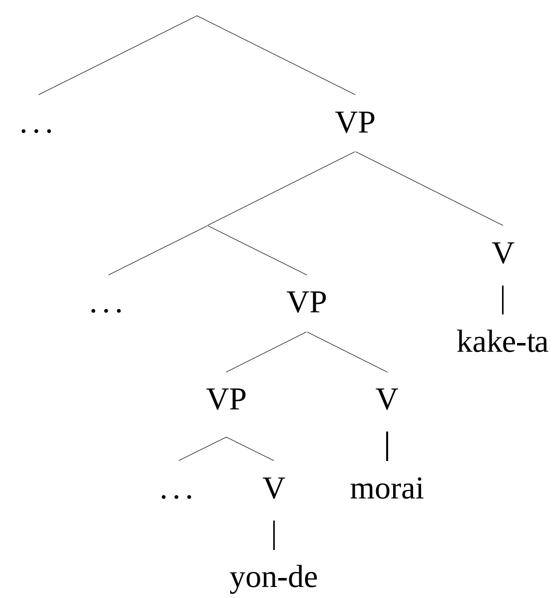
(73) a. Taroo-wa Hanako-ni sono hon-o yon-de morai-kake-ta koto-wa
Taroo-TOP Hanako-DAT that book-ACC read-TE BENEF-begin-PAST
morai-kake-ta ga, . . .
BENEF-begin-PAST though
'Although Taro did start having Hanako read the book for him, . . . '

b. *Taroo-wa Hanako-ni sono hon-o yon-de morai-kake-ta koto-wa
Taroo-TOP Hanako-DAT that book-ACC read-TE BENEF-begin-PAST
kake-ta ga, . . .
begin-PAST though
intended: 'Although Taro did start having Hanako read the book for him, . . . '

Here, the predicate *yon-de morai* (whose V1 is marked by (an allomorph of) -*te*) forms part of the compound verb whose embedding verb is *kake* 'begin'. As can be seen in (73), reduplicating the highest verb alone is ungrammatical (intuitively, this makes sense since *V-kake* is a compound verb construction) but reduplicating the sequence *morai-kake-ta*, leaving out the most embedded verb *yon-de*, is grammatical (intuitively, this also makes sense given that V2 alone can be reduplicated in the -*te* form complex predicate).

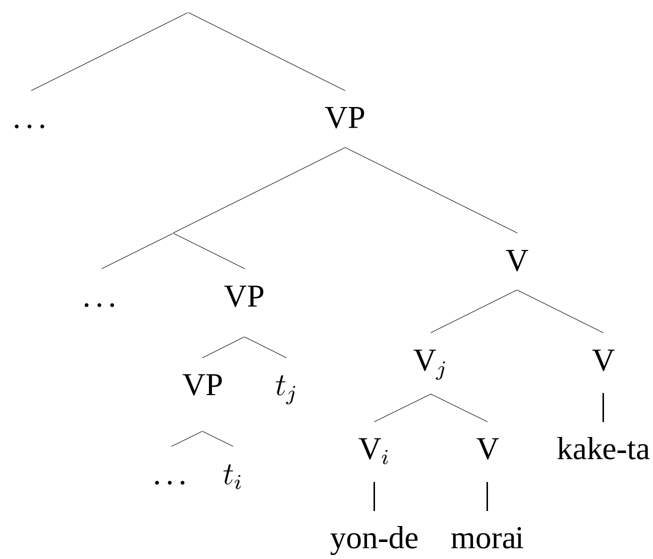
In Kageyama's analysis, the deep structure for (73a,b) is something like the following:

(74)



Now, assuming that verb raising (which is obligatory both in the compound verb construction and the *-te* form complex predicate) applies cyclically from the lower to higher clauses, and assuming that a verb cluster that is formed by means of verb raising always functions as a syntactic unit (which is a crucial assumption in Kageyama's analysis for explaining the morpho-syntactic inseparability of complex predicates), the grammaticality of the reduplication pattern in (73a) is inexplicable. This is so because, at the point that the reduplication process applies in the matrix clause, verb raising has already taken place cyclically to form a verb cluster involving all of the three verbs, as shown in (75):

(75)



Crucially, due to the cyclicity of verb raising, there is no step in the derivation at which the two higher verbs alone form a verb cluster. But then, the only possible reduplication pattern predicted to be possible for sentences like (73) is to reduplicate the whole verb cluster (which, by the way, is also a grammatical pattern), contrary to fact.

Argument composition approach in HPSG

A number of analyses of complex predicates have been proposed in the HPSG literature, building on the idea of **argument composition** (Hinrichs and Nakazawa 1994). Thus, it is worthwhile to consider whether a plausible analysis of the *-te* form complex predicate can be formulated along these lines.

Chung (1998) analyzes a certain type of complex predicate construction in Korean that has similar properties to the *-te* form complex predicate by adopting a version of the argument composition approach. In his analysis, two schemas (HPSG counterparts of PS rules) are posited for combining a head with its arguments: the ordinary head-complement schema and the head-governee schema. The former is used to discharge nominal arguments of the head verb and the latter is used for combining the head verb with a verbal complement, where all the undischarged arguments of the governee daughter are passed on to the head (i.e. this schema is specifically tailored for complex predicate formation). A feature that distinguishes Chung's analysis from argument composition-based analyses of complex predicates in other languages (such as Hinrichs and Nakazawa's (1994) work on German) is that the governee daughter of the head-governee schema is allowed to be nonlexical (i.e. it can have some of its arguments discharged by itself before combining with the governing verb). In other words, just like Matsumoto's (1996) LFG analysis, arguments of V1 can be syntactically realized either as a sister of V1 or of V2, allowing for multiple possible structures in many cases. An analysis of the *-te* form complex predicate along the lines of this approach can account for scrambling, VP coordination and focus particle insertion facts in much the same way as in Matsumoto's analysis. This analysis essentially treats the *-te* form as a kind of syntactic complementation on a par with sentential/VP complementation as opposed to the compound verb construction. It is similar to Matsumoto's analysis in this respect as well, and, for this reason, it shares some of the same problems as Matsumoto's analysis. Specifically, given that V1 projects its own VP in the syntax, the impossibility of nonconstituent coordination involving V1 and clefting of embedded VP can at best be ruled out by means of some extra stipulation.

2.3.3 Summary

In this section, we have examined some possible analyses of complementation constructions in Japanese in PS-based theories. As should be clear from the above discussion, the fact that these constructions coexist within a single language poses a significant challenge for PS-based theories of syntax. Descriptively speaking, these four constructions can be considered to form a continuum in the degree of flexibility in surface constituency, but the PS-based setup is not fine-grained enough for capturing such a generalization. This is the main reason that Matsumoto's (1996) analysis, while effectively making use of the multi-dimensional architecture of LFG in capturing a certain subset of the relevant facts in a simple and uniform manner, is not completely successful in accounting for the whole range of data: in particular, some of the behaviors of the *-te* form complex predicate and the scrambling properties of the VP complementation construction remain unaccounted for in his analysis. Other kinds of PS-based theories such as GB theory and HPSG are equipped with other kinds of analytic techniques (head movement for the former and argument composition for the latter) for coping with the mismatch between predicate-argument structure and surface morpho-syntax found in some of the complementation constructions, but neither of these techniques provides a sufficiently general solution, failing to account for the problematic 'dual' nature of the *-te* form complex predicate.

CHAPTER 3: MULTI-MODAL CATEGORIAL GRAMMAR WITH STRUCTURED PHONOLOGY

When CG is viewed as a linguistic theory, there are two important analytic ideas associated with it that distinguish it from other, more standard theories of syntax. The first is what one might call 'flexibility of constituency', an ability to assign constituent statuses to strings of words that do not form constituents in the standard sense. The second is the separation of semantically-oriented combinatorics from surface-oriented morpho-syntax. Along with related recent variants of CG, the theory that I propose in this dissertation, which I call **Multi-Modal Categorial Grammar with Structured Phonology**, can be thought of as a synthesis of these ideas, which, as it turns out, have been developed somewhat independently in the literature of CG in the past. What distinguishes the present theory from its alternatives is that it achieves this synthesis by explicitly recognizing a distinct component of grammar (which I call **structured phonology**) mediating between 'syntax proper' and phonology. The proposed theory builds on and borrows many ideas from previous research in CG, especially, several variants of Multi-Modal Type-Logical Grammar (MMTLG) (Morrill 1994; Moortgat 1997; Bernardi 2002) for some (but not all) of its logical and conceptual underpinnings and Combinatory Categorial Grammar (CCG) (Steedman 2000b; Baldridge 2002; Steedman and Baldridge 2007) for linguistic applications of certain analytical techniques. In this chapter, I will first present the theory in detail, and then briefly compare it with related approaches, clarifying the differences and similarities between the present proposal and its alternatives; I argue that positing the level of structured phonology leads to an architecture of grammar that is conceptually clearer than alternative approaches.

Before presenting the theory in detail, I will first clarify what I mean by 'synthesis' of 'two ideas' (from the literature of CG). One of the most notable features of CG when it is viewed as a theory of natural language syntax is that it often entertains a considerably more flexible notion of syntactic constituency than other, more standard, syntactic theories. As demonstrated by previous authors (cf., e.g., Ades and Steedman (1982), Steedman (1985) and Dowty (1988)), introducing such flexibility enables elegant analyses of important linguistic phenomena such as long-distance extraction, 'verb raising' in complex predicate constructions, and nonconstituent coordination. I call theories of CG that introduce this kind of flexibility of constituency (in different ways and to different degrees depending on the particular variant) **C-flexible CG**.[56] Introducing flexibility, however, is not always good. Early linguistic applications of CG have suffered from overgeneration; once the flexibility is in principle available, it is often difficult to properly constrain the grammar in order to avoid overgeneration. The present proposal inherits flexibility of constituency from this strand of research in CG, but, like other recent variants, does so in a limited and systematic manner, thereby overcoming the limitations of these earlier variants.

[56]A note for readers familiar with different kinds of CG: It is important to note that having hypothetical reasoning is neither a sufficient nor a necessary condition to count as C-flexible CG. CCG does not have fully general hypothetical reasoning, but counts as C-flexible CG since it gets the effect of collapsing constituency by function composition. Muskens's (2003) Lambda Grammar, on the other hand, has hypothetical reasoning, but it does not count as C-flexible CG since hypothetical reasoning is not used for reassigning constituent statuses for strings of words that do not form constituents by function application alone. (see section 3.2.1 for a more detailed discussion on this point).

In a somewhat different vein, some researchers (e.g. Bach (1979) and Dowty (1982)) working in Montague semantics in the late 70s and early 80s have endorsed an architecture of grammar based on CG wherein surface morpho-syntactic realizations of linguistic expressions are separated from their semantically-oriented combinatorics. Somewhat different aspects of the linguistic significance of such an architecture of grammar have been explored in Oehrle (1994) and Dowty (1996). Oehrle (1994) has shown how a perspicuous treatment of quantifier scope (which is essentially a formalization of Montague's (1973) quantifying-in operation) can be implemented within a variant of CG that makes use of lambda abstraction in the surface-oriented morpho-syntactic (or 'phonological') component. Dowty (1996) introduces the notion of 'modes' of linguistic composition and exploits it in accounting for a range of word order-related phenomena such as adverb placement, scrambling and extraposition. I call this kind of CG **L-flexible CG**, in view of the fact that the primary advantage of this kind of architect is that it introduces greater flexibility in (and systematic organization of) linear word order than in PS-based theories (especially ones in which ID and LP rules are not separated).[57]

Each of these two ideas has its own motivation in the sense that there are certain kinds of linguistic generalizations that are difficult to capture without it. Moreover, as we will see below, there are cases of interactions of multiple linguistic phenomena (each motivating the two kinds of approaches discussed above) that cannot be accounted for adequately except in a theory that embodies both of the two ideas simultaneously. (A concrete example of such an interaction will be discussed at the end of this chapter.) Recent variants of CG (especially, Morrill's (1994) and Moortgat's (1997) variants of MMTLG and Baldridge's

[57]Essentially the same idea of separating surface morpho-syntax from semantically-oriented combinatorics has been adopted in a variant of HPSG called 'linearization-based HPSG' (Reape 1994; Kathol 2000).

(2002) MMCCG) can be seen as moving in the same direction of developing a CG-based theory of grammar in which these two ideas are unified in a single and coherent framework. What is common in these approaches is that the combinatoric component that embodies C-flexible CG is augmented with the notion of **(multi-)modality**, which essentially models different degrees of flexibility in the morpho-syntactic composition of linguistic expressions (i.e. something that is taken care of in a component that is segregated from the combinatoric component in L-flexible CG). The challenge for such an attempt comes from the fact that C-flexible CG and L-flexible CG (at least the original simplest variants of each) rest on fundamentally incompatible assumptions: C-flexible CG presupposes a straightforward mapping between strings of words and their syntactic categories in syntactic derivations whereas L-flexible CG starts from an explicit denial of it. The crux in enabling a synthesis of the two is how to reconcile these seemingly incompatible assumptions. Roughly speaking, both MMTLG and MMCCG attempt to achieve this by extending or enriching some already available components of grammar: in MMTLG, by making the logical combinatoric system multi-modal, and in MMCCG, by fine-tuning the set of combinatory rules with the notion of multi-modality. However, these attempts seem to still fall short of unifying these strands into a coherent and conceptually simple framework. (I will discuss this point in more detail in section 3.2, where I compare the present theory with these alternatives.) The thesis that I will be arguing for in what follows is that, in order to reconcile the incompatible assumptions of C-flexible CG and L-flexible CG and to unify the two ideas in a coherent manner, the grammar needs to recognize a distinct and somewhat abstract component that mediates between syntax and phonology and at which the (inherently abstract) notion of (multi-)modality finds its proper place.

3.1 Multi-Modal Categorial Grammar with Structured Phonology

In this section, I present the full details of the theory of MMCG with Structured Phonology. As discussed above, the proposed theory is in some sense a synthesis of two ways of looking at the syntax of natural language originating from different strands of research in CG. Since these two perspectives themselves already depart significantly from standardly held assumptions in most other syntactic theories and since the heart of my proposal lies in the subtle way in which this synthesis is done (recall from the discussion above that, at least initially, the two perspectives do not seem to be unifiable in any obvious way), I proceed in four steps in my presentation (the four subsections that follow correspond to these four steps). I first introduce basic assumptions about natural language syntax shared by most variants of CG, together with specific assumptions and notational conventions that I adopt in my theory. I then present the proposed theory in two impoverished forms. As will become clear below, the proposed theory has two components and these two components can be thought of as respectively embodying the ideas inherited from one of the two strands of research discussed above. In each of these two impoverished forms, only one of these two components of the present theory will be fully articulated. Thus, these two simplified variants can be thought of as 'emulations' of C-flexible CG and L-flexible CG within the present theory. The two subsections in which I present these two simplified variants of the present theory are intended to serve double purposes: (i) to illustrate the specific properties that these two components have within the present theory and (ii) to provide some background on the conceptual and empirical motivations for the two strands of research that the present theory inherits from. After presenting these two components this way, I show how they can be put together within a single coherent system, justifying the particular way in which this synthesis is done.

The following is a more specific road map. I start in section 3.1.1 by laying out some basic assumptions and developing a fragment equivalent to the simplest form of CG known as the **AB system**. After introducing these basics, section 3.1.2 discusses how this system can be extended to model C-flexible CG, by introducing the rules for **hypothetical reasoning**. The particular system that emerges at this point is basically a labelled deduction presentation of what is known as the **Lambek calculus** (Lambek 1958). I show how two basic theorems in CG—type raising and function composition—can be proved in this system and sketch its linguistic applications to the phenomena of long-distance extraction and nonconstituent coordination. We will see that, while the flexibility of constituency introduced in the grammar with hypothetical reasoning is useful, the system is too simple in that there is no principled way of regulating this flexibility to avoid overgeneration. [58] Then, in section 3.1.3, I present the other aspect of the proposed theory, which it inherits from L-flexible CG. The idea underlying this approach is to separate surface morpho-syntactic realizations of linguistic expressions from their semantically-oriented combinatoric structures. [59] I illustrate the essential properties of such a system by temporarily getting rid of the rules for hypothetical reasoning introduced in section 3.1.2 but augmenting the system instead by fully articulating a component that I call **structured phonology**, which can be thought of as an abstract level of representation that mediates between 'syntax proper' and phonology.

[58] It turns out that this system is not only too flexible but is also inflexible in some respects, when faced with certain word order-related generalizations. Consider, for example, the inability of the Lambek calculus to license non-peripheral extraction (cf. footnote 83). See also the discussion at the beginning of section 3.1.3.

[59] The former is what Dowty (1996) calls 'phenogrammar' and the latter is what he calls 'tectogrammar', following the terminology of Curry (1961). In the literature of CG, various approaches have been proposed to implement these notions in different ways; some of the authors use the terms pheno/tectogrammar following Dowty and some adopt different terms such as 'abstract syntax' and 'concrete syntax' (borrowed from the literature of computer science; cf., e.g., Ranta (2004)); I avoid using these terms myself since what is meant by these terms differ in subtle (but often important) details from one author to another.

I demonstrate empirical applications of such a system to phenomena pertaining to (partial) free word order, taking some aspects of scrambling in Japanese as an example. I end this exposition by observing a limitation of this system: due to the fact that the simplified system presented in this section does not (yet) recognize hypothetical reasoning, analyses of empirical phenomena in C-flexible CG that crucially exploit it to license flexible constituent structures do not straightforwardly carry over to this setup. Finally, based on these expositions of the two components, I explain how they are put together in the proposed theory, which results in a grammar architecture that has the advantages of both C-flexible CG and L-flexible CG without suffering from the inadequacies of either. I finish the discussion by sketching an analysis of a case (specifically, (63b) from Chapter 2) where nonconstituent coordination (which motivates C-flexible CG) and the *-te* form complex predicate (which motivates L-flexible CG) interact. Such an interaction of two empirical phenomena that separately motivate C-flexible CG and L-flexible CG provides strong empirical justification for a theory like the present one in that it cannot be accounted for adequately except in a theory that unifies the two ideas from the previous research within a single coherent framework.

3.1.1 Basic assumptions

3.1.1.1 General assumptions about linguistic expressions

Following the standard practice in CG, I assume that linguistic expressions are represented as triples of phonological representation, semantic interpretation and syntactic category, notated $\langle \pi; \sigma; \gamma \rangle$ (angle brackets will be omitted in lexical entries and derivations). For syntactic category and semantic interpretation, I adopt what is more or less standard in the literature of CG and will not say anything particularly new. However, what I mean by ‘phonological representation’ is significantly different from what is usually meant by this term. As will become clear below, I assume that a distinct component of grammar (called **structured phonology**) is responsible for mediating syntax and phonology and that the phonological representations that the ‘syntax proper’ can see are abstract objects belonging to this interface component,[60] rather than something that straightforwardly corresponds to the actual phonological forms of linguistic expressions. I will elaborate on this aspect of the theory more carefully below. For now, it suffices to keep in mind that the term I write for the ‘phonology’ of a linguistic expression is something that is more abstract than a straightforward representation of the ‘real’ phonology.[61]

In what follows, I spell out the relevant assumptions regarding each of these aspects of a linguistic expression, starting with syntactic categories. As is standard in CG, I assume that the set of syntactic categories is infinite and is recursively defined. As will become clear below, this assumption is closely tied to one of the most fundamental aspects of CG wherein natural language syntax is viewed as a kind of logical system. Syntactic categories are like formulas in propositional logic. Just as the set of well-formed formulas in propositional logic is infinite in order to deal with infinitely complex logical inferences, syntactic categories are infinite in order to deal with infinitely complex combinatory properties of linguistic expressions.

[60] A terminological clarification. By ‘interface component’ (between syntax and phonology) I do not mean a component of grammar that deals with suprasegmental aspects of phonology (such as tone and accent) and their correlates in syntax (as in, for example, Steedman’s (2000a) theory of syntax-phonology interface). Although this is an important topic, I will not deal with these issues in this dissertation.

[61] By ‘real’ phonology, I mean the concrete, but simplified, representation of the phonology of linguistic expressions that syntactic theory deals with, which is usually represented as strings of words.

The following is the definition of syntactic categories that I adopt (in what follows, I will omit the outermost parentheses for complex categories): [62,63]

(76) a. N, NP and S are categories.

b. If A and B are categories, then so are (A/B) and $(B\backslash A)$.

c. Nothing else is a category.

Note that this definition allows for an infinite set of syntactic categories. Just as an illustration, instantiate A and B by NP in clause (76b), which sanctions $\mathrm{NP/NP}$ (and $\mathrm{NP\backslash NP}$ as well) as a category. Then we can apply (76b) again by instantiating A and B with the newly created category $\mathrm{NP/NP}$, which produces $(\mathrm{NP/NP})/(\mathrm{NP/NP})$. Doing the same thing once again yields $((\mathrm{NP/NP})/(\mathrm{NP/NP}))/((\mathrm{NP/NP})/(\mathrm{NP/NP}))$. The step can be repeated as many times as one likes, each time introducing a new, more complex, category into the grammar.

Disregarding for the time being the distinction between **forward** ($/$) and **backward** ($\backslash$) **slashes**, complex syntactic categories transparently encode the subcategorization properties of linguistic expressions. For example, lexical entries for intransitive and transitive verbs in English will look like the following (semantics is omitted here but will be supplied later):

(77) a. ran; $\mathrm{NP\backslash S}$

[62] The set of basic categories will be expanded later to distinguish between different kinds of S's and NPs. Specifically, for NPs, I assume that the grammar recognizes (at least) the following three categories: NP_n, NP_a and NP_d (which designate nominative, accusative and dative NPs, respectively). In a system in which a full-fledged feature system is articulated (see, e.g., McConville (2006) for a proposal in CCG and de Groote and Maarek (2007) for a proposal in terms of dependent products in Abstract Categorial Grammar), the subscripts on these categories can be thought of as syntactic features. Alternatively, one can simply take these categories (and other categories introduced later) as distinct atomic categories.

[63] Notation: the roman font is used for writing syntactic categories; italics are used for writing (meta-language) variables over categories.

b. read; $(\mathrm{NP}\backslash\mathrm{S})/\mathrm{NP}$

(77a) says that the lexicon contains a word which has the phonology ran and the syntactic category $\mathrm{NP}\backslash\mathrm{S}$. The syntactic category tells us that this word combines with an NP to become an S. That is, what is being subcategorized for is notated under the slash—to the left for the backward slash (and to the right for the forward slash). Likewise, (77b) says that the word *saw* combines with the object NP and the subject NP (in that order) to become a sentence. Thus, the category specification of the verb (or, any other argument-taking expression) transparently encodes how many and what kinds of arguments it takes. In order to talk about complex categories, we introduce some basic terminology here: we say that complex categories with slashes designate **functors** that combine with **arguments** to return **results**. For example, the intransitive verb category $\mathrm{NP}\backslash\mathrm{S}$ in (77a) is a functor that takes an NP as an argument to return an S as the result.

The distinction between forward and backward slashes corresponds to the distinction in the directions (in the surface word order) in which functors look for arguments. That is, A/B designates a functor that is looking for a B *to its right* (to become an A) whereas $B\backslash A$ designates a functor that is looking for a B *to its left* (to become an A). [64]

At this point, some clarifications are in order regarding the notations of categories. First, as explained above, I adopt a notation of slashes where the linear order of the argument and the result in complex categories match the actual word order. This is known as the Lambek-style notation. In this notation, in $B\backslash A$, B is written to the left of A since this functor is looking for a B to its left. There is an alternative notation adopted in the literature of Combinatory Categorial Grammar (CCG) (Steedman 2000b) in which the argument is always written to the right of the slash (in other words, in this alternative notation, our $B\backslash A$

[64] By 'a B', etc., I mean 'a linguistic expression of syntactic category B', etc., to be more precise.

will be written $A\backslash B$).[65] Also, in writing complex categories, I sometimes omit parentheses when they can be reconstructed unambiguously. Specifically, when parentheses are omitted for a sequence of forward slashes, the slashes should be taken to associate to the left; thus, for example, $\mathrm{S/NP/NP}$ is an abbreviation for $(\mathrm{S/NP})/\mathrm{NP}$. Likewise, when parentheses are omitted for a sequence of backward slashes, the slashes should be taken to associate to the right; thus, for example, $\mathrm{NP}\backslash\mathrm{NP}\backslash\mathrm{S}$ is an abbreviation for $\mathrm{NP}\backslash(\mathrm{NP}\backslash\mathrm{S})$. I will not omit parentheses in any other circumstances.

I now turn to semantics. I assume that the meanings of linguistic expressions are modelled in terms of standard Montagovian model-theoretic semantics.[66] More specifically, each linguistic expression is assigned a term in the lambda calculus denoting its semantic interpretation. As is standard in CG, there is a function from syntactic categories to semantic types. Intuitively, what this means is that, for each linguistic expression, given its syntactic category, one can determine uniquely and unambiguously what kind of meaning it denotes (e.g. individuals, sets of individuals, sets of sets of individuals, etc.). To work this out, we first assume that semantic types are recursively built from the basic types e (individuals) and t (truth values) in the standard fashion:

(78) a. e and t are semantic types.

b. If α and β are semantic types, then so is $\alpha \rightarrow \beta$.

c. Nothing else is a semantic type.

[65] I adopt the Lambek-style notation here primarily because, as will become clear below, the theory that I will ultimately be developing resembles certain variants of Type-Logical Grammar, for which the Lambek-style notation is almost exclusively used. But it should be noted that the two styles of writing complex categories with slashes are just notational variants and that there is no deep reason for my choice of the Lambek-style notation.

[66] Since I do not deal with phenomena that crucially involve intensionality, I assume an extensionalized fragment throughout.

Then, we can define the function Sem that returns, for each syntactic category given as the input, its semantic type:

(79) (Base Case)

a. Sem(NP) = e

b. Sem(S) = t

(80) (Recursive Clause)

For any complex syntactic category of the form α/β (or $\beta\backslash\alpha$),

Sem(α/β) (= Sem($\beta\backslash\alpha$)) = Sem(β) $\rightarrow$ Sem(α)

(80) says that the semantic type of a complex syntactic category α/β (or $\beta\backslash\alpha$) is that of a function that takes as its argument an expression that has the semantic type of its syntactic argument (i.e. Sem(β)) and returns an expression that has the semantic type of its result syntactic category (i.e. Sem(α)).

We can now write full lexical entries that specify the semantics as well: [67]

(81) a. ran; **ran**; $\mathrm{NP}\backslash\mathrm{S}$

b. saw; **saw**; $(\mathrm{NP}\backslash\mathrm{S})/\mathrm{NP}$

Given the recursive definition of semantic types based on syntactic categories in (80), we see that the intransitive verb *ran* is semantically of type $e \rightarrow t$ (set of individuals) and that the transitive verb *saw* is semantically of type $e \rightarrow (e \rightarrow t)$ (a function from individuals to sets of individuals, i.e., a curried two-place relation). [68]

At this point we can not do anything interesting with these lexical entries since we have not yet introduced the rules for syntactic and semantic combination. We will come back

[67] Constants in semantic translations are written in boldface.

[68] Note that I will systematically refer to characteristic functions of sets of A's simply as 'sets of A's'.

to the significance of the tight correspondence between syntactic categories and semantic types when we discuss below how syntactic and semantic combination work in tandem in the derivations of sentences.

To complete the discussion of the three components of linguistic expressions, I will say a (very) few things about phonology. As I stated above, the terms [69] that I write for 'phonological representations' (which, as I will spell out in the relevant section below, are formally terms called **φ-terms** in a term calculus called the **φ-calculus**) are terms that denote abstract objects belonging to an interface component between syntax and phonology called **structured phonology**.[70] (I call these abstract objects 'structured phonologies' of linguistic expressions.) As will become clear below, in the full-fledged version of the present theory, a distinction will be introduced between 'abstract' and 'concrete' structured phonologies, where only the latter directly correspond to actually pronounceable strings. For the moment (in fact, throughout section 3.1.2), however, just to make things simple but explicit, I introduce a simplifying assumption that all the φ-terms are 'concrete', that is, that they do transparently denote strings of words. Specifically, until I introduce the component of structured phonology in section 3.1.3, there will be only one binary connective $\circ$ (written

[69] As I have already been doing above (cf. e.g. the lexical entries in (81)), I notate these terms in the sans serif font.

[70] As I will explain in section 3.1.3, structured phonology is formally modelled as a preordered algebra called the 'P-algebra'. The φ-calculus is formally a lambda calculus and the relationship between the φ-calculus and the P-algebra is exactly analogous to the relationship between the lambda calculus for semantics (which I call here the σ-calculus) and the (set-theoretic) model for semantic interpretation. Should there ever arise a confusion about which technical term names which concept, the reader is reminded that the names 'φ'-calculus and 'σ'-calculus with Greek letters (which are just mnemonic for 'phonology' (or, 'prosody', if one likes) and 'semantics', respectively) are chosen to bring out the fact that both are lambda calculi for writing terms that denote objects that have actual ontological statuses in the linguistic theory.

infix as in saw $\circ$ mary, for the string *saw Mary*) for forming complex φ-terms out of atomic φ-terms and this binary connective will simply be interpreted as string concatenation.

3.1.1.2 Basics of the combinatoric component: The syntactic calculus

Any theory of syntax has a recursive system in which larger linguistic expressions are built from smaller ones. In the system of CG that we are developing, this combinatoric aspect is taken care of by what I call the **syntactic calculus**. Formally, the syntactic calculus is a deductive system with a set of rules that take as inputs one or more linguistic expressions and produce as outputs new linguistic expressions. Each rule unambiguously specifies the output for any given input(s). As is standard in CG (and other theories of grammar that have precise formal underpinnings), I assume that the closure of the lexicon under the rules in the syntactic calculus defines the set of all well-formed linguistic expressions.[71]

The syntactic calculus has two kinds of rules: **logical rules** and **non-logical rules**. Among non-logical rules, we have the **P-interface rule** and the **coordination rules**. Since the P-interface rule becomes relevant only after the component of structured phonology is introduced (it is the rule that establishes the connection between the syntactic calculus and the structured phonology) and since the coordination rules are special rules employed in the analysis of (conjunctionless) coordination, I will postpone discussion of them until relevant sections. The logical rules of the syntactic calculus are essentially rules that specify how smaller linguistic expressions are combined into larger ones in terms of their 'logical' (or subcategorization) properties encoded in the syntactic categories (recall from above that in CG, syntactic categories are viewed as logical formulas). There are two kinds of

[71] Intuitively, the closure S' of a set S under a set of rules (or operations) R is the set of all objects that can be obtained by recursively applying rules in R to objects in S.

logical rules: **Slash Elimination rules** (introduced below) and **Slash Introduction rules** (introduced in section 3.1.2).

Slash Elimination rules take care of cases in which a functor combines with an argument to produce a larger linguistic expression. There are two variants of the rule, one for the forward slash and the other for the backward slash:[72]

(82) a. **Forward Slash Elimination**

$$\frac{\textsf{a}; \varphi; A/B \qquad \textsf{b}; \psi; B}{\textsf{a} \circ \textsf{b}; \varphi(\psi); A}/\mathrm{E}$$

b. **Backward Slash Elimination**

$$\frac{\textsf{b}; \psi; B \qquad \textsf{a}; \varphi; B\backslash A}{\textsf{b} \circ \textsf{a}; \varphi(\psi); A}\backslash\mathrm{E}$$

These rules are displayed in the so-called **labelled deduction** format of natural deduction. [73] The inputs to the rule are written above the horizontal line and the output is written below the line. For a reason that will become clear below (specifically, the analogy between language and logic that underlies CG-based theories of syntax), I call the inputs of rules in the syntactic calculus **premises** and the outputs **conclusions**. The linear order between the two premises above the line has only mnemonic significance (as will become clear below, what *is* significant to word order is instead the order of $\textsf{a}$ and $\textsf{b}$ in the phonological representation of the expression obtained as the conclusion).[74] The labelled deduction presentation

[72]Notation: Greek letters are used for writing (meta-language) variables over semantic terms and the slanted sans serif font is used for writing (meta-language) variables over φ-terms (i.e. terms denoting structured phonologies of linguistic expressions). Also, rules (and instances of rule application in derivations) are labelled with their abbreviated names (such as /E in (82a)).

[73]See Gabbay (1996) for general and technical discussions of the properties of labelled deduction. See Oehrle (1994) and Morrill (1994) for CG-based theories of syntax using the labelled deduction presentation.

[74]But note that the 'phonology' that the syntactic calculus manipulates is an abstract representation and hence does not directly correspond to the actual word order. The relative order of the functor and the argument

is so called since, in addition to the syntactic categories of the premises and conclusions, the rules are also annotated (or labelled) with how the semantics and phonology of the conclusions are computed given the semantics and phonology of the premises.

Let us examine the rules more carefully. In **Forward Slash Elimination** (82a), a linguistic expression of category A/B combines with another expression of category B to produce an expression of category A. Correspondingly, the semantics is simply that of function application: the meaning of the conclusion expression $\varphi(\psi)$ is the result of applying the meaning of the functor φ to the meaning of the argument ψ.[75] The phonology of the conclusion is obtained by putting together the phonologies of the premises by means of the binary connective $\circ$. For the moment, it suffices to assume that the operation denoted by this connective is just string concatenation. Note that the phonology of the argument b appears to the right of the phonology of the functor a in (82a) in the phonology of the conclusion expression. This should make sense given the assumption that the binary connective $\circ$ denotes string concatenation (but keep in mind that this is a simplifying assumption): with the forward slash, the functor finds its argument to its right. **Backward Slash Elimination** (82b) is the same as Forward Slash Elimination (82a) except that it involves the backward slash, and, correspondingly, the order between the phonologies of the functor and the argument is reversed in the phonology of the conclusion expression.

A system of CG with only the elimination rules like our fragment at this point is called the **AB system**, so called because it corresponds to the earliest form of CG formulated

stays the same as specified in these rules as long as the (structured) phonology of the conclusion expression does not undergo further manipulation (which might affect the surface word order). This point will become clear once the component of structured phonology is introduced in section 3.1.3.

[75] As will become clear in the sample derivation in (83), what the Slash Elimination rule does is essentially subcategorization cancellation. Thus, it corresponds (loosely) to the head-complement rule in HPSG (Pollard and Sag 1994), and the operation of Merge in Minimalist syntax (Chomsky 1995).

by Ajdukiewicz (1935) and Bar-Hillel (1953). With the Slash Elimination rules, we can already derive some simple sentences. The following derivation of the sentence *John saw Mary* illustrates how a **proof** of the sentencehood of a string of words is presented in the present system:

(83)
$$\dfrac{\mathsf{john}; \mathbf{j}; \mathrm{NP} \qquad \dfrac{\mathsf{saw}; \mathbf{see}; (\mathrm{NP}\backslash \mathrm{S})/\mathrm{NP} \quad \mathsf{mary}; \mathbf{m}; \mathrm{NP}}{\mathsf{saw} \circ \mathsf{mary}; \mathbf{see}(\mathbf{m}); \mathrm{NP}\backslash \mathrm{S}}/\mathrm{E}}{\mathsf{john} \circ (\mathsf{saw} \circ \mathsf{mary}); \mathbf{see}(\mathbf{m})(\mathbf{j}); \mathrm{S}}\backslash \mathrm{E}$$

This derivation involves one application of Forward Slash Elimination (82a) and one application of Backward Slash Elimination (82b). Note that each step of the derivation strictly follows one of the rules that we have defined in the syntactic calculus. For now, with the simplifying assumption that $\circ$ designates string concatenation, we can think of the final line of the derivation as stating that the string of words *John saw Mary* paired with the proposition that John saw Mary is a well-formed linguistic expression.

3.1.2 Extending the combinatoric component: Modelling C-flexible CG

The AB system that we have modelled above is too impoverished for the purpose of analyzing actual linguistic phenomena. In this section, I extend the fragment by adding another set of logical rules called **Slash Introduction rules** and further making the assumption that the binary operator for forming complex phonological representations is associative. I will also introduce a third kind of slash that I call the **vertical slash** and Introduction and Elimination rules for this slash. The system with only the Slash Introduction rules added is equivalent to what is known as the **nonassociative Lambek calculus** (Lambek 1961; also known as **NL**) and the further addition of associativity in phonology results in a system that is equivalent to the more standard, associative variant of the **Lambek calculus** (Lambek 1958; also known as **L**). It is known that, in the Lambek calculus, rules such as **type raising** and **function composition**, familiar in the literature of linguistically oriented work in CG, can be derived as theorems. I derive these theorems in the present system and illustrate the linguistic applications of the fragment developed up to this point (without the vertical slash) to the analyses of long-distance extraction and nonconstituent coordination. The addition of the vertical slash is for the purpose of dealing with quantifier scope. Thus, at the end of this section, I will also illustrate how the system with the vertical slash added accounts for simple cases of quantifier scope ambiguity.

The Slash Introduction rules that I introduce below can be best understood by recognizing the analogy drawn between natural language syntax and logic in CG-based syntactic theories. In CG, derivations of sentences are thought of as proofs. In the present setup, the rules of the syntactic calculus are inference rules in a deductive system in which such proofs are formalized. From this perspective, the Slash Elimination rules that we have introduced above should be thought of as directional counterparts of the traditional rule of **modus ponens**. Ignoring word order, both A/B and $B\backslash A$ mean that, if there is a B, then there is an A. Thus, the Slash Elimination rules we have formulated above license steps of logical inference in which we combine this premise with another premise that asserts the existence of B to conclude that there is indeed an A. That is, in the Slash Elimination rules, we are essentially saying the same thing as the rule of modus ponens, or, implication elimination, in propositional logic:

(84) $$\dfrac{B \rightarrow A \qquad B}{A}\ \rightarrow\text{E}$$

Extending this analogy to logic one step further, we introduce into our syntactic calculus rules that correspond to **implication introduction** (aka ‘hypothetical reasoning/proof’ or 'conditionalization'). The rule of implication introduction in standard propositional logic is often presented as in (85).[76]

(85)
$$\dfrac{\dfrac{\begin{matrix} \vdots & \vdots & \dfrac{[A]^n}{\vdots \quad \vdots} & \vdots & \vdots \\ \vdots & \vdots & & \vdots & \vdots \end{matrix}}{B}}{A \to B}{\to}\mathrm{I}^n$$

To paraphrase what this rule says in intuitive terms, what is going on here is that some formula A (whose truth does not need to be known) is hypothetically assumed as a premise together with a set of other premises (the dots around A indicate that A is just one of the premises within a larger proof whose conclusion is B); if one can draw some conclusion, say B, from these premises (A included), then, one is allowed to conclude from this that the original set of premises *without* the hypothesized A proves $A \to B$ (this is so because the total set of premises is such that, if we were to put it together with A, that would allow us to conclude B).

The Slash Introduction rules are rules that correspond to implication introduction in our syntactic calculus.[77] Just like implication introduction in propositional logic, the Slash Introduction rules involve a hypothetically assumed expression that later gets withdrawn, and, hence, are rules of **hypothetical reasoning** in our syntactic calculus. Like Slash Elimination rules, there are two variants, one for the forward slash and one for the backward slash:

[76]The brackets around A indicate that it is a hypothesis, and the matching indices on the closing bracket and the inference step make explicit where in the proof the hypothesis is withdrawn.

[77]In relation to other syntactic theories, the Slash Introduction rules roughly correspond to the binding of a trace by an empty operator in GB theory (and, more indirectly, to the part of the operation of Move in Minimalist syntax that corresponds to it (to the extent that such a correspondence makes sense)). In a certain respect, rules that introduce elements in the SLASH feature in G/HPSG employed in the analysis of long-distance dependencies (originally proposed by Gazdar (1981)) can be thought of as a highly specialized variant of hypothetical reasoning in these theories.

(86) a. **Forward Slash Introduction**

$$\dfrac{\dfrac{\begin{matrix}\vdots & \vdots & \dfrac{[p\,; x; A]^n}{\vdots \quad \vdots} & \vdots & \vdots\end{matrix}}{b \circ p\,; \varphi; B}}{b; \lambda x.\varphi; B/A}/\mathrm{I}^n$$

b. **Backward Slash Introduction**

$$\dfrac{\dfrac{\begin{matrix}\vdots & \vdots & \dfrac{[p\,; x; A]^n}{\vdots \quad \vdots} & \vdots & \vdots\end{matrix}}{p \circ b; \varphi; B}}{b; \lambda x.\varphi; A\backslash B}\backslash\mathrm{I}^n$$

As in (85), the brackets indicate hypotheses and the index n is for keeping track of which hypothesis is withdrawn at which step in the proof. Just as we posit a variable x for the semantics for the hypothetically assumed expression, its phonology is represented by a variable *p*.[78]

These rules are rules of hypothetical reasoning in the following sense: in **Forward Slash Introduction** (86a), the step labelled as '$/\mathrm{I}^n$' licenses the conclusion that the string of words *b* (again, keep in mind that calling it a string of words is actually a simplification) alone is of category B/A, given the proof that *b* concatenated with a hypothetically assumed *p* (whose category is A) to its right is of category B. Note here the close parallel between the Slash Introduction rules in (86) and implication introduction in propositional logic in (85). In both cases, we are essentially saying that, if assuming A leads to the conclusion B, then what we have *without* the hypothetical assumption of A is something that yields B if given A. The only (major) difference is that, in the case of the Slash Introduction rules in our syntactic calculus, the rules also refer to the phonological representations of

[78]I use lower-case letters starting from *p* for (object language) variables in the φ-calculus.

the premise and conclusion expressions since linear order is relevant in natural language. [79] Note also that, unlike in semantics (see below), the phonology of the output does not involve lambda abstraction. This is so because hypothetical reasoning (for the forward and backward slashes) is used in the current fragment to treat cases in which (the phonology of) some expression appears displaced from its local syntactic environment (e.g. as in the case of topicalization in English). Thus, the phonology of the displaced element should not be reconstructed to the 'original' position in the surface string (if it were, it would not

[79] It should be noted that, although somewhat subtle, this is indeed a crucial difference between the syntactic calculus of the present system and more ordinary kinds of logic. In the present system, the grammar is set up in such a way that the (possible) phonological realization of linguistic expressions can potentially make a difference in whether a particular syntactic derivation goes through. And this property sets the present theory and the variant of Type-Logical Grammar (TLG) proposed by Morrill and Solias (1993) and Morrill (1994) apart from the (currently more standard) variant of TLG known under the name of Categorial Type Logics (Moortgat 1997; Bernardi 2002). A comparison among these different variants of TLG and the present theory will be given in section 3.2.2.

be a ‘displaced’ element to begin with). For this reason, the variable for the (structured) phonology of the hypothesis is simply eliminated in the conclusion. [80]

The semantics for Slash Introduction is lambda abstraction: we first posit a variable x as the meaning of the hypothesized expression A and compute the meaning of the whole expression with that hypothesis; then, at the step where the hypothesis is withdrawn (and the whole expression becomes a functor looking for an expression matching the syntactic and semantic type of the hypothesized expression), this variable is bound by a lambda operator so that whatever argument that the newly created functor combines with can supply the appropriate value for that variable slot (that is, assuming that the newly created functor takes an argument; but note that it might instead be *taken* as an argument by another functor). Note that, by defining the semantics for Slash Introduction this way, the tight correspondence between syntactic categories and semantic types is maintained: if the

[80] To be formally more precise, we can think of the conclusion of the Slash Introduction rule to have the following structured phonology:

(i) $\lambda p.[b \circ p\,](\epsilon)$

where ϵ is the identity element (interpreted as a null string). In the inequational logic for φ-terms (explained below), the following equality is provable by β-reduction and by the definition of ϵ as an identity element:

(ii) $\lambda p.[b \circ p\,](\epsilon) = b \circ \epsilon\ = b$

That is, unlike in semantics, when the variable is bound by the lambda operator, the term is immediately applied to an object denoting an empty string so that nothing can be ‘reconstructed’ to a gap in the surface string. Given (ii) and given that $\leq$ is reflexive, we have:

(iii) $\lambda p.[b \circ p\,](\epsilon) \leq b$

with which we can license the conclusion in (86a) by the P-interface rule introduced below (likewise for (86b)). Since explicitly appplying the P-interface rule after each application of Slash Introduction is cumbersome, this step is compressed in the definition of the Slash Introduction rules in the current fragment.

expression is syntactically a functor of category B/A, then its semantic type should be $\mathsf{Sem}(B) \rightarrow \mathsf{Sem}(A)$, which indeed it is.

Backward Slash Introduction (86b) minimally differs from Forward Slash Introduction (86a) in the syntactic category of the conclusion expression and the phonology of the premise expression. Specifically, in (86b), the phonology of the hypothesized expression *p* appears at the left edge instead of the right edge of the phonology of the premise. (As will become clear in a moment, 'right/left edge' here means that the relevant expression does not just occupy linearly the rightmost/leftmost position but also appears at the edge hierarchically by being immediately dominated by the topmost node that dominates the whole φ-term.) As in the case of Slash Elimination rules, this should make sense given the 'meanings' of forward and backward slashes: $A\backslash B$ means that the expression in question becomes a B if it finds an A to its left. The rule is specified in such a way that that conclusion can be drawn just in case a hypothetical presence of A immediately to the left of the expression in question licenses the existence of B.

The fragment so far has only Slash Introduction and Slash Elimination rules. In this system, the structures of the phonological representations of the linguistic expressions that are constructed transparently reflect the structures of the proofs (this will no longer be the case once we introduce the P-interface rule in section 3.1.3). And, as can be seen from the sample derivation in (83), the structures of the proofs roughly correspond to the 'syntactic constituent structures' of sentences. That is, the expression that appears on the right or left edge (in the sense explained above) of the phonology of some linguistic expression is always the phonology of some expression that has been introduced in the proof at the immediately preceding step. Given this, and given that Slash Introduction rules require the phonology of the hypothesis that is withdrawn to appear either at the right or the left edge of the phonology of the whole linguistic expression, it follows that a hypothesis can be withdrawn only if it is introduced at an immediately preceding step in the derivation.

It might then seem as though there would hardly be any use for the Slash Introduction rules since the only thing that one would be able to do with them would be to cancel the effect of an immediately preceding application of Slash Elimination, as in the following example:

(87)
$$\cfrac{\cfrac{\mathsf{a}; \varphi; A/B \quad [\mathsf{p}\,; x; B]^1}{\mathsf{a} \circ \mathsf{p}\,; \varphi(x); A}/\mathrm{E}}{\mathsf{a}; \lambda x.\varphi(x); A/B}/\mathrm{I}^1$$

But this is not the case. To see why, it is crucial to recognize that the Slash Introduction rules do not say anything about the original functor/argument status of the hypothesis that is withdrawn. If the hypothesized expression is originally an argument, then, what happens is exactly as described above (i.e., creating unnecessary redundancy in the proof), but if the hypothesized expression is originally a functor, the application of Slash Introduction has the effect of reversing the relation between a functor and its argument. Thus, in the following proofs of **type raising** (so-called since this rule (or theorem) 'raises' the syntactic type (or category) of the original expression (i.e. B in (88a)) to a more complex, functional one (i.e. $(A/B)\backslash A$ in (88a)), the Slash Introduction rule is crucially made use of in assigning a functor category to what is originally an argument.

(88) a.
$$\cfrac{\cfrac{[\mathsf{p}\,; f; A/B]^1 \quad \mathsf{b}; \alpha; B}{\mathsf{p} \circ \mathsf{b}; f(\alpha); A}/\mathrm{E}}{\mathsf{b}; \lambda f.f(\alpha); (A/B)\backslash A}\backslash\mathrm{I}^1$$

b.
$$\cfrac{\cfrac{\mathsf{b}; \alpha; B \quad [\mathsf{p}\,; f; B\backslash A]^1}{\mathsf{b} \circ \mathsf{p}\,; f(\alpha); A}\backslash\mathrm{E}}{\mathsf{b}; \lambda f.f(\alpha); A/(B\backslash A)}/\mathrm{I}^1$$

Informally, what is going on in (88a) is the following. We first hypothetically assume the existence of A/B to the left of B. Then, by Slash Elimination, we can assign the category A to the whole expression. Finally, we withdraw the hypothesis by Slash Introduction to assign the category $(A/B)\backslash A$ to the original expression with phonology b. We can think of this last step as follows: by hypothetical reasoning, we know at this point that the original expression yields an A if it finds a A/B to its left; but then, the category for such an expression is nothing other than $(A/B)\backslash A$. (88b) is the same as (88a) except that the forward and backward slashes are switched. Note also that, given the definitions of the Slash Elimination and Slash Introduction rules above, the right semantics (i.e. that of type raising) is automatically assigned in both (88a) and (88b).

It is nevertheless true that, in the current system where the phonological representation of a linguistic expression rigidly reflects the history of rule application in the derivation, not much can be done with the addition of the Slash Introduction rules. For example, suppose we wanted to assign the category S/NP to the string *John saw* (in order to analyze this string as something that becomes a sentence when given an NP to its right). We cannot derive this in the current fragment since the object NP combines with the verb before the subject NP does so (see the derivation in (83) above). Thus, even if we replaced the real object with a hypothetical one in the derivation in (83), since its phonology does not appear on the right edge of the phonology of the whole sentence (specifically, the problem here is that it does not occupy the hierarchically topmost position), Forward Slash Introduction fails to apply at the step it needs to.

The full flexibility of hypothetical reasoning becomes available by introducing **associativity** into the phonology, which, as we will see below, has the effect of collapsing the hierarchical 'constituent' structures of linguistic expressions (which is reflected in the structures of the phonological representations of linguistic expressions in the current system). In order to do this appropriately, we need to introduce the component of structured phonology. (As will become clear below, associativity should be introduced in the grammar in a limited manner so that we have a principled way of regulating the flexibility introduced.) But spelling out the details of this component at this point would distract us from the main point of discussion here. Thus, for the rest of this subsection, I will not do so but instead present a simplified picture. Specifically, along with the already introduced assumption that the phonological terms in the present fragment straightforwardly represent the surface string realizations of relevant linguistic expressions, I adopt another simplifying assumption (which I will ultimately abandon) that (what we are tentatively assuming to be) the string concatenation operation for forming complex phonological representations is associative.

We can introduce associativity in the grammar by assuming that the following axiom holds for the binary connective $\circ$ for forming complex phonological terms:

(89) $A \circ (B \circ C) \equiv (A \circ B) \circ C$

Informally, this means that bracketing is completely irrelevant for phonological terms since whatever bracketing is initially assigned can be converted to any other possible bracketing by a successive application of this axiom. For this reason, in the rest of this subsection, I omit parentheses altogether for writing phonological terms.

Introducing associativity widens the range of contexts in which Slash Introduction becomes applicable. Now that the bracketing of the phonological representation of the premise does not matter, the phonology of the hypothesized expression merely needs to appear linearly at the leftmost or rightmost position (but not necessarily at the hierarchically topmost position) of the phonology of the premise.

One consequence of this change in the grammar is that the following order-preserving variants of the **function composition** rules are now derivable as theorems:

(90) a.

$$\dfrac{\mathsf{a};\varphi;A/B \qquad \dfrac{\mathsf{b};\psi;B/C \quad [\mathsf{p}\,;x;C]^1}{\mathsf{b}\circ\mathsf{p}\,;\psi(x);B}/\mathrm{E}}{\dfrac{\mathsf{a}\circ\mathsf{b}\circ\mathsf{p}\,;\varphi(\psi(x));A}{\mathsf{a}\circ\mathsf{b};\lambda x.\varphi(\psi(x));A/C}/\mathrm{I}^1}/\mathrm{E}$$

b.

$$\dfrac{\dfrac{[\mathsf{p}\,;x;C]^1 \quad \mathsf{b};\psi;C\backslash B}{\mathsf{p}\circ\mathsf{b};\psi(x);B}\backslash\mathrm{E} \qquad \mathsf{a};\varphi;B\backslash A}{\dfrac{\mathsf{p}\circ\mathsf{b}\circ\mathsf{a};\varphi(\psi(x));A}{\mathsf{b}\circ\mathsf{a};\lambda x.\varphi(\psi(x));C\backslash A}\backslash\mathrm{I}^1}\backslash\mathrm{E}$$

These rules are called ‘function composition’ since they ‘compose’ two functions (or functors) (i.e. A/B and B/C in (90a)) into a single one (i.e. A/C in (90a))). Intuitively, what (90a) is saying is that when two functors A/B and B/C appear linearly adjacent to each other (in that order), the whole expression can be regarded as a complex functor of category A/C since it is something that returns an A if it finds a C to its right. The proof goes as follows. We first hypothetically assume the existence of C to the right of a sequence of A/B and B/C. Then, by applying Slash Elimination twice, we can assign the category A to the whole expression. At this point, the assumption that string concatenation in phonology is associative becomes crucial. Due to this assumption, we can withdraw the hypothesis C, whose phonology *p* appears at the right edge of the phonology of the whole expression that is assigned the category A. The application of Forward Slash Introduction (86a) assigns the category A/C to an expression whose phonology is $\mathsf{a}\circ\mathsf{b}$, which is nothing other than the concatenation of the original two functors (assuming that $\circ$ denotes string concatenation). Note also that the right semantics is automatically assigned to the resultant expression: the semantics is the composition of the functions φ and ψ. (90b) is a counterpart of (90a) involving the backward slash. The semantics is the same but the linear order of the original two functors and the direction in which the resultant functor is looking for its argument are reversed from (90a).

The flexibility of constituency introduced in the grammar with Slash Introduction rules and the assumption of associativity of string concatenation in phonology turns out to be useful in the analysis of long-distance dependencies. The idea traces back to Ades and

Steedman (1982),[81] in which an analysis of English long-distance dependencies is proposed in terms of function composition in an early version of CCG. I illustrate the essential aspect of this analysis by taking relative clauses in English as an example. Relative clauses in English can be analyzed by assigning the category $(\mathrm{N}\backslash\mathrm{N})/(\mathrm{S}/\mathrm{NP})$ to the relativizer *that*:

(91) that; $\lambda P \lambda Q \lambda x.[P(x) \wedge Q(x)]$; $(\mathrm{N}\backslash\mathrm{N})/(\mathrm{S}/\mathrm{NP})$

This lexical entry says that the relativizer *that* takes a sentence missing an NP on its right periphery (i.e. S/NP) as its first argument and becomes a modifier of a noun (i.e. $\mathrm{N}\backslash\mathrm{N}$). [82] With this lexical entry for the relativizer, we can derive a simple relative clause in (92a) with a gap in the object position as in (92b):

(92) a. the man that John saw __

b.

$$
\dfrac{\begin{matrix}\text{the;}\\ \lambda P.\iota x P(x);\\ \mathrm{NP}/\mathrm{N}\end{matrix} \quad \dfrac{\begin{matrix}\text{man;}\\ \textbf{man};\\ \mathrm{N}\end{matrix} \quad \dfrac{\begin{matrix}\text{that;}\\ \lambda P \lambda Q \lambda x.[P(x) \wedge Q(x)];\\ (\mathrm{N}\backslash\mathrm{N})/(\mathrm{S}/\mathrm{NP})\end{matrix} \quad \dfrac{\dfrac{\begin{matrix}\text{john;}\\ \mathbf{j};\\ \mathrm{NP}\end{matrix} \quad \dfrac{\begin{matrix}\text{saw;}\\ \lambda x \lambda y.\mathbf{saw}(y,x);\\ (\mathrm{NP}\backslash\mathrm{S})/\mathrm{NP}\end{matrix} \quad [p\,;x;\mathrm{NP}]^1}{\text{saw} \circ p\,; \lambda y.\mathbf{saw}(y,x); \mathrm{NP}\backslash\mathrm{S}}{/\mathrm{E}}}{\text{john} \circ \text{saw} \circ p\,; \mathbf{saw}(\mathbf{j},x); \mathrm{S}}{\backslash\mathrm{E}}}{\text{john} \circ \text{saw}; \lambda x.\mathbf{saw}(\mathbf{j},x); \mathrm{S}/\mathrm{NP}}{/\mathrm{I}^1}}{\text{that} \circ \text{john} \circ \text{saw}; \lambda Q \lambda x.[\mathbf{saw}(\mathbf{j},x) \wedge Q(x)]; \mathrm{N}\backslash\mathrm{N}}{/\mathrm{E}}}{\text{man} \circ \text{that} \circ \text{john} \circ \text{saw}; \lambda x.[\mathbf{saw}(\mathbf{j},x) \wedge \mathbf{man}(x)]; \mathrm{N}}{\backslash\mathrm{E}}}{\text{the} \circ \text{man} \circ \text{that} \circ \text{john} \circ \text{saw}; \iota x.[\mathbf{saw}(\mathbf{j},x) \wedge \mathbf{man}(x)]; \mathrm{NP}}{/\mathrm{E}}
$$

The formation of the relative clause crucially involves hypothetical reasoning. Since there is no object in the overt string, we hypothetically assume the existence of an object. This allows us to derive the relative clause (without the relativizer) as an S. Once this S is derived, the hypothetical assumption is withdrawn. Note that Slash Introduction is applicable here since the phonology of the hypothesized expression *p* appears at the right periphery. By

[81] Cf. also Gazdar's (1981) analysis of long-distance dependencies in GPSG in terms of 'slash' categories for a similar idea.

[82] In CG, modifiers are standardly treated as functor categories that do not change the category of the expression that they modify (that is, either X/X or $X\backslash X$).

this application of Slash Introduction, the category S/NP and the semantics $\lambda x.\mathbf{saw}(\mathbf{j}, x)$ (set of objects that John saw) are assigned to the string *John saw*. This is then given as an argument to the relativizer and the derivation goes through to assign the right meaning to the whole NP.

(93a), a case involving long-distance extraction, does not require any special assumption.

(93) a. the man that [Mary said [John saw __]]

b.

$$
\dfrac{\dfrac{\text{mary}; \mathbf{m}; \mathrm{NP} \quad \dfrac{\text{said}; \lambda h \lambda y.\mathbf{said}(y, h); (\mathrm{NP}\backslash\mathrm{S})/\mathrm{S} \quad \dfrac{\text{john}; \mathbf{j}; \mathrm{NP} \quad \dfrac{\text{saw}; \lambda x \lambda y.\mathbf{saw}(y, x); (\mathrm{NP}\backslash\mathrm{S})/\mathrm{NP} \quad [p\,; x; \mathrm{NP}]^1}{\text{saw} \circ p\,; \lambda y.\mathbf{saw}(y, x); \mathrm{NP}\backslash\mathrm{S}}/\mathrm{E}}{\text{john} \circ \text{saw} \circ p\,; \mathbf{saw}(\mathbf{j}, x); \mathrm{S}}\backslash\mathrm{E}}{\text{said} \circ \text{john} \circ \text{saw} \circ p\,; \lambda y.\mathbf{said}(y, \mathbf{saw}(\mathbf{j}, x)); \mathrm{NP}\backslash\mathrm{S}}/\mathrm{E}}{\text{mary} \circ \text{said} \circ \text{john} \circ \text{saw} \circ p\,; \mathbf{said}(\mathbf{m}, \mathbf{saw}(\mathbf{j}, x)); \mathrm{S}}\backslash\mathrm{E}}{\text{mary} \circ \text{said} \circ \text{john} \circ \text{saw}; \lambda x.\mathbf{said}(\mathbf{m}, \mathbf{saw}(\mathbf{j}, x)); \mathrm{S}/\mathrm{NP}}/\mathrm{I}
$$

Since there is nothing in the grammar that prevents hypothetical reasoning from crossing a sentence boundary, by hypothetically assuming an object in the embedded clause and withdrawing that hypothesis once the whole relative clause is formed, the category S/NP (and the right semantics) is assigned to the relative clause.

From this illustration, it should be clear that the gap can be embedded arbitrarily deeply; the appropriate category and meaning can be assigned to the relative clause as long as the gap appears at the right periphery of the string.[83] Thus, this analysis captures the essential

[83] This of course opens up the question of how to treat examples such as *the man that Mary said [John saw __ yesterday]*, where the gap does not appear at the right periphery of the string. A general solution for this problem was first proposed by Moortgat (1988), by means of the ‘extraction’ type constructor $\uparrow$. A somewhat different solution involving interactions among different ‘modes’ of composition to bring the ‘gap’ to the right periphery is proposed in the more recent, multi-modal variant of TLG by Bernardi (2002). However, since the treatment of long-distance dependencies in English is not the topic of this dissertation, I will not explore this issue here.

aspect of long-distance dependencies adequately. Note in particular that hypothetical reasoning is crucially made use of in assigning a category and meaning to a string of words that is not a complete sentence, such as *Mary said John saw*.

Another place where this flexibility of constituency has turned out to be useful is the analysis of nonconstituent coordination. ‘Nonconstituent coordination’ refers to a phenomenon in which strings of words that are not usually taken to form constituents are coordinated, as in (94):

(94) a. I gave [Bill the book] and [John the record].

b. I ate [rice on Monday] and [beans on Tuesday].

As Dowty (1988) has shown using a CCG fragment, an analysis of nonconstituent coordination is straightforward in C-flexible CG. Dowty’s own analysis, couched in CCG, is formulated in terms of type raising and function composition, but as shown by, for example, Morrill (1994), it is straightforward to recast it in a setup like the present one which makes use of hypothetical reasoning fully generally. In essence, the associativity in the grammar together with hypothetical reasoning allows one to reanalyze any arbitrary substring X of a string of words Y of category C as being of such category C_0 that returns C when it combines with Y–X (where Y–X informally stands for whatever is left in Y when X is subtracted). Once such a category is assigned to X, multiple strings having the same category C_0 as X can be coordinated using the general coordination schema (which combines expressions of the same syntactic category A and returns a larger expression of category A). The whole coordinated expression is then put together with Y–X to return an expression of category C. The derivation for (94a) is shown in (95) (here, VP abbreviates $\mathrm{NP}\backslash\mathrm{S}$):

(95)

$$\dfrac{\dfrac{\dfrac{[p\,;f;\mathrm{VP/NP/NP}]^1 \quad \textsf{bill}; \mathbf{b}; \mathrm{NP}}{p\circ \textsf{bill}; f(\mathbf{b}); \mathrm{VP/NP}}/\mathrm{E} \quad \textsf{the}\circ\textsf{book}; \textbf{the-book}; \mathrm{NP}}{p\circ\textsf{bill}\circ\textsf{the}\circ\textsf{book}; f(\mathbf{b})(\textbf{the-book}); \mathrm{VP}}/\mathrm{E}}{\textsf{bill}\circ\textsf{the}\circ\textsf{book}; \lambda f.f(\mathbf{b})(\textbf{the-book}); (\mathrm{VP/NP/NP})\backslash\mathrm{VP}}\backslash\mathrm{I}^1$$

$$\dfrac{\begin{array}{l}\textsf{gave};\\ \lambda x\lambda y\lambda z.\textbf{gave}(z,y,z);\\ \mathrm{VP/NP/NP}\end{array} \quad \dfrac{\begin{array}{c}\vdots\;\vdots\\ \begin{array}{l}\textsf{bill}\circ\textsf{the}\circ\textsf{book};\\ \lambda f.f(\mathbf{b})(\textbf{the-book});\\ (\mathrm{VP/NP/NP})\backslash\mathrm{VP}\end{array}\end{array} \quad \dfrac{\begin{array}{l}\textsf{and};\\ \lambda f\lambda g\lambda h.f(h)\wedge g(h);\\ (X\backslash X)/X\end{array} \quad \begin{array}{c}\vdots\;\vdots\\ \begin{array}{l}\textsf{john}\circ\textsf{the}\circ\textsf{record};\\ \lambda f.f(\mathbf{j})(\textbf{the-record});\\ (\mathrm{VP/NP/NP})\backslash\mathrm{VP}\end{array}\end{array}}{\begin{array}{l}\textsf{and}\circ\textsf{john}\circ\textsf{the}\circ\textsf{record};\\ \lambda g\lambda h.h(\mathbf{j})(\textbf{the-record})\wedge g(h);\\ ((\mathrm{VP/NP/NP})\backslash\mathrm{VP})\backslash((\mathrm{VP/NP/NP})\backslash\mathrm{VP})\end{array}}/\mathrm{E}}{\begin{array}{l}\textsf{bill}\circ\textsf{the}\circ\textsf{book}\circ\textsf{and}\circ\textsf{john}\circ\textsf{the}\circ\textsf{record};\\ \lambda h.h(\mathbf{j})(\textbf{the-record})\wedge h(\mathbf{b})(\textbf{the-book});\\ (\mathrm{VP/NP/NP})\backslash\mathrm{VP}\end{array}}\backslash\mathrm{E}}{\begin{array}{l}\textsf{gave}\circ\textsf{bill}\circ\textsf{the}\circ\textsf{book}\circ\textsf{and}\circ\textsf{john}\circ\textsf{the}\circ\textsf{record};\\ \textbf{gave}(\mathbf{j})(\textbf{the-record})\wedge\textbf{gave}(\mathbf{b})(\textbf{the-book});\\ \mathrm{VP}\end{array}}\backslash\mathrm{E}$$

The key aspect in this analysis is the hypothetical assumption of a ditransitive verb. This hypothetical verb combines with the two object NPs *Bill* and *the book* just like ordinary ditransitive verbs and forms a VP. Then, the hypothesis is withdrawn to assign the category $(\mathrm{VP/NP/NP})\backslash\mathrm{VP}$ to the string *Bill the book*. Intuitively, this is saying that this string is something that becomes a VP if it finds a ditransitive verb to its left. The rest of the derivation is straightforward. *John the record* is assigned the same category and these two 'nonconstituents', having the same category, are coordinated to form a larger expression that is still looking for a ditransitive verb to its left. Since there is indeed a ditransitive verb to the left, a VP is formed and this VP further combines with the subject NP to become an S (this last step is omitted in the above derivation).

It turns out, however, that the flexibility of constituency we have introduced in the grammar is too powerful unless it is properly constrained. Dowty (1988) notes cases of potential overgeneration of his function composition-based analysis of nonconstituent coordination such as the following:

(96) *John saw the [girl in the evening] and [boy in the morning].

This ungrammatical sentence is indeed licensed by our current fragment. The following sketches how the string of words *girl in the evening* can be analyzed as a nonconstituent (semantics is omitted for simplicity):

(97)
$$\dfrac{\dfrac{\dfrac{\dfrac{[q\,;\,;\mathrm{VP/NP}]^2 \quad \dfrac{[p\,;\,;\mathrm{NP/N}]^1 \quad \textsf{girl};\,;\mathrm{N}}{p \circ \textsf{girl};\,;\mathrm{NP}}/\mathrm{E}}{q \circ p \circ \textsf{girl};\,;\mathrm{VP}}/\mathrm{E} \quad \textsf{in} \circ \textsf{the} \circ \textsf{evening};\,;\mathrm{VP}\backslash\mathrm{VP}}{q \circ p \circ \textsf{girl} \circ \textsf{in} \circ \textsf{the} \circ \textsf{evening};\,;\mathrm{VP}}\backslash\mathrm{E}}{p \circ \textsf{girl} \circ \textsf{in} \circ \textsf{the} \circ \textsf{evening};\,;(\mathrm{VP/NP})\backslash\mathrm{VP}}\backslash\mathrm{I}^2}{\textsf{girl} \circ \textsf{in} \circ \textsf{the} \circ \textsf{evening};\,;(\mathrm{NP/N})\backslash((\mathrm{VP/NP})\backslash\mathrm{VP})}\backslash\mathrm{I}^1$$

By hypothetically assuming a transitive verb and a determiner to the left of *girl in the evening*, the string can be analyzed as being in a category that is looking for a determiner and a transitive verb to its left to become a VP. It can then be coordinated with *boy in the morning* of the same category and the coordinated expression can combine with the overt determiner *the* and transitive verb *saw* to become a VP.

Essentially, the problem here is that the current fragment is too flexible, due to the fact that we have made associativity globally available. Because of this assumption, *any* arbitrary substring of a string of words can be reanalyzed as a constituent. But given the ungrammaticality of sentences like (96), we need to restrict places where associativity holds in some way or other so that not all arbitrary strings of words can be assigned a constituent status. In the next subsection, I introduce the component of structured phonology in the present theory. As will become clear below, one of the motivations for introducing this component is to provide a principled solution to this problem of C-flexible CG.

But before moving on to the discussion of structured phonology, we need to augment the syntactic calculus with two rules (specifically, Introduction and Elimination rules) for a new kind of directionality-insensitive slash $|$, which I call the **vertical slash**. The addition of this slash and its Introduction and Elimination rules is for the purpose of dealing with quantifier scope. The treatment of quantifier scope that I adopt here is originally due to Oehrle (1994) and is adopted in some variants of contemporary CG such as Muskens (2003). It crucially exploits lambda-binding in phonology. [84]

Since a new slash is added, we first need to modify the definition of syntactic categories accordingly.

(98) a. N, NP and S are categories.

b. If A and B are categories, then so are (A/B), $(B\backslash A)$ and $(A|B)$.

c. Nothing else is a category.

As with the forward slash, I write the argument to the right of the slash for the vertical slash. The Introduction and Elimination rules for $|$ are defined as follows:

(99) a. **Vertical Slash Introduction**

$$\cfrac{\cfrac{\begin{array}{ccccc}\vdots\ \ \vdots & & \cfrac{[\mathsf{p}\,;x;A]^n}{\vdots\ \ \vdots} & & \vdots\ \ \vdots\\ \vdots\ \ \vdots & & & & \vdots\ \ \vdots\end{array}}{\mathsf{b};\varphi;B}}{\lambda p.\mathsf{b};\lambda x.\varphi;B|A}\,|\mathrm{I}^n$$

[84] For a useful discussion of an alternative treatment of quantification in TLG using Moortgat's (1990) scoping constructor $\Uparrow$, see Carpenter (1997). The scoping constructor $\Uparrow$ was later generalized by Moortgat (1996) as a three place q-constructor, where $q(A,B,C)$ is the type of an expression that locally behaves as A, scopes over B to return C. Morrill (1994) observes that q can be defined by means of the extraction $\uparrow$ and infixation $\downarrow$ constructors as $q(A,B,C) =_{def} (B{\uparrow}A){\downarrow}C$. Oehrle's (1994) approach, which I adopt here, is technically simpler than these alternatives by exploiting lambda binding in phonology, which enables one to explicitly keep track of the position of the 'gap' that the quantifier (or some other scope-taking element) lowers into.

b. **Vertical Slash Elimination**

$$\frac{\mathsf{a}; \varphi; A \quad \mathsf{b}; \psi; B|A}{\mathsf{b}(\mathsf{a}); \psi(\varphi); B}|\mathrm{E}$$

Intuitively, the category $B|A$ means that the expression in question is of category B except that an expression of category A is missing somewhere inside it. Thus, expressions with syntactic category $B|A$ is semantically of type $\mathsf{Sem}(A) \to \mathsf{Sem}(B)$. As can be seen in the **Vertical Slash Introduction** rule (99a), the missing position of A within $B|A$ is kept track of by means of a variable in the φ-term bound by the lambda operator. Assuming that b is of type st (string), the term $\lambda p.\mathsf{b}$ in the conclusion of (99a) is of type $st \to st$. The **Vertical Slash Elimination** rule does function application both in semantics and (structured) phonology. With this rule, the functional phonological term created by Vertical Slash Introduction can be applied to expressions that they are looking for to return an ordinary non-functional phonological term. Crucially, the Introduction and Elimination rules for the vertical slash are different from the corresponding rules for the forward and backward slashes in that they involve abstraction and applicatin with functional φ-terms for the phonology.

Just as the applications of Slash Introduction and Slash Elimination rules one after the other for the forward and backward slashes produce unnecessary detours in proofs (cf. the discussion regarding (87) on p. 99), applying Vertical Slash Introduction and Vertical Slash Elimination one after the other creates redundant steps that have no phonological or semantic consequences. However, as we will see below, the present fragment contains in the lexicon expressions that have phonologies with 'higher-order' phonological types. For example, quantifiers are listed in the lexicon in the syntactic category $\mathrm{S}|(\mathrm{S}|\mathrm{NP})$ with phonological type $(st \to st) \to st$, taking expressions with functional phonologies and returning strings for the phonology of the resultant expression. The Vertical Slash Elimination rule

(99b) is needed to treat expressions with such higher-order phonological types. Another case in which the application of Vertical Slash Elimination is not redundant is when ‘parasitic scope’ (which will be discussed in detail in the next chapter) is involved. For such a case, the Introduction and Elimination steps for the ‘host’ expression (where, by the ‘host’ expression, I mean the expression that the parasite element is parasitic on) are needed to create the scope-taking position for the parasitic element. [85]

The following derivation of the inverse scope reading for the sentence *Someone loves everyone* illustrates how the use of lambda abstraction and beta reduction in the φ-calculus enables a straightforward implementation of Montague’s (1973) quantifying-in operation, an idea originally due to Oehrle (1994). (I assume that quantifiers are lexically specified in the syntactic category $\mathrm{S}|(\mathrm{S}|\mathrm{NP})$, with ordinary generalized quantifier meanings and φ-terms of type $(st \to st) \to st$.)

(100)

$$\dfrac{\begin{array}{l}\lambda P.P(\textsf{everyone}); \mathbf{eo};\\ \mathrm{S}|(\mathrm{S}|\mathrm{NP})\end{array} \quad \dfrac{\dfrac{\begin{array}{l}\lambda P.P(\textsf{someone}); \mathbf{so};\\ \mathrm{S}|(\mathrm{S}|\mathrm{NP})\end{array} \quad \dfrac{\dfrac{[q\,; y; \mathrm{NP}]^2 \quad \dfrac{\begin{array}{l}\textsf{loves}; \mathbf{love};\\ (\mathrm{NP}\backslash\mathrm{S})/\mathrm{NP}\end{array} \quad [p\,; x; \mathrm{NP}]^1}{\textsf{loves} \circ p\,; \mathbf{love}(x); \mathrm{NP}\backslash\mathrm{S}}/\mathrm{E}}{q \circ (\textsf{loves} \circ p); \mathbf{love}(x)(y); \mathrm{S}}\backslash\mathrm{E}}{\lambda q.q \circ (\textsf{loves} \circ p); \lambda y.\mathbf{love}(x)(y); \mathrm{S}|\mathrm{NP}}|\mathrm{I}^2}{\textsf{someone} \circ (\textsf{loves} \circ p); \mathbf{so}(\lambda y.\mathbf{love}(x)(y)); \mathrm{S}}|\mathrm{E}}{\lambda p.\ \textsf{someone} \circ (\textsf{loves} \circ p); \lambda x.\mathbf{so}(\lambda y.\mathbf{love}(x)(y)); \mathrm{S}|\mathrm{NP}}|\mathrm{I}^1}{\textsf{someone} \circ (\textsf{loves} \circ \textsf{everyone}); \mathbf{eo}(\lambda x.\mathbf{so}(\lambda y.\mathbf{love}(x)(y))); \mathrm{S}}|\mathrm{E}$$

[85]The use of lambda abstraction and beta reduction in the φ-calculus enables sophisticated string manipulation operations that can deal with most of the word order-related generalizations. One might thus think that forward and backward slashes and the modality distinctions (introduced later in this chapter) imposed on them (which serve the purpose of making the combinatoric component of syntactic calculus sensitive to the morpho-syntactic hierarchical organizations of linguistic expressions) can all be eliminated, leaving only one mode of implication in the syntactic calculus. In fact, such an architecture of grammar has been advocated by various authors in the literature; cf., e.g., Oehrle (1994); de Groote (2001); Muskens (2003, 2007). While such an architecture (which I call ‘purely L-flexible CG’) is attractive for its conceptual simplicity, it has certain empirical inadequacies, as I will discuss in section 3.2.1.

In this derivation, the subject and object NPs are first hypothetically assumed. The two quantifiers 'lower' into the positions that the variables p and q keep track of in the phonology with the help of Vertical Slash Introduction (which binds a variable in the φ-term) and Vertical Slash Elimination (which applies the quantifier meaning and phonology to the lambda-abstracted meaning and phonology of the sentence). This is essentially a formalization of quantifying-in with the use of lambda-binding in φ-terms. Note that the order in which the quantifiers combine with the sentence in the derivation corresponds to their semantic scope: in (100), since the subject quantifier *someone* combines with the sentence first, it takes narrower scope than the object quantifier *everyone*.

3.1.3 Structured phonology: Modelling L-flexible CG

We have seen above that, once we introduce associativity in the phonology globally (i.e. once we assume that associativity is available everywhere), the grammar becomes too flexible since that assumption gives rise to an undesirable situation in which *any* substring of a sentence (regardless of its original 'constituent structure') can be analyzed as a constituent, leading to overgeneration in certain cases. Moreover, it turns out that just introducing associativity by itself is not flexible enough either; in order to deal with flexibility of word order exhibited by many languages, we need to recognize what we might call 'flexibility in linear organization' in addition to flexibility in hierarchical organization made available with associativity.[86] These two considerations motivate the development of the other aspect of the proposed theory, namely, the component of **structured phonology**.

[86]'Constituent order' is perhaps a better term for 'word order' here, given that units of linguistic expressions whose orders are free (to some extent) in a given language are usually larger than words. But I use the term 'free word order' following the common practice.

As explained at the beginning of this chapter, this component governs properties pertaining to surface morpho-syntactic realizations of linguistic expressions.

The component of structured phonology lies at the heart of the present theory. However, because of the inherently abstract nature of this component, readers might initially find it difficult to grasp the overall picture and understand the technical details at the same time. To alleviate this difficulty, I will first provide a brief road map on how the presentation in the following subsections is structured. Section 3.1.3.1 lays out the general conceptual underpinnings of structured phonology. Then, building on this general characterization, in section 3.1.3.2 I spell out the complete formal details of this component by defining model theoretic interpretations for structured phonologies in terms of a preordered algebra. Finally, section 3.1.3.3 illustrates the system with some concrete linguistic examples. Since the discussion in section 3.1.3.2 is inevitably highly technical, readers who are primarily interested in the linguistic applications of the present theory might decide to skip (or skim) this section and work through the linguistic illustrations in section 3.1.3.3 by referring to the fragment in the appendix.

3.1.3.1 Conceptual underpinnings of structured phonology

To start with a somewhat abstract conceptual characterization, we can think of structured phonology as an intermediate component of grammar that lies between the syntax proper (i.e. the syntactic calculus) and phonology. For now, we can think of the mapping from syntax to phonology in the following way.[87] The syntactic calculus with the logical rules licenses a triple of structured phonology, semantic interpretation and syntactic category as a well-formed linguistic expression. Let us call this structured phonology the **least**

[87] In section 3.1.4, it will become clear that this picture involves a slight simplification.

pronounceable phonology of the linguistic expression in question. Then, we can think of this least pronounceable phonology as representing all of the possible phonological manifestations of that linguistic expression. These 'possible phonological manifestations' are themselves modelled as a special kind of structured phonologies (which I call **concrete** structured phonologies, as opposed to **abstract** structured phonologies that are not directly pronounceable). Thus, the notion of structured phonology should be thought of as a generalization of the notion of phonological form (represented as simple strings) in the sense that only a certain subset of structured phonologies having a special property (of being 'concrete and directly pronounceable) correspond to phonological forms of linguistic expressions in the traditional sense.

Structured phonologies are organized in a preordered algebra that I call the **P-algebra** (for now, it suffices to understand that the P-algebra is a set of structured phonologies in which a certain kind of ordering relation—technically, a preorder—is imposed on its elements; formal details will be spelled out below). The relationship between the least pronounceable phonology and the possible phonological manifestations that it represents is that the latter are 'maximal' elements (in the technical sense) that are ordered above the former in the preorder imposed on the P-algebra. Technically, the actual pronounceable phonology of a given linguistic expression is obtained by positing in the syntactic calculus an interface rule called the **P-interface rule**, which refers to the preorder in the P-algebra and converts the abstract structured phonology of the linguistic expression to one of its actually pronounceable concrete manifestations.

This means that the structure of the P-algebra, that is, the preorder imposed on it, plays a crucial role in determining the actual phonological forms that a given linguistic expression can have. In order to capture linguistically relevant generalizations pertaining to word order and hierarchical organization adequately, the P-algebra is made **multi-modal** (in the sense to be explained below; for readers familiar with the recent 'multi-modal' variants of CG, e.g., Multi-Modal TLG[88] and Multi-Modal CCG (Baldridge 2002; Steedman and Baldridge 2007), the notion of multi-modality here is essentially the same as in these approaches, which stems back to Dowty (1996)). Roughly speaking, multi-modality here means that there are multiple 'modes' of composition for forming complex structured phonologies from smaller ones.[89] As we will see below, these different modes of composition can be thought of as modelling different degrees of 'tightness' of morpho-syntactic bond between the linguistic expressions that are combined. For example, some modes are more flexible than other modes in allowing for a rebracketing of the internal hierarchical structure of a complex structured phonology (associativity) or allowing for a rearrangement of the linear order of the elements that they combine (permutativity) or in having both of these properties.

3.1.3.2 Formalizing structured phonology in terms of a preordered algebra

In this subsection, I spell out the formal details of the component of structured phonology in the present theory. As I stated above, in the present theory, the component of structured phonology is modelled in terms of a preordered algebra called the **P-algebra**. Technically, the P-algebra constitutes the domain into which **φ-terms** (i.e. the terms we write

[88]See Bernardi (2002) for a readable introduction of Multi-Modal TLG. For a more comprehensive discussion, see Moortgat (1997). For some linguistic applications (on phenomena pertaining to morpho-syntax), see Moortgat and Oehrle (1994) (on Dutch verb clustering) and Kraak (1998) (on French clitics). The earliest attempt at a multi-modal system of CG seems to be Oehrle and Zhang (1989), which incorporates **L** and **NL** within a single system of logic for the treatment of the that-trace effect in English extraction.

[89]In the present theory, I will not make use of any unary modality, e.g., of the kind employed in certain variants of Multi-Modal TLG (Moortgat 1997; Bernardi 2002).

for the (structured) phonologies of linguistic expressions) are interpreted. That is, just as with semantics, the grammar (or, syntactic calculus) manipulates objects of the term calculus (i.e. φ-terms) but (the models of) the actual phonology of linguistic expressions are the model-theoretic interpretations of these terms. The preorder in the P-algebra is defined by first defining a binary relation $\leq$ in a logic that I call the **inequational logic** for φ-terms and extending the interpretation function to map the $\leq$ relation in this inequational logic to the preorder $\sqsubseteq$ in the P-algebra. (This is analogous to the use of the inequational logic in the denotational semantics of LCF/PCF (Scott 1993; Plotkin 1977).) This way, the $\leq$ relation in the inequational logic effectively mirrors the preorder in the P-algebra and we can refer to it in the course of a syntactic derivation so that structured phonologies of linguistic expression can potentially constrain the way in which certain syntactic derivations are licensed (or not licensed) in the syntactic calculus.

In what follows, I spell out the specific details of the component of structured phonology by developing a fragment of Japanese that handles certain aspects of word order-related phenomena. For this Japanese fragment, I posit the following seven abstract modes of composition, together with the 'pronounceable' mode designated by $\bullet$ in structured phonology:

(101) a. inflexible mode: $\star$

b. complex predicate mode: $<$

c. scrambling-only mode: $\times$

d. default scrambling mode: $\cdot$

e. associative-only mode: $\diamond$

f. verb raising mode: $\ll$

g. semi-pronounceable mode: $\blacklozenge$

Now that we distinguish between these modes in structured phonology, we need to introduce distinct connectives for forming complex φ-terms, each denoting one of these modes of composition. These connectives are distinguished by the subscripts designating the modes as in, e.g., $\circ_\star$ for the inflexible mode. Also, in what follows, I use indices such as i and j (on the binary connectives in the φ-calculus ($\circ_i$, $\circ_j$), the corresponding binary operators in the P-algebra ($^{\frown i}$,$^{\frown j}$) and the forward and backward slashes ($/_i, /_j, \backslash_i, \backslash_j$)) as metavariables ranging over modes. Importantly, unlike what we have assumed up until the end of the previous section, the binary connectives for forming complex φ-terms, except for the one for the 'pronounceable' mode $\bullet$, do not denote string concatenation. Instead, they are connectives for forming terms that denote certain abstract (phonological) model-theoretic objects called structured phonologies. In order to talk about the relationship between structured phonologies and the actually pronounceable strings below, I introduce here a distinction between two kinds of structured phonologies. I call structured phonologies involving only the pronounceable mode (i.e. those that are maximal elements in the preorder and that represent actually pronounceable strings) **concrete** structured phonologies. All other structured phonologies (i.e. those that involve at least one abstract mode of composition) are called **abstract** structured phonologies.

Since structured phonologies are abstract objects, the 'meanings' of the 'modes' of composition that are used for formimg these objects are inherently abstract as well. Technically, these 'meanings' (or properties such as 'left associativity') are defined in terms of the preorder (i.e. the ordering relation) imposed on the P-algebra. The best way to get the feel for them is to work through actual linguistic examples. These examples will be provided once we have spelled out the formal details in this subsection, that is, from section 3.1.3.3

onward, starting with simple illustrations and gradually developing into full-fledged analyses of the Japanese data through Chapter 4.

Technically, the preorder imposed on the P-algebra is defined by constraining the inequality $\leq$ relations by axioms in the inequational logic for φ-terms. For the Japanese fragment, I assume that the inequational logic has the following inference rules: [90]

(102) Structured phonologies form a preorder.

$$\frac{}{A \leq A}\text{REF}$$

$$\frac{A \leq B \quad B \leq C}{A \leq C}\text{TR}$$

(103) The $\circ_i$ are monotonic in both arguments.

$$\frac{A \leq A' \quad B \leq B'}{A \circ_i B \leq A' \circ_i B'}\text{MON}$$

$$(\circ_i \in \{\circ_\star, \circ_<, \circ_\times, \circ_\bullet, \circ_\diamond, \circ_\ll, \circ_\blacklozenge, \bullet\})$$

(104) ϵ is a two-sided identity for all the $\circ_i$.

$$\frac{}{\epsilon \circ_i A \leq A}\text{ID}_l$$

$$(\circ_i \in \{\circ_\star, \circ_<, \circ_\times, \circ_\bullet, \circ_\diamond, \circ_\ll, \circ_\blacklozenge, \bullet\})$$

$$\frac{}{A \circ_i \epsilon \leq A}\text{ID}_r$$

$$(\circ_i \in \{\circ_\star, \circ_<, \circ_\times, \circ_\bullet, \circ_\diamond, \circ_\ll, \circ_\blacklozenge, \bullet\})$$

(105) (ILA; Intermodal Left Association)

$$\frac{}{(A \circ_i B) \circ_j C \leq A \circ_i (B \circ_j C)}\text{ILA}$$

$$(\circ_i, \circ_j \in \{\circ_\ll, \circ_<, \circ_\diamond, \circ_\bullet\})$$ [91]

[90] As in the notation of syntactic categories, I omit the outermost parentheses when writing φ-terms.

[91] Note about notation: the modes i and j can (but do not need to) be identical.

(106) (IRA; Intermodal Right Association)

$$\frac{}{A \circ_i (B \circ_i C) \leq (A \circ_i B) \circ_i C}\text{IRA}$$

$$(\circ_i \in \{\circ_\diamond, \circ_\bullet\})$$

(107) (SCR; scrambling)

$$\frac{}{A \circ_i (B \circ_j C) \leq B \circ_i (A \circ_j C)}\text{SCR}$$

$$(\circ_i, \circ_j \in \{\circ_\times, \circ_\bullet\})$$

(108) (ULA; Unimodal Left Association)

$$\frac{}{(A \circ_\blacklozenge B) \circ_\blacklozenge C \leq A \circ_\blacklozenge (B \circ_\blacklozenge C)}\text{ULA}$$

$$\frac{}{(A \bullet B) \bullet C \leq A \bullet (B \bullet C)}\text{ULA}$$

(109) (URA; Unimodal Right Association)

$$\frac{}{A \circ_\blacklozenge (B \circ_\blacklozenge C) \leq (A \circ_\blacklozenge B) \circ_\blacklozenge C}\text{URA}$$

$$\frac{}{A \bullet (B \bullet C) \leq (A \bullet B) \bullet C}\text{URA}$$

(110) VP Flattening

$$\frac{}{A \circ_\times B \leq A \circ_\diamond B}\text{VPF}$$

(111) Verb Clustering I

$$\frac{}{A \circ_\ll B \leq A \bullet B}\text{VC1}$$

(where both A and B are terms of type cl)

(112) Verb Clustering II

$$\frac{}{A \circ_< B \leq A \bullet B}\text{VC2}$$

(113) Clustering

$$\frac{}{A \circ_\star B \leq A \bullet B}\text{CL}$$

(114) Semi-Pronunciation

$$\frac{}{A \circ_i B \leq A \circ_{\blacklozenge} B}\mathrm{SPN}$$

$$(\circ_i \in \{\circ_{\times}, \circ_{\cdot}, \circ_{\diamond}\})$$

(115) Pronunciation

$$\frac{}{A \circ_{\blacklozenge} B \leq A \bullet B}\mathrm{PN}$$

(102)–(104) are rules that apply to all modes and that define the basic properties of the pre-order. (105)–(115) are rules that apply to specific modes only and that govern the properties (and interactions) of these specific modes.

The way in which the latter, mode-specific rules (105)–(115) work and interact with one another play crucial roles in capturing linguistically relevant generalizations, but since that is best understood by examining the analyses of specific linguistic phenomena (which will be illustrated in the rest of this chapter with a couple of examples and will be presented in full detail in the next chapter), I will note here only a few things about these rules.

The rules in (105)–(109) are structure-changing rules in the sense that they change the forms of structured phonologies that they apply to. All these rules are constrained to apply only to φ-terms in which elements are combined in certain specific modes, as indicated by the subscripts i and j in (105)–(107) and the direct modality specifications in (108)–(109). The Unimodal Association rules (108)–(109) are constrained to apply only when all of the relevant elements are combined in one of the two modes $\blacklozenge$ (semi-pronounceable mode) or $\bullet$ (pronounceable mode). These rules define the properties of these modes: both $\blacklozenge$ and $\bullet$ are associative themselves but do not interact with other modes. The other three structure-changing rules are more flexible and they define the intermodal relationships among the fully abstract modes $\ll$, $<$, $\times$, $\cdot$ and $\diamond$. These rules are defined in such a way that they are applicable to structures involving two different modes as well. As we will see in the actual linguistic applications in the next chapter, the flexible interactions among the abstract modes that these rules induce will be crucially exploited in capturing the complex patterns of (in)flexibility of word order and constituency that different linguistic phenomena exhibit.

The rules in (110)–(115) are rules that convert one mode into another. The VP Flattening rule (110) is used for accounting for a certain idiosyncratic property of the VP complementation construction. The other rules are for the purpose of converting the abstract unpronounceable modes to the actually pronounceable mode $\bullet$. For a reason that will become clear when the analysis of nonconstituent coordination is presented in the next chapter, all the abstract modes except for the two left associative modes $\ll$ and $<$ and the inflexible mode $\star$ are first mapped to the semi-pronounceable mode $\blacklozenge$ before being mapped to the pronounceable mode $\bullet$. The other three modes are directly mapped to the pronounceable mode by the rules (111)–(113). (The restriction imposed on the verb raising mode $\ll$ is to capture the obligatory verb clustering of the compound verb construction in Japanese, as will be discussed in detail in section 4.3.2.)

We will see below a couple of examples that illustrate the ways in which the rules defined above work in actual linguistic analyses, but before doing so, we need to spell out the complete formal details of the theory. One thing that is still missing above is the exact details of how φ-terms are interpreted in the model. This can be done as follows. The interpretation function $[\![\cdot]\!]$ maps each φ-term to the structured phonology it denotes in the P-algebra. I refer to these objects in the P-algebra by the following meta-language names:

(116) a. $[\![\epsilon]\!] = \varepsilon$

b. $[\![\mathsf{ken}]\!]$ = /kEN/, etc. for all constants of type st

c. $[\![\circ_i]\!] = {}^{\frown i}$ $\quad (\circ_i \in \{\circ_\star, \circ_<, \circ_\times, \circ_\bullet, \circ_\diamond, \circ_\ll, \circ_\blacklozenge\})$

d. $[\![\bullet]\!] = +$

In addition, the interpretation function is extended to map the $\leq$ relation in the inequational logic to the preorder $\sqsubseteq$ in the P-algebra:

(117) $[\![\leq]\!] = \sqsubseteq$

Note that structured phonologies in the P-algebra form a preorder with the $\sqsubseteq$ relation. This is so because the $\leq$ relation is interpreted as $\sqsubseteq$ and $\leq$ in the inequational logic satisfies reflexivity and transitivity (cf. (102)).[92] $+$ in (116d) is the symbol for string concatenation. Thus, the pronounceable mode $\bullet$ is interpreted as string concatenation. By contrast, the interpretations of binary connectives other than $\bullet$ given in (116c) are (phonological) model-theoretic objects that define certain abstract relationships among structured phonologies, relationships that are, in a sense, more general than string concatenation.

Having spelled out the formal details of structured phonology completely, we now need to introduce a new rule to the syntactic calculus so that it can refer to the preorder in the P-algebra through the $\leq$ relation defined on φ-terms. I call this rule the **P-interface rule**. This rule is defined as follows and can be thought of as a rule that interfaces the syntactic calculus and the structured phonology:

(118) **P-interface rule**

$$\frac{\mathsf{A}; \sigma; A}{\mathsf{A}'; \sigma; A}\text{PI}$$

(where $\mathsf{A} \leq \mathsf{A}'$ is a theorem in the inequational logic for φ-terms)

It should now be clear what I meant by saying that a least pronounceable phonology of a linguistic expression 'represents' the total set of possible phonological manifestations of

[92] A preorder is a relation that satisfies reflexivity and transitivity. That is, for any elements a, b and c in the P-algebra, the following hold:

(i) a. $a \sqsubseteq a$ (reflexivity)

b. if $a \sqsubseteq b$ and $b \sqsubseteq c$, then $a \sqsubseteq c$ (transitivity) that linguistic expression. Assuming that the syntactic calculus licenses a certain triple $\langle \pi; \sigma; \gamma \rangle$ as a well-formed linguistic expression, then, with the P-interface rule (118), any triple $\langle \pi'; \sigma; \gamma \rangle$ where π' denotes a structured phonology that is above or equivalent to the structured phonology denoted by π in the P-algebra (i.e. where $[\![\pi]\!] \sqsubseteq [\![\pi']\!]$ holds) is also licensed as a well-formed linguistic expression. In other words, given the general availability of the P-interface rule, the least pronounceable abstract phonology π can be thought of as acting as a proxy for all of the concrete, actually pronounceable structured phonologies that are ordered above it. And this total set of concrete structured phonologies constitutes the set of possible phonological manifestations of the linguistic expression in question.[93]

To complete the extension to a multi-modal system, we need to make slashes in syntactic categories carry modality specifications. This is so because we assume that the specific mode of composition that is involved in combining one expression with another is each specified in the lexicon in the definition of the relevant functor category. Thus, we first minimally revise the definitions of syntactic categories as follows:

(119) a. N, NP and S are categories.

b. If A and B are categories, then so are $A/_iB$, $B\backslash_iA$, and $A|B$ for any $i \in \{\star, <, \times, \cdot, \diamond, \ll, \blacklozenge\}$.

c. Nothing else is a category.

Note that the vertical slash $|$ does not carry any modality specification. This is because, unlike forward and backward slashes, the vertical slash does not interact directly with the component of structured phonology and thus the modality distinction is irrelevant for it (to

[93]This might be an empty set, in which case the grammar fails to license a pronounceable string for the expression in question.

see this, compare the definition of Vertical Slash Introduction and Elimination (99) with the revised definitions of Forward and Backward Slash Introduction and Elimination (120) and (128) introduced below; in the latter, the modality on the slash is required to match the modality of the corresponding binary connective as indicated by the index i). Note also that complex categories cannot be formed with the pronounceable mode $\bullet$. That is, once the abstract structure phonology is mapped to an actually pronounceable string, no logical operations (Slash Introduction and Slash Elimination) are possible.

The rules in the syntactic calculus are redefined accordingly. Since I assume an impoverished application-only system in this subsection, I only introduce the revised Slash Elimination rules here:[94]

(120) a. **Forward Slash Elimination**

$$\frac{\textsf{a}; \varphi; A/_i B \qquad \textsf{b}; \psi; B}{\textsf{a} \circ_i \textsf{b}; \varphi(\psi); A} /_i\mathrm{E}$$

b. **Backward Slash Elimination**

$$\frac{\textsf{b}; \psi; B \qquad \textsf{a}; \varphi; B\backslash_i A}{\textsf{b} \circ_i \textsf{a}; \varphi(\psi); A} \backslash_i\mathrm{E}$$

The subscript i on the slash of the functor in the premise and on the binary connective in the phonology of the conclusion is a variable over modes and ensures that the lexically specified modalities indicated on the slashes of syntactic categories are correctly inherited when the structured phonologies of larger linguistic expressions are formed.

[94] Revised Slash Introduction rules will be introduced in the next subsection.

3.1.3.3 Some linguistic illustrations

We are now ready to see how the grammar works with the newly added component of structured phonology. A sample lexicon for Japanese (which now has modality specifications on slashes) is given in (121):[95]

(121)

mari-ga; **m**; NP_n	piano-o; **the-piano**; NP_a
gitaa-o; **the-guitar**; NP_a	uta-o; **the-song**; NP_a
ken-ni; **k**; NP_d	akira-ni; **a**; NP_d
hii-te; **play**; $\mathrm{NP}_a\backslash_{\cdot}\mathrm{NP}_n\backslash_{\cdot}\mathrm{S}$	utat-te; **sing**; $\mathrm{NP}_a\backslash_{\cdot}\mathrm{NP}_n\backslash_{\cdot}\mathrm{S}$
muri-ni; **forcibly**; $(\mathrm{NP}_n\backslash_{\cdot}\mathrm{S})/_{\cdot}(\mathrm{NP}_n\backslash_{\cdot}\mathrm{S})$	utat-ta; **sang**; $\mathrm{NP}_a\backslash_{\cdot}\mathrm{NP}_n\backslash_{\cdot}\mathrm{S}$
morat-ta; **benef**; $(\mathrm{NP}_n\backslash_{\cdot}\mathrm{S})\backslash_{<}(\mathrm{NP}_d\backslash\mathrm{NP}_n\backslash_{\cdot}\mathrm{S})$	

In this lexicon, all of the slashes carry the default scrambling mode $\cdot$ except for the one for the embedded VP in the lexical entry for the benefactive predicate *morat-ta*, which is specified to be in the complex predicate mode $<$.

With this lexicon and the fragment developed up to this point, an analysis of clause-internal scrambling goes as follows:

(122)
$$\dfrac{\dfrac{\text{mari-ga}; \mathbf{m}; \mathrm{NP}_n \qquad \dfrac{\text{uta-o}; \textbf{the-song}; \mathrm{NP}_a \quad \text{utat-ta}; \textbf{sang}; \mathrm{NP}_a\backslash_{\cdot}\mathrm{NP}_n\backslash_{\cdot}\mathrm{S}}{\text{uta-o} \circ_{\cdot} \text{utat-ta}; \textbf{sang}(\textbf{the-song}); \mathrm{NP}_n\backslash_{\cdot}\mathrm{S}}\backslash_{\cdot}\mathrm{E}}{\text{mari-ga} \circ_{\cdot} (\text{uta-o} \circ_{\cdot} \text{utat-ta}); \textbf{sang}(\textbf{the-song})(\mathbf{m}); \mathrm{S}}\backslash_{\cdot}\mathrm{E}}{\text{uta-o} \bullet (\text{mari-ga} \bullet \text{utat-ta}); \textbf{sang}(\textbf{the-song})(\mathbf{m}); \mathrm{S}}\mathrm{PI}$$

In this derivation, the transitive verb *utat-ta* combines with the direct object and the subject in that order, as lexically specified. The last step in the derivation is new. Here, we see

[95] The lexicon here is simplified in that postpositions, the tense morpheme *-ta* and the suffix *-te* that attach to verbs are not treated as separate entries. As will be discussed in section 4.1.4, I assume that postpositions attach to their heads in the semi-pronounceable mode $\blacklozenge$ to capture the postposition stranding facts in nonconstituent coordination. The other two morphemes should presumably be treated as attaching to their heads in the inflexible mode $\star$. But I will gloss over this aspect here.

an application of the P-interface rule. This step is licensed by the following lemma in the inequational logic for φ-terms:[96]

(123) **Lemma:** $A \circ_{.} (B \circ_{.} C) \;\; \leq \;\; B \bullet (A \bullet C)$

Proof:

$$\dfrac{\dfrac{}{A \circ_{.} (B \circ_{.} C) \leq B \circ_{.} (A \circ_{.} C)}\mathrm{SCR} \qquad \dfrac{\dfrac{\dfrac{}{B \leq B}\mathrm{RFF} \quad \dfrac{\dfrac{}{A \circ_{.} C \leq A \circ_{\blacklozenge} C}\mathrm{SPN} \quad \dfrac{}{A \circ_{\blacklozenge} C \leq A \bullet C}\mathrm{PN}}{A \circ_{.} C \leq A \bullet C}\mathrm{TR}}{B \circ_{.} (A \circ_{.} C) \leq B \circ_{.} (A \bullet C)}\mathrm{MON} \quad \dfrac{\dfrac{}{B \circ_{.} (A \bullet C) \leq B \circ_{\blacklozenge} (A \bullet C)}\mathrm{SPN} \quad \dfrac{}{B \circ_{\blacklozenge} (A \bullet C) \leq B \bullet (A \bullet C)}\mathrm{PN}}{B \circ_{.} (A \bullet C) \leq B \bullet (A \bullet C)}\mathrm{TR}}{B \circ_{.} (A \circ_{.} C) \leq B \bullet (A \bullet C)}\mathrm{REF}}{A \circ_{.} (B \circ_{.} C) \leq B \bullet (A \bullet C)}\mathrm{TR}$$

Since writing all of the steps of proofs in the above format is tedious (and makes proofs unnecessarily difficult to read), I will present proofs in a simplified format shown below, where monotonicity, reflexivity and transitivity are implicitly assumed and multiple applications of the Semi-Pronunciation and Pronunciation rules are collapsed into one step:

(124) $A \circ_{.} (B \circ_{.} C)$

$\leq B \circ_{.} (A \circ_{.} C)$ (SCR)

$\leq B \circ_{\blacklozenge} (A \circ_{\blacklozenge} C)$ (SPN)

$\leq B \bullet (A \bullet C)$ (PN)

Essentially, two things are happening in this proof. First, the order of the subject and object NPs is switched. This is made possible since the mode of combination involved in putting together the verb and its arguments is the default scrambling mode $\cdot$ and hence the Scrambling rule (107) is applicable, switching the order of the two arguments in the φ-term. Then, the unpronounceable abstract mode $\circ_{.}$ is converted to the pronounceable mode

[96] The Scrambling rule is defined as in (107) rather than as a simpler rule that flips the order of any two adjacent elements (corresponding to the structural rule of permutation in LP) in order to capture the fact that the verbal head stays in the final position in Japanese.

• denoting string concatenation via Semi-Pronunciation (114) and Pronunciation (115). Thus, the last line of (122) is saying that the string of words *uta-o Mari-ga utat-ta* is a well-formed sentence in Japanese denoting the proposition that Mari sang the song. In this way, by having the P-interface rule in the syntactic calculus, we can always derive the φ-term that denotes an actually pronounceable structured phonology (if there is one).

Let us now look at a slightly more complicated example. The *-te* form complex predicate construction in Japanese allows for scrambling of arguments of the embedded verb with the arguments of the higher verb quite freely. Thus, in (125) (= (55b) from Chapter 2), the accusative direct object of the embedded verb scrambles over a matrix dative argument so that the former linearly precedes the latter in the surface order:

(125) Mari-ga *piano-o* Ken-ni **hii-te** **morat-ta**.
Mari-NOM piano-ACC Ken-DAT play-TE BENEF-PAST
'Mari had Ken play the piano for her.'

This construction can be analyzed by assigning the complex predicate mode $<$ as the mode of composition involved in putting together the lower verb (V1) and the higher verb (V2). Intuitively, this captures the intermediate degree of tightness of morpho-syntactic bond involved in this construction. (For more details, see the complete analysis in section 4.3.3 in the next chapter.) The derivation for (125) is given in (126):

(126)

$$
\dfrac{\dfrac{\text{ken-ni}; \mathbf{k}; \mathrm{NP}_d \quad \dfrac{\dfrac{\text{piano-o}; \mathbf{p}; \mathrm{NP}_a \quad \text{hii-te}; \mathbf{play}; \mathrm{NP}_a\backslash_{\cdot}\mathrm{NP}_n\backslash_{\cdot}\mathrm{S}}{\text{piano-o} \circ_{\cdot} \text{hii-te}; \mathbf{play}(\mathbf{p}); \mathrm{NP}_n\backslash_{\cdot}\mathrm{S}}\backslash_{\cdot}\mathrm{E} \quad \begin{array}{l}\text{morat-ta}; \lambda P\lambda y\lambda x.\mathbf{benef}(x, P(y));\\ (\mathrm{NP}_n\backslash_{\cdot}\mathrm{S})\backslash_{<}(\mathrm{NP}_d\backslash_{\cdot}\mathrm{NP}_n\backslash_{\cdot}\mathrm{S})\end{array}}{(\text{piano-o} \circ_{\cdot} \text{hii-te}) \circ_{<} \text{morat-ta}; \lambda y\lambda x.\mathbf{benef}(x, \mathbf{play}(\mathbf{p})(y)); \mathrm{NP}_d\backslash\mathrm{NP}_n\backslash_{\cdot}\mathrm{S}}\backslash_{<}\mathrm{E}}{\text{ken-ni} \circ_{\cdot} ((\text{piano-o} \circ_{\cdot} \text{hii-te}) \circ_{<} \text{morat-ta}); \lambda x.\mathbf{benef}(x, \mathbf{play}(\mathbf{p})(\mathbf{k})); \mathrm{NP}_n\backslash_{\cdot}\mathrm{S}}\backslash_{\cdot}\mathrm{E}}{\text{piano-o} \bullet (\text{ken-ni} \bullet (\text{hii-te} \bullet \text{morat-ta})); \lambda x.\mathbf{benef}(x, \mathbf{play}(\mathbf{p})(\mathbf{k})); \mathrm{NP}_n\backslash_{\cdot}\mathrm{S}}\mathrm{PI}
$$

At the last step of the derivation, the direct object *piano-o* of the embedded verb scrambles over the dative argument of the higher verb, resulting in the surface order in which the former linearly precedes the latter. This step is licensed by the P-interface rule since the structured phonology of the conclusion expression is ordered above that of the premise expression in the P-algebra:

(127) **Lemma:** $A \circ. ((B \circ. C) \circ_{<} D) \quad \leq \quad B \bullet (A \bullet (C \bullet D))$

Proof:

$$
\begin{array}{lr}
\ A \circ. ((B \circ. C) \circ_{<} D) & \\
\leq A \circ. (B \circ. (C \circ_{<} D)) & \text{(ILA)} \\
\leq B \circ. (A \circ. (C \circ_{<} D)) & \text{(SCR)} \\
\leq B \circ. (A \circ. (C \bullet D)) & \text{(VC2)} \\
\leq B \bullet (A \bullet (C \bullet D)) & \text{(SPN, PN)}
\end{array}
$$

Intuitively, what is going on here is that, due to the fact that the mode employed in combining V1 and V2 is left associative, V1 and V2 can be analyzed as forming a verb cluster by Intermodal Left Association (105). Once this verb cluster is formed, the object of V1 has the same status as arguments of V2 and thus can scramble over the matrix dative argument by the Scrambling rule (107).

The example of interclausal scrambling of the -*te* form complex predicate above illustrates how the partial flexibility of the complex predicate mode $<$ ('partial', in the sense that this mode is only left associative and neither is right associative nor allows for scrambling) makes available partial flexibility of constituency. As will become clear in the next chapter when the complete analysis of the four kinds of complementation constructions are presented, the present analysis captures the distributional differences among these constructions by assigning to them distinct modes of composition for combining the higher and lower verbs (or clauses) that have different degrees of flexibility, thereby exploiting the component of structured phonology as a locus for capturing surface-oriented morpho-syntactic generalizations.

Now that we have spelled out the component of structured phonology modelling L-flexible CG and have seen some illustrative examples that provide empirical justification for it, in the next section, I will expand the fragment in full by putting back the Slash Introduction rules from section 3.1.2. It will then become clear how the modality distinction introduced above (in particular the distinction between associative and non-associative modes) can be made use of for controlling the flexibility of hierarchical organization which was globally available in C-flexible CG (and in our non-modalized simulation of it in the present theory in section 3.1.2).

3.1.4 Putting the two components together

So far, I have illustrated two kinds of CG by taking a close look at two components of the present theory: C-flexible CG with the syntactic calculus and L-flexible CG with the structured phonology. Each of these approaches has its own empirical motivations, so we need both within a single theory. But we do not yet have anything like that since the fragment from the previous subsection with the component of structured phonology fully articulated is not equipped with a mechanism for doing hypothetical reasoning: the Slash Introduction rules are missing. This means that analyses of empirical phenomena that crucially make use of hypothetical reasoning in C-flexible CG do not straightforwardly carry over to it. Hypothetical reasoning is needed for these phenomena since they are representative cases where functor-argument relationships among linguistic expressions are not established in the immediate local contexts of linguistic composition (if they were, a system with Slash Elimination rules alone for the logical rules would suffice). In such a case, we need to tentatively assume that something of the appropriate sort exists, reason further, and then later remove that hypothetical assumption at the point where the thing that was originally missing is found. The two cases that I have illustrated at the end of section 3.1.2, namely, long-distance dependencies and nonconstituent coordination, both have this property. In a long-distance dependency construction, the missing element does not appear in the local context but rather is displaced to a higher position across an arbitrarily long sequence of structural embedding. Nonconstituent coordination can be characterized as a case in which one expression simultaneously fills some missing slot for two or more expressions of the same sort. Since there is only one instance of an expression that fills the missing slot, the functor-argument relation cannot be established locally; the two (or more) 'incomplete' expressions first need to be coordinated so that the missing slots from each of the conjuncts are merged into one, so to speak.

At a somewhat more conceptual level, we can think of the two kinds of rules that we have posited in our fragment, namely, the logical rules (i.e. Slash Elimination and Slash Introduction) and the P-interface rule, as rules for different kinds of reasoning involved in natural language syntax: the logical rules sanction reasoning about the semantically-oriented functor-argument relationships among linguistic expressions, whereas the P-interface rule sanctions reasoning about the surface phonological realizations of linguistic expressions. This is so because, although the P-interface rule is technically a rule within the syntactic calculus, what it effectively does is to refer to the preorder in the structured phonology, and this preorder is what really governs the latter kind of reasoning. We need both kinds of reasoning in our grammar. Moreover, as I will show below, there are cases in which these two kinds of reasoning need to interact with one another in determining the well-formedness of particular sentences.

It turns out that we already almost have a theory that has the desired property (namely, one in which the two kinds of reasoning interact with one another appropriately). The only thing we need to do is to put the Slash Introduction rules from section 3.1.2 (with slight modification) back into the fragment that we developed in section 3.1.3. The modification needed is that, since the grammar is now multi-modal, we need to make sure that the right mode is inherited to the slash when withdrawing a hypothetically assumed expression, so that the newly created functor looks for the missing expression in the right mode. This is ensured by coindexing (with the subscript i) the mode for the binary connective of the φ-term of the premise expression and the mode for the slash of the conclusion expression in the revised definitions of the Slash Introduction rules in (128):

(128) a. **Forward Slash Introduction**

$$\dfrac{\dfrac{\begin{matrix} \vdots & \vdots & \dfrac{[\mathsf{p}\,; x; A]^n}{\vdots \quad \vdots} & \vdots & \vdots \\ \vdots & \vdots & & \vdots & \vdots \end{matrix}}{\mathsf{b} \circ_i \mathsf{p}\,; \varphi; B}}{\mathsf{b}; \lambda x.\varphi; B/_i A}/_i\mathrm{I}^n$$

b. **Backward Slash Introduction**

$$\dfrac{\dfrac{\begin{matrix} \vdots & \vdots & \dfrac{[\mathsf{p}\,; x; A]^n}{\vdots \quad \vdots} & \vdots & \vdots \\ \vdots & \vdots & & \vdots & \vdots \end{matrix}}{\mathsf{p} \circ_i \mathsf{b}; \varphi; B}}{\mathsf{b}; \lambda x.\varphi; A\backslash_i B}\backslash_i\mathrm{I}^n$$

Note that, by putting the Slash Introduction rules back into the grammar this way, we have a system in which hypothetical reasoning is available but is made sensitive not only to the linear order but also to the hierarchical structures of linguistic expressions (unlike in the (associative) Lambek calculus, and our fragment toward the end of section 3.1.2, which assumed associativity globally). That is, unlike for the vertical slash, the Slash Introduction rules for forward and backward slashes make reference to the structured phonologies of the premises in such a way that they are applicable only when the phonology of the hypothesis appears (both linearly and hierarchically) at the right or left edge of the phonology of the premise. This has the effect of filtering out certain derivations that would be possible if the only thing that mattered were the ‘logical’ combinatoric properties. It will be shown below that constraining the applicability of Slash Introduction this way is precisely what is needed to overcome the problem of overgeneration that simpler variants of C-flexible CG suffer from.

With the Slash Introduction rules back in the grammar, the analysis of nonconstituent coordination from section 3.1.2 is again available, this time overcoming the overgeneration problem (cf. the discussion at the end of section 3.1.2). For concreteness, I assume that a ditransitive verb in English subcategorizes for its direct and indirect objects in the associative-only mode $\diamond$ and that the determiner combines with the noun in the inflexible mode $\star$ (for which none of the ‘restructuring’ rules in the inequational logic are applicable). As will become clear below, the latter assumption turns out to be crucial for preventing overgeneration.

The relevant grammatical and ungrammatical examples of nonconstituent coordination are repeated here in (129).

(129) a. I gave [Bill the book] and [John the record].

b. *John saw the [girl in the evening] and [boy in the morning].

The following derivation shows how the argument cluster ‘nonconstituent’ is formed for (129a) (here, as above and in all English examples throughout, VP abbreviates $\mathrm{NP}\backslash_{\diamond}\mathrm{S}$):

(130)

$$\dfrac{\dfrac{\dfrac{\dfrac{[p\,; f; \mathrm{VP}/_{\diamond}\mathrm{NP}/_{\diamond}\mathrm{NP}]^1 \quad \text{bill}; \mathbf{b}; \mathrm{NP}}{p \circ_\diamond \text{bill}; f(\mathbf{b}); \mathrm{VP}/_\diamond\mathrm{NP}}/_\diamond\mathrm{E} \quad \text{the} \circ_\star \text{book}; \textbf{the-book}; \mathrm{NP}}{(p\circ_\diamond \text{bill}) \circ_\diamond (\text{the} \circ_\star \text{book}); f(\mathbf{b})(\textbf{the-book}); \mathrm{VP}}/_\diamond\mathrm{E}}{p \circ_\diamond (\text{bill} \circ_\diamond (\text{the}\circ_\star\text{book})); f(\mathbf{b})(\textbf{the-book}); \mathrm{VP}}\mathrm{PI}}{\text{bill}\circ_\diamond(\text{the}\circ_\star\text{book}); \lambda f.f(\mathbf{b})(\textbf{the-book}); (\mathrm{VP}/_\diamond\mathrm{NP}/_\diamond\mathrm{NP})\backslash_\diamond\mathrm{VP}}\backslash_\diamond\mathrm{I}^1$$

When a VP is formed with the hypothetically assumed ditransitive verb, the P-interface rule applies to push the phonology of this hypothetically assumed verb to (linearly and hierarchically) the leftmost edge of the structured phonology of the whole expression. This is possible because the verb combines with its arguments in the associative-only mode $\diamond$, which undergoes Intermodal Left Association (105). Once the phonology of this hypothesis appears on the left edge, Slash Introduction can apply to assign the desired syntactic category and semantic interpretation to the nonconstituent as in the analysis from section 3.1.2 on page 105.

Unlike the simplified fragment in section 3.1.2, the present multi-modal fragment does not overgenerate sentences like (129b). The following derivation illustrates an attempt to analyze the string *girl in the evening* as a constituent:

(131)

$$
\dfrac{\dfrac{\dfrac{\dfrac{[q\,;\,;\mathrm{VP}/_{\diamond}\mathrm{NP}]^2 \quad \dfrac{[p\,;\,;\mathrm{NP}/_{\star}\mathrm{N}]^1 \quad \textsf{girl};\,;\mathrm{N}}{p \circ_{\star} \textsf{girl};\,;\mathrm{NP}}/_{\star}\mathrm{E}}{q \circ_{\diamond} (p \circ_{\star} \textsf{girl});\,;\mathrm{VP}}/_{\diamond}\mathrm{E} \quad \textsf{in-the-evening};\,;\mathrm{VP}\backslash_{\diamond}\mathrm{VP}}{(q \circ_{\diamond} (p \circ_{\star} \textsf{girl})) \circ_{\diamond} \textsf{in-the-evening};\,;\mathrm{VP}}\backslash_{\diamond}\mathrm{E}}{q \circ_{\diamond} ((p \circ_{\star} \textsf{girl}) \circ_{\diamond} \textsf{in-the-evening});\,;\mathrm{VP}}\mathrm{PI}}{(p \circ_{\star} \textsf{girl}) \circ_{\diamond} \textsf{in-the-evening};\,;(\mathrm{VP}/_{\diamond}\mathrm{NP})\backslash_{\diamond}\mathrm{VP}}\backslash_{\diamond}\mathrm{I}^2
$$

The derivation goes through in exactly the same way as in the previous fragment up to the point where the hypothetically assumed ditransitive verb is withdrawn (except that we now need to explicitly apply the P-interface rule to get the phonology of the hypothesis appear at the left edge of the phonology of the whole expression before withdrawing the hypothesis with Slash Introduction). The derivation fails at the next step. In order to withdraw the other hypothesis, namely, the determiner, we need to push it to the left edge as well. This time, however, we cannot do so since the determiner combines with its head noun in the inflexible mode $\star$, which is not associative. Thus, the P-interface rule fails to apply at this step and the precondition for Backward Slash Introduction (128b) is not satisfied. The derivation fails at this point and the sentence is not licensed by the grammar.

In short, the introduction of modality gives us a way to control the availability of associativity in the grammar: in the case of two objects of a ditransitive verb like (129a), since all of the relevant elements are combined in an associative mode, the hierarchical structure does not really matter and we can freely treat any substring as a constituent. However, unlike in the fragment in section 3.1.2, that only holds when *all* of the elements are combined in an associative mode; when one of the modes involved is nonassociative, as in the case of the ungrammatical (129b), the necessary restructuring of the structured phonology is not licensed and the relevant string fails to be licensed as a constituent. This constitutes another motivation for the introduction of the multi-modal component of structured phonology.

Finally, let us look at a case that most strongly motivates the kind of architecture embodied in the present theory, where the two components of syntax—the syntactic calculus and the structured phonology—interact with one another. The case in point comes from an interaction of nonconstituent coordination and the *-te* form complex predicate construction that we saw in the previous subsection. As we observed in Chapter 2, with the *-te* form complex predicate, sentences like the following are grammatical:

(132) Mari-ga [Ken-ni piano-o], (sosite) [Akira-ni gitaa-o] **hii-te**
Mari-NOM Ken-DAT piano-ACC and Akira-DAT guitar-ACC play-TE
morat-ta.
BENEF-PAST
'Mari had Ken play the piano and Akira play the guitar for her.'

In (132) (= (63b)), the matrix dative argument and the embedded direct object (with accusative case marking) are coordinated to form an argument cluster and this argument cluster combines with the verb cluster consisting of V1 and V2.

In the present fragment, in which the Slash Introduction rules are put back in the grammar and in which the syntactic calculus refers to the structured phonology in the course of derivation of a sentence via the P-interface rule, sentences like (132) are licensed straightforwardly through an interaction of the two components of the grammar. The derivation goes as follows (here, and in all Japanese examples throughout, VP abbreviates $\mathrm{NP}_n\backslash\mathrm{S}$):

(133) a.

$$\dfrac{\dfrac{\dfrac{\dfrac{[p\,;;\mathrm{NP}_a]^1 \quad \text{hii-te};;\mathrm{NP}_a\backslash_{.}\mathrm{VP}}{p\circ_{.}\text{hii-te};;\mathrm{VP}}\backslash_{.}\mathrm{E} \quad \text{morat-ta}\,;;\mathrm{VP}_{te}\backslash_{<}\mathrm{NP}_d\backslash_{.}\mathrm{VP}_{tns}}{(p\circ_{.}\text{hii-te})\circ_{<}\text{morat-ta};;\mathrm{NP}_d\backslash_{.}\mathrm{VP}}\backslash_{<}\mathrm{E}}{p\circ_{.}(\text{hii-te}\circ_{<}\text{morat-ta});;\mathrm{NP}_d\backslash_{.}\mathrm{VP}}\mathrm{PI}}{\text{hii-te}\circ_{<}\text{morat-ta};;\mathrm{NP}_a\backslash_{.}\mathrm{NP}_d\backslash_{.}\mathrm{VP}}\backslash_{.}\mathrm{I}^1$$

b.

$$\dfrac{\dfrac{\dfrac{\dfrac{\text{ken-ni};;\mathrm{NP}_d \quad \dfrac{\text{piano-o};;\mathrm{NP}_a \quad [q\,;;\mathrm{NP}_a\backslash_{.}\mathrm{NP}_d\backslash_{.}\mathrm{VP}]^2}{\text{piano-o}\circ_{.}q\,;;\mathrm{NP}_d\backslash_{.}\mathrm{VP}}\backslash_{.}\mathrm{E}}{\text{ken-ni}\circ_{.}(\text{piano-o}\circ_{.}q);;\mathrm{VP}}\backslash_{.}\mathrm{E}}{(\text{ken-ni}\circ_{.}\text{piano-o})\circ_{.}q\,;;\mathrm{VP}}\mathrm{PI}}{\text{ken-ni}\circ_{.}\text{piano-o};;\mathrm{VP}/_{.}(\mathrm{NP}_a\backslash_{.}\mathrm{NP}_d\backslash_{.}\mathrm{VP})}/_{.}\mathrm{I}^2 \quad \begin{matrix}\vdots\;\vdots\\ \text{akira-ni}\circ_{.}\text{gitaa-o};;\mathrm{VP}/_{.}(\mathrm{NP}_a\backslash_{.}\mathrm{NP}_d\backslash_{.}\mathrm{VP})\end{matrix}}{(\text{ken-ni}\circ_{.}\text{piano-o})\circ_{\star}(\text{akira-ni}\circ_{.}\text{gitaa-o});;\mathrm{VP}/_{.}(\mathrm{NP}_a\backslash_{.}\mathrm{NP}_d\backslash_{.}\mathrm{VP})}\&$$

c.

$$\dfrac{(\text{ken-ni}\circ_{.}\text{piano-o})\circ_{\star}(\text{akira-ni}\circ_{.}\text{gitaa-o});;\mathrm{VP}/_{.}(\mathrm{NP}_a\backslash_{.}\mathrm{NP}_d\backslash_{.}\mathrm{VP}) \quad \text{hii-te}\circ_{<}\text{morat-ta};;\mathrm{NP}_a\backslash_{.}\mathrm{NP}_d\backslash_{.}\mathrm{VP}}{((\text{ken-ni}\circ_{.}\text{piano-o})\circ_{\star}(\text{akira-ni}\circ_{.}\text{gitaa-o}))\circ_{.}(\text{hii-te}\circ_{<}\text{morat-ta});;\mathrm{VP}}\backslash_{.}\mathrm{E}$$

The key point in this derivation is that the sequence of V1 and V2 is analyzed as a derived ditransitive verb. This is shown in the first chunk of the derivation (133a). By hypothetically assuming a direct object for the embedded verb, we can form an embedded VP which can then be given as an argument to the matrix verb. Once the embedded verb combines with the matrix verb, the P-interface rule is applicable to shift the phonology of the embedded object to the left edge. This feeds into the Slash Introduction rule at the next step, which assigns a ditransitive verb-like category to the string of words composed solely of V1 and

V2. The rest of the derivation is the same as in other cases of nonconstituent coordination. Two argument clusters are coordinated to form a larger expression of the same category (133b) and this coordinated argument cluster takes as its argument the derived ditransitive verb (i.e. the sequence of V1 and V2) as an argument to produce a VP (133c).

In this analysis, the whole derivation crucially depends on the possibility to assign a derived ditransitive verb category to the sequence of V1 and V2. This is made possible in the current fragment since the P-interface rule interleaves with the logical rules through the course of syntactic derivations, licensing hypothetical reasoning that partly depends on (the abstract representations of) the surface phonological forms of linguistic expressions.

3.2 Comparison with related approaches

In this section, I compare the present theory with related approaches in the previous literature. In keeping with the general goal of this dissertation, I will limit my discussion to issues pertaining to linguistic application, that is, how well the respective theories capture (or might be extendable in such a way that they can capture) the empirical generalizations (mainly from Chapter 2) that any linguistic theory should be held responsible for accounting for.

Certain other variants of CG have features that the present theory—at least as it stands—does not share, such as tidy computational tractability that has consistently been one of the major concerns in the tradition of CCG (cf., e.g., Steedman 2000b; Baldridge 2002; Steedman and Baldridge 2007) or well-studied logical properties (such as decidability of proofs) that are the hallmarks of many variants of Type-Logical Grammar (cf., e.g., Morrill 1994; Moortgat 1997; Bernardi 2002). In view of the similarities between the present theory and these alternatives, an attempt at simulating the present theory within these related approaches without losing its empirical coverage (so that one can entertain the advantage of these alternatives as well) would be an interesting project to undertake, but such an investigation is left for future study.

3.2.1 (Purely) L-flexible CG

At least in the literature of syntax, the most salient feature associated with CG is the flexibility of constituency characterizing C-flexible CG such as CCG (familiar to linguists through the series of work by Mark Steedman; cf., e.g., Ades and Steedman 1982; Steedman 1985, 1987, 1990, 1996, 2000a,b) and the Lambek calculus (Lambek 1958). As discussed above, one key feature that distinguishes the present theory from these earlier variants of CG is that it incorporates the features of L-flexible CG as well, namely, the separation of semantically-oriented combinatorics and surface-oriented morpho-syntax. Thus, a comparison between the present theory and previous variants of L-flexible CG merits discussion. In this section, I will focus on variants of CG that have only the features of L-flexible CG (which I call 'purely L-flexible CG' in what follows). Comparison with variants of CG that have features of both C-flexible CG and L-flexible CG will be deferred to the next subsection.

Roughly speaking, different variants of purely L-flexible CG can be classified into two kinds: (i) those that recognize different 'modes' of composition in the morpho-syntactic component (e.g., Dowty 1996; Muskens 2007) and (ii) those that make use of lambda abstraction in the morpho-syntactic component (e.g., Oehrle 1994; de Groote 2001; Muskens 2003, 2007). The most recent variant of Muskens's **Lambda Grammar** (Muskens 2007) is unique in that it has both of these features, resulting in a system that is descriptively most powerful among different variants of purely L-flexible CG. For this reason, I will limit my discussion to Muskens (2007) in what follows. (It should be evident that whatever limitations there are for Muskens's (2007) variant will carry over directly to all other variants of purely L-flexible CG.)

Muskens (2007) proposes a multi-modal extension of **Lambda Grammar** (Muskens 2003), a kind of L-flexible CG in which the combinatoric component is a linear logic with just one mode of implication. Linguistic expressions are modelled as pairs of semantic and phonological information, with a separate term calculus (which is formally a lambda calculus) for each. The logic has application and abstraction rules (corresponding to the Slash Elimination and Slash Introduction rules in the present theory) that manipulate the semantic and phonological terms of linguistic expressions pairwise (that is, the application rule does function application in both semantics and phonology and the abstraction rule binds a variable both in semantics and phonology). Unlike the earlier version of Lambda Grammar presented in Muskens (2003), Muskens (2007) enriches the phonological component with the notion of multi-modality, borrowed from the literature of MMTLG (Morrill 1994; Moortgat 1997; Bernardi 2002). Formally, this is done by recognizing different varieties of binary connectives for forming phonological terms corresponding to different 'modes' of composition (much in the same way as in the present theory) and by constraining the interpretations of these terms with 'accessibility relations' in a Kripke-style semantics of modal logic (in a way analogous to how the preorder that interprets φ-terms is constrained by the inequational logic in the present theory).

As shown by Muskens (2003), through the use of lambda abstraction in the phonological component, this system straightforwardly incorporates the formalization of quantifying-in due to Oehrle (1994). Also, Muskens (2007) demonstrates that the multi-modality introduced in the phonological component enables a perspicuous implementation of the multi-modal, 'verb-raising' analysis of Dutch verbal complexes originally due to Moortgat and Oehrle (1994), which treats verb cluster formation essentially as a phenomenon that takes place in the surface-oriented morpho-syntactic component.

Muskens's (2007) system is thus similar to the present theory in the way in which it makes use of the multi-modal phonological component augmented with lambda abstraction in accounting for phenomena such as quantifier scope and complex predicate formation; these are both phenomena that involve certain degrees of mismatch between surface morpho-syntax and semantically-oriented combinatorics, and the flexibility of the phonological component is crucially exploited in accounting for them. [97] Notwithstanding this similarity, there is an important difference between the two such that the flexibility of constituency that characterizes C-flexible CG is not available in Muskens's (2007) system (at least not in any straightforward way; this point is noted by Muskens (2001)). As we have seen in Chapter 2, nonconstituent coordination and nonconstituent clefting in Japanese call for an architecture of grammar that has the features of C-flexible CG, and, for this reason, purely L-flexible CG such as Muskens (2007) wherein surface-oriented morpho-syntax and semantically-oriented combinatorics are sharply separated from one another is empirically inadequate.

[97] The idea of exploiting the architecture of L-flexible CG in accounting for complex predicate constructions is found in a somewhat preliminary form in Hoeksema (1991). A similar approach is also explored in linearization-based HPSG by Reape (1994).

In particular, interactions between these ‘nonconstituent formation’ phenomena and other phenomena that also involve flexible mapping between surface syntax and combinatorics turn out to be the most challenging for the kind of architecture represented by Lambda Grammar. The relevant cases are:

(i) the interaction between coordination and complex predicate formation (data from section 2.3.1.4)

(ii) the interaction between clefting and complex predicate formation (data from section 2.3.1.3)

(iii) the interaction between coordination and the scope-taking behavior of *onazi* that produces the internal reading of *onazi* (the data in (19) from section 2.1.3)

All of these cases require an architecture of grammar in which strings of words that are not traditionally regarded as constituents can be analyzed as units not just in the morpho-syntactic component but also in the combinatoric component. However, as we will see below, this cannot be done easily in the architecture of a theory like Lambda Grammar, wherein the directionality (in which functors are looking for arguments) is encoded in the phonological terms themselves and is not reflected in the syntactic categories of linguistic expressions that the combinatoric component refers to.

To see how this is the case, let us examine the interaction between nonconstituent coordination and the *-te* form complex predicate. The relevant data are reproduced in (134). In (134a), the matrix dative argument and the embedded accusative argument form an argument cluster to be coordinated. In (134b), the argument cluster involves the embedded verb as well, but this sentence is ungrammatical because the sequence of the embedded verb and the higher verb is split apart for the first conjunct.

(134) a. Mari-ga [Ken-ni piano-o], (sosite) [Akira-ni gitaa-o] **hii-te**
Mari-NOM Ken-DAT piano-ACC and Akira-DAT guitar-ACC play-TE
morat-ta.
BENEF-PAST
'Mari had Ken play the piano and Akira play the guitar for her.'

b. *Mari-ga [Ken-ni piano-o **hii-te**], (sosite) [Akira-ni uta-o
Mari-NOM Ken-DAT piano-ACC play-TE and Akira-DAT song-ACC
utat-te] **morat-ta**.
sing-TE BENEF-PAST
intended: 'Mari had Ken play the piano for her and Akira sing a song for her.'

We have seen above that in the present theory, in which the morpho-syntactic component and the combinatoric component interact closely via the P-interface rule, licenses examples like (134a) as an immediate consequence of an interaction between independently motivated analyses of the *-te* form complex predicate and nonconstituent coordination. It will be shown in the next chapter that the ungrammaticality of (134b) also follows straightforwardly from the fact that the complex predicate mode involved in putting together V1 and V2 is not flexible enough to admit the 'nonconstituent' formation that is necessary to (incorrectly) license the sentence. It turns out that such a straightforward analysis is not available in a system like Lambda Grammar, where the two components are kept separate from one another and do not interact.

As an illustration, let us assume a Lambda Grammar fragment that handles the morpho-syntactic clustering of the *-te* form complex predicate in the same way as in the analysis in the present theory, namely, by means of the left associative complex predicate mode $<$. With the following lexicon and postulates in the multi-modal phonological component, the analysis of interclausal scrambling goes essentially in the same way as in the present analysis:[98]

(135) **M**: $\langle$mari-ga, $\mathbf{m}\rangle$ NP_n

P: $\langle$piano-o, $\mathbf{the\text{-}piano}\rangle$ NP_a

K: $\langle$ken-ni, $\mathbf{k}\rangle$ NP_d

V1: $\langle \lambda x \lambda y. y \circ_{\bullet} (x \circ_{\bullet} \text{hii-te}), \mathbf{play}\rangle\ \mathrm{NP}_a \multimap \mathrm{NP}_n \multimap \mathrm{S}$

V2: $\langle \lambda P \lambda x \lambda y. y \circ_{\bullet} (x \circ_{\bullet} (P(\epsilon) \circ_{<} \text{morat-ta})), \mathbf{benef}\rangle\ (\mathrm{NP}_n \multimap \mathrm{S}) \multimap \mathrm{NP}_d \multimap \mathrm{NP}_n \multimap \mathrm{S}$

(136) ILA; Intermodal Left Association

$(A \circ_i B) \circ_j C \sqsubseteq A \circ_i (B \circ_j C)$ $\quad (\circ_i, \circ_j \in \{\circ_{\ll}, \circ_{<}, \circ_{\diamond}, \circ_{\bullet}\})$

(similarly for all other rules in the inequational logic of the present theory)

The derivation is given in (137):

(137) a. **V2**(**V1**(**P**))(**K**)(**M**) =

$\langle$mari-ga $\circ_{\bullet}$ (ken-ni $\circ_{\bullet}$ ((ϵ $\circ_{\bullet}$ (piano-o $\circ_{\bullet}$ hii-te)) $\circ_{<}$ morat-ta)),

$\mathbf{benef}(\mathbf{m}, \mathbf{play}(\mathbf{p})(\mathbf{k}))\rangle$

b. mari-ga $\circ_{\bullet}$ (ken-ni $\circ_{\bullet}$ ((ϵ $\circ_{\bullet}$ (piano-o $\circ_{\bullet}$ hii-te)) $\circ_{<}$ morat-ta))

$\sqsubseteq$ mari-ga $\circ_{\bullet}$ (ken-ni $\circ_{\bullet}$ ((piano-o $\circ_{\bullet}$ hii-te) $\circ_{<}$ morat-ta)) (ID)

$\sqsubseteq$ mari-ga $\circ_{\bullet}$ (ken-ni $\circ_{\bullet}$ (piano-o $\circ_{\bullet}$ (hii-te $\circ_{<}$ morat-ta))) (LA)

$\sqsubseteq$ mari-ga $\circ_{\bullet}$ (piano-o $\circ_{\bullet}$ (ken-ni $\circ_{\bullet}$ (hii-te $\circ_{<}$ morat-ta))) (SCR)

$\sqsubseteq$ mari-ga $\bullet$ (piano-o $\bullet$ (ken-ni $\bullet$ (hii-te $\bullet$ morat-ta))) (SPN, PN)

c. From (137a) and (137b), the following is a well-formed linguistic sign:

$\langle$mari-ga $\bullet$ (piano-o $\bullet$ (ken-ni $\bullet$ (hii-te $\bullet$ morat-ta))), $\mathbf{benef}(\mathbf{m}, \mathbf{play}(\mathbf{p})(\mathbf{k}))\rangle$

[98] ϵ in (135) is a term that denotes the null string.

The only major difference from the analysis in the present theory is that the basic word order of the sentence is directly encoded in the phonological term of the head verb (which is done by means of functional phonological terms with lambda binding). This difference does not matter here since the restructuring of 'constituency' that yields the surface word order all takes place solely within the phonological component (as in (137b)).

The difference in the way in which directionality is treated in Lambda Grammar and the present theory *does*, however, make a crucial difference in cases like nonconstituent coordination. In order to license the nonconstituent coordination example (134a) in this Lambda Grammar fragment, one might attempt to reanalyze the string composed of V1 and V2 as a 'derived ditransitive verb', along similar lines as in the analysis in the present theory that we saw in section 3.1.4. This will yield the following (for simplicity, I will only write the phonological terms in what follows, omitting semantics):

(138) $\lambda\zeta.\mathbf{V2}(\mathbf{V1}(\zeta))$

$= \lambda p \lambda q \lambda r. r \circ_{\bullet} (q \circ_{\bullet} ((\epsilon \circ_{\bullet} (p \circ_{\bullet} \textsf{hii-te})) \circ_{<} \textsf{morat-ta}))$

As above, Identity and Intermodal Left Association can induce verb clustering, licensing the following as a well-formed expression:

(139) $\lambda p \lambda q \lambda r. r \circ_{\bullet} (q \circ_{\bullet} (p \circ_{\bullet} (\textsf{hii-te} \circ_{<} \textsf{morat-ta})))$

However, this does not help in licensing the nonconstituent coordination example in (134a). The first problem is simply that it is not clear how nonconstituent coordination involving argument clusters can be formulated in purely L-flexible CG like Lambda Grammar. Note that the standard analysis of nonconstituent coordination in CG crucially relies on the property of C-flexible CG that the phonologies of conjuncts are simply strings (so that, as far as phonology is concerned, what the conjunction does is just to concatenate these strings). However, in this Lambda Grammar fragment, since the verbal complex itself has a functional phonological type for sentences like (134a) as in (139), with hypothetical reasoning, the argument cluster ends up having a still more complex higher order phonological type $(st \to st \to st \to st) \to st \to st$ (where st is the type of strings): [99]

(140) $\lambda\zeta.\zeta(\mathbf{P})(\mathbf{K}) = \lambda P.P(\textsf{piano-o})(\textsf{ken-ni})$

But then, formulating the phonology of the conjunction appropriately for such cases (i.e., cases where the phonologies of conjuncts are functions rather than strings) will not be a trivial task. [100]

Even if a solution could be worked out for this problem (perhaps along the lines discussed in footnote 100), it is not clear how this kind of approach would account for the

[99] Note that this problem is not specific to cases involving complex predicates but is also present in simpler cases involving lexical verbs, since, as in the lexicon in (135), verbs are lexically assigned functional phonologies in Lambda Grammar. However, complex predicates present a somewhat stronger case: for lexical verbs, one might attempt to get around the problem by assigning verbs and its arguments to different phonological types additionally in the lexicon, but such a solution is not available for cases involving complex predicates.

[100] Essentially, what one will need to do to work this out is to define the phonology of the conjunction to be a higher order function that takes functional phonologies of the conjuncts and returns a functional phonology of the same type. When the conjuncts have 'first order' phonological types (i.e. when the arguments of the functions are all strings), this is relatively simple. The 'string part' of the output phonology can be formed by concatenating the string parts of the input phonologies. The output phonology should then be defined in such a way that it takes the same number of arguments as the input phonologies and puts together these arguments with the newly formed string part in the same linear order and using the same modes of composition as the input phonologies. And this needs to be generalized to cases involving higher order phonological types (although how such a generalization might be done is not obvious to me).

A difficulty that immediately arises for such an attempt, whose solution I will not explore here, is that even for cases involving first order phonological types, neither the linear order nor the mode of composition involved in putting together the arguments with the string part is reflected in the types of the phonological terms of the input. In other words, the information necessary to construct the output phonology appropriately is not available unless one allows for the relevant operation to directly look at the *forms* of the input phonological terms.

contrast in grammaticality between (134a) and (134b). Note that the following complex functional phonology can be assigned to the expression *Ken-ni piano-o hii-te* with hypothetical reasoning:

(141) $\lambda\zeta.\zeta(\mathbf{V1}(\mathbf{P}))(\mathbf{K}) = \lambda P.P(\textsf{hii-te}(\textsf{piano-o}))(\textsf{ken-ni})$

Assuming that some kind of general treatment of coordination of expressions involving higher order phonological types can be worked out, it is still not clear how the grammar would stop licensing (134b) with (141) if it would be possible to license (134a) with (140).

The conceptual clarity of Muskens's (2003; 2007) Lambda Grammar (or its analogs such as Oehrle's (1994) type calculus with phonological labelling and de Groote's (2001) Abstract Categorial Grammar) is certainly attractive: the combinatoric component, involving only one mode of implication, is clearly separated from the surface morpho-syntactic component and does not have any access to even the remotest correlate of linear order or surface constituency.[101] The cost that one pays for such simplicity, however, is limitation in empirical coverage. As we have seen above, there are certain phenomena in natural

[101]It is worth noting in this connection that the linearization-based variant of HPSG (Reape 1994; Kathol 2000), although not a kind of CG, essentially embodies the same architecture as L-flexible CG. In linearization-based HPSG (at least in the simplest formulation proposed by Reape (1994) and Kathol (2000)), the combinatoric component does not directly manipulate objects belonging to the morpho-syntactic component (i.e. the 'domain objects'). Thus, just like purely L-flexible CG reviewed in this section, it lacks the features of C-flexible CG. And precisely for this reason, even though linearization-based HPSG allows for a considerable degree of flexibility in handling mismatches between surface morpho-syntax and combinatorics (much in the same way as in purely L-flexible CG), phenomena such as nonconstituent coordination remain problematic. Although there are recent proposals within linearization-based HPSG for handling nonconstituent coordination in terms of phonological deletion (Beavers and Sag 2004; Sag and Chaves 2008), I have argued in Chapter 2 that, at least for Japanese, such an analysis is problematic. The analysis of nonconstituent coordination that I formulate in the next chapter overcomes the problems of such approaches by exploiting the property of the present theory wherein a close interaction is maintained between the combinatoric component and the surface morpho-syntactic component, which distinguishes it from purely L-flexible CG and linearization-based HPSG.

language that require the combinatoric and the morpho-syntactic components to interact with one another. I thus conclude that a more elaborate setup like the one embodied in the present theory (wherein the combinatoric component is made sensitive to the workings of the morpho-syntactic component via the P-interface rule and through the use of directed variants of slashes with modality specifications) is more desirable.

3.2.2 Variants that unify C-flexible CG and L-flexible CG

As pointed out at the beginning of this chapter, many contemporary variants of CG, both in the TLG camp (cf., e.g., Morrill 1994; Moortgat 1997; Bernardi 2002) and in the CCG camp (cf., e.g., Baldridge 2002; Steedman and Baldridge 2007) are moving in the same direction of integrating the features of C-flexible CG and those of L-flexible CG. (In what follows, I will collectively refer to these approaches as 'C- and L-flexible CG'.) Thus, they overcome the limitations of purely L-flexible variants discussed in the previous section, and, to a certain extent, can be seen as notational variants of one another as far as linguistic application is concerned. There are nevertheless important differences among these alternatives and between each of these alternatives and the present theory, as I will discuss below. The main difference between these approaches and the present theory is that, like the purely L-flexible variants discussed in the previous section, the present theory recognizes the component (i.e. structured phonology) that mediates syntax proper and phonology as a distinct component of grammar that is separate from the combinatoric component of syntax. This, I will argue, results in an architecture that is both conceptually simpler and technically more explicit and precise than these related approaches of C- and L-flexible CG.

3.2.2.1 Multi-Modal Type-Logical Grammar with prosodic labelling (Morrill and Solias 1993; Morrill 1994)

Of all the variants of contemporary CG, the present theory resembles most closely the one developed by Morrill and Solias (1993) and Morrill (1994). The feature that distinguishes this variant (and the present theory) from the competing (and perhaps currently the more standard) variant of TLG commonly referred to as Categorial Type Logics (Moortgat 1997; Bernardi 2002) is that it explicitly represents the phonology ('prosody' in Morrill and Solias's term, but I will keep using the word 'phonology') of linguistic expressions by notating derivations with terms that denote phonological information. Since Morrill (1994) supersedes Morrill and Solias (1993) and has all the essential features of the latter (although the two differ in some details), I will mostly limit my discussion to Morrill (1994) in what follows.[102]

As in the present theory, in Morrill's (1994) system, linguistic expressions are conceived of as tuples of phonology, semantics and syntactic category, and syntactic derivations are presented in the labelled deduction format of natural deduction with explicit semantic and phonological labelling. Crucially, in keeping with this explicit labelling of phonology in syntactic derivations, the Slash Introduction rules are defined in the same

[102] The treatment of discontinuous constituency in terms of discontinuity operators along the lines of Morrill and Solias (1993) and Morrill (1994) is further refined in a recent proposal by Morrill et al. (2007). However, unlike Morrill (1994), Morrill et al. (2007) do not make use of the notion of multi-modality to account for different degrees of flexibility in morpho-syntactic constituency. As should be clear from the discussion in the main text, the way in which the multi-modal component interacts with the calculus of syntactic types is what crucially distinguishes C- and L-flexible CG (which includes both Morrill (1994) and the present theory) and purely L-flexible CG (such as Muskens's (2007) Lambda Grammar). Although there is no reason to believe that the more recent proposal of Morrill et al. (2007) could not be extended in essentially the same way in which the notion of multi-modality is encoded in Morrill (1994), since such an extended version does not yet exist, I will not discuss Morrill et al. (2007) in what follows.

way as in the present theory, where they directly refer to the forms of the phonological terms of the premise and the conclusion (such that, e.g., Forward Slash Introduction requires the phonology of the hypothesis to appear at the right edge of the phonology of the premise and the phonology of the conclusion is obtained by stripping off that phonology of the hypothesis).

Thus, both in Morrill's (1994) system and in the present theory, phonological labelling is used to filter out certain otherwise 'logically valid' derivations. In this sense, the present theory can be thought of as a direct descendant of Morrill (1994). Moreover, since Morrill's (1994) system is multi-modal, (although, as I will explain below, the way in which the notion of modality is technically implemented is slightly different), if desired, it is relatively straightforward to simulate all the workings of the multi-modal component of structured phonology of the present theory in Morrill's system (except possibly for cases involving lambda abstraction in the φ-calculus; cf. footnote 104).

This means that, in terms of empirical coverage, the two systems are more or less notational variants of one another. However, the present theory improves on Morrill's system in separating the semantically-oriented combinatoric component and the surface-oriented morpho-syntactic component more clearly. Specifically, Morrill's system recognizes a set of rules called 'label(led) structural rules' within the combinatoric component whose sole effects are to manipulate the phonological terms of linguistic expressions. Since the system is multi-modal, a variety of such rules (analogous to the specific rules in the inequational logic of the present theory) are posited in the combinatoric component to model the properties of (and interactions among) different morpho-syntactic modes (such as associativity and permutativity).[103] The present theory relegates all of the workings of such modalities to

[103] Morrill and Solias's (1993) system is somewhat different from Morrill (1994) in this respect in that it relies on term equality in the prosodic calculus to derive the effects of label(led) structural rules of the latter.

a separate component called structured phonology and interfaces that component with the combinatoric component of syntactic calculus by just one rule (viz. the P-interface rule), thus attaining greater conceptual clarity.

It should also be noted that, not only is the present theory conceptually simpler than its precursor by Morrill (1994), but it also works out the formal details of the phonological component more explicitly, by formalizing the φ-calculus as a lambda calculus with interpretation into a preordered algebra. Building on this, the component of structured phonology in the present theory is made more elaborate than its counterpart in Morrill (1994) in the following two respects: (i) it recognizes a distinction between 'abstract' and 'concrete' (or 'pronounceable') modes of composition explicitly so that the mapping from syntax to actually audible strings of words is made totally explicit and (ii) it incorporates the idea of using lambda abstraction for φ-terms due to Oehrle (1994), which enables manipulating the (abstract) phonologies of linguistic expressions in a flexible but formally precise manner.[104] As we will see in the next chapter, the analyses of some of the empirical phenomena from the previous chapter within the present theory crucially exploit these properties of the present theory. While it would probably not be totally impossible to implement the same

In this respect, it is more similar to the present theory. However, Morrill and Solias (1993) do not work out their prosodic calculus and the notion of term equality within it in detail.

[104] In this connection, it should be noted that Morrill (1994) employs the wrapping operator W to implement quantifying-in (and for the treatment of other discontinuity phenomena as well). The use of lambda abstraction in phonology accomplishes the same effect in a much more perspicuous manner. The main advantage of the latter over the former is that one can explicitly keep track of 'insertion points' (i.e. points in the string at which a certain expression is inserted at a later point in the derivation to create discontinuity in the surface string) by means of lambda binding. This turns out to be especially useful when multiple insertion points need to be kept track of simultaneously at some point in the derivation, as in the analysis of parasitic scope presented in the next chapter.

(or similar) features within the setup of Morrill (1994), an architecture in which the phonological component is clearly separated from the combinatoric component makes it easier to work out the relevant formal details rigorously, as is done in the present theory.

3.2.2.2 Multi-Modal Categorial Type Logics (Moortgat 1997; Bernardi 2002)

A variant of MMTLG that resembles the kind formulated by Morrill and Solias (1993) and Morrill (1994) (I will call this 'Morrill-style TLG' below) has been developed in a series of work by, e.g., Moortgat and Oehrle (1994), Moortgat (1997), Bernardi (2002) and Vermaat (2005). This line of research is usually referred to by the name **(Multi-Modal) Categorial Type Logics** (**MMCTL**). Superficially, Morrill-style TLG and MMCTL look very similar to one another, and, at some (appropriate) level of abstraction, they (and the present theory) can be regarded as notational variants of one another (in the sense that, for any linguistic phenomenon, essentially the same analysis can be formulated in each theory).

The most crucial difference between the present theory and Morrill-style TLG on the one hand and CTL on the other is that the latter takes a more abstract view on the notion of modality than the former two. More specifically, unlike in the present theory and in Morrill-style TLG, different 'modes of composition' in MMCTL do not directly represent different kinds of operations that are used to form (abstract) phonological representations of linguistic expressions (although there is an implicitly understood connection between the two, as I will explain below).

To illustrate the relevant point, the following is a (slightly adapted) sample derivation from Bernardi (2002), which illustrates the treatment of non-peripheral extraction in her MMCTL fragment:

(142)

$$
\dfrac{(\mathrm{N}\backslash\mathrm{N})/(\mathrm{S}/_a\mathrm{NP}) \vdash (\mathrm{N}\backslash\mathrm{N})/(\mathrm{S}/_a\mathrm{NP}) \qquad
\dfrac{\dfrac{\dfrac{\mathrm{NP} \vdash \mathrm{NP} \qquad \dfrac{\dfrac{(\mathrm{NP}\backslash\mathrm{S})/_a\mathrm{NP} \vdash (\mathrm{NP}\backslash\mathrm{S})/_a\mathrm{NP} \qquad [\mathrm{NP} \vdash \mathrm{NP}]^1}{(\mathrm{NP}\backslash\mathrm{S})/_a\mathrm{NP} \circ_a \mathrm{NP} \vdash \mathrm{NP}\backslash\mathrm{S}}/_a\mathrm{E} \qquad (\mathrm{NP}\backslash\mathrm{S})\backslash(\mathrm{NP}\backslash\mathrm{S}) \vdash (\mathrm{NP}\backslash\mathrm{S})\backslash(\mathrm{NP}\backslash\mathrm{S})}{((\mathrm{NP}\backslash\mathrm{S})/_a\mathrm{NP} \circ_a \mathrm{NP}) \circ (\mathrm{NP}\backslash\mathrm{S})\backslash(\mathrm{NP}\backslash\mathrm{S}) \vdash \mathrm{NP}\backslash\mathrm{S}}\backslash\mathrm{E}}{\mathrm{NP} \circ (((\mathrm{NP}\backslash\mathrm{S})/_a\mathrm{NP} \circ_a \mathrm{NP}) \circ (\mathrm{NP}\backslash\mathrm{S})\backslash(\mathrm{NP}\backslash\mathrm{S})) \vdash \mathrm{S}}\backslash\mathrm{E}}{\dfrac{\mathrm{NP} \circ (((\mathrm{NP}\backslash\mathrm{S})/_a\mathrm{NP} \circ (\mathrm{NP}\backslash\mathrm{S})\backslash(\mathrm{NP}\backslash\mathrm{S})) \circ_a \mathrm{NP}) \vdash \mathrm{S}}{(\mathrm{NP} \circ ((\mathrm{NP}\backslash\mathrm{S})/_a\mathrm{NP} \circ (\mathrm{NP}\backslash\mathrm{S})\backslash(\mathrm{NP}\backslash\mathrm{S}))) \circ_a \mathrm{NP} \vdash \mathrm{S}}\mathrm{mixass}}\mathrm{diss}}{(\mathrm{NP} \circ ((\mathrm{NP}\backslash\mathrm{S})/_a\mathrm{NP} \circ (\mathrm{NP}\backslash\mathrm{S})\backslash(\mathrm{NP}\backslash\mathrm{S}))) \vdash \mathrm{S}/_a\mathrm{NP}}/_a\mathrm{I}^1}
{(\mathrm{N}\backslash\mathrm{N})/(\mathrm{S}/_a\mathrm{NP}) \circ (\mathrm{NP} \circ ((\mathrm{NP}\backslash\mathrm{S})/_a\mathrm{NP} \circ (\mathrm{NP}\backslash\mathrm{S})\backslash(\mathrm{NP}\backslash\mathrm{S}))) \vdash \mathrm{N}\backslash\mathrm{N}}/\mathrm{E}
$$

Unlike in the present theory or in Morrill-style TLG, derivations are not written in the labelled deduction format. Instead, they are written in the so-called sequent style natural deduction format.[105] A sequent is a formal construct used in presenting proofs in a kind of notation called the 'sequent style notation'. A sequent in MMCTL is defined as follows, with Γ a structure (defined below) and Δ a formula (i.e., syntactic category):

(143) $\Gamma \vdash \Delta$

Γ is called the 'antecedent' of the sequent, and Δ is called the 'consequent'. A structure is defined as follows:

(144) a. If Δ is a formula, then Δ is a structure.

b. If Δ_1 and Δ_2 are structures, then $(\Delta_1 \circ_i \Delta_2)$ is a structure for all of the binary connectives $\circ_i$.

A derivation, then, is a proof that a certain structure deduces a certain syntactic category, taking the identity statement for any formula of the form '$\Delta \vdash \Delta$' as an axiom and assuming the set of 'logical' rules (i.e. Introduction and Elimination rules) and 'structural' rules (whose workings will be explained below) posited in the calculus.

[105]There is an alternative, less readable notation also commonly adopted in the literature of CTL which formalizes proofs in the Gentzen sequent calculus, which (despite the similarity in names) is distinct from sequent-style natural deduction.

Conceptually, the structural rules correspond to the rules in the inequational logic in the present theory and the label(led) structural rules in Morrill's system. As their name suggests, structural rules manipulate the structures that appear as antecedents of sequents (these antecedents are called 'structured antecedents') and thereby regulate the properties of different modes of composition which are supposed to capture surface-oriented properties of linguistic expressions. Formally, however, modes in MMCTL are modes of connectives for forming abstract objects called 'structures' within the calculus of syntactic categories (or 'types').

But then, what exactly is the ontological status of these formal objects called 'structures' when MMCTL is viewed as a theory of *natural language* syntax? The assumption that I have deliberately left out above (and one which is not always clearly stated in published expositions of MMCTL) is that there is some kind of 'lexical insertion' operation that takes structured antecedents and replaces each of the syntactic categories within it with some actual string that is assigned the given syntactic category in the lexicon. This 'lexical insertion' process will, for example, produce the following object from the structured antecedent obtained in the derivation in (142):

(145) which ∘ (sara ∘ (wrote ∘ there))

After this lexical insertion process, the meaning of the binary connectives changes crucially (or, more formally, one might assume that the 'lexical insertion' process defines a mapping relation between the connectives for forming structures and connectives for forming phonological terms as well). They are no longer connectives for forming abstract objects called structures but should be understood as connectives within some kind of term calculus that is used for modelling the surface phonological forms of linguistic expressions, just as in the present theory and in Morrill-style TLG.

Only by assuming that this phonological component is worked out adequately, together with the assumption of lexical insertion along the above lines, can the connection between syntax and phonology be made totally explicit in MMCTL. [106] That is, with this understanding, the sequent that appears on the bottom line of (142), which literally says that a certain structure (in the technical sense) of syntactic categories *deduces* a certain syntactic category, can now be read as asserting that a certain string of words that can be obtained from that structure through the above lexical insertion process *belongs to* that syntactic category.

In comparison with the present theory, we can think of MMCTL as going in the way of conflating the combinatoric component and the surface morpho-syntactic component even more than does Morrill-style TLG. That is, the abstract objects called 'structures' do not belong to a component that deals with surface phonological realizations of linguistic expressions but instead are part of an enriched and finely articulated combinatoric component.[107] This might have certain advantages when studying the logical and mathematical properties of (different kinds of) multi-modal systems, since, in this setup, all of the technical apparatuses are assembled within a single calculus. However, from the viewpoint

[106]This point has been somewhat obscured by the notational shorthand often adopted in the presentations of CTL in the context of linguistic application, where all of the formulas in a structured antecedent are replaced with actual 'words' (i.e. strings) in derivations (as is done, for example, in the original presentation of (142) in Bernardi (2002)). This makes derivations more 'readable', but also makes them look (somewhat misleadingly) similar to the labelled deduction format with explicit phonological labelling adopted in some other variants of CG, including the present one.

[107]Admittedly, the unpronounceable, abstract structured phonologies in the present theory are also abstract objects that do not directly correspond to pronounceable strings. However, as I have already discussed above in this chapter, the notion of structured phonology of the present theory has a clear ontological status within the overall linguistic theory in the sense that it is essentially a generalization of the notion of phonological form: a structured phonology is an object that inhabits the component of grammar dealing with surface phonological realizations of linguistic expressions and that represents the total set of possible phonological realizations that a given linguistic expression can have.

of linguistic theorizing, the clear separation of the combinatoric and the morpho-syntactic components exemplified in the present theory leads to a more intelligible design architecture. It should also be noted that the degree to which the phonological component is worked out explicitly in the present theory has so far never been attained in any variant of (MM)CTL.[108]

3.2.2.3 Multi-Modal Combinatory Categorial Grammar (Baldridge 2002; Steedman and Baldridge 2007)

Multi-Modal Combinatory Categorial Grammar (Baldridge 2002; Steedman and Baldridge 2007) is a recent variant of CCG that incorporates into the 'rule-based' setup of CCG the notion of '(multi-)modality' originally developed in the tradition of MMTLG. As discussed in detail in Baldridge (2002), this constitutes a significant theoretical advance in CCG in that the resulting theory captures linguistic universals (which is mainly taken care of in the universal component of combinatory rules) and cross-linguistic variation (which is mainly taken care of in terms of modality specifications in the lexicon, just as in MMTLG) in a much more principled way than in earlier versions of CCG. Since one of the hallmarks of CCG is that it has the features of C-flexible CG, with the incorporation

[108]The highly abstract nature of structured antecedents becomes even more worrisome in a variant like that proposed by Barker (2007), whose innovation involves augmenting the standard system of CTL with a structural rule, reproduced in (i), that essentially simulates Oehrle's (1994) use of lambda binding in phonological terms within the CTL setup (the derivability relation holds in both directions in (i), which is indicated in the original rule format in Barker (2007) with a double line separating the premise and the conclusion):

(i) $$\frac{\Gamma[p]}{p \circ \lambda x \Gamma[x]}\lambda$$

Without formally precise definitions of (what look like) the lambda operator and variables for forming structures, the introduction of such a structural rule within the setup of CTL makes it look somewhat disturbingly similar to the (ab)use (from a certain perspective) of LF as a representational component within the setup of Heim and Kratzer-style (Heim and Kratzer 1998) LF-based semantics.

of modality, MMCCG attains a unification of L-flexible CG and C-flexible CG within the setup of CCG, thus constituting a variant of C- and L-flexible CG.

There are, however, several important differences between the present theory and MMCCG, which essentially derive from one fundamental difference between CCG and other variants of contemporary C- and L-flexible CG (including the present one), which (as I have done above) is sometimes referred to as the 'rule-based' nature of CCG. By the 'rule-based' nature of CCG, what is meant is that rules like type raising and function composition are simply posited as axioms rather than derived as theorems. In what follows, I will focus on the most important issue in the present context, namely, how this rule-based nature of CCG affects the way in which the notion of modality is implemented in it. [109]

Unlike in the present theory (or the other related approaches discussed in the previous sections), when it comes to implementing the notion of modality, the rule-based architecture of CCG precludes an option in which a distinct component (or a set of rules) that takes care of surface-oriented properties interacts with the combinatoric component in a fully general manner. Faced with this difficulty, the compromise (or, ingenuity, depending on one's perspective) that MMCCG opts for is to directly 'compile' into the set of combinatory rules the properties that the notion of modality is intended to model. That is, MMCCG

[109] Another major difference between (MM)CCG and theories like the present one (which is somewhat orthogonal to the question of how the unification of C- and L-flexible CGs is to be done by incorporating the notion of modality) is that not all theorems that are derivable in the more general systems of CGs are posited as axioms in (standard variants of) (MM)CCG. See, e.g., Kubota (2008), where it is pointed out that in order to account for all of the possible word order patterns involving arguments and adjuncts in the *-te* form complex predicate in Japanese, one needs to posit some variant(s) of the Geach rule (something that is not usually recognized as an admissible combinatory rule in standard variants of CCG). See also Hoyt and Baldridge (2008), who argue that the **D** combinator (Curry and Feys 1958) needs to be added to CCG to capture certain linguistic generalizations that fail to be captured by the standard set of combinatory rules in CCG.

replicates the effects of structural rules in MMTLG by means of making the applicability of certain flexible syntactic operations such as function composition sensitive to the modality specifications of the input categories. For example, the rule of harmonic composition:

(146) $A/_{\diamond}B \quad B/_{\diamond}C \quad \Rightarrow \quad A/_{\diamond}C$

is specified to be applicable only if both of the input categories carry 'associative' modes, as indicated by the subscripts on the slashes. Crucially, unlike in the other, more general kinds of C- and L-flexible CG, where the analog of this harmonic composition rule is a theorem that is derivable only in modes that have the property of associativity in the multi-modal (surface-oriented) component, rules like (146) are simply assumed to be axioms in CCG. That is, each combinatory rule separately stipulates the appropriate modality specifications for its inputs and output.

While it might be argued that eliminating a distinct component that takes care of the behaviors and interactions of different modes of composition leads to a simpler architecture (especially in view of computational implementation), a theoretical downside of such an approach is that a certain systematicity that is available in other kinds of multi-modal C- and L-flexible CG is lost. The case in point comes from the interactions of different modes of composition. To see the relevant point, let us assume a fragment of MMCCG that has at least two associative modes—one that is only associative ($\diamond$) and the other that is both associative and permutative ($\cdot$). In such a system, the harmonic composition rule (146) should be applicable when both of the input categories carry one of these modes. But then, when the modes of the input categories are different, as in (147), a question arises as to which of the two modes the output category inherits.

(147) a. $A/_{\diamond}B \quad B/_{\cdot}C$

b. $A/_{\bullet}B \quad B/_{\diamond}C$

There is good reason to believe that, as far as linguistic application is concerned, the mode that should be inherited to the output category is the mode of the slash associated with the argument that gets inherited (that is, since the argument that gets inherited is C in both cases, the modality for the output category should be $\bullet$ in (147a) and $\diamond$ in (147b)).[110] Since MMCCG lacks a separate component that takes care of the behaviors of modalities, in a situation like this, one needs to specify the proper instantiations of underspecified modality specifications in rules like (146) for each specific case. In other words, formally, in a system that involves the two associative modes $\diamond$ and $\bullet$, (146) is just an abbreviation of the following four distinct rules:

(148) a. $A/_{\diamond}B \quad B/_{\diamond}C \quad \Rightarrow \quad A/_{\diamond}C$

b. $A/_{\diamond}B \quad B/_{\bullet}C \quad \Rightarrow \quad A/_{\bullet}C$

c. $A/_{\bullet}B \quad B/_{\diamond}C \quad \Rightarrow \quad A/_{\diamond}C$

d. $A/_{\bullet}B \quad B/_{\bullet}C \quad \Rightarrow \quad A/_{\bullet}C$

However, this effectively means that the notion of modality is not given any general characterization and instead is merely used as a diacritic feature for regulating the applicability of *each* specific combinatory rule. Steedman and Baldridge (2007) claim that the

[110]For example, consider the analysis of the *-te* form complex predicate briefly discussed in sections 3.1.3 and 3.1.4 above. This analysis can be reformulated in MMCCG by modelling the effects of hypothetical reasoning in terms of function composition, as is done in Kubota (2008). Just as in the present analysis, in the MMCCG analysis, V1 and V2 look for their nominal arguments in the default scrambling mode but V1 combines with V2 in the left associative, complex predicate mode. Now, crucially, in order to account for properties of interclausal scrambling, namely, the fact that after V1 and V2 are function composed, the (nominal) arguments of V1 can scramble with arguments of V2, the original mode (i.e. the scrambling mode) by means of which V1 was looking for its argument needs to be preserved. See Kubota (2008) for more details.

pattern in (148) falls out as a consequence of a more general constraint on allowable forms of combinatory rules that they call ‘the Principle of Inheritance’. However, the status of such a ‘principle’ is rather unclear, and hence, the notion of modality within MMCCG, which crucially depends on this principle, remains somewhat obscure.

CHAPTER 4: ANALYSIS

This chapter presents the analyses of the three phenomena discussed in Chapter 2 in MMCG with Structured Phonology.[111] I will show that the flexibility of constituency and the systematic control of that flexibility in terms of the notion of modality—two properties that distinguish the present theory from PS-based alternatives—enable straightforward analyses of these empirical phenomena that have turned out to pose significant problems for PS-based theories. As we will see, an additional advantage of the present proposal is that not only do the proposed analyses adequately account for the individual properties of each of these constructions, they work together properly to make correct predictions about cases in which the relevant phenomena interact. I will point out such interactions of the independently formulated analyses of the specific constructions wherever relevant; these interactions, I claim, provide further confirmation for the general approach to syntactic theorizing advocated in this dissertation (as well as for the specific analyses of the individual phenomena within it).

4.1 Nonconstituent coordination

This section presents an analysis of nonconstituent coordination in Japanese in MMCG with Structured Phonology. As we have seen in Chapter 3, CG is known for an elegant

[111]Preliminary versions of the analyses of nonconstituent clefting and the *-te* form complex predicate that are formulated in (Multi-Modal) Combinatory Categorial Grammar, a theory of CG related to but distinct from the present one, have appeared in Kubota and Smith (2006, 2007) and Kubota (2008).

treatment of nonconstituent coordination. However, to the best of my knowledge, there is no previous analysis of nonconstituent coordination in Japanese in CG that addresses in detail the set of problems examined in Chapter 2. I will show below that such an analysis is straightforwardly available in the present theory.

We have seen in Chapter 2 that both deletion-based and movement-based analyses of nonconstituent coordination in Japanese suffer from serious problems. An advantage of the CG analysis that I will present below is that it provides a principled solution for these problems. Specifically, the proposed analysis avoids the problematic assumption shared by previous deletion-based and movement-based analyses that nonconstituent coordination is semantically equivalent to coordination of full-fledged clauses. This semantic non-equivalence of nonconstituent coordination and clausal coordination naturally follows from the assumption, well-established in the literature of CG, that nonconstituent coordination is just an instance of surface constituent coordination (involving constituents that are not full-fledged clauses). As we will see, the internal reading of *onazi* 'same' and the binding patterns of *zibun* immediately fall out from this assumption without any additional mechanisms. Furthermore, since the proposed analysis is not based on any kind of deletion mechanism, it does not suffer from any of the problems for deletion-based analyses either. This leaves only the alleged evidence for deletion-based analyses as potential challenges. Indeed, these cases are not so straightforward, and are arguably problematic for analyses within simpler, non-modalized variants of CG (such as earlier versions of Combinatory Categorial Grammar (Steedman 2000b) or the original Lambek calculus (Lambek 1958) without the multi-modal enrichment). However, the present theory, being equipped with the component of structured phonology that is capable of capturing fine-grained morpho-syntactic generalizations, adequately deals with these apparent challenges for non-deletion-based analyses as well.

4.1.1 The basic analysis

I assume that sentences like (4), repeated here as (149), are analyzed in the same way as nonconstituent coordination in English.

(149) [Taroo-ga Hanako-o], (sosite) [Ziroo-ga Mitiko-o] mi-ta.
Taro-NOM Hanako-ACC and Jiro-NOM Michiko-ACC see-PAST
'Taro saw Hanako and Jiro saw Michiko.'

In the present fragment, verbs are specified in the lexicon to combine with their arguments in the default scrambling mode $\cdot$, which is associative in both directions. As we will see below, this makes it possible to analyze sentences like (149) in a way exactly parallel to the cases of nonconstituent coordination in English.

Unlike in English, the conjunction is optional in Japanese nonconstituent coordination. In order to analyze coordination constructions without overt conjunctions, I posit the following coordination rules in the syntactic calculus: [112,113,114]

[112] Another possibility would be to posit phonologically empty conjunctions. The choice between these two options does not have any significance to the overall analysis that I propose below.

[113] The variable X ranges over syntactic categories. In order to prevent overgeneration, the actual set of categories that X can instantiate needs to be appropriately constrained. However, I will not attempt to work out the relevant details here, since this issue is orthogonal to the problem that I deal with below.

[114] In the coordination rules in (150), the two conjuncts are put together in the inflexible mode $\star$. This rules out a possibility in which an element is syntactically displaced (e.g. scrambled) out of only one conjunct. That is, assigning the $\star$ mode produces the effect of Ross's (1967) Coordinate Structure Constraint (CSC). Such examples do indeed seem to be generally unacceptable. For example, in the following ill-formed example, the direct object is scrambled out of the second conjunct alone:

(150) a. **Coordination rule I**

$$\frac{\mathsf{a};\varphi;X \quad \mathsf{b};\psi;X}{\mathsf{a}\circ_\star \mathsf{b};\varphi\sqcap\psi;X}\&_1$$

b. **Coordination rule II**

$$\frac{\mathsf{a};\varphi;X \quad \mathsf{b};\psi;X}{\mathsf{a}\circ_\star \mathsf{b};\varphi\oplus\psi;X}\&_2$$

These coordination rules embody the idea of **generalized conjunction** (cf., e.g., Partee and Rooth 1983) standardly assumed in CG, which enables coordinating expressions of any syntactic category directly and assigning to the whole coordinate structure the appropriate semantics without any syntactic operations like conjunction reduction. That is, two expressions can be coordinated if and only if their syntactic categories match, yielding a larger expression of the same category. (150a) and (150b) differ only in their semantics. Specifically, (150a) involves the standard semantic operator for generalized conjunction $\sqcap$ whereas (150b) involves a (generalized) sum formation operator, designated here by the symbol $\oplus$.[115] As we will see, the latter rule is needed for the treatment of internal readings of *onazi* 'same' with non-NP triggers.

With the coordination rule (150a), the analysis for (149) is straightforward. The derivation is shown in (151) (here, again, VP abbreviates $\mathrm{NP}_n\backslash\mathrm{S}$).

(i) *Gitaa-o$_i$ [John-ga piano-o], (sosite) [Bill-ga t_i] hii-ta.
guitar-ACC John-NOM piano-ACC and Bill-NOM play-PAST
intended: 'John played the piano and Bill played the guitar.'

However, it is not clear to me whether this syntactic solution is appropriate. Nonconstituent coordination in Japanese (just like English gapping) arguably serves the discourse function of establishing some kind of semantic parallel among conjuncts. Given this, an explanation of the unacceptability of (i) in terms of a pragmatic account of the CSC along the lines of Lakoff (1986) and Kehler (2002) seems equally plausible, and a syntactic constraint might then turn out to be superfluous. I leave this issue for future research.

[115]The sum formation operator $\oplus$ adopted here is generalized in the sense that, following Barker (2007), I assume that sums can be formed of semantic objects of any type, not just objects of type e (as in the original definition of the sum formation operation in Link (1983)).

(151)

$$\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\text{taroo-ga}; \mathbf{t}; \mathrm{NP}_n \quad \dfrac{\text{hanako-o}; \mathbf{h}; \mathrm{NP}_a \quad [p\,; f; \mathrm{NP}_a \backslash_{\cdot} \mathrm{VP}]^1}{\text{hanako-o} \circ_{\cdot} p\,; f(\mathbf{h}); \mathrm{VP}}\backslash_{\cdot}\mathrm{E}}{\text{taroo-ga} \circ_{\cdot} (\text{hanako-o} \circ_{\cdot} p); f(\mathbf{h})(\mathbf{t}); \mathrm{S}}\backslash_{\cdot}\mathrm{E}}{(\text{taroo-ga} \circ_{\cdot} \text{hanako-o}) \circ_{\cdot} p\,; f(\mathbf{h})(\mathbf{t}); \mathrm{S}}\mathrm{PI}}{\text{taroo-ga} \circ_{\cdot} \text{hanako-o}; \lambda f.f(\mathbf{h})(\mathbf{t}); \mathrm{S}/_{\cdot}(\mathrm{NP}_a \backslash_{\cdot} \mathrm{VP})}/_{\cdot}\mathrm{I}^1 \quad \begin{array}{c} \vdots\ \vdots \\ \text{ziroo-ga} \circ_{\cdot} \text{mitiko-o}; \\ \lambda f.f(\mathbf{m})(\mathbf{j}); \\ \mathrm{S}/_{\cdot}(\mathrm{NP}_a \backslash_{\cdot} \mathrm{VP}) \end{array}}{(\text{taroo-ga} \circ_{\cdot} \text{hanako-o}) \circ_{\star} (\text{ziroo-ga} \circ_{\cdot} \text{mitiko-o}); \lambda f.f(\mathbf{h})(\mathbf{t}) \wedge f(\mathbf{m})(\mathbf{j}); \mathrm{S}/_{\cdot}(\mathrm{NP}_a \backslash_{\cdot} \mathrm{VP})}\&_1 \quad \begin{array}{c} \text{mi-ta}; \mathbf{see}; \\ \mathrm{NP}_a \backslash_{\cdot} \mathrm{VP} \end{array}}{((\text{taroo-ga} \circ_{\cdot} \text{hanako-o}) \circ_{\star} (\text{ziroo-ga} \circ_{\cdot} \text{mitiko-o})) \circ_{\cdot} \text{mi-ta}\,; \mathbf{see}(\mathbf{h})(\mathbf{t}) \wedge \mathbf{see}(\mathbf{m})(\mathbf{j}); \mathrm{S}}/_{\cdot}\mathrm{E}$$

What is crucial here is that, as in (grammatical cases of) English nonconstituent coordination, the mode by which the verb combines with its arguments is associative. This makes it possible for the hypothesized verb to be pushed to the right periphery within the structured phonology of the two conjuncts and then withdrawn by Slash Introduction, so that the two conjuncts are assigned the right category $\mathrm{S}/_{\cdot}(\mathrm{NP}_a \backslash_{\cdot} \mathrm{VP})$ to combine with a transitive verb to their right after being conjoined. Note also that the right semantics is assigned for the whole sentence given the standard syntax-semantics interface in CG.

4.1.2 Cases that are problematic for all previous analyses

In this section, I show how the internal readings of *onazi* and the binding pattern of *zibun*, phenomena that have turned out to be problematic for all previous analyses of nonconstituent coordination in Japanese, are accounted for in the present analysis.

4.1.2.1 Parasitic scope and nonconstituent coordination

The internal readings of *onazi* in sentences like (19), repeated here as (152), can be straightforwardly accounted for by adopting Barker's (2007) analysis of *same* in terms of **parasitic scope**.

(152) Taroo-ga Hanako-ni, (sosite) Ziroo-ga Mitiko-ni **onazi** hon-o
Taro-NOM Hanako-DAT and Jiro-NOM Michiko-DAT same book-ACC
kasi-ta.
lend-PAST

'Taro lent Hanako and Jiro lent Michiko, the same book.'

Barker's analysis is formalized using the technique of continuations,[116] but here I will recast the essential aspects of his analysis within the present theory with the use of λ-binding in φ-terms rather than with continuations. More specifically, I adopt Pollard's (2009) reformulation of Barker's analysis of parasitic scope, which simplifies some complications of the original formulation. I call this the Barker/Pollard analysis of parasitic scope. Thus, the details of implementation are somewhat different, but the analytic idea of parasitic scope that I crucially exploit (which will be explained below) is essentially that of Barker (2007).

In the present fragment, quantifiers are uniformly assigned the semantic type of ordinary generalized quantifiers, namely, $(e \rightarrow t) \rightarrow t$. (Recall the discussion of quantifier scope ambiguity in the previous chapter.) The innovative aspect of Barker's (2007) analysis that enables a simple and accurate account of the internal readings of *same* is that it treats the word *same* as having a semantic type such that it can take scope only when there is a plural entity that it can distribute over. In this sense, the scope-taking behavior of *same* is parasitic on some plural-denoting expression.[117,118] Specifically, in the

[116] See Barker (2002, 2004) for some discussion on the possible linguistic applications of the notion of continuations.

[117] Since *same* can distribute over non-NP meanings, the notion of plurality here should be understood in a generalized sense. As stated above, I assume, following Barker (2007), that non-NP meanings can also be pluralized using the generalized sum forming operation $\oplus$.

[118] Saying that the scope-taking behavior of *same* is dependent on a plural-denoting *expression* is actually too strong (although that happens to be the case in many examples including (152)). For example, in the following example involving what Pollard (2009) calls the associate-remnant construction, the relevant plurality $\mathbf{k} \oplus \mathbf{s}$ ('Kim and Sandy') does not appear as a continuous string:

(i) Kim read the same book as Sandy.

See Pollard (2009) for how the analysis of parasitic scope can be extended to deal with cases like (i) as well.

Barker/Pollard analysis, the expression *the same N* is semantically a quantifier of type $(e \rightarrow (e \rightarrow t)) \rightarrow (e \rightarrow t)$.[119] This is different from ordinary quantifier meanings in that, unlike ordinary quantifiers, which take singly abstracted propositions (of type $e \rightarrow t$) as arguments to return non-abstracted propositions, *same* takes a doubly abstracted proposition and returns a singly abstracted proposition. The extra slot that is abstracted over corresponds to the position to be filled by the plural entity. Making this slot 'visible' for *same* is crucial in ensuring that *same* distributes over the plural entity in the right way.

The denotation for the expression *the same* is given as follows:[120,121]

(153) $$\lambda P \lambda Q \lambda X.\exists f[\mathbf{partial}(f) \wedge \mathbf{constant}(f) \wedge \mathbf{dom}(f) = \lambda x.x <_a X \wedge \forall x[x \in \mathbf{dom}(f) \rightarrow [Q(f(x))(x) \wedge P(f(x))]]]$$

With this lexical entry for *the same*, the derivation for the sentence *The same waiter served John and Bill* goes as follows:

(154)

$$\dfrac{\text{served};\ \mathbf{serve};\ \mathrm{VP}/_{\diamond}\mathrm{NP} \qquad [p\ ;x;\mathrm{NP}]^1}{\text{served} \circ_{\diamond} p\ ; \mathbf{serve}(x); \mathrm{VP}}\ /_{\diamond}\mathrm{E}$$

$$\dfrac{[q\ ;y;\mathrm{NP}]^2 \qquad \text{served} \circ_{\diamond} p\ ; \mathbf{serve}(x); \mathrm{VP}}{q \circ_{\diamond} (\text{served} \circ_{\diamond} p); \mathbf{serve}(x)(y); \mathrm{S}}\ \backslash_{\diamond}\mathrm{E}$$

$$\dfrac{q \circ_{\diamond} (\text{served} \circ_{\diamond} p); \mathbf{serve}(x)(y); \mathrm{S}}{\lambda p.q \circ_{\diamond} (\text{served} \circ_{\diamond} p); \lambda x.\mathbf{serve}(x)(y); \mathrm{S|NP}}\ |\mathrm{I}^1$$

$$\dfrac{\lambda p.q \circ_{\diamond} (\text{served} \circ_{\diamond} p); \lambda x.\mathbf{serve}(x)(y); \mathrm{S|NP}}{\lambda q \lambda p.q \circ_{\diamond} (\text{served} \circ_{\diamond} p); \lambda y \lambda x.\mathbf{serve}(x)(y); \mathrm{(S|NP)|NP}}\ |\mathrm{I}^2$$

$$\dfrac{\lambda q\ \lambda P.P\ (\text{the} \circ_{\star} (\text{same} \circ_{\star} q));\ \mathbf{same};\ \mathrm{((S|X)|((S|X)|NP))|N} \qquad \text{waiter};\ \mathbf{waiter};\ \mathrm{N}}{\lambda P.P\ (\text{the} \circ_{\star} (\text{same} \circ_{\star} \text{waiter})); \mathbf{same}(\mathbf{waiter});\ \mathrm{(S|X)|((S|X)|NP)}}\ |\mathrm{E}$$

$$\dfrac{\lambda P.P\ (\text{the} \circ_{\star} (\text{same} \circ_{\star} \text{waiter})); \mathbf{same}(\mathbf{waiter});\ \mathrm{(S|X)|((S|X)|NP)} \qquad \lambda q \lambda p.q \circ_{\diamond} (\text{served} \circ_{\diamond} p); \lambda y \lambda x.\mathbf{serve}(x)(y); \mathrm{(S|NP)|NP}}{\lambda p.(\text{the} \circ_{\star} (\text{same} \circ_{\star} \text{waiter})) \circ_{\diamond} (\text{served} \circ_{\diamond} p); \mathbf{same}(\mathbf{waiter})(\lambda y \lambda x.\mathbf{serve}(x)(y)); \mathrm{S|NP}}\ |\mathrm{E}$$

$$\dfrac{\begin{matrix}\vdots\ \vdots \\ \text{john} \circ_{\star} (\text{and} \circ_{\star} \text{bill});\ \mathbf{j} \oplus \mathbf{b};\ \mathrm{NP}\end{matrix} \qquad \lambda p.(\text{the} \circ_{\star} (\text{same} \circ_{\star} \text{waiter})) \circ_{\diamond} (\text{served} \circ_{\diamond} p); \mathbf{same}(\mathbf{waiter})(\lambda y \lambda x.\mathbf{serve}(x)(y)); \mathrm{S|NP}}{(\text{the} \circ_{\star} (\text{same} \circ_{\star} \text{waiter})) \circ_{\diamond} (\text{served} \circ_{\diamond} (\text{john} \circ_{\star} (\text{and} \circ_{\star} \text{bill}))); \mathbf{same}(\mathbf{waiter})(\lambda y \lambda x.\mathbf{serve}(x)(y))(\mathbf{j} \oplus \mathbf{b}); \mathrm{S}}\ |\mathrm{E}$$

---

[119] Unlike Barker (2007), Pollard (2009) treats the expression *the same* as a single unit. I adopt this assumption since it simplifies the analysis of *onazi* that I present below.

[120] Pollard (2009) dispenses with the choice function in Barker's (2007) original analysis and instead employs a partial and constant function, which is a less powerful theoretical device but which serves the intended purpose equally well.

[121] $<_a$ denotes the 'atomic subpart of' relation, which can be defined as follows:

(i) $x <_a X$ iff $x < X \wedge \neg\exists y \wedge y < x$

Here, the Vertical Slash Introduction and Elimination steps for the parasitic quantifier *the same waiter* are nested inside the Vertical Slash Introduction and Elimination steps for the plural expression *John and Bill*. This enables *same* to take parasitic scope with respect to *John and Bill* and identify the right plural entity to distribute over. (Note the close parallel between this derivation and the LF and the TLG derivation in Barker's (2007) original account.)

By unpacking the final translation for the sentence, we get the following truth conditions:

(155) $\textbf{same}(\textbf{waiter})(\lambda y \lambda x.\textbf{serve}(x)(y))(\textbf{j} \oplus \textbf{b}) =$
$$\exists f[\textbf{partial}(f) \wedge \textbf{constant}(f) \wedge \textbf{dom}(f) = \lambda x.x <_a \textbf{j} \oplus \textbf{b} \wedge$$
$$\forall x[x \in \textbf{dom}(f) \rightarrow [\textbf{serve}(x)(f(x)) \wedge \textbf{waiter}(f(x))]]]$$

This says that there is a partial and constant function f whose domain is the set of individuals that are atomic subparts of the sum $\textbf{j} \oplus \textbf{b}$ (i.e. the set $\{\textbf{j}, \textbf{b}\}$) such that for each member x of that set, x is served by $f(x)$ (which is the same individual for any choice of x since f is a constant function) where $f(x)$ is a waiter. In other words, there is a unique waiter who served both John and Bill. This correctly captures the meaning of the sentence on the relevant reading.

Barker's (2007) analysis is formulated in a variant of TLG augmented with a structural rule for handling continuations. Although Barker does not explicitly discuss this point, one of the advantages of adopting a CG syntax-semantics interface is that an elegant analysis of nonconstituent coordination is available, with fully explicit compositional semantics. And it turns out that Barker's analysis of parasitic scope straightforwardly interacts with the standard analysis of nonconstituent coordination in CG to yield the internal readings of sentences like the following (cf., e.g., Abbott 1976), long known to be problematic for virtually all existing analyses of right-node raising in any framework:

(156) Ann read and Bill reviewed the same book.

In particular, examples like (156) pose significant problems for deletion-based analyses of right-node raising (of the kind advocated, for example, by Sag and Chaves (2008)) for exactly the same reason that analogous examples of Japanese nonconstituent coordination are problematic for deletion-based analyses (cf. the discussion in Chapter 2): as noted by Abbott (1976), sentences like (156) are not synonymous with paraphrases that recover the supposedly deleted material.

In the Barker-style analysis of parasitic scope, the internal readings of sentences like (156) can be licensed by letting *same* take parasitic scope with respect to a pluralized property denoted by the string *Ann read and Bill reviewed*. Adopting the CG analysis of nonconstituent coordination, the grammar automatically assigns just the right meaning for the coordinated expression without any additional assumptions: with hypothetical reasoning, the strings *Ann read* and *Bill reviewed* are analyzed as denoting properties of individuals, and the sum-forming coordination rule (150b) (or, for English, the lexical meaning for *and* that produces the same semantics) assigns the sum of these properties as the meanings of the coordinated string. The derivation for (156) is given in (157):

(157)

$$\dfrac{\dfrac{\begin{array}{c}\lambda q\, \lambda P.P\ (\text{the} \circ_{\star} (\text{same} \circ_{\star} q)); \textbf{same};\\ ((\mathrm{S}|\mathrm{X})|((\mathrm{S}|\mathrm{X})|\mathrm{NP}))|\mathrm{N}\end{array} \qquad \text{book}; \textbf{book}; \mathrm{N}}{\begin{array}{c}\lambda P.P\ (\text{the} \circ_{\star} (\text{same} \circ_{\star} \text{book})); \textbf{same}(\textbf{book});\\ (\mathrm{S}|\mathrm{X})|((\mathrm{S}|\mathrm{X})|\mathrm{NP})\end{array}}|\mathrm{E} \qquad \dfrac{\dfrac{\dfrac{[p\,; f; \mathrm{S}/_{\diamond}\mathrm{NP}]^1 \quad [q\,; g; \mathrm{NP}]^2}{p \circ_{\diamond} q\,; f(g); \mathrm{S}}/_{\diamond}\mathrm{E}}{\lambda p.p \circ_{\diamond} q\,; \lambda f.f(g); \mathrm{S}|(\mathrm{S}/_{\bullet}\mathrm{NP})}|\mathrm{I}^1}{\begin{array}{c}\lambda q \lambda p.p \circ_{\diamond} q\,; \lambda g \lambda f.f(g);\\ (\mathrm{S}|(\mathrm{S}/_{\bullet}\mathrm{NP}))|\mathrm{NP}\end{array}}|\mathrm{I}^2}{\lambda p.p \circ_{\diamond} (\text{the} \circ_{\star} (\text{same} \circ_{\star} \text{book})); \textbf{same}(\textbf{book})(\lambda g \lambda f.f(g)); \mathrm{S}|(\mathrm{S}/_{\bullet}\mathrm{NP})}|\mathrm{E}$$

$$
\cfrac{
\cfrac{
\cfrac{
\begin{array}{l}\text{ann};\\ \mathbf{a};\\ \mathrm{NP}\end{array}
\quad
\cfrac{\begin{array}{l}\text{read};\\ \lambda x\lambda y.\mathbf{read}(y,x);\\ \mathrm{VP}/_{\diamond}\mathrm{NP}\end{array} \quad [p\,; x; \mathrm{NP}]^1}{\text{read} \circ_{\diamond} p\,; \lambda y.\mathbf{read}(y,x); \mathrm{VP}}\,/_{\diamond}\mathrm{E}
}{\text{ann} \circ_{\diamond} (\text{read} \circ_{\diamond} p); \mathbf{read}(\mathbf{a},x); \mathrm{S}}\,\backslash_{\diamond}\mathrm{E}
}{\begin{array}{l}\text{ann} \circ_{\diamond} \text{read}; \lambda x.\mathbf{read}(\mathbf{a},x);\\ \mathrm{S}/_{\diamond}\mathrm{NP}\end{array}}\,/_{\diamond}\mathrm{I}^1
\quad
\cfrac{\begin{array}{l}\text{and};\\ \lambda f\lambda g.f \oplus g;\\ (X\backslash_{\star}X)/_{\star}X\end{array} \quad \begin{array}{l}\vdots\ \vdots\\ \text{bill} \circ_{\diamond} \text{reviewed};\\ \lambda x.\mathbf{review}(\mathbf{b},x);\\ \mathrm{S}/_{\diamond}\mathrm{NP}\end{array}}{\begin{array}{l}\text{and} \circ_{\star} (\text{bill} \circ_{\diamond} \text{reviewed}); \lambda g.[\lambda x.\mathbf{review}(\mathbf{b},x)] \oplus g;\\ (\mathrm{S}/_{\diamond}\mathrm{NP})\backslash_{\star}(\mathrm{S}/_{\diamond}\mathrm{NP})\end{array}}\,/_{\star}\mathrm{E}
}{(\text{ann} \circ_{\diamond} \text{read}) \circ_{\star} (\text{and} \circ_{\star} (\text{bill} \circ_{\diamond} \text{reviewed})); \lambda x.\mathbf{review}(\mathbf{b},x) \oplus \lambda x.\mathbf{read}(\mathbf{a},x); \mathrm{S}/_{\diamond}\mathrm{NP}}\,\backslash_{\star}\mathrm{E}
$$

$$
\cfrac{\begin{array}{l}\vdots\ \vdots\\ (\text{ann} \circ_{\diamond} \text{read}) \circ_{\star} (\text{and} \circ_{\star} (\text{bill} \circ_{\diamond} \text{reviewed}));\\ \lambda x.\mathbf{review}(\mathbf{b},x) \oplus \lambda x.\mathbf{read}(\mathbf{a},x);\\ \mathrm{S}/_{\diamond}\mathrm{NP}\end{array} \quad \begin{array}{l}\vdots\ \vdots\\ \lambda p.p \circ_{\diamond} (\text{the} \circ_{\star} (\text{same} \circ_{\star} \text{book}));\\ \mathbf{same}(\lambda g\lambda f.g(\iota(f(\mathbf{book}))));\\ \mathrm{S}|(\mathrm{S}/_{\diamond}\mathrm{NP})\end{array}}{\begin{array}{l}((\text{ann} \circ_{\diamond} \text{read}) \circ_{\star} (\text{and} \circ_{\star} (\text{bill} \circ_{\diamond} \text{reviewed}))) \circ_{\diamond} (\text{the} \circ_{\star} (\text{same} \circ_{\star} \text{book}));\\ \mathbf{same}(\mathbf{book})(\lambda g\lambda f.f(g))(\lambda x.\mathbf{review}(\mathbf{b},x) \oplus \lambda x.\mathbf{read}(\mathbf{a},x));\\ \mathrm{S}\end{array}}\,|\mathrm{E}
$$

The final translation for this sentence can be unpacked as follows:

(158)
$$
\begin{aligned}
&\mathbf{same}(\mathbf{book})(\lambda g\lambda f.f(g))(\lambda x.\mathbf{review}(\mathbf{b},x) \oplus \lambda x.\mathbf{read}(\mathbf{a},x)) = \\
&\quad \exists f[\mathbf{partial}(f) \wedge \mathbf{constant}(f) \wedge \\
&\quad \mathbf{dom}(f) = \lambda P.P <_a (\lambda x.\mathbf{review}(\mathbf{b},x) \oplus \lambda x.\mathbf{read}(\mathbf{a},x)) \wedge \\
&\quad \forall P[P \in \mathbf{dom}(f) \rightarrow [P(f(P)) \wedge \mathbf{book}(f(P))]]]
\end{aligned}
$$

To paraphrase (158): there is a partial and constant function f from properties to individuals such that f ranges over the atomic subparts of the sum of two properties $\lambda x.\mathbf{review}(\mathbf{b},x)$ and $\lambda x.\mathbf{read}(\mathbf{a},x)$, and, for each P that is in the domain of f, f maps P to some constant individual $f(P)$ that is a book and that satisfies the property P. In other words, there is some unique book that satisfies both the property of being read by Ann and the property of being reviewed by Bill.

We are now ready to see how the internal readings of *onazi* in sentences like (152) are licensed in the present fragment. The analysis goes essentially in the same way as that for the English right-node raising example (156). The only major difference is the semantic type of the coordinated string: instead of sums of one-place properties, we have sums of properties of transitive verb meanings.[122] I assume that the word *onazi* receives the same translation as the English expression *the same* given in (153). The derivation for (152) is given in (159) and the translation for the whole sentence is paraphrased in (160) (here, DTV and TV abbreviate $\mathrm{NP}_d\backslash_{\!\cdot}\mathrm{NP}_a\backslash_{\!\cdot}\mathrm{NP}_n\backslash_{\!\cdot}\mathrm{S}$ and $\mathrm{NP}_a\backslash_{\!\cdot}\mathrm{NP}_n\backslash_{\!\cdot}\mathrm{S}$, respectively).

(159)

$$
\dfrac{
\dfrac{\lambda q\,\lambda P.P\ (\text{onazi} \circ_{\star} q); \mathbf{same}; ((\mathrm{S}|\mathrm{X})|((\mathrm{S}|\mathrm{X})|\mathrm{NP}))|\mathrm{N} \qquad \text{hon-o}; \mathbf{book}; \mathrm{N}}{\lambda P.P\ (\text{onazi} \circ_{\star} \text{hon-o}); \mathbf{same}(\mathbf{book}); (\mathrm{S}|\mathrm{X})|((\mathrm{S}|\mathrm{X})|\mathrm{NP})}{\scriptstyle /_{\star}\mathrm{E}}
\qquad
\dfrac{\dfrac{\dfrac{[p\,;f;\mathrm{S}/_{\!\cdot}\mathrm{TV}]^1 \qquad \dfrac{[q\,;x;\mathrm{NP}]^2 \quad \text{kasi-ta}; \mathbf{lend}; \mathrm{DTV}}{q \circ_{\cdot} \text{kasi-ta}; \mathbf{lend}(x); \mathrm{TV}}{\scriptstyle \backslash_{\!\cdot}\mathrm{E}}}{p \circ_{\cdot} (q \circ_{\cdot} \text{kasi-ta}); f(\mathbf{lend}(x)); \mathrm{S}}{\scriptstyle /_{\!\cdot}\mathrm{E}}}{\lambda p.\ p \circ_{\cdot} (q \circ_{\cdot} \text{kasi-ta}); \lambda f.f(\mathbf{lend}(x)); \mathrm{S}|(\mathrm{S}/_{\!\cdot}\mathrm{TV})}{\scriptstyle |\mathrm{I}^1}}{\lambda q\lambda p.\ p \circ_{\cdot} (q \circ_{\cdot} \text{kasi-ta}); \lambda x\lambda f.f(\mathbf{lend}(x)); (\mathrm{S}|(\mathrm{S}/_{\!\cdot}\mathrm{TV}))|\mathrm{NP}}{\scriptstyle |\mathrm{I}^2}
}{\lambda p.p \circ_{\cdot} ((\text{onazi} \circ_{\star} \text{hon-o}) \circ_{\cdot} \text{kasi-ta}); \mathbf{same}(\mathbf{book})(\lambda x\lambda f.f(\mathbf{lend}(x))); \mathrm{S}|(\mathrm{S}/_{\!\cdot}\mathrm{TV})}{\scriptstyle |\mathrm{E}}
$$

$$
\dfrac{
\dfrac{\dfrac{\dfrac{\text{taroo-ga}; \mathbf{t}; \mathrm{NP}_n \qquad \dfrac{\text{hanako-ni}; \mathbf{h}; \mathrm{NP}_d \quad [p\,;f;\mathrm{TV}]^1}{\text{hanako-ni} \circ_{\cdot} p\,; f(\mathbf{h}); \mathrm{VP}}{\scriptstyle \backslash_{\!\cdot}\mathrm{E}}}{\text{taroo-ga} \circ_{\cdot} (\text{hanako-ni} \circ_{\cdot} p); f(\mathbf{h})(\mathbf{t}); \mathrm{S}}{\scriptstyle \backslash_{\!\cdot}\mathrm{E}}}{(\text{taroo-ga} \circ_{\cdot} \text{hanako-ni}) \circ_{\cdot} p\,; f(\mathbf{h})(\mathbf{t}); \mathrm{S}}{\scriptstyle \mathrm{PI}}}{\text{taroo-ga} \circ_{\cdot} \text{hanako-ni}; \lambda f.f(\mathbf{h})(\mathbf{t}); \mathrm{S}/_{\!\cdot}\mathrm{TV}}{\scriptstyle /_{\!\cdot}\mathrm{I}^1}
\qquad
\begin{array}{c} \vdots\ \vdots \\ \text{ziroo-ga} \circ_{\cdot} \text{mitiko-ni}; \lambda f.f(\mathbf{j})(\mathbf{m}); \mathrm{S}/_{\!\cdot}\mathrm{TV} \end{array}
}{(\text{taroo-ga} \circ_{\cdot} \text{hanako-ni}) \circ_{\star} (\text{ziroo-ga} \circ_{\cdot} \text{mitiko-ni}); \lambda f.f(\mathbf{h})(\mathbf{t}) \oplus \lambda f.f(\mathbf{j})(\mathbf{m}); \mathrm{S}/_{\!\cdot}\mathrm{TV}}{\scriptstyle \&_2}
$$

$$
\dfrac{
\begin{array}{l} \qquad\qquad \vdots\ \vdots \\ (\text{taroo-ga} \circ_{\cdot} \text{hanako-ni}) \circ_{\star} (\text{ziroo-ga} \circ_{\cdot} \text{mitiko-ni}); \\ \lambda f.f(\mathbf{h})(\mathbf{t}) \oplus \lambda f.f(\mathbf{j})(\mathbf{m}); \\ \mathrm{S}/_{\!\cdot}\mathrm{TV} \end{array}
\qquad
\begin{array}{l} \qquad\qquad \vdots\ \vdots \\ \lambda p.p \circ_{\cdot} ((\text{onazi} \circ_{\star} \text{hon-o}) \circ_{\cdot} \text{kasi-ta}); \\ \mathbf{same}(\lambda f\lambda g.g(\mathbf{lend}(x))); \\ \mathrm{S}|(\mathrm{S}/_{\!\cdot}\mathrm{TV}) \end{array}
}{
\begin{array}{l} ((\text{taroo-ga} \circ_{\cdot} \text{hanako-ni}) \circ_{\star} (\text{ziroo-ga} \circ_{\cdot} \text{mitiko-ni})) \circ_{\cdot} ((\text{onazi} \circ_{\star} \text{hon-o}) \circ_{\cdot} \text{kasi-ta}); \\ \mathbf{same}(\mathbf{book})(\lambda x\lambda f.f(\mathbf{lend}(x)))(\lambda f.f(\mathbf{h})(\mathbf{t}) \oplus \lambda f.f(\mathbf{j})(\mathbf{m})); \\ \mathrm{S} \end{array}
}{\scriptstyle |\mathrm{E}}
$$

(160) $\mathbf{same}(\mathbf{book})(\lambda x\lambda f.f(\mathbf{lend}(x)))(\lambda f.f(\mathbf{h})(\mathbf{t}) \oplus \lambda f.f(\mathbf{j})(\mathbf{m})) =$

$\exists f[\mathbf{partial}(f) \wedge \mathbf{constant}(f) \wedge$

[122] Argument cluster constituents such as *Taroo-ga Hanako-ni* denote properties of transitive verb meanings—properties that are either true or false of each two place relation such as ‘love’, ‘hit’, ‘see’, etc.—since they take transitive verb meanings as arguments to return propositions (that are either true or false). For example, if Taro met Hanako, then the argument cluster *Taroo-ga Hanako-ni* denotes a property that is true of the two-place relation ‘met’.

$$\textbf{dom}(f) = \lambda g.g <_a (\lambda f.f(\textbf{h})(\textbf{t}) \oplus \lambda f.f(\textbf{j})(\textbf{m})) \wedge$$

$$\forall g[g \in \textbf{dom}(f) \rightarrow [g(\textbf{lend}(f(g))) \wedge \textbf{book}(f(g))]]]$$

In words: there is a partial and constant function f whose domain is the set of two functions $\lambda f.f(\mathbf{h})(\mathbf{t})$ and $\lambda f.f(\mathbf{j})(\mathbf{m})$ such that for each g in the domain of f, f maps g to some constant individual $f(g)$ (for any g) which is a book and such that g is true of the two-place relation **lend**$(f(g))$ (i.e. the relation 'lending $f(g)$ to'). To put it plainly, there is a unique book for which both of the following propositions are true: Taro lent it to Hanako and Jiro lent it to Michiko.

4.1.2.2 Binding

In this subsection, I will briefly sketch how the data involving binding of *zibun* can be handled in the present approach. I will not attempt to work out a full account of *zibun* binding, which is too huge an issue to deal with here. The point here is rather that, in a syntactic theory like CG, in which the semantic effects of binding are properly taken into account, the contrast between the available and unavailable readings of (161) (= (23)) falls out immediately. To review the relevant facts, we have seen in Chapter 2 that sentences like the following are ambiguous only in two ways instead of four, as indicated in the English translations:

(161) Taroo-wa Hanako-ni, (sosite) Ziroo-wa Mitiko-ni zibun-no heya-de
Taro-TOP Hanako-DAT and Jiro-TOP Michiko-DAT self-GEN room-in
odor-ase-ta.
dance-cause-PAST
'Taro$_i$ made Hanako dance in his$_i$ room and Jiro$_j$ made Michiko dance in his$_j$ room.'
'Taro made Hanako$_i$ dance in her$_i$ room and Jiro made Michiko$_j$ dance in her$_j$

room.'

Not: 'Taro$_i$ made Hanako dance in his$_i$ room and Jiro made Michiko$_j$ dance in her$_j$ room.'

Not: 'Taro made Hanako$_i$ dance in her$_i$ room and Jiro$_j$ made Michiko dance in his$_j$ room.'

This fact remains unexplained in deletion-based and movement-based analyses of nonconstituent coordination.

With a suitable account of binding in place, the binding pattern observed in (161) falls out immediately in the present analysis. For the sake of concreteness, I will adopt the 'quantificational' analysis of reflexives and pronouns which is originally due to Bach and Partee (1980) and which has been implemented in several different ways by subsequent authors (cf., e.g., Morrill 1994; Carpenter 1997; Dowty 2007). Implementational details aside (Bach and Partee (1980) formulate their analysis in terms of what later came to be called 'Cooper storage'), the essential idea of the Bach-Partee analysis of binding is to treat pronouns as (parasitic) scope-taking elements. Specifically, a bound pronoun (or reflexive) takes scope immediately below its antecedent and binds the 'trace' that it has left behind to its antecedent. Within the present theory, this parasitic scope-taking behavior of pronouns and reflexives can be treated by means of lambda binding in phonology with the vertical slash. Since the Japanese reflexive (except for its 'logophoric' uses, which I will not deal with here) is subject-oriented, I assume the following lexical entry for *zibun*:

(162) $\lambda P.P$ (zibun); $\lambda R\lambda x.R(x)(x)$; $(\mathrm{NP}_n\backslash_{\bullet}\mathrm{S})|((\mathrm{NP}_n\backslash_{\bullet}\mathrm{S})|\mathrm{N})$

The syntactic category says that *zibun* takes scope at the 'VP node' ($\mathrm{NP}_n\backslash_{\bullet}\mathrm{S}$) and binds its trace (i.e. the missing noun sought via the vertical slash). When *zibun* takes scope, what it does semantically is that it takes the relation denoted by its scope and identifies the two arguments of the relation. Since these two arguments correspond to the trace of zibun and the subject of the sentence, respectively, this amounts to binding the trace position to the subject antecedent. Phonologically, *zibun* lowers itself into its trace position just like ordinary quantifiers.

This analysis immediately predicts the ambiguity of the interpretation of *zibun* in causative sentences like the following:

(163) Taroo-wa Hanako-ni zibun-no heya-de odor-ase-ta.
Taro-TOP Hanako-DAT self-GEN room-in dance-cause-PAST
'Taro$_i$ made Hanako$_j$ dance in his$_i$/her$_j$ room.'

The causative construction belongs to the class of biclausal lexical complex predicates discussed in section 4.3.2 below: morpho-syntactically, the verb stem and the causative suffix behave as a single word by all criteria, but semantically, the construction has 'biclausal' properties with respect to phenomena such as binding, quantifier scope and adverb scope (cf., e.g., Kuroda 1965; Shibatani 1976; Matsumoto 1996). Since all we need to do here is to demonstrate that biclausal interpretations can indeed be derived for the case of binding, I will assume a somewhat simplified analysis of lexical complex predicates. [123] As will be explained in greater detail in section 4.3.2, the morpho-syntactic clustering of the higher and lower verbs in lexical complex predicates is accounted for in the present analysis by specifying in the lexical entry for the higher predicate that it combines with the lower predicate in the 'verb raising' mode $\ll$, as in the following lexical entry for the causative suffix -*(s)ase*:

(164) (s)ase-ta; $\lambda P.\lambda x \lambda y.\mathbf{cause}(y, P(x))$; $\mathrm{VP}\backslash_{\ll}\mathrm{NP}_d\backslash_{\bullet}\mathrm{NP}_n\backslash_{\bullet}\mathrm{S}$

[123] The more complete analysis of this type of complex predicate will be developed in section 4.3.2.2.

As its name suggests, the 'verb raising' mode induces obligatory verb clustering. Thus, in the surface morpho-syntax, the causative predicate behaves like a single word, exhibiting a monoclausal structure. Crucially, though, in the semantically-oriented combinatoric structure (i.e. in the derivation in the syntactic calculus), there is a step corresponding to the embedded VP where the lower verb combines with its own arguments. Thus, if the reflexive takes scope at this step, the embedded subject binding reading results. The derivation for this reading for (163) is given in (165):[124]

(165)

$$
\dfrac{
\dfrac{
\begin{array}{l}\lambda P.P \text{ (zibun)};\\ \lambda R\lambda x.R(x)(x);\\ (\mathrm{NP}_n\backslash_{\bullet}\mathrm{S})|((\mathrm{NP}_n\backslash_{\bullet}\mathrm{S})|\mathrm{N})\end{array}
\quad
\dfrac{
\dfrac{\vdots\ \vdots \quad \dfrac{[p\,;x;\mathrm{N}]^1}{\vdots\ \vdots} \quad \vdots\ \vdots}
{\begin{array}{l}p\text{-no-heya-de} \circ_{\bullet} \text{odor};\\ \lambda y.\textbf{dance-in-the-room-of}(y,x);\\ \mathrm{NP}_n\backslash_{\bullet}\mathrm{S}\end{array}}
}
{\begin{array}{l}\lambda p.p\text{-no-heya-de} \circ_{\bullet} \text{odor};\\ \lambda x\lambda y.\textbf{dance-in-the-room-of}(y,x);\\ (\mathrm{NP}_n\backslash_{\bullet}\mathrm{S})|\mathrm{N}\end{array}}{|\mathrm{I}^1}
}
{\text{zibun-no-heya-de} \circ_{\bullet} \text{odor}; \lambda x.\textbf{dance-in-the-room-of}(x,x); \mathrm{NP}_n\backslash_{\bullet}\mathrm{S}}{|\mathrm{E}}
\quad
\begin{array}{l}\text{ase-ta};\\ \lambda P.\lambda x\lambda y.\textbf{cause}(y,P(x));\\ \mathrm{VP}\backslash_{\ll}\mathrm{NP}_d\backslash_{\bullet}\mathrm{NP}_n\backslash_{\bullet}\mathrm{S}\end{array}
}
{\dfrac{(\text{zibun-no-heya-de} \circ_{\bullet} \text{odor}) \circ_{\ll} \text{ase-ta}; \lambda x\lambda y.\textbf{cause}(y,\textbf{dance-in-the-room-of}(x,x)); \mathrm{NP}_d\backslash_{\bullet}\mathrm{NP}_n\backslash_{\bullet}\mathrm{S}}
{\text{zibun-no-heya-de} \bullet (\text{odor} \bullet \text{ase-ta}); \lambda x\lambda y.\textbf{cause}(y,\textbf{dance-in-the-room-of}(x,x)); \mathrm{NP}_d\backslash_{\bullet}\mathrm{NP}_n\backslash_{\bullet}\mathrm{S}}\,\mathrm{PI}}
\,\backslash_{\ll}\mathrm{E}
$$

There is an alternative derivation for this sentence in which the reflexive takes scope at the matrix VP level. This yields the matrix subject binding reading, as shown in the following derivation:

[124]Hyphenation is used for abbreviation whenever the internal structure of some expression is not relevant. It does not necessarily correspond to morpheme boundaries (as opposed to word boundaries).

(166)

$$
\dfrac{
\begin{array}{c}\text{(NP-style)}\\ \lambda P.P\ (\text{zibun});\\ \lambda R\lambda x.R(x)(x);\\ (\mathrm{NP}_n\backslash_{\bullet}\mathrm{S})|((\mathrm{NP}_n\backslash_{\bullet}\mathrm{S})|\mathrm{N})\end{array}
\quad
\dfrac{
\dfrac{
\begin{array}{c}\text{hanako-ni};\\ \mathbf{h};\\ \mathrm{NP}_d\end{array}
\quad
\dfrac{
\dfrac{\begin{array}{c}\vdots\ \vdots \quad \dfrac{[p\,;x;\mathrm{N}]^1}{\vdots\ \vdots}\quad \vdots\ \vdots\\ \vdots\ \vdots \qquad\qquad\quad \vdots\ \vdots\end{array}}{\begin{array}{l}p\text{-no-heya-de}\circ_{\bullet}\text{odor};\\ \lambda y.\textbf{dance-in-the-room-of}(y,x);\\ \mathrm{NP}_n\backslash_{\bullet}\mathrm{S}\end{array}}
\quad
\begin{array}{l}\text{ase-ta};\\ \lambda P.\lambda x\lambda y.\textbf{cause}(y,P(x));\\ \mathrm{VP}\backslash_{\ll}\mathrm{NP}_d\backslash_{\bullet}\mathrm{NP}_n\backslash_{\bullet}\mathrm{S}\end{array}
}{\begin{array}{l}(p\text{-no-heya-de}\circ_{\bullet}\text{odor})\circ_{\ll}\text{ase-ta};\\ \lambda y\lambda z.\textbf{cause}(z,\textbf{dance-in-the-room-of}(y,x));\\ \mathrm{NP}_d\backslash_{\bullet}\mathrm{NP}_n\backslash_{\bullet}\mathrm{S}\end{array}}\backslash_{\ll}\mathrm{E}
}{\begin{array}{l}\text{hanako-ni}\circ_{\bullet}((p\text{-no-heya-de}\circ_{\bullet}\text{odor})\circ_{\ll}\text{ase-ta});\\ \lambda z.\textbf{cause}(z,\textbf{dance-in-the-room-of}(\mathbf{h},x));\\ \mathrm{NP}_n\backslash_{\bullet}\mathrm{S}\end{array}}\backslash_{\bullet}\mathrm{E}
}{\begin{array}{l}\lambda p.\text{hanako-ni}\circ_{\bullet}((p\text{-no-heya-de}\circ_{\bullet}\text{odor})\circ_{\ll}\text{ase-ta});\\ \lambda x\lambda z.\textbf{cause}(z,\textbf{dance-in-the-room-of}(\mathbf{h},x));\\ (\mathrm{NP}_n\backslash_{\bullet}\mathrm{S})|\mathrm{N}\end{array}}|\mathrm{I}^1
}{\text{hanako-ni}\circ_{\bullet}((\text{zibun-no-heya-de}\circ_{\bullet}\text{odor})\circ_{\ll}\text{ase-ta});\ \lambda x.\textbf{cause}(x,\textbf{dance-in-the-room-of}(\mathbf{h},x));\ \mathrm{NP}_n\backslash_{\bullet}\mathrm{S}}|\mathrm{E}
$$

Assuming this approach to binding, the present analysis predicts the two-way ambiguity of nonconstituent coordination examples like (161). Specifically, to derive the embedded subject binding reading, we just need to take the part of the derivation for (163) shown in (165) corresponding to the pivot *zibun-no heya-de odor-ase-ta* ‘made dance in self’s room’, which has the following denotation:

(167) $\lambda x\lambda y.\textbf{cause}(y,\textbf{dance-in-the-room-of}(x,x))$

and put it together with the coordinated argument cluster which can be formed in the usual manner. Since (167) already specifies the embedded subject to be the binder, this yields the reading in which the embedded subject is the binder in both conjuncts.

To derive the matrix subject binding reading, we need to replace the actual dative NP in (166) with a hypothetical one, then let *zibun* take scope at the matrix VP and withdraw that hypothetical dative as in the following derivation:

(168)

$$
\dfrac{
\dfrac{
\begin{array}{l}\lambda P.P\ (\text{zibun});\\ \lambda R\lambda x.R(x)(x);\\ (\mathrm{NP}_n\backslash_{.}\mathrm{S})|((\mathrm{NP}_n\backslash_{.}\mathrm{S})|\mathrm{N})\end{array}
\quad
\dfrac{
\dfrac{
[q\,;y;\mathrm{NP}]^2
\quad
\dfrac{\vdots\ \vdots \quad \dfrac{[p\,;x;\mathrm{N}]^1}{\vdots\ \vdots} \quad \vdots\ \vdots}{\begin{array}{l}(p\text{-no-heya-de} \circ_{.} \text{odor}) \circ_{\ll} \text{ase-ta};\\ \lambda y\lambda z.\mathbf{cause}(z,\mathbf{dance\text{-}in\text{-}the\text{-}room\text{-}of}(y,x));\\ \mathrm{NP}_d\backslash_{.}\mathrm{NP}_n\backslash_{.}\mathrm{S}\end{array}}
}{
\begin{array}{l}q \circ_{.} ((p\text{-no-heya-de} \circ_{.} \text{odor}) \circ_{\ll} \text{ase-ta});\\ \lambda z.\mathbf{cause}(z,\mathbf{dance\text{-}in\text{-}the\text{-}room\text{-}of}(y,x));\\ \mathrm{NP}_n\backslash_{.}\mathrm{S}\end{array}
}\backslash_{.}\mathrm{E}
}{
\begin{array}{l}\lambda p.q \circ_{.} ((p\text{-no-heya-de} \circ_{.} \text{odor}) \circ_{\ll} \text{ase-ta});\\ \lambda x\lambda z.\mathbf{cause}(z,\mathbf{dance\text{-}in\text{-}the\text{-}room\text{-}of}(y,x));\\ (\mathrm{NP}_n\backslash_{.}\mathrm{S})|\mathrm{N}\end{array}
}|\mathrm{I}^1
}{
q \circ_{.} ((\text{zibun-no-heya-de} \circ_{.} \text{odor}) \circ_{\ll} \text{ase-ta}); \lambda x.\mathbf{cause}(x,\mathbf{dance\text{-}in\text{-}the\text{-}room\text{-}of}(y,x)); \mathrm{NP}_n\backslash_{.}\mathrm{S}
}|\mathrm{E}
}{
(\text{zibun-no-heya-de} \circ_{.} \text{odor}) \circ_{\ll} \text{ase-ta}; \lambda y\lambda x.\mathbf{cause}(x,\mathbf{dance\text{-}in\text{-}the\text{-}room\text{-}of}(y,x)); \mathrm{NP}_d\backslash_{.}\mathrm{NP}_n\backslash_{.}\mathrm{S}
}\backslash_{.}\mathrm{I}^2
$$

This assigns the following denotation to the pivot and the rest goes in the same way as in the case of embedded subject binding reading:

(169) $\lambda x\lambda y.\mathbf{cause}(y, \mathbf{dance\text{-}in\text{-}the\text{-}room\text{-}of}(x, y))$

Again, since the denotation of the pivot (169) already specifies the matrix subject to be the binder, this yields the reading in which the matrix subject is the binder in both conjuncts.

What is crucial here is that, in the CG analysis of nonconstituent coordination, there is exactly one occurrence of the pivot in the syntactic derivation. Unlike in deletion-based analyses (and in most movement-based analyses), since the shared element is not separately present in each conjunct at the level relevant for binding, the problem of overgeneration simply goes away. The single occurrence of the pivot in the syntactic derivation needs to be assigned either (167) or (169) as its denotation. In the former case, the matrix subject ends up being the binder in both conjuncts, whereas in the latter case, the embedded subject ends up being the binder in both conjuncts. Since these are the only two readings derivable, the other two impossible readings are correctly blocked.

4.1.3 Cases that are problematic for deletion-based analyses

In the present analysis of nonconstituent coordination in Japanese, cases such as (14), (16) and (17), which pose problems for deletion-based analyses, are not problematic. I repeat here (14), the example involving a polysemous expression in the pivot:

(170)	John-ga	Mary-ni,	(sosite)	Bill-ga	Susan-ni	kumo-o	mise-ta.
	John-NOM	Mary-DAT	and	Bill-NOM	Susan-DAT	cloud/spider-ACC	show-PAST

‘John showed a cloud to Mary and Bill showed a cloud to Susan.’
‘John showed a spider to Mary and Bill showed a spider to Susan.’
Not: ‘John showed a cloud to Mary and Bill showed a spider to Susan.’
Not: ‘John showed a spider to Mary and Bill showed a cloud to Susan.’

As discussed above with respect to how impossible patterns of binding are ruled out, assuming the standard syntax-semantics interface in CG, in examples like (170), the pivot is assigned a single denotation that is shared among the two conjuncts. The unavailable readings would arise only if it were possible to interpret the polysemous expression in the pivot *differently* with respect to each conjunct, but since such a possibility does not exist in the present analysis, these readings do not arise.

4.1.4 Cases that apparently provide evidence for deletion-based analyses

As noted in Chapter 2, there are examples of nonconstituent coordination that do not seem to respect surface constituency, such as (8)–(10). In (171) (= (10)), a relative clause is split into the conjuncts and the pivot; in (172) (= (8)), a postposition is stranded in the pivot from the head nouns that appear in each conjunct.

(171) [Mike-ga *raion-ni*], (sosite) [Tom-ga *kuma-ni*] ***osow-are-ta*** ***otoko*-o**
Mike-NOM lion-DAT and Tom-NOM bear-DAT attack-PASS-PAST man-ACC
tasuke-ta.
save-PAST
'Mike saved a man who was attacked by a lion and Tom saved a man who was attacked by a bear.' (Mukai 2003)

(172) [Taroo-wa *hon*], (sosite) [Ziroo-wa *zassi*]***-o*** **kat-ta**.
Taro-TOP book and Jiro-TOP magazine-ACC buy-PAST
'Taro bought a book and Jiro bought a magazine.'

These examples seem to support deletion-based analyses and thus are potentially problematic for the present approach, which essentially analyzes all cases of nonconstituent coordination as constituent coordination. Recall also from section 2.1.1 that the kind of radical 'distortion' of syntactic structure found in the nonconstituent coordination examples in (8)–(10) leads to strict ungrammaticality with leftward scrambling, as exemplified by (11)–(13).

What needs to be accounted for is the fact that nonconstituent coordination exhibits a pattern that is more flexible than the more typical kinds of displacement constructions such as scrambling and clefting (clefting essentially exhibits the same patterns as scrambling; an explicit analysis of the cleft construction that captures this fact will be formulated in the next section). This can be done by exploiting the multi-modal component of structured phonology of the present theory and thereby constraining the morpho-syntactic flexibility allowed in different kinds of displacement constructions appropriately.

To start with, note one difference between scrambling and clefting on the one hand and nonconstituent coordination on the other such that the former but not the latter involve actually displacing some element in terms of linear order (that is, in nonconstituent coordination, the pivot always appears immediately adjacent to the coordinate structure and it is displaced from the left conjunct only because the left conjunct is coordinated with the right conjunct). The account of the different degrees of flexibility observed in different kinds of displacement constructions that I formulate below takes this difference as an important distinguishing property. To be more specific, the idea is essentially the following: scrambling and clefting are less flexible than nonconstituent coordination since they both manipulate the hierarchical organizations of (fully) abstract structured phonologies of linguistic expressions reflecting constituent structures (in the traditional sense), while nonconstituent coordination is a more surface-oriented phenomenon which targets less abstract (or 'more pronounceable') structured phonologies that lie somewhere between the fully abstract structured phonologies and the fully concrete (i.e. 'pronounceable') structured phonologies.

For implementing the idea outlined above, I posit the 'semi-pronounceable' mode $\blacklozenge$ in structured phonology, which is both left and right associative, as ensured by the following Unimodal Left and Right Association rules:

(173) (ULA; Unimodal Left Association)

$$\frac{}{(A \circ_{\blacklozenge} B) \circ_{\blacklozenge} C \leq A \circ_{\blacklozenge} (B \circ_{\blacklozenge} C)}\text{ULA}$$

(174) (URA; Unimodal Right Association)

$$\frac{}{A \circ_{\blacklozenge} (B \circ_{\blacklozenge} C) \leq (A \circ_{\blacklozenge} B) \circ_{\blacklozenge} C}\text{URA}$$

I further assume that, except for the inflexible mode $\star$ and the two left associative modes $\circ_{<}$ and $\circ_{\ll}$ that are used in the analyses of the *-te* form complex predicate and the compound verb construction below in section 4.3, all abstract modes of composition are first mapped to this mode and then to the fully pronounceable mode. [125] This is ensured by the interaction of the following two rules in the inequational logic:

(175) Semi-Pronunciation

$$\frac{}{A \circ_i B \leq A \circ_{\blacklozenge} B}\text{SPN}$$

$$(\circ_i \in \{\circ_\times, \circ_\bullet, \circ_\diamond\})$$

(176) Pronunciation

$$\frac{}{A \circ_{\blacklozenge} B \leq A \bullet B}\text{PN}$$

Intuitively, the semi-pronounceable mode should be understood as a mode of composition that has an ‘intermediate’ degree of abstractness, lying somewhere between the fully abstract modes (for which rules of the inequational logic interact with one another to govern the properties of each specific mode) and the fully concrete, pronounceable mode (which has only the property of (unimodal) associativity and which is directly interpreted as string concatenation). The semi-pronounceable mode is similar to the pronounceable mode in that it is associative in both directions (in this respect, it is closer to surface strings than the fully abstract modes since associativity collapses the hierarchical structure), but crucially differs from it in allowing for Forward and Backward Slash Introduction rules (in this respect, it is still an abstract mode for which hypothetical reasoning is possible). Since Slash Introduction rules are applicable, unlike the pronounceable mode, there are forward and backward slashes for the semi-pronounceable mode.

[125] The other three modes are instead directly mapped to the pronounceable mode, in order to prevent overgeneration in nonconstituent coordination. This point will become clear when the analyses of the complex predicate constructions are presented in section 4.3.

With these assumptions, we can now think of coordination essentially as a phenomenon that targets structured phonologies involving the semi-pronounceable mode.[126] Specifically, except for the inflexible mode $\star$ and the two left associative modes $<$ and $\ll$ for the two kinds of complex predicate constructions, any abstract mode of composition can be mapped to the semi-pronounceable mode $\blacklozenge$. But since the semi-pronounceable mode $\blacklozenge$ is associative, this means that, as long as the relevant structured phonology involves only the 'fully' abstract modes, any substring of a sentence can be analyzed as a conjoinable constituent, by first mapping all the abstract modes to the semi-pronounceable mode $\blacklozenge$ by Semi-Pronunciation (175). In this way we can retain the analysis of nonconstituent coordination developed above while at the same time accounting for the difference in the morpho-syntactic flexibility between nonconstituent coordination and other displacement constructions, as we will see below.

I will first show how the flexible patterns of nonconstituent coordination is accounted for by making these assumptions. The following derivation illustrates the analysis of the postposition stranding case (172):

(177)

$$\dfrac{\text{hanako};\,;\mathrm{N} \qquad [p;\,;\mathrm{N}\backslash_{\blacklozenge}\mathrm{NP}_a]^1}{\text{hanako} \circ_{\blacklozenge} p;\,;\mathrm{NP}_a}\backslash_{\blacklozenge}\mathrm{E}$$

$$\dfrac{\text{hanako} \circ_{\blacklozenge} p;\,;\mathrm{NP}_a \qquad [q;\,;\mathrm{TV}]^2}{(\text{hanako} \circ_{\blacklozenge} p) \circ_{\cdot} q;\,;\mathrm{VP}}\backslash_{\cdot}\mathrm{E}$$

$$\dfrac{\text{taroo} \circ_{\blacklozenge} \text{ga};\,;\mathrm{NP}_n \qquad (\text{hanako} \circ_{\blacklozenge} p) \circ_{\cdot} q;\,;\mathrm{VP}}{(\text{taroo} \circ_{\blacklozenge} \text{ga}) \circ_{\cdot} ((\text{hanako} \circ_{\blacklozenge} p) \circ_{\cdot} q);\,;\mathrm{S}}\backslash_{\cdot}\mathrm{E}$$

$$\dfrac{(\text{taroo} \circ_{\blacklozenge} \text{ga}) \circ_{\cdot} ((\text{hanako} \circ_{\blacklozenge} p) \circ_{\cdot} q);\,;\mathrm{S}}{\text{taroo} \circ_{\blacklozenge} \text{ga} \circ_{\blacklozenge} \text{hanako} \circ_{\blacklozenge} p \circ_{\blacklozenge} q;\,;\mathrm{S}}\mathrm{PI}$$

$$\dfrac{\text{taroo} \circ_{\blacklozenge} \text{ga} \circ_{\blacklozenge} \text{hanako} \circ_{\blacklozenge} p \circ_{\blacklozenge} q;\,;\mathrm{S}}{\text{taroo} \circ_{\blacklozenge} \text{ga} \circ_{\blacklozenge} \text{hanako} \circ_{\blacklozenge} p;\,;\mathrm{S}/_{\blacklozenge}\mathrm{TV}}/_{\blacklozenge}\mathrm{I}^2$$

$$\dfrac{\text{taroo} \circ_{\blacklozenge} \text{ga} \circ_{\blacklozenge} \text{hanako} \circ_{\blacklozenge} p;\,;\mathrm{S}/_{\blacklozenge}\mathrm{TV}}{\text{taroo} \circ_{\blacklozenge} \text{ga} \circ_{\blacklozenge} \text{hanako};\,;(\mathrm{S}/_{\blacklozenge}\mathrm{TV})/_{\blacklozenge}(\mathrm{N}\backslash_{\blacklozenge}\mathrm{NP}_a)}/_{\blacklozenge}\mathrm{I}^1$$

$$\dfrac{\text{taroo} \circ_{\blacklozenge} \text{ga} \circ_{\blacklozenge} \text{hanako};\,;(\mathrm{S}/_{\blacklozenge}\mathrm{TV})/_{\blacklozenge}(\mathrm{N}\backslash_{\blacklozenge}\mathrm{NP}_a) \qquad \dfrac{\vdots \quad \vdots}{\text{ziroo} \circ_{\blacklozenge} \text{ga} \circ_{\blacklozenge} \text{mitiko};\,;(\mathrm{S}/_{\blacklozenge}\mathrm{TV})/_{\blacklozenge}(\mathrm{N}\backslash_{\blacklozenge}\mathrm{NP}_a)}}{\text{taroo} \circ_{\blacklozenge} \text{ga} \circ_{\blacklozenge} \text{hanako} \circ_{\blacklozenge} \text{ziroo} \circ_{\blacklozenge} \text{ga} \circ_{\blacklozenge} \text{mitiko};\,;(\mathrm{S}/_{\blacklozenge}\mathrm{TV})/_{\blacklozenge}(\mathrm{N}\backslash_{\blacklozenge}\mathrm{NP}_a)}\&_1$$

$$\dfrac{\dfrac{\text{taroo} \circ_{\blacklozenge} \text{ga} \circ_{\blacklozenge} \text{hanako} \circ_{\blacklozenge} \text{ziroo} \circ_{\blacklozenge} \text{ga} \circ_{\blacklozenge} \text{mitiko};\,;(\mathrm{S}/_{\blacklozenge}\mathrm{TV})/_{\blacklozenge}(\mathrm{N}\backslash_{\blacklozenge}\mathrm{NP}_a) \qquad \text{o};\,;\mathrm{N}\backslash_{\blacklozenge}\mathrm{NP}_a}{\text{taroo} \circ_{\blacklozenge} \text{ga} \circ_{\blacklozenge} \text{hanako} \circ_{\blacklozenge} \text{ziroo} \circ_{\blacklozenge} \text{ga} \circ_{\blacklozenge} \text{mitiko} \circ_{\blacklozenge} \text{o};\,;\mathrm{S}/_{\blacklozenge}\mathrm{TV}}/_{\blacklozenge}\mathrm{E} \qquad \text{mi-ta};\,;\mathrm{TV}}{\text{taroo} \circ_{\blacklozenge} \text{ga} \circ_{\blacklozenge} \text{hanako} \circ_{\blacklozenge} \text{ziroo} \circ_{\blacklozenge} \text{ga} \circ_{\blacklozenge} \text{mitiko} \circ_{\blacklozenge} \text{o} \circ_{\blacklozenge} \text{mi-ta};\,;\mathrm{S}}/_{\blacklozenge}\mathrm{E}$$

[126] But the grammar still allows for the possibility that coordination is formed at the level of fully abstract modes, which is necessary in accounting for the interaction between coordination and clefting discussed at the end of section 4.2.2 on p. 193.

Here, crucially, the postposition is lexically specified to attach to the head noun in the semi-pronounceable mode $\diamond$. This being the case, the derivation goes through by hypothetically assuming a postposition and a transitive verb to the right of the string *Taroo-ga Hanako* and then withdrawing these hypotheses one by one after the whole structured phonology is converted to one involving the semi-pronounceable mode $\diamond$ by Semi-Pronunciation (175). Since the hierarchical structure is irrelevant for the semi-pronounceable mode, I omit parentheses for writing structured phonologies exclusively involving this mode, implicitly assuming the applications of Left Association and Right Association. Crucially, the applications of the Slash Introduction rules employed in analyzing the 'semi-pronounceable string' *Taroo-ga Hanako* as a constituent are made possible due to the fact that the semi-pronounceable mode is associative in both directions: since the hierarchical structure does not matter, the hypotheses need only appear linearly at the right edge of the phonology of the premise (which indeed they do). Once this 'nonconstituent' is formed, the analysis goes through in just the same way as in other examples. The other cases (i.e. those involving relative clauses and prenominal adjectives) exemplifying the flexible patterns of nonconstituent coordination can be treated similarly, by assuming that relative clauses and prenominal adjectives attach to their heads in the semi-pronounceable mode $\diamond$.

The semi-pronounceable mode needs to be associative in both directions. The above example of postposition stranding involved right associativity. In order to derive examples like the following, left associativity is also needed:

(178) a. [Nihon-zin-no] [[zyosei-wa nizyuudai-de], [dansei-wa sanzyuudai-de]]
Japanese-GEN female-TOP 20s-in male-TOP 30s-in
daitai kekkon-sur-u.
generally marry-do-NPST

‘On average, Japanese females get married in their 20s and Japanese males get married in their 30s.’

b. [Nihon-ni sun-de ir-u] [[Huransu-zin-wa wain-o], [Doitu-zin-wa
Japan-LOC live-TE COP-NPST French-TOP wine-ACC German-TOP
biiru-o]] zikoku-kara yunyuu-sur-u.
beer-ACC own.country-from import-do-NPST
‘French who live in Japan import wine from their own country and Germans in Japan import beer from their own country.’

In these examples, the leftmost element of the sentence is displaced from the head noun within each conjunct, which involves restructuring a left-branching structure to a right-branching one via Unimodal Left Association (173).

Importantly, recognizing flexible constituent structures at the level of semi-pronounceable mode does not lead to unwanted overgeneration in other displacement constructions. Specifically, for the case of scrambling, such flexible patterns are ruled out since scrambling involves manipulating (fully) abstract structured phonologies and its application is restricted to those abstract modes that specifically allow for such restructuring. The following example illustrates the illicit derivation of (11) (p. 15), where the scrambling of the head noun is attempted, leaving behind the postposition as stranded: [127]

(179)

$$\frac{\begin{array}{c}\vdots \quad \vdots\\ \textsf{(taroo} \circ_{\blacklozenge} \textsf{wa)} \circ_{\cdot} \textsf{((hon} \circ_{\blacklozenge} \textsf{o)} \circ_{\cdot} \textsf{kat-ta)}; \mathbf{buy}(\mathbf{the\text{-}book})(\mathbf{t}); \mathrm{S}\end{array}}{\textsf{hon} \circ_{\blacklozenge} \textsf{((taroo} \circ_{\blacklozenge} \textsf{wa)} \circ_{\cdot} \textsf{(o} \circ_{\cdot} \textsf{kat-ta))}; \mathbf{buy}(\mathbf{the\text{-}book})(\mathbf{t}); \mathrm{S}}\,{**PI**}$$

The step shown here is illicit since Scrambling (107) is not applicable to structures involving the semi-pronounceable mode $\blacklozenge$. Clefting patterns in the same way as scrambling. I will come back to this point in the next section, where a detailed analysis of the cleft construction is presented.

[127] The notation **PI** here indicates that the application of the P-interface rule at this step is illicit.

At this point, one might question the need to recognize the semi-pronounceable mode $\blacklozenge$ as an independent mode (especially given the existence of the abstract associative mode $\diamond$), and think that simply specifying postpositions, adjectives and relative clauses to attach to their heads in the abstract associative mode $\diamond$ would suffice. However, there is a need to distinguish between the abstract associative mode $\diamond$ and the semi-pronounceable mode $\blacklozenge$. The abstract associative mode $\diamond$ is used in accounting for the word order patterns of the VP complementation construction analyzed in section 4.3. Crucially, the VP complementation construction differs from cases involving postpositions, prenominal adjectives and relative clauses in that an element that is combined via the abstract associative mode $\diamond$ can be displaced in the focus position in the cleft construction. As will become clear when the analysis of VP complementation is present in section 4.3, the distinction between the abstract associative mode $\diamond$ and the semi-pronounceable mode $\blacklozenge$ in the present analysis will be exploited in accounting for this difference.

4.1.5 Summary

The key property of the analysis of nonconstituent coordination in Japanese that I have proposed in this section is that it treats the apparent nonconstituents that are coordinated as full-fledged syntactic constituents. This assumption is fully in line with a well-established analysis of nonconstituent coordination in CG, and, unlike previous approaches in PS-based theories, the proposed analysis depends on no *ad hoc* mechanism in capturing the basic properties of this construction.

The more striking finding, however, is the fact (previously unrecognized in the literature) that this CG-based analysis of nonconstituent coordination, when applied to Japanese, provides straightforward solutions for the problems that all previous alternatives suffer from. Note especially that, in the present analysis, all that are needed to account for these problematic cases are independently motivated mechanisms for (parasitic) scope and binding. This provides significant empirical evidence for the kind of analysis of (nonconstituent) coordination in CG, which has been known to date primarily for its theoretical elegance rather than for empirical coverage. More specifically, it is nothing other than the fact that the apparent nonconstituents are recognized as full-fledged syntactic constituents (having their own well-defined meanings) that circumvents the identification of nonconstituent coordination with clausal coordination (which is the source of the problem for previous approaches) in the present analysis. I thus take this result to provide important empirical justification for the architecture of grammar embodied in the present theory, which recognizes a considerable degree of flexibility of constituency in syntactic composition. Furthermore, it was shown in the final subsection that the present theory is also capable of dealing with cases (such as ‘island violation’ and postposition stranding) that apparently pose problems for non-deletion-based approaches to nonconstituent coordination. As has been shown above, these problems can be handled successfully by exploiting the component of structured phonology. This provides further support for the architecture of the present theory, which not only recognizes the necessary flexibility but is also equipped with a mechanism for regulating that flexibility systematically.

4.2 Nonconstituent clefting

As we have seen in Chapter 2, the cleft construction in Japanese exhibits flexibility of constituency in a way that is very similar to nonconstituent coordination, yet the flexibility in the former is somewhat more restricted than in the latter. I will show in this section that basically the same analysis of ‘nonconstituent’ formation in terms of hypothetical reasoning that is employed in the analysis of nonconstituent coordination is also applicable to nonconstituent clefting. The gist of the analysis that I formulate below is essentially that of Kubota and Smith (2006), where it is shown that the mechanisms of function composition and type raising in CCG (which implement hypothetical reasoning within the rule-based setup of CCG) will allow for the kind of flexibility of constituency that is exactly needed in capturing the patterns of nonconstituent clefting. However, the present analysis improves on this earlier account in that the multi-modal setup of the present theory enables an analysis that accounts naturally for the different degrees of flexibility exhibited by nonconstituent coordination and nonconstituent clefting by differentiating the flexibility allowed in the two constructions appropriately by means of the notion of modality.

4.2.1 Syntax of the cleft construction in Japanese

I will start by spelling out the basic assumptions about the cleft construction and illustrating an analysis of simple cleft sentences like (24), repeated here as (180), within the present fragment.

(180) [Ken-ga t_i kat-ta]-no-wa *sono hon-o*$_i$ da.
Ken-NOM buy-PAST-NMLZ-TOP that book-ACC COP
‘It is that book that Ken bought.’

The cleft construction in Japanese involves a topicalized sentence (marked with the topic marker -*wa*) from which some element(s) are missing. Morpho-syntactically, the -*wa* marking makes it obligatorily that the sentence is nominalized with the morpheme -*no*. This topicalized sentence is followed by the missing element(s) together with the sentence-final copula.

I introduce a three-way distinction in sentential categories with the atomic categories S_{tns}, S_{no} and S_{wa}, where the first one is for a tensed unmarked sentence and the latter two are for *-no*-marked and *-wa*-marked sentences, respectively.[128] The lexical entries for the nominalizer *-no* and the topic marker *-wa* can then be defined as follows:

(181) a. no; $\lambda f.f$; $\mathrm{S}_{tns}\backslash_{<}\mathrm{S}_{no}$

b. wa; $\lambda f.f$; $\mathrm{S}_{no}\backslash_{<}\mathrm{S}_{wa}$

Semantically, these markers are just identity functions.[129]

As in (181), *-no* and *-wa* combine with their arguments in the left associative mode. This ensures that hypothetically assumed expressions within the topicalized sentence can be withdrawn by Slash Introduction. (182) shows part of the derivation for (180).

(182)

$$\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\text{ken-ga};\,;\mathrm{NP}_n \quad \dfrac{[p;\,;\mathrm{NP}_a]^1 \quad \text{kat-ta};\,;\mathrm{NP}_a\backslash.\mathrm{NP}_n\backslash.\mathrm{S}_{tns}}{p \circ. \text{kat-ta};\,;\mathrm{NP}_n\backslash.\mathrm{S}_{tns}}\backslash.\mathrm{E}}{\text{ken-ga} \circ. (p \circ. \text{kat-ta});\,;\mathrm{S}_{tns}}\backslash.\mathrm{E} \quad \text{no};\,;\mathrm{S}_{tns}\backslash_{<}\mathrm{S}_{no}}{(\text{ken-ga} \circ. (p \circ. \text{kat-ta})) \circ_{<} \text{no};\,;\mathrm{S}_{no}}\backslash_{<}\mathrm{E} \quad \text{wa};\,;\mathrm{S}_{no}\backslash_{<}\mathrm{S}_{wa}}{((\text{ken-ga} \circ. (p \circ. \text{kat-ta})) \circ_{<} \text{no}) \circ_{<} \text{wa};\,;\mathrm{S}_{wa}}\backslash_{<}\mathrm{E}}{p \circ. (((\text{ken-ga} \circ. \text{kat-ta}) \circ_{<} \text{no}) \circ_{<} \text{wa});\,;\mathrm{S}_{wa}}\mathrm{PI}}{((\text{ken-ga} \circ. \text{kat-ta}) \circ_{<} \text{no}) \circ_{<} \text{wa};\,;\mathrm{NP}_a\backslash.\mathrm{S}_{wa}}\backslash.\mathrm{I}^1$$

[128] In a system in which syntactic features (or some device equivalent to it) are fully articulated, the subscripts in these categories could be thought of as syntactic features encoding the morpho-syntactic forms of sentences.

[129] I will not spell out the semantics and pragmatics of the cleft construction in Japanese in this dissertation. Assigning truth conditions to cleft sentences that are equivalent to those of their unclefted counterparts is straightforward. The more challenging task is to model pragmatics appropriately. Roughly speaking, the topicalized sentence conveys 'old information' and the material that appears in the focus position conveys 'new information' (where the notions of 'old' and 'new' need to be made precise within a proper theory of discourse structure). For a preliminary attempt of working out the semantics and pragmatics of the cleft construction in Japanese within Steedman's (2000a) theory of syntax-pragmatics interface, see Kubota and Smith (2006).

In (182), the direct object of the verb is hypothesized within the topicalized sentence and then that hypothesis is later withdrawn so that the whole sentence is assigned a category that is looking for an accusative NP to its left to become a complete sentence. The application of the P-interface rule in this derivation is licensed by the following lemma in the inequational logic for φ-terms:

(183) **Lemma:** $((A \circ_{\bullet} (B \circ_{\bullet} C)) \circ_{<} D) \circ_{<} E \quad \leq \quad B \circ_{\bullet} (((A \circ_{\bullet} C) \circ_{<} D) \circ_{<} E)$

Proof:

$$((A \circ_{\bullet} (B \circ_{\bullet} C)) \circ_{<} D) \circ_{<} E$$

$$\leq ((B \circ_{\bullet} (A \circ_{\bullet} C)) \circ_{<} D) \circ_{<} E \qquad \text{(SCR)}$$

$$\leq B \circ_{\bullet} (((A \circ_{\bullet} C) \circ_{<} D) \circ_{<} E) \qquad \text{(ILA)}$$

Intuitively, what is going on here is as follows. We first switch the order of the subject and the object. This is possible since the two arguments are combined with the verb in the scrambling mode. Once the object is linearly at the leftmost position of the structured phonology, it can further be pushed to the hierarchically topmost position due to the fact that all modes involved are left associative.

After the application of Slash Introduction, the topicalized sentence is looking for the missing element to its left, but the corresponding accusative NP actually appears to the right followed by a copula. I assume that the copula is responsible for resolving the mismatch in the direction in which the missing element is sought by the topicalized sentence and the surface order in which the two actually combine. Specifically, the copula *da* is assigned the lexical entry in (184):[130]

(184) da; $\lambda f.f$; $(\mathrm{S}_{wa}/_i Y)\backslash_{\star}(Y\backslash_i \mathrm{S}_{tns})$ $\qquad (\circ_i \in \{\circ_{\bullet}, \circ_{\diamond}\})$

[130] Y is a variable over syntactic categories. The two occurrences of Y in (184) are required to match with one another when instantiated.

Intuitively, (184) says that the copula combines with an expression $\mathrm{S}_{wa}/_i Y$ (i.e. the material that appears in the focus position) that is looking for an expression of category Y (which corresponds to the topicalized sentence) to its right and changes the direction in which that missing expression is sought, yielding an expression of category $Y\backslash_i \mathrm{S}_{tns}$. The copula additionally requires the focused element to be looking for the rest of the sentence in one of the abstract associative modes $\cdot$ and $\diamond$. As will become clear below, this assumption is crucial in ensuring that the impossible cases of clefting (e.g. the one involving a prenominal adjective (35) from Chapter 2) are correctly ruled out. (Other aspects of this lexical entry will be explained below.) Like *-no* and *-wa,* the copula *da* does not make any semantic contribution. So, it is semantically an identity function.

In the derivation of the simple cleft sentence (180), the accusative NP undergoes type raising so that it has the right syntactic category to combine with the copula. The relevant steps are shown in (185).

(185)
$$\dfrac{\dfrac{\dfrac{\textsf{sono-hon-o}; ; \mathrm{NP}_a \quad [p ; ; \mathrm{NP}_a\backslash_{\bullet} \mathrm{S}_{wa}]^1}{\textsf{sono-hon-o} \circ_{\bullet} p ; ; \mathrm{S}_{wa}}\backslash_{\bullet}\mathrm{E}}{\textsf{sono-hon-o}; ; \mathrm{S}_{wa}/_{\bullet}(\mathrm{NP}_a\backslash_{\bullet}\mathrm{S}_{wa})}/_{\bullet}\mathrm{I}^1 \quad \textsf{da}; ; (\mathrm{S}_{wa}/_i Y)\backslash_{\star}(Y\backslash_i \mathrm{S}_{tns})}{\textsf{sono-hon-o} \circ_{\star} \textsf{da} ; ; (\mathrm{NP}_a\backslash_{\bullet}\mathrm{S}_{wa})\backslash_{\bullet}\mathrm{S}_{tns}}\backslash_{\star}\mathrm{E}$$

Syntactically, the copula combines with a type-raised expression and changes the linear order in which that expression is looking for its argument. Thus, in order to combine with the copula, the accusative NP first type-raises over S_{wa}.[131] Since type raising does not change the linear order between the original functor and argument, at this point, the type-raised accusative NP is looking for its argument $\mathrm{NP}_a\backslash_{\bullet}\mathrm{S}$ (sentence missing an accusative NP) to its right. The copula then takes this type-raised NP and flips the order in which

[131]The reason that the argument category is rooted in S_{wa} whereas the result category is rooted in S_{tns} in the lexical entry for the copula *da* in (184) will be explained below.

it looks for its argument, so that the ‘gapped’ sentence is now being sought to the left. The copula combines with its argument in the inflexible mode $\star$. This is to ensure that the material that combines with it does not float out of the focus position.

The rest of the derivation simply involves combining the two chunks derived above by Slash Elimination:

(186)

$$\dfrac{\begin{matrix}\vdots\ \vdots \\ \text{((ken-ga} \circ_{\bullet} \text{kat-ta)} \circ_{<} \text{no)} \circ_{<} \text{wa};;\mathrm{NP}_{a}\backslash_{\bullet}\mathrm{S}_{wa}\end{matrix} \qquad \begin{matrix}\vdots\ \vdots \\ \text{sono-hon-o} \circ_{\star} \text{da};;(\mathrm{NP}_{a}\backslash_{\bullet}\mathrm{S}_{wa})\backslash_{\bullet}\mathrm{S}_{tns}\end{matrix}}{\text{(((ken-ga} \circ_{\bullet} \text{kat-ta)} \circ_{<} \text{no)} \circ_{<} \text{wa)} \circ_{\bullet} \text{(sono-hon-o} \circ_{\star} \text{da)};;\mathrm{S}_{tns}}\backslash_{\bullet}\mathrm{E}$$

Note here that, by virtue of the lexical specification on the copula, the resultant cleft sentence as a whole is derived as S_{tns}, even though the accusative NP that the copula first combines with is type-raised over S_{wa}. This is as it should be, since the matrix sentence is not an instance of a topicalized sentence.

The derivation for a case in which an adjunct is clefted is also straightforward. Assuming that the adverb *kinoo* ‘yesterday’ is a sentential modifier of category $\mathrm{S}_{wa}/_{\bullet}\mathrm{S}_{wa}$, the derivation for (29), repeated here as (187), goes as in (188):

(187) [Ken-ga t_i ki-ta]-no-wa *kinoo*$_i$ da.
Ken-NOM come-PAST-NMLZ-TOP yesterday COP
‘It is yesterday that Ken came.’

(188)

$$\dfrac{\begin{matrix}\vdots\ \vdots \\ \text{((ken-ga} \circ_{\bullet} \text{ki-ta)} \circ_{<} \text{no)} \circ_{<} \text{wa};;\mathrm{S}_{wa}\end{matrix} \qquad \dfrac{\text{kinoo};;\mathrm{S}_{wa}/_{\bullet}\mathrm{S}_{wa} \quad \text{da};;(\mathrm{S}_{wa}/_{i}Y)\backslash_{\star}(Y\backslash_{i}\mathrm{S}_{tns})}{\text{kinoo} \circ_{\star} \text{da};;\mathrm{S}_{wa}\backslash_{\bullet}\mathrm{S}_{tns}}\backslash_{\star}\mathrm{E}}{\text{(((ken-ga} \circ_{\bullet} \text{ki-ta)} \circ_{<} \text{no)} \circ_{<} \text{wa)} \circ_{\bullet} \text{(kinoo} \circ_{\star} \text{da)};;\mathrm{S}_{tns}}\backslash_{\bullet}\mathrm{E}$$

The adverb is already in a functor category that takes as its argument the sentence it modifies. So, it can directly combine with the copula without being type-raised so that the copula flips the direction in which it looks for its argument.

This section has presented the basic analysis of the cleft construction in Japanese in the present fragment and illustrated how it licenses cleft sentences involving single constituents in the focus position. In the next section, we will see how this analysis straightforwardly extends to the case of nonconstituent clefting.

4.2.2 Analyzing nonconstituent clefting

As discussed in Chapter 3 and as we have seen in the analysis of nonconstituent coordination in the previous section, the present theory allows for the possibility of assigning flexible 'constituent structures' to strings of words that are not recognized as constituents in most PS-based theories of syntax. More specifically, as long as all of the elements are combined in associative modes, the hierarchical structure does not make a difference since the original bracketing of the structured phonology—which reflects the order in which the components of a complex expression are combined in accordance with their lexical specifications—can be replaced by any other possible bracketing. It turns out that this flexibility of constituency enables a straightforward analysis of nonconstituent clefting in Japanese. In fact, the analysis of the cleft construction above, which was formulated without any consideration for cases of nonconstituent clefting, automatically interacts with this property of the present theory to license cases of nonconstituent clefting. Unlike analyses in PS-based theories reviewed in Chapter 2, no additional mechanism is needed.

In the present fragment of Japanese, verbs are specified in the lexicon to combine with their arguments in the default scrambling mode $\cdot$. This mode is associative in both directions. The motivation for this assumption comes from the fact that nonconstituent coordination is possible with argument clusters in Japanese, just as in English, as we have seen in the previous section. That is, this assumption enables an analysis of nonconstituent coordination like the following as a case of ordinary constituent coordination:

(189) [Taroo-ga Hanako-o], (sosite) [Ziroo-ga Mitiko-o] mi-ta.
Taro-TOP Hanako-ACC and Jiro-NOM Michiko-ACC see-PAST
'Taro saw Hanako and Jiro saw Michiko.'

Thus, the fragment of Japanese developed so far already recognizes argument clusters of the kind found in nonconstituent clefting as expressions for which well-defined syntactic categories and semantic interpretations can be assigned. Given this property, the analysis of nonconstituent clefting is straightforward. (191) shows the derivation for (190), a sentence in which a cluster of the direct and indirect objects of the verb *watasi-ta* 'gave' appears in the focus position.

(190) Ken-ga t_i t_j watasi-ta-no-wa *Mari-ni*$_i$ *sono hon-o*$_j$ da.
Ken-NOM give-PAST-NMLZ-TOP Mari-DAT that book-ACC COP
lit. 'It was that book to Mari that Ken gave.'

(191)

$$\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\text{ken-ga} ;; \mathrm{NP}_n \quad \dfrac{[q ;; \mathrm{NP}_d]^2 \quad \dfrac{[p ;; \mathrm{NP}_a]^1 \quad \begin{matrix}\text{watasi-ta} ;; \\ \mathrm{NP}_a\backslash.\mathrm{NP}_d\backslash.\mathrm{NP}_n\backslash.\mathrm{S}_{tns}\end{matrix}}{p \circ. \text{watasi-ta} ;; \mathrm{NP}_d\backslash.\mathrm{NP}_n\backslash.\mathrm{S}_{tns}}\backslash.\mathrm{E}}{q \circ. (p \circ. \text{watasi-ta}) ;; \mathrm{NP}_n\backslash.\mathrm{S}_{tns}}\backslash.\mathrm{E}}{\text{ken-ga} \circ. (q \circ. (p \circ. \text{watasi-ta})) ;; \mathrm{S}_{tns}}\backslash.\mathrm{E} \quad \begin{matrix}\text{no} ;; \\ \mathrm{S}_{tns}\backslash_<\mathrm{S}_{no}\end{matrix}}{(\text{ken-ga} \circ. (q \circ. (p \circ. \text{watasi-ta}))) \circ_< \text{no} ;; \mathrm{S}_{no}}\backslash_<\mathrm{E} \quad \begin{matrix}\text{wa} ;; \\ \mathrm{S}_{no}\backslash_<\mathrm{S}_{wa}\end{matrix}}{((\text{ken-ga} \circ. (q \circ. (p \circ. \text{watasi-ta}))) \circ_< \text{no}) \circ_< \text{wa} ;; \mathrm{S}_{wa}}\backslash_<\mathrm{E}}{\dfrac{q \circ. (p \circ. (((\text{ken-ga} \circ. \text{watasi-ta}) \circ_< \text{no}) \circ_< \text{wa})) ;; \mathrm{S}_{wa}}{\dfrac{p \circ. (((\text{ken-ga} \circ. \text{watasi-ta}) \circ_< \text{no}) \circ_< \text{wa}) ;; \mathrm{NP}_d\backslash.\mathrm{S}_{wa}}{((\text{ken-ga} \circ. \text{watasi-ta}) \circ_< \text{no}) \circ_< \text{wa} ;; \mathrm{NP}_a\backslash.\mathrm{NP}_d\backslash.\mathrm{S}_{wa}}\backslash.\mathrm{I}^1}\backslash.\mathrm{I}^2}\mathrm{PI}$$

$$\dfrac{\dfrac{\dfrac{\dfrac{\text{mari-ni} ;; \mathrm{NP}_d \quad \dfrac{\text{sono-hon-o} ;; \mathrm{NP}_a \quad [r ;; \mathrm{NP}_a\backslash.\mathrm{NP}_d\backslash.\mathrm{S}_{wa}]^2}{\text{sono-hon-o} \circ. r ;; \mathrm{NP}_d\backslash.\mathrm{S}_{wa}}\backslash.\mathrm{E}}{\text{mari-ni} \circ. (\text{sono-hon-o} \circ. r) ;; \mathrm{S}_{wa}}\backslash.\mathrm{E}}{(\text{mari-ni} \circ. \text{sono-hon-o}) \circ. r ;; \mathrm{S}_{wa}}\mathrm{PI}}{\text{mari-ni} \circ. \text{sono-hon-o} ;; \mathrm{S}_{wa}/.(\mathrm{NP}_a\backslash.\mathrm{NP}_d\backslash.\mathrm{S}_{wa})}/.\mathrm{I}^2 \quad \text{da} ;; (\mathrm{S}_{wa}/_i Y)\backslash_\star(Y\backslash_i\mathrm{S}_{tns})}{(\text{mari-ni} \circ. \text{sono-hon-o}) \circ_\star \text{da} ;; (\mathrm{NP}_a\backslash.\mathrm{NP}_d\backslash.\mathrm{S}_{wa})\backslash.\mathrm{S}_{tns}}\backslash_\star\mathrm{E}$$

$$\dfrac{\begin{array}{cc} \vdots\ \vdots & \vdots\ \vdots \\ \text{((ken-ga} \circ_{.} \text{watasi-ta)} \circ_{<} \text{no)} \circ_{<} \text{wa; ;} & \text{(mari-ni} \circ_{.} \text{sono-hon-o)} \circ_{\star} \text{da; ;} \\ \mathrm{NP}_a \backslash_{.} \mathrm{NP}_d \backslash_{.} \mathrm{S}_{wa} & (\mathrm{NP}_a \backslash_{.} \mathrm{NP}_d \backslash_{.} \mathrm{S}_{wa}) \backslash_{.} \mathrm{S}_{tns} \end{array}}{\text{(((ken-ga} \circ_{.} \text{watasi-ta)} \circ_{<} \text{no)} \circ_{<} \text{wa)} \circ_{.} \text{((mari-ni} \circ_{.} \text{sono-hon-o)} \circ_{\star} \text{da); ;} \mathrm{S}_{tns}} \backslash_{.}\mathrm{E}$$

Unlike in the case of single constituent clefting, the topicalized sentence is missing two NPs, one accusative and the other dative, and is thus assigned the category $\mathrm{NP}_a \backslash_{.} \mathrm{NP}_d \backslash_{.} \mathrm{S}$. These two missing NPs form an argument cluster in the focus position in exactly the same way that argument clusters are formed in nonconstituent coordination. The rest of the derivation is basically the same as in the case of single constituent clefting. Just as the type-raised NP in the focus position in single constituent clefting is looking to its right for an S missing one NP, the argument cluster in the focus position in (191) is looking to its right for a sentence missing two NPs. The copula flips the order in which this argument cluster looks for that incomplete sentence so that a complete sentence is derived.

We have seen in Chapter 2 that the order of NPs in the focus position is free. In the present analysis, this is a direct consequence of the fact that Japanese allows for clause-internal scrambling. To derive (192), a variant of (190) in which the order of the direct and indirect objects in the focus position is reversed, we merely need to apply the P-interface rule immediately after combining the two NPs with the hypothetically assumed verb in the focus position. (Technically, the successive applications of the P-interface rule in (193) can be collapsed into one step, but the intermediate step is shown here for expository ease.)

(192) Ken-ga t_i t_j watasi-ta-no-wa *sono hon-o*$_j$ *Mari-ni*$_i$ da.
Ken-NOM give-PAST-NMLZ-TOP that book-ACC Mari-DAT COP
lit. 'It was that book to Mari that Ken gave.'

(193)

$$\dfrac{\dfrac{\dfrac{\vdots \quad \vdots}{\text{mari-ni} \circ_{\cdot} (\text{sono-hon-o} \circ_{\cdot} r);\,;\,\mathrm{S}_{wa}}}{\text{sono-hon-o} \circ_{\cdot} (\text{mari-ni} \circ_{\cdot} r);\,;\,\mathrm{S}_{wa}}\,\mathrm{PI}}{\dfrac{(\text{sono-hon-o} \circ_{\cdot} \text{mari-ni}) \circ_{\cdot} r\,;\,;\,\mathrm{S}_{wa}}{\vdots \quad \vdots}}\,\mathrm{PI}$$

Since the application of the P-interface rule does not change the syntactic category of the expression and only affects the linear order of the elements involved, the rest of the derivation goes through in exactly the same way as in (191) and the surface string corresponding to (192) is derived.

Cases involving multiple adjuncts such as (32a) and cases involving a combination of an argument and an adjunct such as (33) (repeated here as (194) and (195), respectively) are equally straightforward. The derivations are given in (196) and (197), respectively.

(194) Taroo ga t_i t_j happyoo-si-ta-no-wa *kyonen*$_i$ *NELS-de*$_j$ da.
Taro NOM present-do-PAST-NMLZ-TOP last.year NELS-at COP
'It is last year at NELS that Taro presented (a paper).'

(195) Ken ga t_i t_j kat-ta-no-wa *kinoo*$_i$ *sono hon-o*$_j$ da.
Ken NOM buy-PAST-NMLZ-TOP yesterday that book-ACC COP
lit. 'It was yesterday that book that Ken bought.'

(196)

$$\dfrac{\dfrac{\vdots \quad \vdots}{((\text{ken-ga} \circ_{\cdot} \text{happyoo-si-ta}) \circ_{<} \text{no}) \circ_{<} \text{wa};\,;\,\mathrm{S}_{wa}} \qquad \dfrac{\dfrac{\dfrac{\dfrac{\text{kyonen};\,;\,\mathrm{S}_{wa}/_{\cdot}\mathrm{S}_{wa} \quad \dfrac{\text{NELS-de};\,;\,\mathrm{S}_{wa}/_{\cdot}\mathrm{S}_{wa} \quad [p\,;\,;\,\mathrm{S}_{wa}]^1}{\text{NELS-de} \circ_{\cdot} p\,;\,;\,\mathrm{S}_{wa}}\,/_{\cdot}\mathrm{E}}{\text{kyonen} \circ_{\cdot} (\text{NELS-de} \circ_{\cdot} p);\,;\,\mathrm{S}_{wa}}\,/_{\cdot}\mathrm{E}}{(\text{kyonen} \circ_{\cdot} \text{NELS-de}) \circ_{\cdot} p\,;\,;\,\mathrm{S}_{wa}}\,\mathrm{PI}}{\text{kyonen} \circ_{\cdot} \text{NELS-de};\,;\,\mathrm{S}_{wa}/_{\cdot}\mathrm{S}_{wa}}\,/_{\cdot}\mathrm{I}^1 \quad \text{da};\,;\,(\mathrm{S}_{wa}/_{i}Y)\backslash_{\star}(Y\backslash_{i}\mathrm{S}_{tns})}{(\text{kyonen} \circ_{\cdot} \text{NELS-de}) \circ_{\star} \text{da};\,;\,\mathrm{S}_{wa}\backslash_{\cdot}\mathrm{S}_{tns}}\,\backslash_{\star}\mathrm{E}}{(((\text{ken-ga} \circ_{\cdot} \text{happyoo-si-ta}) \circ_{<} \text{no}) \circ_{<} \text{wa}) \circ_{\cdot} ((\text{kyonen} \circ_{\cdot} \text{NELS-de}) \circ_{\star} \text{da});\,;\,\mathrm{S}_{tns}}\,\backslash_{\cdot}\mathrm{E}$$

(197)

$$
\dfrac{
\begin{matrix}\vdots \;\; \vdots \\ ((\text{ken-ga} \circ_{.} \text{kat-ta}) \circ_{<} \text{no}) \circ_{<} \text{wa};;\\ \mathrm{NP}_a \backslash_{.} \mathrm{S}_{wa}\end{matrix}
\qquad
\dfrac{
\dfrac{
\dfrac{
\dfrac{
\begin{matrix}\text{kinoo};;\\ \mathrm{S}_{wa}/_{.}\mathrm{S}_{wa}\end{matrix}
\quad
\dfrac{\begin{matrix}\text{sono-hon-o};;\\ \mathrm{NP}_a\end{matrix} \qquad [p\,;;\,\mathrm{NP}_a\backslash_{.}\mathrm{S}_{wa}]^1}{\text{sono-hon-o} \circ_{.} p\,;;\,\mathrm{S}_{wa}}\backslash_{.}\mathrm{E}
}{\text{kinoo} \circ_{.} (\text{sono-hon-o} \circ_{.} p);;\,\mathrm{S}_{wa}}/_{.}\mathrm{E}
}{(\text{kinoo} \circ_{.} \text{sono-hon-o}) \circ_{.} p\,;;\,\mathrm{S}_{wa}}\mathrm{PI}
}{\text{kinoo} \circ_{.} \text{sono-hon-o};;\,\mathrm{S}_{wa}/_{.}(\mathrm{NP}_a\backslash_{.}\mathrm{S}_{wa})}/_{.}\mathrm{I}^1
\quad
\begin{matrix}\text{da};;\\ (\mathrm{S}_{wa}/_{i}\,Y)\backslash_{\star}(Y\backslash_{i}\mathrm{S}_{tns})\end{matrix}
}{(\text{kinoo} \circ_{.} \text{sono-hon-o}) \circ_{\star} \text{da};;\,(\mathrm{NP}_a\backslash_{.}\mathrm{S}_{wa})\backslash_{.}\mathrm{S}_{tns}}\backslash_{\star}\mathrm{E}
}{(((\text{ken-ga} \circ_{.} \text{kat-ta}) \circ_{<} \text{no}) \circ_{<} \text{wa}) \circ_{.} ((\text{kinoo} \circ_{.} \text{sono-hon-o}) \circ_{\star} \text{da});;\,\mathrm{S}_{tns}}\backslash_{.}\mathrm{E}
$$

In (196), by hypothetical reasoning, a sequence of two adverbs is assigned the category $\mathrm{S}/_{.}\mathrm{S}$, which is identical to the category of a single adverb. Once this 'reanalysis' takes place, the rest of the derivation is the same as the case involving a single adverb in the focus position (cf. (188)). In (197), again, with hypothetical reasoning, a sequence of an adverb and an NP is analyzed as having the same syntactic category as a single type-raised NP, and the rest of the derivation goes through in exactly the same way as a case involving a single argument NP.

It should now be clear how the interaction between nonconstituent coordination and nonconstituent clefting in examples like the following ((52a) from Chapter 2) is accounted for:

(198) [Ken-ga t_i t_j watasi-ta]-no-wa [[Mari-ni$_i$ kono hon-o$_j$] sosite [Rika-ni$_i$
Ken-NOM give-PAST-NMLZ-TOP Mari-DAT this book-ACC and Rika-DAT
ano hon-o$_j$]] da.
that book-ACC COP
lit. 'It is this book to Mari and that book to Rika that Ken gave.'

The argument cluster constituents that appear in nonconstituent clefting are formed in exactly the same way as in nonconstituent coordination. Thus, it follows that they can also be coordinated in the focus position, as in the following derivation, which shows how the focus position of (198) is formed (the rest of the derivation goes through in the same way as in the simpler case of nonconstituent clefting in (191)):

(199)

$$
\dfrac{
\dfrac{
\begin{array}{c}\vdots\ \vdots\\ \text{mari-ni} \circ_{\cdot} \text{sono-hon-o};\,; \\ \mathrm{S}_{wa}/_{\cdot}(\mathrm{NP}_a\backslash_{\cdot}\mathrm{NP}_d\backslash_{\cdot}\mathrm{S}_{wa})\end{array}
\quad
\dfrac{
\begin{array}{c}\text{sosite};\,; \\ (X\backslash_{\star}X)/_{\star}X\end{array}
\quad
\begin{array}{c}\vdots\ \vdots\\ \text{rika-ni} \circ_{\cdot} \text{ano-hon-o};\,; \\ \mathrm{S}_{wa}/_{\cdot}(\mathrm{NP}_a\backslash_{\cdot}\mathrm{NP}_d\backslash_{\cdot}\mathrm{S}_{wa})\end{array}
}{
\begin{array}{c}\text{sosite} \circ_{\star} (\text{rika-ni} \circ_{\cdot} \text{ano-hon-o});\,; \\ (\mathrm{S}_{wa}/_{\cdot}(\mathrm{NP}_a\backslash_{\cdot}\mathrm{NP}_d\backslash_{\cdot}\mathrm{S}_{wa}))\backslash_{\star}(\mathrm{S}_{wa}/_{\cdot}(\mathrm{NP}_a\backslash_{\cdot}\mathrm{NP}_d\backslash_{\cdot}\mathrm{S}_{wa}))\end{array}
}/_{\star}\mathrm{E}
}{
(\text{mari-ni} \circ_{\cdot} \text{sono-hon-o}) \circ_{\star} (\text{sosite} \circ_{\star} (\text{rika-ni} \circ_{\cdot} \text{ano-hon-o}));\,; \mathrm{S}_{wa}/_{\cdot}(\mathrm{NP}_a\backslash_{\cdot}\mathrm{NP}_d\backslash_{\cdot}\mathrm{S}_{wa})
}\backslash_{\star}\mathrm{E}
\quad
\text{da};\,; (\mathrm{S}_{wa}/_{i}Y)\backslash_{\star}(Y\backslash_{i}\mathrm{S}_{tns})
}{
((\text{mari-ni} \circ_{\cdot} \text{sono-hon-o}) \circ_{\star} (\text{sosite} \circ_{\star} (\text{rika-ni} \circ_{\cdot} \text{ano-hon-o}))) \circ_{\star} \text{da};\,; (\mathrm{NP}_a\backslash_{\cdot}\mathrm{NP}_d\backslash_{\cdot}\mathrm{S}_{wa})\backslash_{\cdot}\mathrm{S}_{tns}
}\backslash_{\star}\mathrm{E}
$$

4.2.3 Impossible cases of clefting

We have seen above that the present analysis naturally accounts for patterns of nonconstituent clefting by means of ‘nonconstituent’ formation via hypothetical reasoning, essentially in the same way as in the analysis of nonconstituent coordination. The parallel between coordination and cleft, however, is not complete. More specifically, as we have observed in Chapter 2, the cleft construction is somewhat more restricted than coordination in that certain patterns that appear to radically distort surface constituency are possible in the latter but not in the former. The relevant ungrammatical examples are (34)–(36) from section 2.2.3. I repeat the example involving a prenominal adjective here:

(200) *[Ken-ga [t_i hon-o] yon-da]-no-wa *nagai*$_i$ da.
Ken-NOM book-ACC read-PAST-NMLZ-TOP long COP
intended: lit. ‘It is long that Ken read a book.’ (where the adjective ‘long’ modifies the noun ‘book’)

It turns out that examples like (200) are correctly ruled out in the present analysis, due to the fact that the relevant syntactic environments exhibit a limited degree of flexibility of constituency, allowing only for the kind of restructuring that licenses nonconstituent coordination.

Specifically, in order to derive (200), we would first need to hypothetically assume an adjective in the prenominal position, as in (201):

(201)

$$
\dfrac{
  \dfrac{
    \text{ken-ga}; ; \mathrm{NP}_n
    \quad
    \dfrac{
      \dfrac{[p ; ; \mathrm{NP}/_{\blacklozenge}\mathrm{NP}]^1 \quad \text{hon-o}; ; \mathrm{NP}_a}{p \circ_{\blacklozenge} \text{hon-o}; ; \mathrm{NP}_a}/_{\blacklozenge}\mathrm{E}
      \quad
      \begin{array}{l}\text{yon-da}; ; \\ \mathrm{NP}_a\backslash_{\cdot}\mathrm{NP}_n\backslash_{\cdot}\mathrm{S}_{tns}\end{array}
    }{(p \circ_{\blacklozenge} \text{hon-o}) \circ_{\cdot} \text{yon-da}; ; \mathrm{NP}_n\backslash_{\cdot}\mathrm{S}_{tns}}\backslash_{\cdot}\mathrm{E}
  }{
    \dfrac{\text{ken-ga} \circ_{\cdot} ((p \circ_{\blacklozenge} \text{hon-o}) \circ_{\cdot} \text{yon-da}); ; \mathrm{NP}_n\backslash_{\cdot}\mathrm{S}_{tns} \quad \begin{array}{l}\text{no}; ; \\ \mathrm{S}_{tns}\backslash_{<}\mathrm{S}_{no}\end{array}}{(\text{ken-ga} \circ_{\cdot} ((p \circ_{\blacklozenge} \text{hon-o}) \circ_{\cdot} \text{yon-da})) \circ_{<} \text{no}; ; \mathrm{S}_{no}}\backslash_{<}\mathrm{E}
  }\backslash_{\cdot}\mathrm{E}
  \quad
  \begin{array}{l}\text{wa}; ; \\ \mathrm{S}_{no}\backslash_{<}\mathrm{S}_{wa}\end{array}
}{((\text{ken-ga} \circ_{\cdot} ((p \circ_{\blacklozenge} \text{hon-o}) \circ_{\cdot} \text{yon-da})) \circ_{<} \text{no}) \circ_{<} \text{wa}; ; \mathrm{S}_{wa}}\backslash_{<}\mathrm{E}
$$

We would then need to withdraw that hypothesis by bringing it to the left periphery of the structured phonology of the whole topicalized sentence. However, assuming that the adjective combines with the head noun in the semi-pronounceable mode $\blacklozenge$ (the motivation for which comes from the fact that a prenominal adjective can be displaced from the head in nonconstituent coordination but not in scrambling; cf. the contrast between (9) and (12)), it is not possible to bring the hypothesized adjective to the left periphery of the structured phonology of the whole topicalized sentence. Such a restructuring would be possible only with the help of the Scrambling rule (107), which is not applicable to the semi-pronounceable mode. Thus, the derivation does not go through and sentences like (200) are correctly ruled out.

Even if the noun phrase containing the hypothesized adjective appears at the leftmost position of the topicalized sentence, the hypothesis is still not withdrawable, since it does not occupy the hierarchically topmost position in the (abstract) structured phonology of the topicalized sentence. Thus, examples like the following are correctly blocked as well:

(202) *[[t_i hon-o] Ken-ga yon-da]-no-wa *nagai*$_i$ da.
book-ACC Ken-NOM read-PAST-NMLZ-TOP long COP
intended: lit. 'It is long that Ken read a book.'

Examples like (202) would be licensed if the lexical entry for the copula (184) allowed for the focused element to look for the rest of the sentence in the semi-pronounceable mode $\blacklozenge$, since the prenominal adjective in (202) could then be brought to the left periphery of the sentence by first converting all of the modes of composition to the semi-pronounceable mode and thereby collapsing constituency (this is needed for licensing nonconstituent co-ordination). Thus, the requirement that the copula imposes on the slash of the focused element that it involve an abstract associative mode (and not the semi-pronounceable mode) is crucial in differentiating the flexibility allowed in nonconstituent coordination and the cleft construction appropriately.[132]

The other examples, namely, the one involving a case particle (34) and the one involving a relative clause (36), are also correctly ruled out essentially for the same reason: the relevant hypothetical reasoning does not go through due to the fact that the cleft construction requires the displaced element in the focus position to be looking for the rest of the sentence in one of the abstract associative modes, not in the semi-pronounceable mode.

Thus, we have seen above that, while the present analysis allows for a considerable degree of flexibility in what kinds of expressions can be clefted, it is also appropriately constrained so as not to overgenerate; independently motivated restrictions on the flexibility in morpho-syntactic composition of linguistic expressions interact properly with the analysis of the cleft construction presented in this section to block ungrammatical examples. We will see another such case in the next section, where it will be shown that the present analysis of the cleft construction interacts with the analyses of the compound verb construction and the *-te* form complex predicate construction proposed below to predict the possible and impossible patterns of clefting in these constructions correctly.

[132]Essentially, the requirement encoded in the lexical entry of the copula amounts to the claim that the cleft construction, like scrambling but unlike nonconstituent coordination, is a phenomenon that targets fully abstract structured phonologies.

4.3 Complementation constructions

In the previous two sections, we have seen cases in which introducing flexible constituent structures leads to straightforward analyses of certain empirical phenomena. In this section, we will consider a somewhat different case, specifically, a set of data for which recognizing different ‘degrees’ of flexibly of constituency is useful. The empirical data are the morpho-syntactic properties of different kinds of complementation constructions. We have seen in Chapter 2 that the fact that these constructions coexist within a single language poses a significant challenge for PS-based theories. This is essentially because PS-based theories, due to their design architecture which presupposes the notion of (rigid) phrase structure, are inherently unsuitable for capturing the relevant empirical generalization.

The theory of MMCG with Structured Phonology developed in Chapter 3 recognizes a finer-grained distinction in the degrees of flexibility in the morpho-syntactic composition of linguistic expressions. I will demonstrate in this section that, in a theory like the present one, the empirical patterns found in the complementation constructions in Japanese receive a natural account. Specifically, the different ‘degrees’ of flexibility exhibited by different constructions are captured by positing different modes of composition, each governed by different sets of structure-changing operations in the structured phonology. As we will see below, these modes of composition are lexically specified as part of the subcategorization properties of the governing verbs. Thus, the account in the present theory is strictly lexical, where the surface-oriented properties of specific constructions are captured by means of lexical specifications, thereby maintaining the logical component (i.e. the syntactic calculus) uniform. This is fully in line with the general approach in ‘multi-modal’ variants of CG (cf., e.g., Moortgat (1997); Bernardi (2002); Baldridge (2002)) and sets the present proposal apart from the alternative approaches considered in Chapter 2. In these alternative approaches, the only way to account for the morpho-syntactic differences among the four constructions is to assign different phrase structures for these constructions. However, as we have seen, such an account runs into serious problems in accounting for the behavior of the *-te* form complex predicate, which exhibits an apparently inconsistent distributional properties with respect to the tests for morphological wordhood considered in Chapter 2.

The analysis of the complementation constructions presented in this section is a further elaboration of an idea first explored in Kubota (2008), in which it is argued that the apparently puzzling morpho-syntactic properties of the *-te* form complex predicate receives a straightforward account in a syntactic theory with a multi-modal morpho-syntactic component like the present one by assigning to it a mode of composition that has an 'intermediate' degree of flexibility. While the gist of the analysis of the *-te* form complex predicate remains unchanged from this earlier account, the present analysis improves on it by clearing up some complications in the original analysis formulated in Multi-Modal CCG. The present account also expands the empirical scope by formulating detailed analyses of the other kinds of complementation constructions that were only alluded to in Kubota (2008). By explicitly working out the details of how the *-te* form complex predicate behaves differently from these constructions, the present account provides further confirmation that the basic idea first presented there is on the right track.

4.3.1 Sentential complementation and VP complementation

The sentential complementation construction is the least problematic case among the four constructions. In this construction, the embedded clause has a full-fledged clausal status and no restructuring is allowed among elements of the embedded clause and those of the higher clause.[133] To capture this property, I assume that the complementizer (-*to* in (53d)) subcategorizes for the embedded clause in the semi-pronounceable mode $\blacklozenge$ (the reason that this mode is employed rather than the inflexible mode $\star$ is to allow for the possibility of nonconstituent coordination involving arguments/adjuncts of both V1 and V2; cf. below) but that the -*to*-marked clause itself is subcategorized for by the matrix verb in the default scrambling mode. The former specification ensures that no element can scramble out of the embedded clause, while the latter allows for the possibility for the embedded clause itself to scramble with other elements of the matrix clause. Thus, the lexical entries for the complementizer and the matrix verb can be specified as follows: [134]

---

[133] A potential exception to this generalization is the possibility of long-distance scrambling (cf., e.g., Saito 1985; Matsumoto 1996), as exemplified by the following sentence:

(i) *Sono hon-o*$_i$ Mari-wa Ken-ni [Akira-ga t_i kat-ta]-to it-ta.
that book-ACC Mari-TOP Ken-DAT Akira-NOM buy-PAST-COMP say-PAST
'Mari told Ken that Akira bought that book.'

Note that, unlike the ungrammatical interclausal scrambling example (55d), the scrambled phrase in (i) occupies the sentence-initial position. I assume, following Matsumoto (1996), that this fact suggests that long-distance scrambling is a phenomenon distinct from the ordinary kind of scrambling and that it needs to be analyzed by means of some special mechanism. I will not go into this issue any further here since working out an analysis of long-distance scrambling is a topic that is beyond the scope of this dissertation.

[134] In order to distinguish sentences ending in different morphemes, I posit the following syntactic categories:

(i) a. S_{tns} (tensed sentence)
b. S_{to} (-*to*-marked sentence)
c. S_{yooni} (-*yooni*-marked sentence)
d. S_{te} (-*te*-marked sentence)
e. S_{unt} (untensed sentence, the form that is subcategorized for by V2 of the compound verb construction)

Semantically, these categories are all of type t. In a system in which syntactic features (or some device equivalent to it) are fully articulated, the subscripts in the above categories could be viewed as syntactic

(203) a. to; ; $\mathrm{S}_{tns}\backslash_{\blacklozenge}\mathrm{S}_{to}$

b. it-ta; ; $\mathrm{S}_{to}\backslash_{.}\mathrm{NP}_{d}\backslash_{.}\mathrm{NP}_{n}\backslash_{.}\mathrm{S}_{tns}$

With the lexical specifications given above, all of the properties of the sentential complementation construction follow straightforwardly. First, the embedded clause itself can be scrambled with other matrix elements since the matrix verb subcategorizes for the embedded clause in the default scrambling mode. (205) illustrates the relevant step in the derivation for (57d), repeated here as (204); here, the order between the matrix dative argument and the sentential complement is switched via the Scrambling rule (107).

(204) Mari-wa [Akira-ga piano-o hii-ta]-to Ken-ni it-ta.
Mari-TOP Akira-NOM piano-ACC play-PAST-COMP Ken-DAT say-PAST
'Mari told Ken that Akira played the piano.'

(205)

$$\dfrac{\text{ken-ni} \circ_{.} (((\text{akira-ga} \circ_{.} (\text{piano-o} \circ_{.} \text{hii-ta})) \circ_{\blacklozenge} \text{to}) \circ_{.} \text{it-ta});\,;\,\mathrm{NP}\backslash_{.}\mathrm{S}_{tns}}{((\text{akira-ga} \circ_{.} (\text{piano-o} \circ_{.} \text{hii-ta})) \circ_{\blacklozenge} \text{to}) \circ_{.} (\text{ken-ni} \circ_{.} \text{it-ta});\,;\,\mathrm{NP}\backslash_{.}\mathrm{S}_{tns}}\,\mathrm{PI}$$

Second, the impossibility of leftward interclausal scrambling of an embedded element to the higher clause exemplified in (206) (= (55d)) follows from the fact that the complementizer combines with the embedded clause in the semi-pronounceable mode ◆, which does not allow for the relevant restructuring. (207) illustrates a failed derivation for (206).

(206) *Mari-wa *piano-o*$_i$ Ken-ni [Akira-ga t_i hii-ta]-to it-ta.
Mari-TOP piano-ACC Ken-DAT Akira-NOM play-PAST-COMP say-PAST
intended: 'Mari told Ken that Akira played the piano.'

features encoding the morpho-syntactic forms of sentences. Alternatively, one could simply regard the five categories above as distinct atomic categories.

(207)

$$\begin{array}{c} \vdots \quad \vdots \\ \dfrac{\textsf{ken-ni} \circ_{\cdot} (((\textsf{akira-ga} \circ_{\cdot} (\textsf{piano-o} \circ_{\cdot} \textsf{hii-ta})) \circ_{\blacklozenge} \textsf{to}) \circ_{\cdot} \textsf{it-ta}); ; \mathrm{NP}\backslash_{\cdot}\mathrm{S}_{tns}}{\textsf{ken-ni} \circ_{\cdot} (((\textsf{piano-o} \circ_{\cdot} (\textsf{akira-ga} \circ_{\cdot} \textsf{hii-ta})) \circ_{\blacklozenge} \textsf{to}) \circ_{\cdot} \textsf{it-ta}); ; \mathrm{NP}\backslash_{\cdot}\mathrm{S}_{tns}}\mathrm{PI} \\ \vdots \quad \vdots \end{array}$$

While it is possible to bring the accusative object *piano-o* of the embedded verb to the leftmost position inside the embedded clause as in (207), this is insufficient to license leftward interclausal scrambling. In order for interclausal scrambling to be possible, a ‘reanalysis’ of the structured phonology would have to take place, which would produce a structure in which the lower and higher verbs form a unit (and the clause boundary between the lower and higher clauses is thereby collapsed) via Intermodal Left Association (105). (See the analyses of interclausal scrambling in the other three constructions below for how this works.) However, since the semi-pronounceable mode ♦, by which the complementizer combines with the embedded clause, prevents the relevant reanalysis, the ungrammatical word order in (206) is not derived.[135]

The nonconstituent coordination patterns are also straightforward. The embedded clause syntactically combines with the head verb in the default scrambling mode. Thus, it can be part of an argument cluster constituent, just as ordinary nominal arguments of the matrix verb can. (209) illustrates the relevant steps in the derivation for (208) (= (64d)) at which the argument cluster constituent is formed:

---

[135] Converting all of the relevant modes to the semi-pronounceable mode ♦ *would* have the effect of collapsing clause boundary, but this would not help in deriving the surface order in (206) since once the whole structured phonology is converted to one involving the semi-pronounceable mode, then scrambling would no longer be applicable to change the surface word order.

(208) Mari-wa Tomoko-ni [Ken-ga piano-o hii-ta]-to, sosite
Mari-TOP Tomoko-DAT Ken-NOM piano-ACC play-PAST-COMP and
Kumiko-ni [Akira-ni uta-o utat-ta]-to it-ta.
Kumiko-DAT Akira-NOM song-ACC sing-PAST-COMP say-PAST
'Mari told Tomoko that Ken played the piano and told Kumiko that Akira sang a song.'

(209)

$$
\dfrac{\dfrac{\dfrac{\text{tomoko-ni}; ; \mathrm{NP}_d \quad \dfrac{\begin{array}{cc}\vdots & \vdots \\ (\text{ken-ga} \circ_{.} (\text{piano-o} \circ_{.} \text{hii-ta})) \circ_{\blacklozenge} \text{to}; ; \mathrm{S}_{to} & [p ; ; \mathrm{S}_{to} \backslash_{.} \mathrm{NP}_d \backslash_{.} \mathrm{NP}_n \backslash_{.} \mathrm{S}_{tns}]^1\end{array}}{((\text{ken-ga} \circ_{.} (\text{piano-o} \circ_{.} \text{hii-ta})) \circ_{\blacklozenge} \text{to}) \circ_{.} p ; ; \mathrm{NP}_d \backslash_{.} \mathrm{NP}_n \backslash_{.} \mathrm{S}_{tns}}\backslash_{.}\mathrm{E}}{\text{tomoko-ni} \circ_{.} (((\text{ken-ga} \circ_{.} (\text{piano-o} \circ_{.} \text{hii-ta})) \circ_{\blacklozenge} \text{to}) \circ_{.} p) ; ; \mathrm{NP}_n \backslash_{.} \mathrm{S}_{tns}}\backslash_{.}\mathrm{E}}{(\text{tomoko-ni} \circ_{.} ((\text{ken-ga} \circ_{.} (\text{piano-o} \circ_{.} \text{hii-ta})) \circ_{\blacklozenge} \text{to})) \circ_{.} p ; ; \mathrm{NP}_n \backslash_{.} \mathrm{S}_{tns}}\mathrm{PI}}{\text{tomoko-ni} \circ_{.} ((\text{ken-ga} \circ_{.} (\text{piano-o} \circ_{.} \text{hii-ta})) \circ_{\blacklozenge} \text{to}); ; (\mathrm{NP}_n \backslash_{.} \mathrm{S}_{tns}) /_{.} (\mathrm{S}_{to} \backslash_{.} \mathrm{NP}_d \backslash_{.} \mathrm{NP}_n \backslash_{.} \mathrm{S}_{tns})}/_{.}\mathrm{I}
$$

It is also possible to form nonconstituent coordination splitting the embedded clause in the middle, as exemplified by the following sentences:

(210) [Mari-wa Tomoko-ni Ken-ga], sosite [Mika-wa Kumiko-ni Akira-ga
Mari-TOP Tomoko-DAT Ken-NOM and Mika-TOP Kumiko-DAT Akira-NOM
uta-o utat-ta-to it-ta.
song-ACC sing-PAST-COMP say-PAST
'Mari told Tomoko that Ken sang a song and Mika told Kumiko that Akira sang a song.'

This sentence can be derived by analyzing the strings that are coordinated as constituents in the semi-pronounceable mode, for which the hierarchical structure is completely collapsed, just as in the analysis of postposition stranding that we saw in section 4.1.4. Note that this is possible since the marker *-to* combines with the embedded clause in the semi-pronounceable mode and the default scrambling mode by which the *-to*-marked clause combines with the matrix verb can be converted to the semi-pronounceable mode via Semi-Pronunciation (114).

I omit the analysis of the cleft example (61d). Given the analysis of the cleft construction proposed in section 4.2, it should be obvious how sentences like (61d) can be derived. The derivation is parallel to cases involving a single nominal argument of the verb such as (182). The other phenomena, namely, embedded VP coordination, focus particle insertion and reduplication will be discussed below in connection to the analysis of the compound verb construction.

Let us now move on to the VP complementation construction. As we have seen in section 2.3, the distributional properties of sentential complementation and VP complementation constructions are very similar: for all phenomena except for one (interclausal scrambling), they behave in the same way. This suggests that, like sentential complementation, VP complementation involves a full-fledged embedded constituent headed by V1, and that V1 and V2 do not form a morphological cluster in this construction either. However, VP complementation differs from sentential complementation in one important respect, namely, in allowing for interclausal scrambling of an embedded element to the higher clause. The challenge, then, is how to account for the mostly similar distributional properties of the two constructions while at the same time capturing this difference between them.

To account for the properties of VP complementation, I employ two modes defined in the previous chapter that are less flexible than the default scrambling mode: the 'scrambling-only' mode $\times$ and the 'associative-only' mode $\diamond$. I assume that the former is used as the mode by which the higher verb subcategorizes for the embedded VP. By contrast, the latter mode is not directly tied to any lexical element, but there is an intermodal rule of 'VP Flattening' in the φ-calculus, repeated here as in (211), which relates it to the $\times$ mode: [136]

(211) VP Flattening

$$\frac{}{A \circ_{\times} B \leq A \circ_{\diamond} B}\text{VPF}$$

The $\times$ and $\diamond$ modes have the properties that their names suggest: the only rule in the φ-calculus applicable to $\times$ (except for the VP Flattening rule (211) that relates it to $\diamond$ and Semi-Pronunciation (114)) is Scrambling (107); $\diamond$ is associative in both directions (with Intermodal Left Association (105) and Intermodal Right Association (106)) but undergoes no other structure-changing rule.

With these modes, the properties of the VP complementation construction can be captured by assigning the following specifications to the relevant lexical items:

(212) a. yooni; ; $(\mathrm{NP}_n\backslash_{\bullet}\mathrm{S}_{tns})\backslash_{<}(\mathrm{NP}_n\backslash_{\bullet}\mathrm{S}_{yooni})$

b. tanon-da; ; $(\mathrm{NP}_n\backslash_{\bullet}\mathrm{S}_{yooni})\backslash_{\times}\mathrm{NP}_d\backslash_{\bullet}\mathrm{NP}_n\backslash_{\bullet}\mathrm{S}_{tns}$

The complementizer -*yooni* is assumed to combine with the embedded VP in the $<$ mode, which is left associative. As we will see immediately below, this makes it possible for an embedded element to scramble into the higher clause when certain conditions are met.

The interaction of the $\times$ and $\diamond$ modes enables an analysis of scrambling out of VP complements, as well as the fact that a matrix element can scramble with the embedded VP to appear between V1 and V2, but an embedded element cannot do so. First, the embedded clause can scramble with other matrix arguments freely since the $\times$ mode allows for scrambling. (213) (= (57c)) is thus derived as in (214).

[136]In the present fragment, since the $\times$ mode is used only in the VP complementation construction, the $\diamond$ mode also comes into play only in the analysis of this construction.

(213) Mari-wa [piano-o hiku]-yooni *Ken-ni* tanon-da.
Mari-TOP piano-ACC play-COMP Ken-DAT ask-PAST
'Mari asked Ken to play the piano.'

(214)

$$\dfrac{\text{ken-ni}; ; \mathrm{NP}_d \qquad \dfrac{\begin{matrix}\vdots \quad \vdots \\ \text{(piano-o} \circ. \text{ hiku)} \circ_< \text{yooni} ; ; \mathrm{NP}_n\backslash.\mathrm{S}_{yooni} \qquad \text{tanon-da}; ; (\mathrm{NP}_n\backslash.\mathrm{S}_{yooni})\backslash_\times\mathrm{NP}_d\backslash.\mathrm{NP}_n\backslash.\mathrm{S}_{tns}\end{matrix}}{\text{((piano-o} \circ. \text{ hiku)} \circ_< \text{yooni)} \circ_\times \text{tanon-da} ; ; \mathrm{NP}_d\backslash.\mathrm{NP}_n\backslash.\mathrm{S}_{tns}}\backslash_\times\mathrm{E}}{\text{ken-ni} \circ. \text{(((piano-o} \circ. \text{ hiku)} \circ_< \text{yooni)} \circ_\times \text{tanon-da)} ; ; \mathrm{NP}_n\backslash.\mathrm{S}_{tns}}\backslash.\mathrm{E}$$

Interclausal scrambling out of the embedded VP is also allowed since the scrambling-only mode $\times$ can always be converted to the associative-only mode $\diamond$ via VP Flattening (211). This makes it possible to restructure the structured phonology so that V1 and V2 form a unit, which, as a whole, combines with all of the arguments of V1 and V2 in the default scrambling mode. Once this restructuring takes place, the Scrambling rule (107) can be applied to switch the order between the embedded accusative argument and the matrix dative argument, yielding the surface word order in (215) (= (55c)). (216) illustrates part of the derivation for (215); the first application of the P-interface rule corresponds to the restructuring of the structured phonology by which V1 and V2 form a unit and the second application of the P-interface rule scrambles the matrix and embedded arguments. (As in other derivations, technically these two steps can be collapsed into one.)

(215) Mari-wa *piano-o*$_i$ Ken-ni [t_i hiku]-yooni tanon-da.
Mari-TOP piano-ACC Ken-DAT play-COMP ask-PAST
'Mari asked Ken to play the piano.'

(216)

$$\dfrac{\dfrac{\begin{matrix}\vdots \quad \vdots \\ \text{ken-ni} \circ. \text{(((piano-o} \circ. \text{ hiku)} \circ_< \text{yooni)} \circ_\times \text{tanon-da)} ; ; \mathrm{NP}_n\backslash.\mathrm{S}_{tns}\end{matrix}}{\text{ken-ni} \circ. \text{(piano-o} \circ. \text{((hiku} \circ_< \text{yooni)} \circ_\diamond \text{tanon-da))} ; ; \mathrm{NP}_n\backslash.\mathrm{S}_{tns}}\mathrm{PI}}{\text{piano-o} \circ. \text{(ken-ni} \circ. \text{((hiku} \circ_< \text{yooni)} \circ_\diamond \text{tanon-da))} ; ; \mathrm{NP}_n\backslash.\mathrm{S}_{tns}}\mathrm{PI}$$

The first application of the P-interface rule in (216) is supported by the following lemma in the inequational logic.

(217) **Lemma:** $A \circ. (((B \circ. C) \circ_< D) \circ_\times E) \;\leq\; B \circ. (A \circ. ((C \circ_< D) \circ_\diamond E))$

Proof:

$$A \circ. (((B \circ. C) \circ_< D) \circ_\times E)$$

$$\leq A \circ. ((B \circ. (C \circ_< D)) \circ_\times E) \qquad \text{(ILA)}$$

$$\leq A \circ. ((B \circ. (C \circ_< D)) \circ_\diamond E) \qquad \text{(VPF)}$$

$$\leq A \circ. (B \circ. ((C \circ_< D) \circ_\diamond E)) \qquad \text{(ILA)}$$

The corresponding example with an embedded adverb (56c), repeated here as (218) can similarly be derived, by first having the adverb (of category $\mathrm{VP}/.\mathrm{VP}$) combine with the embedded VP and then scrambling it out to the matrix clause through the same steps as above.

(218) Mari-ga *anpu-de*$_i$ Ken-ni [t_i piano-o hiku]-yooni tanon-da.
Mari-NOM without music Ken-DAT piano-ACC play-COMP ask-PAST
'Mari asked Ken to play the piano without music.'

Since the derivation is essentially parallel, I omit it here.

Crucially, the present analysis successfully blocks the ungrammatical pattern exemplified in (59) and (60), repeated here as (219) and (220), in which an embedded argument or adjunct scrambles to the *right* (instead of the left) of the embedded VP.

(219) *Mari-ga Ken-ni [t_i hiku]-yooni *piano-o*$_i$ tanon-da.
Mari-NOM Ken-DAT play-COMP piano-ACC ask-PAST
intended: 'Mari asked Ken to play the piano.'

(220) *Mari-ga Ken-ni [t_i piano-o hiku]-yooni *anpu-de*$_i$ tanon-da.
Mari-NOM Ken-DAT piano-ACC play-COMP without music ask-PAST

‘Mari asked Ken to play the piano without music.’

This is because the two modes $\times$ and $\diamond$ interact in such a way that possibilities for restructuring the structured phonology in the VP complementation construction are somewhat restricted. Note that the ungrammatical pattern *would* be licensed if it were possible to first scramble an embedded element *out of* the embedded VP to the left and then to scramble it further *with* the embedded VP itself to the right. However, this is impossible in the present fragment for the following reason: in order to scramble the embedded element to the higher clause, the mode by which the embedded VP combines with the matrix verb needs to be converted from $\times$ to $\diamond$ to allow for interclausal scrambling; but once this happens, the embedded VP itself is no longer able to be scrambled with other elements, since the $\diamond$ mode does not itself allow for scrambling of elements that it directly combines. (221) illustrates an illicit application of the P-interface rule in an attempted derivation for (219). [137]

(221)

$$\dfrac{\begin{array}{c}\vdots \quad \vdots \\ \text{ken-ni} \circ_{.} (\text{piano-o} \circ_{.} ((\text{hiku} \circ_{<} \text{yooni}) \circ_{\diamond} \text{tanon-da})) \;;\; \mathrm{NP}_{n}\backslash_{.}\mathrm{S}_{tns}\end{array}}{\text{ken-ni} \circ_{.} ((\text{hiku} \circ_{<} \text{yooni}) \circ_{\diamond} (\text{piano-o} \circ_{.} \text{tanon-da})) \;;\; \mathrm{NP}_{n}\backslash_{.}\mathrm{S}_{tns}}\,\text{**PI**}$$

On the top line of (221), the embedded accusative argument *piano-o* is scrambled out of the embedded VP via interclausal scrambling (which is why V1 is combined with V2 in the $\diamond$ mode). But then, the relevant structure involves the $\diamond$ mode, for which the Scrambling rule (107) cannot be applied to switch the order of this accusative NP and the embedded VP, and the derivation fails at this point.

Clefting of the embedded VP, as exemplified by (222) (= (61c)), is possible since the embedded VP can be scrambled to the left periphery of the sentence. (223) illustrates

[137] The notation **PI** here indicates that the application of the P-interface rule at this step is illicit.

how the topicalized sentence can be derived as $(\mathrm{NP}_n\backslash_{\cdot}\mathrm{S}_{yooni})\backslash_{\diamond}\mathrm{S}_{tns}$, a sentence missing an embedded VP.

(222) [Mari-ga Ken-ni tanon-da]-no-wa *sono hon-o* *yomu-yooni* da.
Mari-NOM Ken-DAT ask-PAST-NMLZ-TOP that book-ACC read-COMP COP
'What Mari asked Ken to do was to read that book.'

(223)

$$
\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\mathsf{mari\text{-}ga};;\ \mathrm{NP}_n \quad \dfrac{\mathsf{ken\text{-}ni};;\ \mathrm{NP}_d \quad \dfrac{[p\,;;\ \mathrm{NP}_n\backslash_{\cdot}\mathrm{S}_{yooni}]^1 \quad \mathsf{tanon\text{-}da};;\ (\mathrm{NP}_n\backslash_{\cdot}\mathrm{S}_{yooni})\backslash_{\times}\mathrm{NP}_d\backslash_{\cdot}\mathrm{NP}_n\backslash_{\cdot}\mathrm{S}_{tns}}{p \circ_{\times} \mathsf{tanon\text{-}da};;\ \mathrm{NP}_d\backslash_{\cdot}\mathrm{NP}_n\backslash_{\cdot}\mathrm{S}_{tns}}\backslash_{\times}\mathrm{E}}{\mathsf{ken\text{-}ni} \circ_{\cdot} (p \circ_{\times} \mathsf{tanon\text{-}da});;\ \mathrm{NP}_n\backslash_{\cdot}\mathrm{S}_{tns}}\backslash_{\cdot}\mathrm{E}}{\mathsf{mari\text{-}ga} \circ_{\cdot} (\mathsf{ken\text{-}ni} \circ_{\cdot} (p \circ_{\times} \mathsf{tanon\text{-}da}));;\ \mathrm{S}_{tns}}\backslash_{\cdot}\mathrm{E} \quad \mathsf{no};;\ \mathrm{S}_{tns}\backslash_{<}\mathrm{S}_{no}}{(\mathsf{mari\text{-}ga} \circ_{\cdot} (\mathsf{ken\text{-}ni} \circ_{\cdot} (p \circ_{\times} \mathsf{tanon\text{-}da}))) \circ_{<} \mathsf{no};;\ \mathrm{S}_{no}}\backslash_{<}\mathrm{E} \quad \mathsf{wa};;\ \mathrm{S}_{no}\backslash_{<}\mathrm{S}_{wa}}{((\mathsf{mari\text{-}ga} \circ_{\cdot} (\mathsf{ken\text{-}ni} \circ_{\cdot} (p \circ_{\times} \mathsf{tanon\text{-}da}))) \circ_{<} \mathsf{no}) \circ_{<} \mathsf{wa};;\ \mathrm{S}_{wa}}\backslash_{<}\mathrm{E}}{p \circ_{\diamond} (((\mathsf{mari\text{-}ga} \circ_{\cdot} (\mathsf{ken\text{-}ni} \circ_{\cdot} \mathsf{tanon\text{-}da})) \circ_{<} \mathsf{no}) \circ_{<} \mathsf{wa});;\ \mathrm{S}_{wa}}\mathrm{PI}}{\mathsf{mari\text{-}ga} \circ_{\cdot} (((\mathsf{ken\text{-}ni} \circ_{\cdot} \mathsf{tanon\text{-}da}) \circ_{<} \mathsf{no}) \circ_{<} \mathsf{wa});;\ (\mathrm{NP}_n\backslash_{\cdot}\mathrm{S}_{yooni})\backslash_{\diamond}\mathrm{S}_{wa}}\backslash_{\diamond}\mathrm{I}^1
$$

The PI step in the above derivation is licensed by the following lemma in the inequational logic:

(224) **Lemma:** $((A \circ_{\cdot} (B \circ_{\cdot} (C \circ_{\times} D))) \circ_{<} E) \circ_{<} F \;\leq\; C \circ_{\diamond} (((A \circ_{\cdot} (B \circ_{\cdot} D)) \circ_{<} E) \circ_{<} F)$

Proof:

$$
\begin{aligned}
& ((A \circ_{\cdot} (B \circ_{\cdot} (C \circ_{\times} D))) \circ_{<} E) \circ_{<} F & \\
\leq\ & ((C \circ_{\times} (A \circ_{\cdot} (B \circ_{\times} D))) \circ_{<} E) \circ_{<} F & \text{(SCR, twice)} \\
\leq\ & ((C \circ_{\diamond} (A \circ_{\cdot} (B \circ_{\times} D))) \circ_{<} E) \circ_{<} F & \text{(VPF)} \\
\leq\ & C \circ_{\diamond} (((A \circ_{\cdot} (B \circ_{\times} D)) \circ_{<} E) \circ_{<} F) & \text{(ILA, twice)}
\end{aligned}
$$

The hypothesized embedded VP (which instantiates C in the above lemma) is first brought to the left edge of the embedded clause via Scrambling (107), and then, by converting the $\times$ mode to the $\diamond$ mode by VP Flattening (211), it can further be brought to the hierarchically topmost position with Intermodal Left Association (105) so that Slash Introduction can apply to withdraw the hypothesis. Note crucially here that the clefting of the embedded VP is possible since the abstract associative mode $\diamond$ is involved instead of the semi-pronounceable mode $\blacklozenge$ (which is also associative). As noted in section 4.2.1, clefting of elements involving the semi-pronounceable mode $\blacklozenge$ is not possible due to the specification in the copula. Note that this restriction is imposed on the lexical entry of the copula in (184) for the purpose of ruling out certain ungrammatical cleft sentences (such as (200) involving a prenominal adjective). Thus, in order to account for the fact that, unlike these cases, clefting of the embedded VP is possible with VP complementation, the abstract associative mode $\diamond$ needs to be recognized as a distinct mode and we need to employ this mode in the analysis of VP complementation.

As noted above, in the present analysis, when an element is scrambled out of the embedded VP, the embedded VP itself can no longer be scrambled with other elements. This predicts that clefting of the embedded VP is impossible if some element gets scrambled out of it and is left stranded in the topicalized sentence. The ungrammaticality of (225) shows that this prediction is borne out:

(225) *[Mari-ga Ken-ni sono hon-o$_i$ tanon-da]-no-wa [t_i yomu-yooni] da.
Mari-NOM Ken-DAT that book-ACC ask-PAST-NMLZ-TOP read-COMP COP
intended: ‘What Mari asked Ken to do with the book was to read it.

(226) shows a failed derivation for (225).

(226)

$$\dfrac{\dfrac{\text{mari-ga};\,;\ \mathrm{NP}_n \qquad \dfrac{\text{ken-ni};\,;\ \mathrm{NP}_d \qquad \dfrac{\dfrac{\text{sono-hon-o};\,;\ \mathrm{NP}_a \qquad [p\,;\,;\mathrm{NP}_a\backslash.\mathrm{NP}_n\backslash.\mathrm{S}_{yooni}]^1}{\text{sono-hon-o} \circ.\ p\,;\,;\mathrm{NP}_n\backslash.\mathrm{S}_{yooni}}\backslash.\mathrm{E} \qquad \text{tanon-da};\,;\ (\mathrm{NP}_n\backslash.\mathrm{S}_{yooni})\backslash_{\times}\mathrm{NP}_d\backslash.\mathrm{NP}_n\backslash.\mathrm{S}_{tns}}{(\text{sono-hon-o} \circ.\ p) \circ_{\times} \text{tanon-da};\,;\mathrm{NP}_d\backslash.\mathrm{NP}_n\backslash.\mathrm{S}_{tns}}\backslash_{\times}\mathrm{E}}{\text{ken-ni} \circ.\ ((\text{sono-hon-o} \circ.\ p) \circ_{\times} \text{tanon-da});\,;\mathrm{NP}_n\backslash.\mathrm{S}_{tns}}\backslash.\mathrm{E}}{\text{mari-ga} \circ.\ (\text{ken-ni} \circ.\ ((\text{sono-hon-o} \circ.\ p) \circ_{\times} \text{tanon-da}));\,;\mathrm{S}_{tns}}\backslash.\mathrm{E}}{\text{mari-ga} \circ.\ (\text{ken-ni} \circ.\ (\text{sono-hon-o} \circ.\ (p \circ_{\diamond} \text{tanon-da})));\,;\mathrm{S}_{tns}}\mathrm{PI}$$

In order for this derivation to go through, the hypothesized embedded verb needs to be pushed to the left periphery of the topicalized sentence. However, unlike in the case of (223), this is impossible, since the embedded VP combines with the matrix verb in the associative-only mode $\diamond$ after the embedded accusative object *sono hon-o* 'that book' scrambles out of the embedded VP.[138]

Finally, the pattern of nonconstituent coordination is also correctly accounted for. The embedded VP can form argument cluster constituents with other matrix elements because the $\diamond$ mode by which the embedded VP combines with the matrix verb can be converted to the semi-pronounceable mode $\blacklozenge$ via Semi-Pronunciation (114). Once this conversion takes place, nonconstituent coordination is freely available. (228) illustrates the relevant steps at which the argument cluster constituent is formed in the derivation for (227) (= (64c)).

(227) Mari-wa [Ken-ni piano-o hiku-yooni], (sosite) [Akira-ni uta-o
Mari-TOP Ken-DAT piano-ACC play-COMP and Akira-DAT song-ACC
utau-yooni] tanon-da.
sing-COMP ask-PAST
'Mari asked Ken to play the piano and Akira to sing a song.'

(228)

$$
\dfrac{\dfrac{\dfrac{\text{ken-ni};;\, NP_d \qquad \dfrac{\begin{array}{c}\vdots \quad \vdots\\ (\text{piano-o} \circ_{.} \text{hiku}) \circ_{<} \text{yooni};;\\ NP_n\backslash_{.}S_{yooni}\end{array} \qquad [p;;(NP_n\backslash_{.}S_{yooni})\backslash_{\times}NP_d\backslash_{.}NP_n\backslash_{.}S_{tns}]^1}{((\text{piano-o} \circ_{.} \text{hiku}) \circ_{<} \text{yooni}) \circ_{\times} p;;\, NP_d\backslash_{.}NP_n\backslash_{.}S_{tns}}\backslash_{\times}\mathrm{E}}{\text{ken-ni} \circ_{.} (((\text{piano-o} \circ_{.} \text{hiku}) \circ_{<} \text{yooni}) \circ_{\times} p);;\, NP_n\backslash_{.}S_{tns}}\backslash_{.}\mathrm{E}}{\text{ken-ni} \circ_{\blacklozenge} ((\text{piano-o} \circ_{.} \text{hiku}) \circ_{<} \text{yooni}) \circ_{\blacklozenge} p;;\, NP_n\backslash_{.}S_{tns}}\mathrm{PI}}{\text{ken-ni} \circ_{\blacklozenge} ((\text{piano-o} \circ_{.} \text{hiku}) \circ_{<} \text{yooni});;\, (NP_n\backslash_{.}S_{tns})/_{\blacklozenge}((NP_n\backslash_{.}S_{yooni})\backslash_{\times}NP_d\backslash_{.}NP_n\backslash_{.}S)}/_{\blacklozenge}\mathrm{I}^1
$$

To summarize the discussion in this section, we have seen that an analysis that correctly captures the similarities and differences between sentential complementation and VP complementation can be formulated within the present theory. The key ingredient that enables

[138] If this restructuring does not take place and the embedded VP combines with the matrix clause in the $\times$ mode, it remains the case that there is no way to restructure the structured phonology to bring the hypothesized embedded verb alone to the left periphery of the structured phonology of the whole topicalized sentence.

an account of the slightly more flexible patterns of scrambling in VP complementation is the interaction of two modes $\times$ and $\diamond$ via the VP Flattening rule (211). Thus, the present analysis crucially makes use of the level of structured phonology in capturing the relevant morpho-syntactic properties of the two constructions. The treatments of the other three phenomena, namely, embedded VP coordination, focus particle insertion, and reduplication are postponed to the next subsection, where morpho-syntactic differences between sentential complementation and VP complementation on the one hand and compound verbs on the other will be systematically investigated. The different degrees of morpho-syntactic flexibility of linguistic composition at the level of structured phonology in the present theory will be further exploited there to formulate a simple and accurate account of the relevant contrasts between these constructions.

4.3.2 Compound verbs

The compound verb construction systematically contrasts with the sentential and VP complementation constructions in almost all respects. That is, all of the data reviewed in Chapter 2 uniformly suggest that V1 and V2 form a tight morphological cluster in this construction. In the analysis that I propose below, V2 in the compound verb construction subcategorizes for the embedded VP headed by V1 in a special mode of composition called the 'verb raising' mode, which makes clustering of the two verbs obligatory. I will show that this simple assumption straightforwardly accounts for all of the relevant morpho-syntactic properties of this construction.

There is, however, a complication with the compound verb construction that I did not address in Chapter 2, since the problem in question was somewhat tangential to the main focus in that chapter (namely, the morpho-syntactic properties of this construction). The problem that I have left unaddressed there is that different kinds of compound verbs contrast with one another as to whether or not they exhibit what one might call 'semantic biclausality' effects. This issue has been discussed extensively in the literature of compound verbs in Japanese (cf., e.g., Kageyama 1993; Matsumoto 1996; Yumoto 2005) and thus is something that any adequate analysis of compound verbs needs to be able to account for.[139] I will show below that a relatively simple analysis of this aspect of compound verbs is also possible in the present theory, once the morpho-syntactic properties of the construction have been properly analyzed.

4.3.2.1 Morpho-syntactic properties of the compound verb construction

The morpho-syntactic properties of the compound verb construction can be captured by assuming that the higher verb subcategorizes for the embedded VP in the 'verb raising' mode $\ll$ defined in Chapter 3. Thus, the lexical entry for the verb *hazime-ta* 'began', which functions as V2 in the compound verb *V-hazime* 'begin to V' is given as follows:[140]

(229) hazime-ta; **begin**; $(\mathrm{NP}_n \backslash_{\boldsymbol{.}} \mathrm{S}_{unt}) \backslash_{\ll} (\mathrm{NP}_n \backslash_{\boldsymbol{.}} \mathrm{S}_{tns})$

Like the complex predicate mode $<$ employed in the analysis of the *-te* form complex predicate (cf. the next subsection), the verb raising mode is left associative (this similarity

[139] Discussions of the issue of (semantic) biclausality of morphologically monoclausal complex predicates in Japanese (including, but not limited to, the compound verb construction) actually go back much earlier in the literature, with the causative complex predicate being the most extensively discussed case (cf., e.g., Kuroda (1965), Kuno (1973) and Shibatani (1976)). Although I focus on the compound verb construction below for expository ease, since the causative construction (and some other derivational suffixes discussed in the literature in this context) essentially exhibit the same distributional properties as what I call 'biclausal compound verbs' below, the same analysis that I propose for these compound verbs can be applied to these predicates as well.

[140] I gloss over the treatment of tense in the present fragment. Thus, I assume that a tensed form of the verb (e.g., with the past tense marker *-ta* as in as in (229)) is directly listed in the lexicon.

captures the parallels between the two constructions found in some, but not all, of the relevant phenomena; cf. the table in (54) on p. 50), but the two modes differ in that morpho-syntactic clustering of V1 and V2 is obligatory in the latter but not in the former.

The obligatoriness of morpho-syntactic clustering of V1 and V2 in the compound verb construction is ensured by assuming that the verb-raising mode can be mapped to the pronounceable mode just in case the elements that it combines are **clusters** in the φ-calculus (in the technical sense to be defined below; intuitively, a 'cluster' is either (the phonology of) a lexical verb or a pronounceable structured phonology consisting solely of (the phonologies of) lexical verbs).

The relevant mode-specific rule that converts the verb raising mode to the pronounceable mode can be stated as follows:

(230) Verb Clustering I

$$\overline{\mathsf{A} \circ_{\ll} \mathsf{B} \leq \mathsf{A} \bullet \mathsf{B}}\,\mathrm{VC1}$$

(where both A and B are terms of type cl)

Here, cl is a **subtype** of the type st, so that any expression of type cl is also of type st.[141] I assume that the grammar includes a set of axioms asserting that the phonologies of lexical

[141] Some remarks are in order regarding the notion of (phonological) subtypes in the present theory. First, to be technically more precise, we should assume that the φ-calculus is a higher-order theory, for which the notion of subtype can be straightforwardly provided via embedding functions.

Second, although the current fragment recognizes only one subtype (i.e. cl) for the type st, it seems plausible to exploit subtyping in the φ-calculus for capturing fine-grained distinctions among structured phonologies when dealing with more complex phenomena pertaining to the syntax-phonology interface (such as the intonational break in English right-node raising).

verbs (e.g. hiki, hazime-ta, etc.) are of type cl, together with the following rule in the φ-calculus:[142]

(231) If a and b are terms of type cl, then so is $a \bullet b$.

To give a simple example, among the φ-terms in (232), (232a) and (232b) and clusters but (232c) is not (since the phonology of the NP piano-o is not a cluster).

(232) a. hiki

b. hiki • hazime-ta

c. piano-o • hiki

Imposing the condition that Verb Clustering I (230) is applicable only when the elements that it combines are clusters captures the intuition that compound verbs obligatorily form a morpho-syntactic cluster (since otherwise they would not be pronounceable). As we will see below, this accounts for the tight morpho-syntactic bond between the higher and lower verbs in this construction that we observed in Chapter 2.

The derivation (234) for a simple example (233) (= (53a)) of the compound verb construction illustrates how this verb cluster formation is enforced.[143]

(233) Mari-ga piano-o hiki-hazime-ta.
Mari-NOM piano-ACC play-begin-PAST
'Mari started playing the piano.'

[142]The relationship between the type st and its subtype cl with respect to • (string concatenation) is similar to the relationship between the types real (real number) and nat in programming languages with respect to + (addition). nat is a subtype of real and adding two numbers of type nat produces an expression of type nat while adding two numbers where one is of type real and the other is of type nat produces an expression of type real. Similarly, cl is a subtype of st and a complex term formed out of strings belongs to the subtype cl only when both of the arguments of the connective • belong to the type cl.

[143]Here, VP_{unt} and VP_{tns} abbreviate $\mathrm{NP}_n \backslash\!. \mathrm{S}_{unt}$ and $\mathrm{NP}_n \backslash\!. \mathrm{S}_{tns}$, respectively.

(234)

$$\dfrac{\dfrac{\dfrac{\text{mari-ga}; ; \mathrm{NP}_n \qquad \dfrac{\dfrac{\text{piano-o}; \mathbf{p}; \mathrm{NP}_a \quad \text{hiki}; \mathbf{play}; \mathrm{NP}_a \backslash_{\bullet} \mathrm{VP}_{unt}}{\text{piano-o} \circ_{\bullet} \text{hiki}; \mathbf{play}(\mathbf{p}); \mathrm{VP}_{unt}}\backslash_{\bullet}\mathrm{E} \quad \text{hazime-ta}; \mathbf{begin}; \mathrm{VP}_{unt} \backslash_{\ll} \mathrm{VP}_{tns}}{(\text{piano-o} \circ_{\bullet} \text{hiki}) \circ_{\ll} \text{hazime-ta}; \mathbf{begin}(\mathbf{play}(\mathbf{p})); \mathrm{VP}_{tns}}\backslash_{\ll}\mathrm{E}}{\text{mari-ga} \circ_{\bullet} ((\text{piano-o} \circ_{\bullet} \text{hiki}) \circ_{\ll} \text{hazime-ta}); \mathbf{begin}(\mathbf{play}(\mathbf{p}))(\mathbf{m}); \mathrm{S}_{tns}}\backslash_{\bullet}\mathrm{E}}{\text{mari-ga} \circ_{\bullet} (\text{piano-o} \circ_{\bullet} (\text{hiki} \circ_{\ll} \text{hazime-ta})); \mathbf{begin}(\mathbf{play}(\mathbf{p}))(\mathbf{m}); \mathrm{S}_{tns}}\mathrm{PI}}{\text{mari-ga} \bullet (\text{piano-o} \bullet (\text{hiki} \bullet \text{hazime-ta})); \mathbf{begin}(\mathbf{play}(\mathbf{p}))(\mathbf{m}); \mathrm{S}_{tns}}\mathrm{PI}$$

V2 *hazime-ta* 'began' is lexically specified to subcategorize for a VP. Just combining this V2 with the embedded VP does not, however, yield a pronounceable structured phonology, since the resultant structure involves the unpronounceable verb raising mode $\ll$. In order to obtain a pronounceable phonology, we first need to restructure the whole expression into a structure in which the verb raising mode $\ll$ combines the phonologies of the two verbs (which are both clusters according to the definition given above). As shown in the first application of the P-interface rule in (234), this can be achieved by applying Intermodal Left Association (105). Once this restructuring takes place, we can apply Verb Clustering I (230) so that the unpronounceable $\ll$ mode is eliminated, as shown in the second application of the P-interface rule. (As in earlier examples, technically, the two successive applications of the P-interface rule can be collapsed into one; they are shown here as separate steps solely for expository ease.) The application of Verb Clustering I (230) here has the effect of forming a morphological cluster: once the $\ll$ mode is converted to the pronounceable mode $\bullet$, no restructuring operations are applicable since the pronounceable mode does not undergo any structure-changing rule.

The reason that the applicability condition on Verb Clustering I (230) refers to the notion of cluster instead of simply saying that the elements combined are constants is to account for cases of multiple embedding of compound verbs, such as the following:

(235) Mari-ga piano-o hiki-sugi-tuduke-ta.
Mari-NOM piano-ACC play-overdo-continue-PAST

'Mari continued playing the piano too much.'

Here, the matrix verb *tuduke-ta* 'continue to V' subcategorizes for the verb *hiki-sugi*, which itself is a compound verb with V1 *hiki* 'play' and V2 *sugi* 'over-V'. The relevant PI step in the derivation for (235) is given in (236). The lemma that licenses this application of the P-interface rule is proved in (237).

(236)

$$\dfrac{\begin{array}{c}\vdots \quad \vdots \\ \text{((piano-o} \circ_{\cdot} \text{hiki)} \circ_{\ll} \text{sugi)} \circ_{\ll} \text{tuduke-ta}; ; \mathrm{VP}_{\mathit{tns}}\end{array}}{\text{piano-o} \bullet \text{((hiki} \bullet \text{sugi)} \bullet \text{tuduke-ta)}; ; \mathrm{VP}_{\mathit{tns}}}\mathrm{PI}$$

(237) **Lemma:** $((A \circ_{\cdot} B) \circ_{\ll} C) \circ_{\ll} D \leq A \bullet ((B \bullet C) \bullet D)$

(where B, C, D are of type cl)

Proof:

$((A \circ_{\cdot} B) \circ_{\ll} C) \circ_{\ll} D$

$\leq A \circ_{\cdot} ((B \circ_{\ll} C) \circ_{\ll} D)$ (ILA, twice)

$\leq A \bullet ((B \circ_{\ll} C) \circ_{\ll} D)$ (SPN, PN)

$\leq A \bullet ((B \bullet C) \circ_{\ll} D)$ (VC1)

$\leq A \bullet ((B \bullet C) \bullet D)$ (VC1)

Just as in the simpler example involving one level of embedding we saw above, the verbs first need to form a cluster in order for the structured phonology to be converted to a pronounceable one. This is done by first forming the verb cluster by Intermodal Left Association (the first step in (237)) and then applying Verb Clustering I recursively from the innermost part of the cluster to the outermost part (the last two steps in (237)). Crucially, in the second application of Verb Clustering I, the lefthand side element is not a constant but a complex φ-term of the form hiki $\bullet$ sugi. But the application of the rule is licit here since this φ-term is a (complex) cluster (with both hiki and sugi being constant clusters), according to the definition of cluster given above.

I will now illustrate that the obligatory verb clustering of V1 and V2 enforced by the verb raising mode explains the distributional properties of the compound verb construction adequately. First, the possibility of interclausal scrambling of an embedded element arises as an immediate consequence of the obligatory clustering of V1 and V2. (239) illustrates the derivation for (55a), repeated here as (238), an example in which an embedded argument scrambles over an adverb that modifies the matrix verb.

(238) Mari-wa *piano-o* hui-ni hiki-hazime-ta.
Mari-TOP piano-ACC suddenly play-begin-PAST
'Mari suddenly started playing the piano.'

(239)

$$\begin{array}{c}\vdots \quad \vdots \\ \dfrac{\dfrac{\dfrac{\text{hui-ni}; ; \mathrm{VP}_{tns}/_{\cdot}\mathrm{VP}_{tns} \qquad (\text{piano-o} \circ_{\cdot} \text{hiki}) \circ_{\ll} \text{hazime-ta}; ; \mathrm{VP}_{tns}}{\text{hui-ni} \circ_{\cdot} ((\text{piano-o} \circ_{\cdot} \text{hiki}) \circ_{\ll} \text{hazime-ta}); ; \mathrm{VP}_{tns}}/_{\cdot}\mathrm{E}}{\text{hui-ni} \circ_{\cdot} (\text{piano-o} \circ_{\cdot} (\text{hiki} \circ_{\ll} \text{hazime-ta})); ; \mathrm{VP}_{tns}}\mathrm{PI}}{\text{piano-o} \circ_{\cdot} (\text{hui-ni} \circ_{\cdot} (\text{hiki} \circ_{\ll} \text{hazime-ta})); ; \mathrm{VP}_{tns}}\mathrm{PI} \\ \vdots \quad \vdots\end{array}$$

Once V1 and V2 form a cluster, all the arguments and adjuncts of V1 and V2 are combined with this verb cluster in the default scrambling mode, which enables the embedded argument *piano-o* to be scrambled with the adverb *hui-ni* (which modifies the matrix verb) via the Scrambling rule (107).

Second, the impossibility of scrambling of the embedded VP also follows directly. The embedded VP is combined with the matrix verb in the verb raising mode $\ll$. But this mode, unlike the default scrambling mode $\cdot$ and the 'scrambling only' mode $\times$ employed in the analysis of VP complementation above, does not itself undergo the Scrambling rule (107).

Thus, it is impossible to scramble the embedded VP with other elements of the matrix clause, which accounts for the ungrammaticality of examples like the following (= (57a)):

(240) *[Piano-o hiki] *Mari-wa* hazime-ta.
piano-ACC play Mari-TOP begin-PAST
intended: 'Mari started playing the piano.'

Third, the impossibility of clefting of the embedded VP follows from the fact, noted immediately above, that scrambling of the embedded VP is impossible. Recall from the previous section that, in the analysis of the cleft construction in the present fragment, in order to displace some expression to the focus position, we first need to hypothesize a corresponding expression in the topicalized sentence and then withdraw that hypothesis by pushing it to the left periphery of the structured phonology. However, this is impossible in examples like (241) (= (61a)) below involving the compound verb construction, since, as noted above, scrambling of the embedded VP (to the left periphery) is impossible here.

(241) *[Mari-ga hazime-ta]-no-wa *sono hon-o* *yomi* da.
Mari-NOM begin-PAST-NMLZ-TOP that book-ACC read COP
intended: 'What Mari began to do was to read that book.'

Fourth, the impossibility of nonconstituent coordination involving V1, exemplified by (242) (= (64a)) follows from the fact that the verb raising mode is left associative but not right associative.

(242) *[Ken-ga piano-o hiki], (sosite) [Akira-ga uta-o utai]-oe-ta.
Ken-NOM piano-ACC play and Akira-NOM song-ACC sing-finish-PAST
intended: 'Ken finished playing the piano and Akira finished singing a song.'

Recall from section 4.1 that, in order to form an argument cluster constituent to be coordinated, restructuring of a right-branching structure to a left-branching one needs to take place. However, with the verb raising mode $\ll$ (which is not right associative), this restructuring is impossible. (243) shows a failed derivation for (242).

(243)

$$\dfrac{\text{ken-ga}; ; \mathrm{NP}_{n} \qquad \dfrac{\overset{\vdots}{\text{piano-o} \circ_{.} \text{hiki}; ; \mathrm{VP}_{unt}} \qquad \overset{\vdots}{[p ; ; \mathrm{VP}_{unt}\backslash_{\ll}\mathrm{VP}_{tns}]^{1}}}{(\text{piano-o} \circ_{.} \text{hiki}) \circ_{\ll} p ; ; \mathrm{VP}_{tns}}\,\backslash_{\ll}\mathrm{E}}{\text{ken-ga} \circ_{.} ((\text{piano-o} \circ_{.} \text{hiki}) \circ_{\ll} p); ; \mathrm{S}_{tns}}\,\backslash_{.}\mathrm{E}$$

Here, by hypothesizing V2 of the compound verb *hiki-oe-ta* ‘finished playing’, an attempt is made to derive the string *Ken-ga piano-o hiki* as an argument cluster constituent. In order for the derivation to go through, the hypothesized V2 has to be pushed to the right periphery of the structured phonology and withdrawn via Slash Introduction. However, this is impossible because the verb raising mode $\ll$ does not itself undergo Intermodal Right Association (106) nor can it be converted to the semi-pronounceable mode $\blacklozenge$ via Semi-Pronunciation (114).[144] Thus, the derivation fails at the final step in (243) and the ungrammatical example (242) is not derived.

The contrasts between the compound verb construction and the other complementation constructions in the other three phenomena, namely, embedded VP coordination, focus particle insertion, and reduplication, also naturally follow from the assumption that morphological clustering of V1 and V2 is obligatory in the former but not in the latter. (245) shows a failed derivation for (244) (= (65a)), an example in which coordination of the embedded VP is attempted in the compound verb construction.[145]

[144]Here, the assumption that the verb raising mode is directly mapped to the pronounceable mode becomes crucial. Without this assumption, the grammar would incorrectly overgenerate examples like (242).

[145]The disjunction word *matawa* in (245) has the syntactic category of generalized conjunction that takes as arguments two expressions matching in syntactic category to its right and left to produce a larger expression of the same category.

(244) *Dono gakusei-mo [piano-o hiki] matawa [uta-o utai]-oe-ta.
Which student-also piano-ACC play or song-ACC sing-finish-PAST
intended: 'Every student finished playing the piano or singing a song.'

(245)

$$\dfrac{\dfrac{\dfrac{\text{piano-o}; ; \mathrm{NP}_a \quad \text{hiki}; ; \mathrm{NP}_a \backslash_{\bullet} \mathrm{VP}_{unt}}{\text{piano-o} \circ_{\bullet} \text{hiki}; ; \mathrm{VP}_{unt}}\backslash_{\bullet}\mathrm{E} \quad \dfrac{\text{matawa}; ; (X\backslash_{\star}X)/_{\star}X \quad \begin{array}{c}\vdots \; \vdots \\ \text{uta-o} \circ_{\bullet} \text{utai}; ; \mathrm{VP}_{unt}\end{array}}{\text{matawa} \circ_{\star} (\text{uta-o} \circ_{\bullet} \text{utai}); ; \mathrm{VP}_{unt}\backslash_{\star}\mathrm{VP}_{unt}}/_{\star}\mathrm{E}}{(\text{piano-o} \circ_{\bullet} \text{hiki}) \circ_{\star} (\text{matawa} \circ_{\star} (\text{uta-o} \circ_{\bullet} \text{utai})); ; \mathrm{VP}_{unt}}\backslash_{\star}\mathrm{E} \quad \text{oe-ta}; ; \mathrm{VP}_{unt}\backslash_{\ll}\mathrm{VP}_{tns}}{((\text{piano-o} \circ_{\bullet} \text{hiki}) \circ_{\star} (\text{matawa} \circ_{\star} (\text{uta-o} \circ_{\bullet} \text{utai}))) \circ_{\ll} \text{oe-ta}; ; \mathrm{VP}_{tns}}\backslash_{\ll}\mathrm{E}$$

The problem with (245) is that, in order to convert the structured phonology into a pronounceable one that does not contain the verb raising mode $\ll$, V2 needs to cluster with V1 so that a local structure is created to which Verb Clustering I (230) can be applied. However, this is impossible in (245), since the embedded VP involves a coordinate structure (which is not left associative), and, hence, there is no way to form a cluster of V1 and V2.[146] Thus, the whole expression remains unpronounceable and the example is correctly ruled out.

Unlike the compound verb construction, other complementation constructions do not involve the obligatory clustering of V1 and V2, and, for this reason, embedded VP coordination is possible. See (283) in the next subsection for a derivation for the case of the *-te* form complex predicate. Since the derivations for the cases of sentential complementation and VP complementation are essentially the same, I omit them here.

The patterns of focus particle insertion can be accounted for similarly. I call the expression that a focus particle attaches to the 'host' of the focus particle. Assuming that a focus

[146] I have suggested above in section 4.1 that the assumption that coordinate structures involve the $\star$ mode might be superfluous. But here it is crucial to assume that the mode involved in forming coordinate structures is at least not associative. I thus keep the assumption that coordinate structures involve the $\star$ mode.

particle attaches to its host in the semi-pronounceable mode $\blacklozenge$,[147] an attempted derivation for (246) (= (66a)) goes as in (247).[148]

(246) *Ken-wa piano-o hiki-*sae*-hazime-ta.
Ken-TOP piano-ACC play-even-begin-PAST
intended: ‘Ken started to even play the piano.’

(247)
$$\cfrac{\cfrac{\text{piano-o}; ; \mathrm{NP}_a \qquad \cfrac{\text{hiki}; ; \mathrm{NP}_a\backslash_{\cdot}\mathrm{VP}_{unt} \quad \text{sae}; ; X\backslash_{\blacklozenge}X}{\text{hiki} \circ_{\blacklozenge} \text{sae}; ; \mathrm{NP}_a\backslash_{\cdot}\mathrm{VP}_{unt}}\,\backslash_{\blacklozenge}\mathrm{E}}{\text{piano-o} \circ_{\cdot} (\text{hiki} \circ_{\blacklozenge} \text{sae}); ; \mathrm{VP}_{unt}}\,\backslash_{\cdot}\mathrm{E} \qquad \text{hazime-ta}; ; \mathrm{VP}_{unt}\backslash_{\ll}\mathrm{VP}_{tns}}{\cfrac{(\text{piano-o} \circ_{\cdot} (\text{hiki} \circ_{\blacklozenge} \text{sae})) \circ_{\ll} \text{hazime-ta}; ; \mathrm{VP}_{tns}}{\text{piano-o} \circ_{\cdot} ((\text{hiki} \circ_{\blacklozenge} \text{sae}) \circ_{\ll} \text{hazime-ta}); ; \mathrm{VP}_{tns}}\,\mathrm{PI}}\,\backslash_{\ll}\mathrm{E}$$

This derivation fails at the last step. While a cluster can be formed which consists of V1 (with a focus particle attached to it) and V2, this verb cluster cannot undergo Verb Clustering I (230) since the applicability condition of the rule is not satisfied. Specifically, the φ-term hiki $\circ_{\blacklozenge}$ sae that is given as the lefthand-side argument of the connective $\circ_{\ll}$ is not

[147] The reason that the semi-pronounceable mode $\blacklozenge$ is involved here (rather than, for example, the inflexible mode $\star$) is that, just like case markers such as *-ga* and *-o*, focus particles can be displaced from conjuncts in coordination, as exemplified by the following example (crucially, (i) has an interpretation in which *sae* semantically scopes over the whole coordinate structure, excluding an alternative analysis where *sae* just attaches to the second conjunct):

(i) Mari-ga [[Ken-ni piano-o hiku-yooni], (sosite) [Akira-ni uta-o utau-yooni]] *sae*
Mari-NOM Ken-DAT piano-ACC play-COMP and Akira-DAT song-acc sing-COMP even
tanon-da.
ask-PAST
‘Mari even asked Ken to play the piano and Akira to sing a song.’

[148] The focus particle is given a polymorphic syntactic category $X\backslash_{\blacklozenge}X$ in this derivation. I will provide below a more complete treatment in which the semantics of the focus particle is fully specified. However, the simplified treatment here suffices since the only relevant point here is the mode by which the focus particle attaches to its host, which remains the same in the more complete treatment given below.

a cluster (even if the semi-pronounceable mode $\circ_{\blacklozenge}$ is converted to the pronounceable mode $\bullet$), since the phonology of the focus particle sae is not a cluster. Thus, the unpronounceable verb raising mode $\ll$ remains unconverted in the structured phonology and the example is correctly blocked.

This problem does not arise in the other three constructions, because conversion of the structured phonology to a pronounceable one is not constrained in any way in the modes involved in these constructions, unlike with the verb raising mode for the compound verb construction. The derivation for the corresponding case with the *-te* form complex predicate is given in (277) in the next subsection. And, once again, it should be straightforward to see that the cases involving sentential complementation and VP complementation are parallel to the case of the *-te* form complex predicate.

Finally, the reduplication patterns can be accounted for similarly. I assume that the reduplication construction has a syntax similar to that of coordination. That is, the expression *koto-wa*, which triggers reduplication, is given the polymorphic syntactic category $X\backslash_{\star}(X/_{\star}X)$ (again, X needs to be appropriately constrained, but I ignore this detail since it is not relevant to our main concerns here) so that it combines with two predicates matching in syntactic category to the left and to the right to form a larger expression of the same category. Given this assumption, an attempted derivation for (248) (= (67a)) goes as in (249).

(248) *Ken-ga piano-o hiki-hazime-ta koto-wa hazime-ta ga, …
Ken-NOM piano-ACC play-begin-PAST begin-PAST though
intended: 'Though Ken did start to play the piano, …'

(249)

$$\dfrac{\dfrac{\begin{array}{c}\vdots\;\;\vdots\\ \text{piano-o}\circ_{\cdot}\text{hiki};\,;\\ \mathrm{VP}_{unt}\end{array}\quad \dfrac{\dfrac{\begin{array}{c}\text{hazime-ta};\,;\\ \mathrm{VP}_{unt}\backslash_{\ll}\mathrm{VP}_{tns}\end{array}\quad \begin{array}{c}\text{koto-wa};\,;\\ X\backslash_{\star}(X/_{\star}X)\end{array}}{\begin{array}{c}\text{hazime-ta}\circ_{\star}\text{koto-wa};\,;\\ (\mathrm{VP}_{unt}\backslash_{\ll}\mathrm{VP}_{tns})/_{\star}(\mathrm{VP}_{unt}\backslash_{\ll}\mathrm{VP}_{tns})\end{array}}\backslash_{\star}\mathrm{E}\quad \begin{array}{c}\text{hazime-ta};\,;\\ \mathrm{VP}_{unt}\backslash_{\ll}\mathrm{VP}_{tns}\end{array}}{(\text{hazime-ta}\circ_{\star}\text{koto-wa})\circ_{\star}\text{hazime-ta};\,;\mathrm{VP}_{unt}\backslash_{\ll}\mathrm{VP}_{tns}}/_{\star}\mathrm{E}}{(\text{piano-o}\circ_{\cdot}\text{hiki})\circ_{\ll}((\text{hazime-ta}\circ_{\star}\text{koto-wa})\circ_{\star}\text{hazime-ta});\,;\mathrm{VP}_{tns}}\backslash_{\ll}\mathrm{E}}{\text{piano-o}\circ_{\cdot}(\text{hiki}\circ_{\ll}((\text{hazime-ta}\circ_{\star}\text{koto-wa})\circ_{\star}\text{hazime-ta}));\,;\mathrm{VP}_{tns}}\mathrm{PI}$$

Here again, although V1 can be clustered with V2 by Intermodal Left Association (105), the resultant structure does not satisfy the applicability condition for Verb Clustering I (230). The problem in this case is not with V1 but with V2. Since V2 involves a complex reduplication structure, the right-hand side element combined by the verb raising mode $\ll$ is not a cluster. Thus, Verb Clustering I fails to apply and the example is correctly ruled out.

Again, the problem arises only in the compound verb construction, for which the morphological clustering of V1 and V2 is obligatory. Thus, the corresponding examples involving the other three constructions can be straightforwardly derived in the present fragment, as illustrated for the *-te* form complex predicate in (279) in the next subsection.

4.3.2.2 Semantic properties of the compound verb construction

We have seen above that the assumption that V2 subcategorizes for the embedded VP in the verb raising mode adequately accounts for the morpho-syntactic properties of the compound verb construction in Japanese. Building on this analysis, in this subsection I will discuss how the problem of ‘semantic biclausality’ effects of compound verbs in Japanese can be dealt with within the present fragment. The relevant fact to be accounted for is that compound verbs in Japanese, despite the fact that they uniformly exhibit the morpho-syntactic clustering of V1 and V2, do not behave uniformly with respect to certain semantically oriented phenomena such as quantifier scope, adverb scope and binding. More specifically, (at least) two kinds of compound verbs have been recognized in the literature: those that behave as if they had biclausal, complex structures with respect to the phenomena listed above and those that do not. I will call the former **biclausal compound verbs** and the latter **monoclausal compound verbs**. Some examples of each type of compound verbs are given in (250).

(250) **biclausal compound verbs**: *V-sugiru* 'over-V', *V-hazimeru* 'begin to V', etc.
monoclausal compound verbs: *V-wasureru* 'forget to V', *V-naosu* 're-V', etc.

Since the purpose of this section is not to conduct a thorough study of compound verbs in Japanese but merely to illustrate that the most widely-discussed and problematic property of this construction can be adequately dealt with within the present theory, this somewhat oversimplified two-way distinction suffices for our purposes. Also, to keep the discussion down to a manageable size, I will focus on the scope-taking properties of adverbs and quantifiers below and will not deal with other phenomena that have been adduced in the literature as evidence for the bi-/monoclausal distinction between different kinds of compound verbs, such as binding and honorification patterns. For a more detailed discussion of these issues, the reader is referred to Kageyama (1993), Matsumoto (1996), and Yumoto (2005).

As stated above, biclausal and monoclausal compound verbs contrast with one another in terms of the kinds of interpretations they exhibit with respect to semantically-oriented phenomena. Specifically, biclausal compound verbs allow for scope ambiguity for both adverbs and quantifiers (i.e., these expressions can semantically take scope either immediately above V1 (and below V2) or scope over the whole complex predicate including

V2) whereas monoclausal compound verbs do not allow for any such ambiguity for either adverbs or quantifiers. The relevant data are as follows: [149]

(251) **biclausal compound verb, adverb scope:**

a. Jon-wa sono ziken-o *koi-ni* **tuuhoo-si-tuduke-ta**.
John-TOP that accident-ACC intentionally report-do-repeat-PAST
'John repeatedly reported that accident on purpose.'

b. Jon-wa sono ziken-o *koi-ni* **tuuhoo-si-sugi-ta**.
John-TOP that accident-ACC intentionally report-do-overdo-PAST
'John excessively reported that accident on purpose.'

(252) **biclausal compound verb, quantifier scope:**

a. Naomi-wa *yooguruto-dake* **tabe-tuduke-ta**.
Naomi-TOP yogurt-only eat-continue-PAST
'The only thing that Naomi continued eating was yogurt.' (only>continue)
'Naomi continued the practice of eating yogurt only.' (continue>only)

b. Naomi-wa *yooguruto-dake* **tabe-sugi-ta**.
Naomi-TOP yogurt-only eat-overdo-PAST
'The only thing that Naomi ate too much of was yogurt.' (only>too)
'Naomi did too much of eating nothing other than yogurt.' (too>only)

(253) **monoclausal compound verb, adverb scope:**

a. Jon-wa sono ziken-o *koi-ni* **tuuhoo-si-wasure-ta**.
John-TOP that accident-ACC intentionally report-do-forget-PAST
'John deliberately forgot to report that accident.'

[149] In the examples of quantifier scope, NPs with the focus particle *dake* 'only' are used instead of the more prototypical quantifiers. This is due to a methodological reason: with more ordinary quantifiers, the wide scope reading and the narrow scope reading are difficult to distinguish from one another, since one of them entails the other.

b. Jon-wa sono ziken-o *koi-ni* **tuuhoo-si-naosi-ta**.
John-TOP that accident-ACC intentionally report-do-redo-PAST
'John deliberately re-reported that accident.'

(254) **monoclausal compound verb, quantifier scope:**

a. Naomi-wa *yooguruto-dake* **tabe-wasure-ta**.
Naomi-TOP yogurt-only eat-forget-PAST
'The only thing that Naomi forgot to eat was yogurt.' (only>forget)
Not: 'Naomi forgot to restrict her diet to yogurt.' ~~(forget>only)~~

b. Naomi-wa *yooguruto-dake* **tabe-naosi-ta**.
Naomi-TOP yogurt-only eat-redo-PAST
'The only thing that Naomi ate again was yogurt.' (only>re-)
Not: 'Naomi again ate only yogurt.' ~~(re->only)~~

The analysis of compound verbs in terms of the verb raising mode presented in the previous subsection already accounts for the scope ambiguity of biclausal compound verbs. Specifically, the scope ambiguity for adverbs and quantifiers arises due to the fact that these scope-taking elements can either originate in the embedded clause (yielding the narrow scope reading) or in the higher clause (yielding the wide scope reading). (A detailed illustration will be given below.)

This means that what needs to be accounted for is the fact that monoclausal compound verbs do not allow for this kind of ambiguity for either adverbs or quantifiers. In previous analyses of complex predicates in Japanese in PS-based theories, this fact has been accounted for either by assuming different syntactic structures (VP vs. V$'$ projection for the embedded verb in Kageyama's (1993) analysis) or different (i.e. 'biclausal' vs. 'monoclausal') f-structures (in Matsumoto's (1996) LFG analysis), that is, essentially by complicating some syntactic component by elaborate representations. In the present theory, in which the mismatch between morpho-syntactic monoclausality and semantic biclausality of complex predicates is accounted for strictly in terms of lexical specifications, the difference between monoclausal and biclausal compound verbs can also be accounted lexically, without complicating syntactic representations. Specifically, in order to block the undesired narrow scope readings, what we need to do is to prevent scope-taking elements (i.e. adverbs and quantifiers) from originating within the embedded VP and then 'climbing up' to the matrix clause level. To ensure this, I introduce a category distinction (not reflected in any overt phonological form) between 'lexical' and 'nonlexical' untensed S's, by further decomposing the category S_{unt} into S_{lex} and S_{nl}, together with the following assumptions:[150]

- V1 of monoclausal compound verbs (and nothing else) is rooted in S_{lex}.
- Quantifiers and adverbs are lexically specified so as not to be able to scope over S_{lex}-rooted categories.

By making the above assumptions, there is no way for quantifiers and adverbs to take narrow scope in monoclausal compound verbs, as I will illustrate below.

The following lexicon lists lexical entries for bi-/monoclausal compound verbs, adverbs and quantifiers that reflect the above assumptions.[151]

(255)	yomi; **read**; $\mathrm{NP}_a \backslash\!. \mathrm{NP}_n \backslash\!. \mathrm{S}_{lex}$	tuduke-ta; **continue**; $\mathrm{VP}_{nl} \backslash_{\ll} \mathrm{VP}_{tns}$
	yomi; **read**; $\mathrm{NP}_a \backslash\!. \mathrm{NP}_n \backslash\!. \mathrm{S}_{nl}$	naosi-ta; **redo**; $\mathrm{VP}_{lex} \backslash_{\ll} \mathrm{VP}_{tns}$
	tuuhoo-si; **report**; $\mathrm{NP}_a \backslash\!. \mathrm{NP}_n \backslash\!. \mathrm{S}_{lex}$	koi-ni; **on-purpose**; $\mathrm{VP}_{nl} /\!. \mathrm{VP}_{nl}$
	tuuhoo-si; **report**; $\mathrm{NP}_a \backslash\!. \mathrm{NP}_n \backslash\!. \mathrm{S}_{nl}$	

[150] In order to write the lexical entries for adverbs and quantifiers properly, we need a way of capturing the class of 'S's' that are not S_{lex} as a natural class. This requires distinguishing S_{lex} from the rest of the sentential categories by means of a syntactic feature or some equivalent device. However, since the present fragment does not have a fully articulated feature system, I leave this detail unresolved here.

[151] Here, VP_{nl} and VP_{lex} abbreviate $\mathrm{NP}_n \backslash\!. \mathrm{S}_{nl}$ and $\mathrm{NP}_n \backslash\!. \mathrm{S}_{lex}$, respectively.

Given this lexicon, the scope-taking behaviors of adverbs and quantifiers in the two kinds of compound verb constructions are accounted for properly.

First, the narrow scope reading for the adverb *koi-ni* 'intentionally' in the biclausal compound verb construction in (251a) is derived as follows:

(256)

koi-ni; **on-purpose**; $\mathrm{VP}_{nl} /_{\cdot} \mathrm{VP}_{nl}$

sono-ziken-o; **that-accident**; NP_a

tuuhoo-si; **report**; $\mathrm{NP}_a \backslash_{\cdot} \mathrm{VP}_{nl}$

tuduke-ta; **cont**; $\mathrm{VP}_{nl} \backslash_{\ll} \mathrm{VP}_{tns}$

sono-ziken-o ∘. tuuhoo-si; **report**(**that-accident**); VP_{nl} ($\backslash_{\cdot}$E)

koi-ni ∘. (sono-ziken-o ∘. tuuhoo-si); **on-purpose**(**report**(**that-accident**)); VP_{nl} ($/_{\cdot}$E)

(koi-ni ∘. (sono-ziken-o ∘. tuuhoo-si)) $\circ_{\ll}$ tuduke-ta; **cont**(**on-purpose**(**report**(**that-accident**))); VP_{tns} ($\backslash_{\ll}$E)

sono-ziken-o ∘. (koi-ni ∘. (tuuhoo-si $\circ_{\ll}$ tuduke-ta)); **cont**(**on-purpose**(**report**(**that-accident**))); VP_{tns} (PI)

sono-ziken-o • (koi-ni • (tuuhoo-si • tuduke-ta)); **cont**(**on-purpose**(**report**(**that-accident**))); VP_{tns} (PI)

Note here that the adverb originates in the embedded VP (thus semantically scoping immediately above it) and then via the restructuring of the structured phonology (i.e. verb clustering) ends up being structurally indistinguishable from matrix arguments/adjuncts in terms of phenomena such as scrambling.

The wide scope reading for adverbs can be obtained by having the adverb modify the higher VP. I omit the derivation here, but it should be obvious that that will yield the same surface string as (256) but assign to it a different semantics scope for the adverb.

Unlike with biclausal compound verbs, with monoclausal compound verbs, there is only one scoping possibility for the adverb. Specifically, since V2 of monoclausal compound verbs are lexically specified to subcategorize for V1 that are rooted in S_{lex}, the narrow scope reading for adverbs is blocked. The following is a failed derivation for (253a) with the narrow scope reading for the adverb:

(257)

koi-ni; **on-purpose**; $\mathrm{VP}_{nl} /_{\cdot} \mathrm{VP}_{nl}$

sono-ziken-o; **that-accident**; NP_a

tuuhoo-si; **report**; $\mathrm{NP}_a \backslash_{\cdot} \mathrm{VP}_{lex}$

sono-ziken-o ∘. tuuhoo-si; **report**(**that-accident**); VP_{lex} ($\backslash_{\cdot}$E)

$/_{\cdot}$E

In order to derive the narrow scope reading, the adverb needs to originate in the embedded VP. However, the problem here is that the syntactic category of the lower VP (VP_{lex}) does not match the specification on the adverb (which requires the embedded VP to be rooted in S_{nl}). Thus, the derivation in (257) fails. And since generating the adverb within the lower VP is the only way to make it take narrow scope, the narrow scope reading is blocked.

The contrast between the two kinds of compound verbs in terms of the scope-taking properties of quantificational expressions can be accounted for similarly, with the help of the 'lexical' vs. 'nonlexical' distinction introduced above. In what follows, I will first sketch a quantificational analysis of the semantics of focus particles that incorporates the treatment of association with focus in Rooth's (1985; 1992) alternative semantics within the present theory and then show that the contrast in the availability of scope ambiguity observed above with (252) and (254) falls out straightforwardly from an interaction of the present analysis of compound verbs and the quantificational analysis of focus particles. [152] As we will see, the flexible mapping between semantically-oriented combinatorics and surface phonological realizations of linguistic expressions made possible with lambda binding in structured phonology in the present theory enables a treatment of association with focus that dispenses with the multi-dimensional semantic architecture of the kind embodied in Rooth's (1985; 1992) alternative semantics.

The term 'association with focus' (Rooth 1985) refers to a phenomenon in which the meanings of sentences containing focus particles such as *only* depend on what expression is

[152] Rooth (1985) disputes quantificational treatments of focus particles of the kind formulated by, e.g., Karttunen and Peters (1979). However, since I do not know of any other way of treating the ambiguity of focus particles in Japanese when they interact with biclausal compound verbs than by treating them as quantificational expressions, I adopt a quantificational treatment of focus particles here.

focused in the sentence.[153] For example, in (258), with focus on the NP *Chomsky* inside the larger NP that the focus particle *dake* attaches to, the sentence receives the truth conditions that can be paraphrased as 'Chomsky is the only person whose book Taro read.'

(258) Taroo-wa [Chomsky$_F$-no hon]-dake yon-da.
Taro-TOP Chomsky-GEN book-only read-PAST
'Taro read only Chomsky's book.'

Crucially, the set of entities compared with Chomsky's book is not any object but is more restricted, specifically, something that can be appropriately described by the expression 'x's book' (or 'the book written by x'), which can be obtained by abstracting over the focused position of the expression that *dake* attaches to.

In order to assign the appropriate truth conditions for the sentence, then, what we need to do is to form an open proposition that is obtained by abstracting over the position corresponding to the focused expression, and define the meaning of the focus particle as an operator that takes this open proposition and the focused element as arguments to return the truth conditions of the whole sentence. In Rooth's alternative semantics, this is done by recursively assigning to each phrase the 'alternative set' in addition to its ordinary denotation. For expressions not containing any focused element, the alternative set is just the singleton set containing the ordinary denotation. For expressions containing a focused element, the alternative set is the set of model-theoretic objects of the same type as the ordinary denotation that can be obtained by interpreting the expression in question with the focused element replaced by contextually salient alternatives.

[153] In English, focus is typically marked with prosodic prominence. The relationship between focus and prosody seems less direct in Japanese.

Since the present theory is equipped with lambda binding in both semantics and phonology to keep track of 'missing pieces' in deriving larger expressions from smaller ones, we can assign the appropriate truth conditions for sentences like (258) without explicitly associating with each expression its alternative set, but merely by assigning the following phonology and semantics to *dake*:[154]

(259) $\langle \lambda P\ \lambda p\ \lambda Q.\ Q\ (P\ (p) \circ_{\blacklozenge} \textsf{dake}); \textbf{only}; ((S|(S|Y))|X)|(Y|X) \rangle$

(where **only** $\equiv \lambda P \lambda x \lambda Q. \forall y \in C[y \neq x \rightarrow \neg Q(P(y))]$ and $S \in \{\mathrm{S}_{nl}, \mathrm{S}_{te}, \mathrm{S}_{tns}\}$)

This analysis can be thought of as a continuation-based analysis of association with focus.[155] In this analysis, *dake* takes the following three arguments (in the given order): (i) the phrase that it directly attaches to in the surface string, with the position corresponding to the focused expression abstracted over (I call this the 'focus scope' of the focus particle), (ii) the focused expression that fills the missing position in the focus scope, (iii) and the scope of the focus particle itself (with the position corresponding to the focus scope abstracted over). Semantically, (i) can be thought of as a delimited continuation of the focused expression (a delimited continuation of an expression Σ is some larger expression

[154] I assume, without argument, that the prejacent of *dake* 'only' (i.e. the part of the meaning of a sentence containing *dake* (or *only*) that corresponds to the meaning of the sentence with *dake* (or *only*) removed; i.e., for (258), the proposition 'Taro read Chomsky's book') is a presupposition. The status of the prejacent of *only* is a controversial issue, but this point does not affect the compositional treatment of scope and focus of focus particles, which is the main concern for us here.

[155] In this sense, the present analysis of association with focus shares the same spirit as (and bears more than a passing resemblance to) Barker's (2004) treatment of the same phenomenon, which, to my knowledge, is the first explicit treatment of focus in terms of continuations. Essentially, both approaches derive the effects of the Rooth-style alternative semantics (without explicitly invoking alternative sets) by decoupling surface morpho-syntax from semantically-oriented combinatorics. In Barker's (2004) approach, this is done purely on the semantic side by employing the technique of 'Continuation Passing Style' transforms (Plotkin 1975). In the present approach, part (or most) of the work to achieve the same effect is taken over by lambda binding in phonology.

(not necessarily a root sentence, hence 'delimited') that contains a 'gap' corresponding to Σ) and (iii) as a propositional delimited continuation of the focus scope (that is, an open proposition with the position corresponding to the focus scope abstracted over). *Dake* is thus semantically of type $(X \to Y) \to X \to (Y \to t) \to t$, with X the type of the focused expression and Y the type of the focus scope.[156]

In this analysis, the alternative set (in Rooth's sense) that is necessary for the proper interpretation of focus particles can be obtained by function composition of (i) and (iii). In other words, the trick here is that decoupling the focused expression (which the focus particle semantically associates with) and the focus scope (which the focus particle attaches to in the surface string) in terms of continuations enables an analysis that gets the effect of alternative semantics without invoking a multidimensional semantic architecture.

For the phonology, we only need to make sure that (i) the focused expression is lowered into the gap inside the focus scope, (ii) *dake* attaches to the 'saturated' focus scope created by (i), and (iii) the *dake*-marked expression obtained via (ii) is itself lowered into the gap within the continuation of the focus scope (i.e. the expression over which *dake* takes its own scope). The functional phonology of *dake* in (259) is specified to do exactly this.

With the lexical entry for *dake* in (259), the derivation for (258) is straightforward:

[156]Note that this is transparently reflected in the syntactic category of *dake*; I have used here the same variable letters to highlight this point.

(260)

$$
\dfrac{
  \dfrac{
    \dfrac{
      \begin{array}{l}
      \lambda P\, \lambda p\, \lambda Q.\ Q\ (P\ (p) \circ_{\blacklozenge} \text{dake}); \\
      \textbf{only}; \\
      ((S|(S|Y))|X)|(Y|X)
      \end{array}
      \quad
      \begin{array}{l}
      \lambda p.\ p\text{-no-hon}; \\
      \lambda x.\textbf{the-book-by}(x); \\
      \mathrm{NP}|\mathrm{N}
      \end{array}
    }{
      \begin{array}{l}
      \lambda p\, \lambda Q.\ Q\ (p\text{-no-hon} \circ_{\blacklozenge} \text{dake}); \\
      \textbf{only}(\lambda x.\textbf{the-book-by}(x)); \\
      (S|(S|\mathrm{NP}))|\mathrm{N}
      \end{array}
    }|\mathrm{E}
    \quad
    \begin{array}{l}
    \text{chomsky}; \\
    \textbf{c}; \\
    \mathrm{N}
    \end{array}
  }{
    \begin{array}{l}
    \lambda Q.\ Q\ (\text{chomsky-no-hon} \circ_{\blacklozenge} \text{dake}); \\
    \textbf{only}(\lambda x.\textbf{the-book-by}(x))(\textbf{c}); \\
    S|(S|\mathrm{NP})
    \end{array}
  }|\mathrm{E}
  \quad
  \begin{array}{l}
  \vdots \quad \vdots \\
  \lambda q.\ \text{taroo-wa} \circ_{\cdot} (q \circ_{\cdot} \text{yon-da}); \\
  \lambda y.\textbf{read}(\textbf{t}, y); \\
  \mathrm{S}_{tns}|\mathrm{NP}
  \end{array}
}{
  \begin{array}{l}
  \text{taroo-wa} \circ_{\cdot} ((\text{chomsky-no-hon} \circ_{\blacklozenge} \text{dake}) \circ_{\cdot} \text{yon-da}); \\
  \textbf{only}(\lambda x.\textbf{the-book-by}(x))(\textbf{c})(\lambda y.\textbf{read}(\textbf{t}, y)); \\
  \mathrm{S}_{tns}
  \end{array}
}|\mathrm{E}
$$

The final translation for the whole sentence can be unpacked as follows:

(261) $\textbf{only}(\lambda x.\textbf{the-book-by}(x))(\textbf{c})(\lambda y.\textbf{read}(\textbf{k}, y))$

$= \lambda P \lambda x \lambda Q.\forall y \in C[y \neq x \rightarrow \neg Q(P(y))](\lambda x.\textbf{the-book-by}(x))(\textbf{c})(\lambda y.\textbf{read}(\textbf{t}, y))$

$= \forall y \in C[y \neq \textbf{c} \rightarrow \neg \textbf{read}(\textbf{k}, \textbf{the-book-by}(y))]$

This quantificational treatment of focus particles immediately predicts the scope ambiguity of sentences like the following that involve biclausal compound verbs: [157]

(262) Taroo-wa Chomsky$_F$-GEN hon-dake yomi-tuduke-ta.
Taro-TOP Chomsky-GEN book-only read-continue-PAST
'Taro kept reading only Chomsky's book.'

The two readings can be paraphrased roughly as follows:

(263) a. **Narrow scope reading:** Taro continued to practice the following reading behavior (over some period of time): among the books written by different authors, read only Chomsky's.

[157] For the sake of exposition, I keep using examples in which the focused expression appears strictly within the focus scope. The examples given above at the beginning of this section (i.e. (252)) are cases in which the focused expression and the focus scope are identical. Such cases can be treated within the present approach by feeding an identity function for both the semantics and phonology of the second argument of *dake*.

b. **Wide scope reading:** Among the books written by different authors, the only one that Taro kept reading was Chomsky's.

The derivations for these readings are shown in (264) and (266) with the final translations unpacked in (265) and (267), respectively.

(264)

$$\dfrac{\dfrac{\dfrac{\dfrac{\begin{array}{c}\vdots\ \ \vdots\\ \lambda Q.\,Q\ \text{(chomsky-no-hon}\circ_{\blacklozenge}\text{dake)};\\ \mathbf{only}(\lambda x.\mathbf{the\text{-}book\text{-}by}(x))(\mathbf{c});\\ S|(S|\mathrm{NP})\end{array}\quad \dfrac{\dfrac{[p\,;y;\mathrm{NP}_n]^1\quad \dfrac{[q\,;x;\mathrm{NP}_a]^2\quad \begin{array}{l}\text{yomi};\\ \lambda x\lambda y.\mathbf{read}(y,x);\\ \mathrm{NP}_a\backslash_{.}\mathrm{VP}_{nl}\end{array}}{q\circ_{.}\text{yomi};\lambda y.\mathbf{read}(y,x);\mathrm{VP}_{nl}}\backslash_{.}\mathrm{E}}{p\circ_{.}(q\circ_{.}\text{yomi});\mathbf{read}(y,x);\mathrm{S}_{nl}}\backslash_{.}\mathrm{E}}{\lambda q.\,p\circ_{.}(q\circ_{.}\text{yomi});\lambda x.\mathbf{read}(y,x);\mathrm{S}_{nl}|\mathrm{NP}}|\mathrm{I}^2}{p\circ_{.}((\text{chomsky-no-hon}\circ_{\blacklozenge}\text{dake})\circ_{.}\text{yomi});\mathbf{only}(\lambda x.\mathbf{the\text{-}book\text{-}by}(x))(\mathbf{c})(\lambda x.\mathbf{read}(y,x));\mathrm{S}_{nl}}|\mathrm{E}}{(\text{chomsky-no-hon}\circ_{\blacklozenge}\text{dake})\circ_{.}\text{yomi};\lambda y.\mathbf{only}(\lambda x.\mathbf{the\text{-}book\text{-}by}(x))(\mathbf{c})(\lambda x.\mathbf{read}(y,x));\mathrm{NP}_n\backslash_{.}\mathrm{S}_{nl}}\backslash_{.}\mathrm{I}^1\quad \begin{array}{l}\text{tuduke-ta};\\ \mathbf{cont};\\ \mathrm{VP}_{nl}\backslash_{\ll}\mathrm{VP}_{tns}\end{array}}{((\text{chomsky-no-hon}\circ_{\blacklozenge}\text{dake})\circ_{.}\text{yomi})\circ_{\ll}\text{tuduke-ta};\mathbf{cont}(\lambda y.\mathbf{only}(\lambda x.\mathbf{the\text{-}book\text{-}by}(x))(\mathbf{c})(\lambda x.\mathbf{read}(y,x)));\mathrm{NP}_n\backslash_{.}\mathrm{S}_{tns}}\backslash_{\ll}\mathrm{E}}{(\text{chomsky-no-hon}\bullet\text{dake})\bullet(\text{yomi}\bullet\text{tuduke-ta});\mathbf{cont}(\lambda y.\mathbf{only}(\lambda x.\mathbf{the\text{-}book\text{-}by}(x))(\mathbf{c})(\lambda x.\mathbf{read}(y,x)));\mathrm{NP}_n\backslash_{.}\mathrm{S}_{tns}}\mathrm{PI}$$

(265) $\mathbf{cont}(\mathbf{t},\lambda y.\mathbf{only}(\lambda x.\mathbf{the\text{-}book\text{-}by}(x))(\mathbf{c})(\lambda x.\mathbf{read}(y,x)))$

$= \mathbf{cont}(\mathbf{t},\lambda y.\forall z\in C[z\neq \mathbf{c}\rightarrow\neg\mathbf{read}(y,\mathbf{the\text{-}book\text{-}by}(z))]$

(266)

$$\dfrac{\dfrac{\begin{array}{c}\vdots\ \ \vdots\\ \lambda Q.\,Q\ \text{(chomsky-no-hon}\circ_{\blacklozenge}\text{dake)};\\ \mathbf{only}(\lambda x.\mathbf{the\text{-}book\text{-}by}(x))(\mathbf{c});\\ S|(S|\mathrm{NP})\end{array}\quad \dfrac{\dfrac{\begin{array}{l}\text{taroo-wa};\\ \mathbf{t};\\ \mathrm{NP}_n\end{array}\quad \dfrac{\dfrac{[q\,;x;\mathrm{NP}_a]^1\quad \begin{array}{l}\text{yomi};\\ \lambda x\lambda y.\mathbf{read}(y,x);\\ \mathrm{NP}_a\backslash_{.}\mathrm{VP}_{nl}\end{array}}{q\circ_{.}\text{yomi};\lambda y.\mathbf{read}(y,x);\mathrm{VP}_{nl}}\backslash_{.}\mathrm{E}\quad \begin{array}{l}\text{tuduke-ta};\\ \mathbf{cont};\\ \mathrm{VP}_{nl}\backslash_{\ll}\mathrm{VP}_{tns}\end{array}}{(q\circ_{.}\text{yomi})\circ_{\ll}\text{tuduke-ta};\mathbf{cont}(\lambda y.\mathbf{read}(y,x));\mathrm{VP}_{tns}}\backslash_{\ll}\mathrm{E}}{\text{taroo-wa}\circ_{.}((q\circ_{.}\text{yomi})\circ_{\ll}\text{tuduke-ta});\mathbf{cont}(\mathbf{t},\lambda y.\mathbf{read}(y,x));\mathrm{S}_{tns}}\backslash_{.}\mathrm{E}}{\lambda q.\,\text{taroo-wa}\circ_{.}((q\circ_{.}\text{yomi})\circ_{\ll}\text{tuduke-ta});\lambda x.\mathbf{cont}(\mathbf{t},\lambda y.\mathbf{read}(y,x));\mathrm{S}_{tns}|\mathrm{NP}}|\mathrm{I}^1}{\text{taroo-wa}\circ_{.}(((\text{chomsky-no-hon}\circ_{\blacklozenge}\text{dake})\circ_{.}\text{yomi})\circ_{\ll}\text{tuduke-ta});\mathbf{only}(\lambda x.\mathbf{the\text{-}book\text{-}by}(x))(\mathbf{c})(\lambda x.\mathbf{cont}(\mathbf{t},\lambda y.\mathbf{read}(y,x)));\mathrm{S}_{tns}}|\mathrm{E}}{\text{taroo-wa}\bullet((\text{chomsky-no-hon}\bullet\text{dake})\bullet(\text{yomi}\bullet\text{tuduke-ta}));\mathbf{only}(\lambda x.\mathbf{the\text{-}book\text{-}by}(x))(\mathbf{c})(\lambda x.\mathbf{cont}(\mathbf{t},\lambda y.\mathbf{read}(y,x)));\mathrm{S}_{tns}}\mathrm{PI}$$

(267) $\mathbf{only}(\lambda x.\mathbf{the\text{-}book\text{-}by}(x))(\mathbf{c})(\lambda x.\mathbf{cont}(\mathbf{t},\lambda y.\mathbf{read}(y,x)))$

$= \forall z\in C[z\neq \mathbf{c}\rightarrow\neg\mathbf{cont}(\mathbf{t},\lambda y.\mathbf{read}(y,\mathbf{the\text{-}book\text{-}by}(z)))]$

The key difference between the two derivations is that, just as in the derivations for adverb scope, the focus particle takes semantic scope over the embedded VP in the narrow scope reading whereas it takes scope over the matrix VP in the wide scope reading. Thus, in the derivation for the narrow scope reading in (264), the *dake*-marked phrase originates in the embedded VP, scopes immediately above it, and then, via the (obligatory) restructuring of the structured phonology, its phonology ends up appearing in the matrix clause. By contrast, in the derivation for the wide scope reading, the *dake*-marked phrase appears in the derivation after the higher verb takes the lower VP as its argument and lowers itself in the gap position within the lower VP, which, again, ends up appearing in the matrix clause in the end via restructuring of the structured phonology.

With monoclausal CVs, only the wide scope reading is possible for quantifiers, essentially for the same reason as with adverbs. The derivation for the wide scope reading for quantifiers with monoclausal CVs is almost identical to (266). The only difference is that V1 is rooted in S_{lex}. This does not make a difference for the derivation to go through since the quantifier takes scope at the matrix level.

On the other hand, the narrow scope reading is blocked for monoclausal compound verbs. The problem is that, unlike with biclausal compound verbs (cf. (264)), the quantifier cannot combine with V1 directly due to the mismatch in the lexical specifications in the quantifier and V1. In order to derive the narrow scope reading, the quantifier needs to directly combine with V1. However, the quantifier, by assumption, is lexically specified so as not to be able to combine with VPs that are rooted in S_{lex}, whereas V1 of the monoclausal compound verb is rooted in S_{lex}, due to the requirement from the higher verb. Because of this category mismatch, the derivation is blocked.

Thus, we have seen in this subsection that, by regulating the possible places within the syntactic derivation in which the adverb or quantifier can appear, the scope-taking properties of biclausal and monoclausal compound verbs can be adequately accounted for in the present fragment. The analysis is technically implemented by subclassifying untensed verb forms by means of the categories S_{lex} and S_{nl}, which interacts appropriately with the verb-clustering analysis of the morpho-syntax of compound verbs in the present fragment.

4.3.3 *-te* form complex predicate

We now turn to the last and apparently the most recalcitrant problem, namely the morpho-syntactic structure of the *-te* form complex predicate. We have seen in Chapter 2 that the seemingly self-contradictory distributional properties of this construction are highly problematic for PS-based theories and that there is as yet no completely successful analysis within the PS-based setup that accounts for all of the properties of this construction. It turns out that an analysis of the *-te* form complex predicate is straightforward in the present theory of MMCG with Structured Phonology. The gist of the proposal is that the mode of composition employed in the *-te* form complex predicate formation is 'tighter' (in a way to be made precise below) than the way in which ordinary arguments are combined with the head verb but 'looser' than the way in which certain elements (such as V1 and V2 in the compound verb construction discussed above) are put together in the syntax. As we will see, all of the relevant properties of this construction immediately follow from this simple assumption within the present theory.

4.3.3.1 Basic cases

Let us start with the case of scrambling of arguments of V1 and V2. The relevant example is (55b), repeated here as (268), where the embedded accusative object *piano-o* scrambles over the matrix dative argument *Ken-ni*:

(268) Mari-ga *piano-o* Ken-ni **hii-te** **morat-ta**.
Mari-NOM piano-ACC Ken-DAT play-TE BENEF-PAST
'Mari had Ken play the piano for her.'

The lexical entry for the matrix benefactive verb (V2) *morat-ta* is given in (269).

(269) morat-ta (benefactive); $(\mathrm{NP}_n\backslash_{\cdot}\mathrm{S}_{te})\backslash_{<}(\mathrm{NP}_d\backslash_{\cdot}\mathrm{NP}_n\backslash_{\cdot}\mathrm{S}_{tns})$

The derivation for (268) goes as in (270). The key assumption here is that V2 subcategorizes for V1 in the complex predicate mode $<$. The surface order in (268) is derived since the complex predicate mode is left associative and optionally allows for V1 and V2 to form a 'verb cluster'.

(270)

$$
\dfrac{\dfrac{\text{ken-ni}; \mathbf{k}; \mathrm{NP}_d \quad \dfrac{\dfrac{\text{piano-o}; \mathbf{p}; \mathrm{NP}_a \quad \text{hii-te}; \mathbf{play}; \mathrm{NP}_a\backslash_{\cdot}\mathrm{NP}_n\backslash_{\cdot}\mathrm{S}_{te}}{\text{piano-o} \circ_{\cdot} \text{hii-te}; \mathbf{play}(\mathbf{p}); \mathrm{NP}_n\backslash_{\cdot}\mathrm{S}_{te}}\backslash_{\cdot}\mathrm{E} \quad \begin{array}{l}\text{morat-ta}; \lambda P\lambda y\lambda x.\mathbf{benef}(x,P(y));\\ (\mathrm{NP}_n\backslash_{\cdot}\mathrm{S}_{te})\backslash_{<}(\mathrm{NP}_d\backslash_{\cdot}\mathrm{NP}_n\backslash_{\cdot}\mathrm{S}_{tns})\end{array}}{(\text{piano-o} \circ_{\cdot} \text{hii-te}) \circ_{<} \text{morat-ta}; \lambda y\lambda x.\mathbf{benef}(x,\mathbf{play}(\mathbf{p})(y)); \mathrm{NP}_d\backslash_{\cdot}\mathrm{NP}_n\backslash_{\cdot}\mathrm{S}_{tns}}\backslash_{<}\mathrm{E}}{\text{ken-ni} \circ_{\cdot} ((\text{piano-o} \circ_{\cdot} \text{hii-te}) \circ_{<} \text{morat-ta}); \lambda x.\mathbf{benef}(x,\mathbf{play}(\mathbf{p})(\mathbf{k})); \mathrm{NP}_n\backslash_{\cdot}\mathrm{S}_{tns}}\backslash_{\cdot}\mathrm{E}}{\text{piano-o} \bullet (\text{ken-ni} \bullet (\text{hii-te} \bullet \text{morat-ta})); \lambda x.\mathbf{benef}(x,\mathbf{play}(\mathbf{p})(\mathbf{k})); \mathrm{NP}_n\backslash_{\cdot}\mathrm{S}_{tns}}\mathrm{PI}
$$

The application of the P-interface rule at the end is the crucial step in this derivation. As already discussed in Chapter 3, the validity of this step is supported by the following lemma:

(271) **Lemma:** $A \circ_{\cdot} ((B \circ_{\cdot} C) \circ_{<} D) \quad \leq \quad B \bullet (A \bullet (C \bullet D))$

Proof: see (127) on p. 127

The elements C and D in this proof correspond to V1 and V2. Since the mode employed in combining V1 and V2 is left associative, Intermodal Left Association (105) applies to collapse the original 'constituent structure' in which V1 forms a unit with the accusative NP that it subcategorizes for, and in the resultant structure V1 and V2 form a unit. Once this verb cluster is formed, the accusative object of V1 has the same status as arguments of V2 and thus can scramble over the dative argument of V2 by the Scrambling rule (107).

Thus, making the 'constituent structure' partially flexible automatically interacts with the mechanism for local scrambling independently posited in the grammar to account for the fact that arguments of higher and lower verbs can scramble with one another freely in this construction. However, word order is not totally unconstrained in the *-te* form complex predicate. On the contrary, the limited degree of flexibility of the complex predicate mode prevents any lexical item other than focus particles to split the sequence of V1 and V2. For example, the matrix dative NP *Ken-ni* in (268) cannot appear between V1 and V2. The relevant example is repeated in (272):

(272) * Mari-ga piano-o **hii-te** *Ken-ni* **morat-ta**.
Mari-NOM piano-ACC play-TE Ken-DAT BENEF-PAST
intended: 'Mari had Ken play the piano for her.'

For such a word order to be licensed, the following would need to be derivable as a lemma in the inequational logic of φ-terms:

(273) **Non-Lemma:** $A \circ_{\cdot} (B \circ_{<} C) \leq B \circ_{<} (A \circ_{\cdot} C)$

This inequality, however, is not provable since the complex predicate mode $<$ does not undergo the Scrambling rule (107).

The word order possibilities for adverbs is accounted for in essentially the same way. The generalization is that both adverbs modifying V1 and those modifying V2 can scramble freely with arguments of V1 and V2, but that, like arguments, adverbs cannot split the sequence of V1 and V2. The relevant data from Chapter 2 are repeated in (274).

(274) a. Mari-ga *anpu-de* Ken-ni piano-o hii-te morat-ta.
Mari-NOM without music Ken-DAT piano-ACC play-TE BENEF-PAST
'Mari had Ken play the piano for her without music.'

b. *Mari-ga Ken-ni piano-o hii-te *murini* morat-ta.
Mari-NOM Ken-DAT piano-ACC play-TE forcibly BENEF-PAST
intended: 'Mari forcibly had Ken play the piano for her.'

(275) shows the derivation for (274a):[158,159]

(275)

$$
\dfrac{\text{ken-ni; ; }\mathrm{NP}_d \quad \dfrac{\dfrac{\begin{array}{c}\text{anpu-de; ;}\\ \mathrm{VP}_{te}/_{\cdot}\mathrm{VP}_{te}\end{array} \quad \dfrac{\text{piano-o; ; }\mathrm{NP}_a \quad \begin{array}{c}\text{hii-te; ;}\\ \mathrm{NP}_a\backslash_{\cdot}\mathrm{VP}_{te}\end{array}}{\text{piano-o} \circ_{\cdot} \text{hii-te; ; }\mathrm{VP}_{te}}\backslash_{\cdot}\mathrm{E}}{\text{anpu-de} \circ_{\cdot} (\text{piano-o} \circ_{\cdot} \text{hii-te})\text{; ; }\mathrm{VP}_{te}}/_{\cdot}\mathrm{E} \quad \begin{array}{c}\text{morat-ta; ;}\\ \mathrm{VP}_{te}\backslash_{<}\mathrm{NP}_d\backslash_{\cdot}\mathrm{VP}_{tns}\end{array}}{(\text{anpu-de} \circ_{\cdot} (\text{piano-o} \circ_{\cdot} \text{hii-te})) \circ_{<} \text{morat-ta; ; }\mathrm{NP}_d\backslash_{\cdot}\mathrm{VP}_{tns}}\backslash_{<}\mathrm{E}}{\dfrac{\text{ken-ni} \circ_{\cdot} ((\text{anpu-de} \circ_{\cdot} (\text{piano-o} \circ_{\cdot} \text{hii-te})) \circ_{<} \text{morat-ta})\text{; ; }\mathrm{VP}_{tns}}{\text{anpu-de} \bullet (\text{ken-ni} \bullet ((\text{piano-o} \bullet \text{hii-te}) \bullet \text{morat-ta}))\text{; ; }\mathrm{VP}_{tns}}\mathrm{PI}}\backslash_{\cdot}\mathrm{E}
$$

The adverb *anpu-de* has a subject-oriented entailment. Thus, I assume that it is in category $\mathrm{VP}/_{\cdot}\mathrm{VP}$. In the derivation in (275), this adverb first combines with the embedded VP, which is its semantic argument. Then, the application of the P-interface rule at the last step yields the surface word order in (274a). This step is supported by the lemma (271), the same one as that used above in accounting for argument scrambling.

It is also correctly predicted that an adverb cannot split the sequence of V1 and V2, for the same reason that a nominal argument cannot do so, that is, the non-lemma (273), which would yield the wrong word order, is not provable. Thus, the ungrammaticality of (274b) also follows.

The cases we have seen above are ones in which the *-te* form behaves like the compound verb construction examined in the previous subsection (in that V1 and V2 seem to form a morphological cluster). In the present analysis, this parallel essentially follows from the fact that both constructions involve modes that are left associative (specifically, the verb raising mode $\ll$ and the complex predicate mode $<$) in combining V2 with the embedded VP. Before moving on to more complex cases, let us examine here two cases that show the opposite pattern, namely, the cases of focus particle insertion and reduplication. As

[158] Semantics is omitted in the derivations for the rest of this section.

[159] Here, VP_{te} and VP_{tns} abbreviate $\mathrm{NP}_n\backslash_{\cdot}\mathrm{S}_{te}$ and $\mathrm{NP}_n\backslash_{\cdot}\mathrm{S}_{tns}$, respectively.

we have seen in Chapter 2, in the *-te* form complex predicate, focus particles can split the sequence of V1 and V2, suggesting that the bond between V1 and V2 is not as tight as in the compound verb construction:

(276) Ken-ni piano-o **hii-te** *sae* **morat-ta**.
Ken-DAT piano-ACC play-TE even BENEF-PAST
'I asked Ken even the favor of playing the piano for me.'

The contrast between the compound verb construction and the *-te* form complex predicate here essentially follows from the fact that the clustering of V1 and V2 is obligatory in the former (as we have seen in the previous subsection), but is only optional in the latter. The derivation for (276) goes as in (277):[160,161]

[160] Semantically, the focus particle associates with elements in the 'embedded VP', but not with elements in the 'higher clause', which justifies the present treatment where it syntactically attaches to V1 rather than to V2. Also, the focus particle forms a phonological unit with V1 and not with V2.

[161] Although I have given in (277) an analysis in which V1 and V2 do not form a cluster, note that this is not the only option. With a focus particle attached to V1, V1 and V2 can still form a cluster and allow for an embedded argument to scramble over a matrix argument, as in the derivation for (i) in (ii):

(i) Piano-o Ken-ni hii-te sae morat-ta.
Piano-ACC Ken-DAT play-TE even BENEF-PAST
'I asked Ken even the favor of playing the piano for me.'

(ii)

$$\dfrac{\dfrac{\begin{array}{c}\vdots \quad \vdots \\ \text{ken-ni} \circ_{\bullet} ((\text{piano-o} \circ_{\bullet} (\text{hii-te} \circ_{\blacklozenge} \text{sae})) \circ_{<} \text{morat-ta}); ; \mathrm{NP}_d \backslash_{\bullet} \mathrm{VP}_{tns}\end{array}}{\text{ken-ni} \circ_{\bullet} (\text{piano-o} \circ_{\bullet} ((\text{hii-te} \circ_{\blacklozenge} \text{sae}) \circ_{<} \text{morat-ta})); ; \mathrm{NP}_d \backslash_{\bullet} \mathrm{VP}_{tns}}\mathrm{PI}}{\text{piano-o} \bullet (\text{ken-ni} \bullet ((\text{hii-te} \bullet \text{sae}) \bullet \text{morat-ta})) ; ; \mathrm{NP}_d \backslash_{\bullet} \mathrm{VP}_{tns}}\mathrm{PI}$$

(277)

$$\dfrac{\dfrac{\dfrac{\text{piano-o}; ; \mathrm{NP}_a \quad \dfrac{\text{hii-te}; ; \mathrm{NP}_a\backslash_{.}\mathrm{NP}_n\backslash_{.}\mathrm{S}_{te} \quad \text{sae}; ; X\backslash_{\blacklozenge}X}{\text{hii-te} \circ_{\blacklozenge} \text{sae} ; ; \mathrm{NP}_a\backslash_{.}\mathrm{NP}_n\backslash_{.}\mathrm{S}_{te}}\backslash_{\blacklozenge}\mathrm{E}}{\text{piano-o} \circ_{.} (\text{hii-te} \circ_{\blacklozenge} \text{sae}); ; \mathrm{NP}_n\backslash_{.}\mathrm{S}_{te}}\backslash_{.}\mathrm{E} \quad \begin{array}{l}\text{morat-ta}; ;\\ (\mathrm{NP}_n\backslash_{.}\mathrm{S}_{te})\backslash_{<}(\mathrm{NP}_d\backslash_{.}\mathrm{NP}_n\backslash_{.}\mathrm{S}_{tns})\end{array}}{(\text{piano-o} \circ_{.} (\text{hii-te} \circ_{\blacklozenge} \text{sae})) \circ_{<} \text{morat-ta}; ; \mathrm{NP}_d\backslash_{.}\mathrm{NP}_n\backslash_{.}\mathrm{S}_{tns}}\backslash_{.}\mathrm{E}}{(\text{piano-o} \bullet (\text{hii-te} \bullet \text{sae})) \bullet \text{morat-ta}; ; \mathrm{NP}_d\backslash_{.}\mathrm{NP}_n\backslash_{.}\mathrm{S}_{tns}}\mathrm{PI}$$

Unlike the $\ll$ mode, the $<$ mode can be converted to the pronounceable mode freely. Thus, V1 and V2 do not need to form a cluster in the derivation in (277) for the structured phonology of the sentence to be converted to a pronounceable one.

The pattern of reduplication is similarly unproblematic in the present account. Again, the key difference between the *-te* form complex predicate and the compound verb construction is that clustering of V1 and V2 is not obligatory in the former. Thus, in the derivation (279) for (278) (= (67b)), the reduplicated V2 combines with V1 and the application of the P-interface rule at the final step yields a pronounceable structured phonology for the whole expression.[162]

(278) Mari-ga Ken-ni piano-o hii-te morat-ta koto-wa morat-ta
Mari-NOM Ken-DAT piano-ACC play-TE BENEF-PAST BENEF-PAST
ga, ...
though
'Though Mari did have Ken play the piano for her, ...'

(279)

$$\dfrac{\dfrac{\begin{array}{c}\vdots \;\; \vdots\\ \text{piano-o} \circ_{.} \text{hii-te}; ;\\ \mathrm{VP}_{te}\end{array} \quad \dfrac{\dfrac{\begin{array}{l}\text{morat-ta}; ;\\ \mathrm{VP}_{te}\backslash_{<}\mathrm{NP}_d\backslash_{.}\mathrm{VP}_{tns}\end{array} \quad \begin{array}{l}\text{koto-wa}; ;\\ X\backslash_{\star}(X/_{\star}X)\end{array}}{\begin{array}{l}\text{morat-ta} \circ_{\star} \text{koto-wa}; ;\\ (\mathrm{VP}_{te}\backslash_{<}\mathrm{NP}_d\backslash_{.}\mathrm{VP}_{tns})/_{\star}(\mathrm{VP}_{te}\backslash_{<}\mathrm{NP}_d\backslash_{.}\mathrm{VP}_{tns})\end{array}}\backslash_{\star}\mathrm{E} \quad \begin{array}{l}\text{morat-ta}; ;\\ \mathrm{VP}_{te}\backslash_{<}\mathrm{NP}_d\backslash_{.}\mathrm{VP}_{tns}\end{array}}{(\text{morat-ta} \circ_{\star} \text{koto-wa}) \circ_{\star} \text{morat-ta}; ; \mathrm{VP}_{te}\backslash_{<}\mathrm{NP}_d\backslash_{.}\mathrm{VP}_{tns}}/_{\star}\mathrm{E}}{(\text{piano-o} \circ_{.} \text{hii-te}) \circ_{<} ((\text{morat-ta} \circ_{\star} \text{koto-wa}) \circ_{\star} \text{morat-ta}); ; \mathrm{NP}_d\backslash_{.}\mathrm{VP}_{tns}}\backslash_{<}\mathrm{E}}{(\text{piano-o} \bullet \text{hii-te}) \bullet ((\text{morat-ta} \bullet \text{koto-wa}) \bullet \text{morat-ta}); ; \mathrm{NP}_d\backslash_{.}\mathrm{VP}_{tns}}\mathrm{PI}$$

[162] Again, in cases involving reduplication, clustering of V1 and V2 is still possible. Thus, the present fragment correctly accounts for the fact that the accusative object of the embedded verb can be scrambled with matrix arguments in examples like (278).

The present analysis also correctly licenses more complicated patterns of reduplication such as (280) (= (73a) from Chapter 2), where V2 of the *-te* form complex predicate that is embedded under another verb (where the latter verb enforces obligatory verb clustering) is reduplicated together with the higher verb:

(280) Taroo-wa Hanako-ni sono hon-o yon-de **morai-kake-ta** koto-wa
Taroo-TOP Hanako-DAT that book-ACC read-TE BENEF-begin-PAST
morai-kake-ta ga, ...
BENEF-begin-PAST though
'Although Taro did start having Hanako read the book for him, ...'

Intuitively, reduplication of the higher two verbs is possible here because the morpho-syntactic combination of the most embedded verb and the intermediate verb involves the *-te* form, for which verb clustering is not obligatory. Recall also from Chapter 2 that examples like (280) pose problems for the verb raising analysis of the *-te* form complex predicate of the kind advocated by Kageyama (1993). (281) shows the derivation for (280):

(281)

$$
\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{[q\,;\,;\mathrm{NP}_{d}]^{2} \quad \dfrac{[p\,;\,;\mathrm{VP}_{te}]^{1} \quad \text{morai};\,;\mathrm{VP}_{te}\backslash_{<}\mathrm{NP}_{d}\backslash_{\cdot}\mathrm{VP}_{nl}}{p \circ_{<} \text{morai};\,;\mathrm{NP}_{d}\backslash_{\cdot}\mathrm{VP}_{nl}}\backslash_{<}\mathrm{E}}{q \circ_{\cdot} (p \circ_{<} \text{morai});\,;\mathrm{VP}_{nl}}\backslash_{\cdot}\mathrm{E} \quad \text{kake-ta};\,;\mathrm{VP}_{nl}\backslash_{\ll}\mathrm{VP}_{tns}}{(q \circ_{\cdot} (p \circ_{<} \text{morai})) \circ_{\ll} \text{kake-ta};\,;\mathrm{VP}_{tns}}\backslash_{\ll}\mathrm{E}}{q \circ_{\cdot} (p \circ_{<} (\text{morai} \circ_{\ll} \text{kake-ta}));\,;\mathrm{VP}_{tns}}\mathrm{PI}}{p \circ_{<} (\text{morai} \circ_{\ll} \text{kake-ta});\,;\mathrm{NP}_{d}\backslash_{\cdot}\mathrm{VP}_{tns}}\backslash_{\cdot}\mathrm{I}^{2}}{\text{morai} \circ_{\ll} \text{kake-ta};\,;\mathrm{VP}_{te}\backslash_{<}\mathrm{NP}_{d}\backslash_{\cdot}\mathrm{VP}_{tns}}\backslash_{<}\mathrm{I}^{1}}{\text{morai} \bullet \text{kake-ta};\,;\mathrm{VP}_{te}\backslash_{<}\mathrm{NP}_{d}\backslash_{\cdot}\mathrm{VP}_{tns}}\mathrm{PI}
$$

Crucially, since both the complex predicate mode $<$ and the verb raising mode $\ll$ are left associative, the higher two verbs can form a cluster after the most embedded VP and the dative argument of the intermediate benefactive verb are hypothesized and combined with the benefactive verb. With this restructuring, the hypothesized expressions can be withdrawn and the cluster consisting of the higher two verbs can be mapped to the pronounceable mode via Verb Clustering I (230) and then reduplicated.

4.3.3.2 Interactions with coordination and clefting

We have seen above how the proposed analysis of the *-te* form complex predicate accounts for some basic cases in which it exhibits a partial degree of flexibility in the morpho-syntactic bond between V1 and V2. In what follows, we will examine more complex cases where this construction interacts with phenomena that (potentially) allow for a greater degree of flexibility of constituency. As we will see, the restricted degree of flexibility assigned to the complex predicate mode $<$ interacts properly with independently motivated analyses of these constructions to predict the correct patterns of grammaticality in these cases.

Let us start with cases involving coordination. We have seen in Chapter 2 that the patterns exhibited by nonconstituent coordination and VP coordination in the *-te* form complex predicate apparently contradict with one another in that the former but not the latter suggests a tight bond between V1 and V2. We have also seen there that previous analyses of this construction in PS-based approaches fail to account for these two facts at the same time in a principled manner. Now, it turns out that, when coupled with independently motivated and standardly accepted assumptions about coordination in CG, the present analysis automatically predicts the possibility of VP coordination and the patterns of nonconstituent coordination without any further stipulation.

Examples involving VP coordination such as (65b), repeated here as (282), are licensed as in (283). In the present analysis, since V1 and V2 do not form a lexical unit, two embedded VPs headed by V1 can be coordinated without any problem.

(282) Mari-ga dono gakusei-ni-mo [piano-o hii-te] matawa [uta-o utat-te]
Mari-NOM which student-DAT-also piano-ACC play-TE or song-ACC sing-TE
morat-ta.
BENEF-PAST
'Mari had every student play the piano or sing a song for her.'

(283)

$$\dfrac{\dfrac{\dfrac{\begin{array}{c}\text{piano-o}; ;\\ \mathrm{NP}_a\end{array} \qquad \begin{array}{c}\text{hii-te}; ;\\ \mathrm{NP}_a\backslash_{\cdot}\mathrm{VP}_{te}\end{array}}{\text{piano-o} \circ_{\cdot} \text{hii-te}; ; \mathrm{VP}_{te}}\backslash_{\cdot}\mathrm{E} \qquad \dfrac{\begin{array}{c}\text{matawa}; ;\\ (X\backslash_{\star}X)/_{\star}X\end{array} \qquad \dfrac{\begin{array}{c}\text{uta-o}; ;\\ \mathrm{NP}_a\end{array} \qquad \begin{array}{c}\text{utat-te}; ;\\ \mathrm{NP}_a\backslash_{\cdot}\mathrm{VP}_{te}\end{array}}{\text{uta-o} \circ_{\cdot} \text{utat-te}; ; \mathrm{VP}_{te}}\backslash_{\cdot}\mathrm{E}}{\text{matawa} \circ_{\star} (\text{uta-o} \circ_{\cdot} \text{utat-te}); ; \mathrm{VP}_{te}\backslash_{\star}\mathrm{VP}_{te}}/_{\star}\mathrm{E}}{(\text{piano-o} \circ_{\cdot} \text{hii-te}) \circ_{\star} (\text{matawa} \circ_{\star} (\text{uta-o} \circ_{\cdot} \text{utat-te})); ; \mathrm{VP}_{te}}\backslash_{\star}\mathrm{E} \qquad \begin{array}{c}\text{morat-ta}; ;\\ \mathrm{VP}_{te}\backslash_{<}\mathrm{NP}_d\backslash_{\cdot}\mathrm{VP}_{tns}\end{array}}{((\text{piano-o} \circ_{\cdot} \text{hii-te}) \circ_{\star} (\text{matawa} \circ_{\star} (\text{uta-o} \circ_{\cdot} \text{utat-te}))) \circ_{<} \text{morat-ta}; ; \mathrm{NP}_d\backslash_{\cdot}\mathrm{VP}_{tns}}\backslash_{<}\mathrm{E}}{((\text{piano-o} \bullet \text{hii-te}) \bullet (\text{matawa} \bullet (\text{uta-o} \bullet \text{utat-te}))) \bullet \text{morat-ta}; ; \mathrm{NP}_d\backslash_{\cdot}\mathrm{VP}_{tns}}\mathrm{PI}$$

Let us now move on to the case of nonconstituent coordination. As shown in (63b) and (64b), repeated here as in (284), arguments of V1 and V2 can cluster together to form a conjunct, while an attempt to form an argument cluster that splits the sequence of V1 and V2 fails.

(284) a. Mari-ga [Ken-ni piano-o], (sosite) [Akira-ni gitaa-o] **hii-te**
Mari-NOM Ken-DAT piano-ACC and Akira-DAT guitar-ACC play-TE
morat-ta.
BENEF-PAST
'Mari had Ken play the piano and Akira play the guitar for her.'

b. *Mari-ga [Ken-ni piano-o **hii-te**], (sosite) [Akira-ni uta-o
Mari-NOM Ken-DAT piano-ACC play-TE and Akira-DAT song-ACC
utat-te] **morat-ta**.
sing-TE BENEF-PAST
intended: 'Mari had Ken play the piano for her and Akira sing a song for her.'

These facts immediately follow in the present account. Recall from the previous section that the possibility of nonconstituent coordination crucially depends on the fact that all of the modes involved are associative. As will become clear below, in the present analysis, the contrast between (284a) and (284b) is essentially due to the intermediate flexibility of the complex predicate mode.

We have already seen in Chapter 3 how the present analysis correctly licenses (284a) as a consequence of independently motivated analyses of the *-te* form complex predicate and nonconstituent coordination. The derivation is repeated in (285).

(285) a.

$$\dfrac{\dfrac{\dfrac{\dfrac{[p\,;;\,\mathrm{NP}_a]^1 \quad \text{hii-te};;\,\mathrm{NP}_a\backslash.\mathrm{VP}_{te}}{p \circ.\, \text{hii-te};;\,\mathrm{VP}_{te}}\backslash.\mathrm{E} \quad \text{morat-ta};;\,\mathrm{VP}_{te}\backslash_{<}\mathrm{NP}_d\backslash.\mathrm{VP}_{tns}}{(p \circ.\, \text{hii-te}) \circ_{<} \text{morat-ta};;\,\mathrm{NP}_d\backslash.\mathrm{VP}_{tns}}\backslash_{<}\mathrm{E}}{p \circ.\, (\text{hii-te} \circ_{<} \text{morat-ta});;\,\mathrm{NP}_d\backslash.\mathrm{VP}_{tns}}\mathrm{PI}}{\text{hii-te} \circ_{<} \text{morat-ta};;\,\mathrm{NP}_a\backslash.\mathrm{NP}_d\backslash.\mathrm{VP}_{tns}}\backslash.\mathrm{I}^1$$

b.

$$\dfrac{\dfrac{\dfrac{\dfrac{\text{ken-ni};;\,\mathrm{NP}_d \quad \dfrac{\text{piano-o};;\,\mathrm{NP}_a \quad [q\,;;\,\mathrm{NP}_a\backslash.\mathrm{NP}_d\backslash.\mathrm{VP}_{tns}]^2}{\text{piano-o} \circ.\, q\,;;\,\mathrm{NP}_d\backslash.\mathrm{VP}_{tns}}\backslash.\mathrm{E}}{\text{ken-ni} \circ.\, (\text{piano-o} \circ.\, q);;\,\mathrm{VP}_{tns}}\backslash.\mathrm{E}}{(\text{ken-ni} \circ.\, \text{piano-o}) \circ.\, q\,;;\,\mathrm{VP}_{tns}}\mathrm{PI}}{\text{ken-ni} \circ.\, \text{piano-o};;\,\mathrm{VP}_{tns}/.(\mathrm{NP}_a\backslash.\mathrm{NP}_d\backslash.\mathrm{VP}_{tns})}/.\mathrm{I}^2 \quad \begin{matrix}\vdots\;\;\vdots \\ \text{akira-ni} \circ.\, \text{gitaa-o};; \\ \mathrm{VP}_{tns}/.(\mathrm{NP}_a\backslash.\mathrm{NP}_d\backslash.\mathrm{VP}_{tns})\end{matrix}}{(\text{ken-ni} \circ.\, \text{piano-o}) \circ_{\star} (\text{akira-ni} \circ.\, \text{gitaa-o});;\,\mathrm{VP}_{tns}/.(\mathrm{NP}_a\backslash.\mathrm{NP}_d\backslash.\mathrm{VP}_{tns})}\&$$

c.

$$\dfrac{(\text{ken-ni} \circ.\, \text{piano-o}) \circ_{\star} (\text{akira-ni} \circ.\, \text{gitaa-o});;\,\mathrm{VP}_{tns}/.(\mathrm{NP}_a\backslash.\mathrm{NP}_d\backslash.\mathrm{VP}_{tns}) \quad \text{hii-te} \circ_{<} \text{morat-ta};;\,\mathrm{NP}_a\backslash.\mathrm{NP}_d\backslash.\mathrm{VP}_{tns}}{((\text{ken-ni} \circ.\, \text{piano-o}) \circ_{\star} (\text{akira-ni} \circ.\, \text{gitaa-o})) \circ.\, (\text{hii-te} \circ_{<} \text{morat-ta});;\,\mathrm{VP}_{tns}}\backslash.\mathrm{E}$$

This derivation might look a bit complicated, but it does not involve anything new. It consists of the following three ‘steps’, each corresponding to the above three chunks:

(285a): By hypothesizing the accusative object of V1 and withdrawing it after V1 and V2 are put together (this hypothetical reasoning crucially relies on the complex predicate mode being left associative), the cluster of V1 and V2 is assigned a ditransitive verb-like category that is looking for arguments of both V1 and V2 to its left.

(285b): By hypothesizing the ditransitive verb-like category corresponding to the verb cluster obtained in (285a), an argument cluster composed of dative and accusative

NPs can be assigned a category that is looking for such a verb cluster to become a VP. The last step in (285b) coordinates two instances of such an argument cluster.

(285c): Finally, the coordinated argument cluster is combined with the verb cluster that it is looking for as its argument to form a VP.

The present analysis also correctly predicts the ungrammaticality of examples like (284b) that involve nonconstituent coordination where V1 is contained within the conjuncts and is thereby split from V2. For (284b) to be derived, a string composed of the matrix dative argument and the embedded VP would need to be assigned a category that is looking for the matrix verb to return a VP. However, this is impossible given the limited flexibility of the complex predicate mode. (286) shows a failed derivation for (284b).

(286)

$$\dfrac{\text{ken-ni}; ; \mathrm{NP}_d \qquad \dfrac{\dfrac{\text{piano-o}; ; \mathrm{NP}_a \quad \begin{array}{c}\text{hii-te}; ;\\ \mathrm{NP}_a \backslash_{.} \mathrm{VP}_{te}\end{array}}{\text{piano-o} \circ_{.} \text{hii-te}; ; \mathrm{VP}_{te}}\backslash_{.}\mathrm{E} \quad [p ; ; \mathrm{VP}_{te}\backslash_{<}\mathrm{NP}_d\backslash_{.}\mathrm{VP}_{tns}]^1}{(\text{piano-o} \circ_{.} \text{hii-te}) \circ_{<} p ; ; \mathrm{NP}_d\backslash_{.}\mathrm{VP}_{tns}}\backslash_{<}\mathrm{E}}{\text{ken-ni} \circ_{.} ((\text{piano-o} \circ_{.} \text{hii-te}) \circ_{<} p); ; \mathrm{VP}_{tns}}\backslash_{.}\mathrm{E}$$

In (286), the matrix verb is hypothesized so that the coordinated string would be assigned the desired syntactic category. For this derivation to go through, the structured phonology of the expression derived at the last step in (286) would have to be restructured with the P-interface rule to push the phonology of the hypothesized verb to the right edge (i.e. not just linearly the rightmost position but also hierarchically occupying the right edge alone) so that it can be withdrawn by Slash Introduction. But this restructuring is not allowed since the complex predicate mode $<$ is not right associative. In other words, in order for the illicit derivation for (284b) to go through, the non-lemma in (287) would have to be provable, but it is not.

(287) **Non-Lemma:** $A \circ_{\cdot} (B \circ_{<} C) \;\; \leq \;\; (A \circ_{\cdot} B) \circ_{<} C$

Thus, the ungrammaticality of sentences such as (284b) is predicted as a direct consequence of the limited degree of morpho-syntactic flexibility of the complex predicate mode. [163]

We now turn to the interaction of the *-te* form complex predicate and (nonconstituent) clefting. It turns out that the analyses of the clefting construction presented in section 4.2 and of the *-te* form complex predicate in this section interact properly to make correct predictions.[164] The relevant data are reproduced in (288):

(288) a. [Ken-ga Mari-ni **yon-de morat-ta**]-no-wa *sono hon-o* da.
Ken-NOM Mari-DAT read-TE BENEF-PAST-NMLZ-TOP that book-ACC COP
'What Ken had Mari read for him was that book.'

b. [Ken-ga **yon-de morat-ta**]-no-wa *Mari-ni sono hon-o* da.
Ken-NOM read-TE BENEF-PAST-NMLZ-TOP Mari-DAT that book-ACC COP
lit. 'What Ken had read for him was Mari that book.'

c. *[Ken-ga Mari-ni **morat-ta**]-no-wa *sono hon-o* ***yon-de*** da.
Ken-NOM Mari-DAT BENEF-PAST-NMLZ-TOP that book-ACC read-TE COP
intended: lit. 'What Ken had Mari do for him was read that book.'

d. *[Ken-ga Mari-ni sono-hon-o **morat-ta**]-no-wa ***yon-de*** da.
Ken-NOM Mari-DAT that-book BENEF-PAST-NMLZ-TOP read-TE COP
intended: lit. 'What Ken had Mari do for him with that book was read it.'

[163]Note also here that forming nonconstituent coordination at the level of semi-pronounceable mode ◆ is not a possibility either. This is because, unlike other abstract modes (except for the verb raising mode $\ll$ and the inflexible mode $\star$), the complex predicate mode $<$ is directly mapped to the pronounceable mode ● without being mapped to the intermediate, semi-pronounceable mode ◆ for which the hierarchical structure is collapsed. Thus, there is no way in the present fragment to derive the ungrammatical sentence (284b).

[164]Consideration of these cases and the inflexible pattern of clefting with prenominal adjectives discussed in section 2.2.3 has led Kubota and Smith (2007) to recast Kubota and Smith's (2006) CCG analysis of nonconstituent clefting within the multi-modal setup of MMCCG, by building on the fragment proposed by Kubota (2008) for the analysis of the *-te* form complex predicate.

The pattern we see here is that arguments of both V1 and V2 can be clefted either alone (as in (288a)) or together (as in (288b)), but splitting the sequence of V1 and V2 by putting V1 in the focus position results in ungrammaticality (as in (288c,d)).

It is straightforward to see that the present analysis licenses (288a), a case in which the accusative argument of the embedded verb is clefted, once we recognize that the left associativity of the complex predicate mode $<$ makes it possible to assign a ditransitive verb-like category to the sequence of V1 and V2 (and that any argument of a ditransitive verb can be clefted in the analysis of the cleft construction from the previous section); see, for example, the derivation in (285a). I omit the derivation for (288a).

(288b), a case in which the matrix dative argument and the embedded accusative argument are clefted together, is licensed essentially for the same reason. Once the ditransitive verb-like category $\mathrm{NP}_a \backslash\!. \mathrm{NP}_d \backslash\!. \mathrm{NP}_n \backslash\!. \mathrm{S}$ is assigned to the sequence of V1 and V2, it does not make any difference whether the argument was originally an argument of V1 or V2. Since this syntactic category is exactly identical to that of a lexically ditransitive verb, the two arguments can be clefted together just as direct and indirect objects of a lexically ditransitive verb can be clefted together, as we have already seen in the previous section. The derivation for (288b) is shown in (289):

(289)

$$\vdots \quad \vdots$$

$$\dfrac{[p\,;;\mathrm{NP}_a]^1 \qquad \text{yon-de} \circ_< \text{morat-ta};;\ \mathrm{NP}_a\backslash\!.\mathrm{NP}_d\backslash\!.\mathrm{NP}_n\backslash\!.\mathrm{S}_{tns}}{p \circ\!.\ (\text{yon-de} \circ_< \text{morat-ta});;\ \mathrm{NP}_d\backslash\!.\mathrm{NP}_n\backslash\!.\mathrm{S}_{tns}}\ \backslash\!.\mathrm{E}$$

$$\dfrac{[q\,;;\mathrm{NP}_d]^2 \qquad p \circ\!.\ (\text{yon-de} \circ_< \text{morat-ta});;\ \mathrm{NP}_d\backslash\!.\mathrm{NP}_n\backslash\!.\mathrm{S}_{tns}}{q \circ\!.\ (p \circ\!.\ (\text{yon-de} \circ_< \text{morat-ta}));;\ \mathrm{NP}_n\backslash\!.\mathrm{S}_{tns}}\ \backslash\!.\mathrm{E}$$

$$\dfrac{\text{ken-ga};;\ \mathrm{NP}_n \qquad q \circ\!.\ (p \circ\!.\ (\text{yon-de} \circ_< \text{morat-ta}));;\ \mathrm{NP}_n\backslash\!.\mathrm{S}_{tns}}{\text{ken-ga} \circ\!.\ (q \circ\!.\ (p \circ\!.\ (\text{yon-de} \circ_< \text{morat-ta})));;\ \mathrm{S}_{tns}}\ \backslash\!.\mathrm{E}$$

$$\dfrac{\text{ken-ga} \circ\!.\ (q \circ\!.\ (p \circ\!.\ (\text{yon-de} \circ_< \text{morat-ta})));;\ \mathrm{S}_{tns} \qquad \text{no};;\ \mathrm{S}_{tns}\backslash_<\mathrm{S}_{no}}{(\text{ken-ga} \circ\!.\ (q \circ\!.\ (p \circ\!.\ (\text{yon-de} \circ_< \text{morat-ta})))) \circ_< \text{no};;\ \mathrm{S}_{no}}\ \backslash_<\mathrm{E}$$

$$\dfrac{(\text{ken-ga} \circ\!.\ (q \circ\!.\ (p \circ\!.\ (\text{yon-de} \circ_< \text{morat-ta})))) \circ_< \text{no};;\ \mathrm{S}_{no} \qquad \text{wa};;\ \mathrm{S}_{no}\backslash_<\mathrm{S}_{wa}}{((\text{ken-ga} \circ\!.\ (q \circ\!.\ (p \circ\!.\ (\text{yon-de} \circ_< \text{morat-ta})))) \circ_< \text{no}) \circ_< \text{wa};;\ \mathrm{S}_{wa}}\ \backslash_<\mathrm{E}$$

$$\dfrac{((\text{ken-ga} \circ\!.\ (q \circ\!.\ (p \circ\!.\ (\text{yon-de} \circ_< \text{morat-ta})))) \circ_< \text{no}) \circ_< \text{wa};;\ \mathrm{S}_{wa}}{q \circ\!.\ (p \circ\!.\ (((\text{ken-ga} \circ\!.\ (\text{yon-de} \circ_< \text{morat-ta})) \circ_< \text{no}) \circ_< \text{wa}));;\ \mathrm{S}_{wa}}\ \mathrm{PI}$$

$$\dfrac{q \circ\!.\ (p \circ\!.\ (((\text{ken-ga} \circ\!.\ (\text{yon-de} \circ_< \text{morat-ta})) \circ_< \text{no}) \circ_< \text{wa}));;\ \mathrm{S}_{wa}}{p \circ\!.\ (((\text{ken-ga} \circ\!.\ (\text{yon-de} \circ_< \text{morat-ta})) \circ_< \text{no}) \circ_< \text{wa});;\ \mathrm{NP}_d\backslash\!.\mathrm{S}_{wa}}\ \backslash\!.\mathrm{I}^2$$

$$\dfrac{p \circ\!.\ (((\text{ken-ga} \circ\!.\ (\text{yon-de} \circ_< \text{morat-ta})) \circ_< \text{no}) \circ_< \text{wa});;\ \mathrm{NP}_d\backslash\!.\mathrm{S}_{wa}}{((\text{ken-ga} \circ\!.\ (\text{yon-de} \circ_< \text{morat-ta})) \circ_< \text{no}) \circ_< \text{wa};;\ \mathrm{NP}_a\backslash\!.\mathrm{NP}_d\backslash\!.\mathrm{S}_{wa}}\ \backslash\!.\mathrm{I}^1$$

$$\dfrac{\begin{matrix}\vdots\ \vdots \\ ((\text{ken-ga} \circ_{.} (\text{yon-de} \circ_{<} \text{morat-ta})) \circ_{<} \text{no}) \circ_{<} \text{wa} ; ; \\ NP_a \backslash_{.} NP_d \backslash_{.} S_{wa} \end{matrix} \qquad \begin{matrix}\vdots\ \vdots \\ (\text{mari-ni} \circ_{.} \text{sono-hon-o}) \circ_{\star} \text{da} ; ; \\ (NP_a \backslash_{.} NP_d \backslash_{.} S_{wa}) \backslash_{.} S_{tns} \end{matrix}}{(((\text{ken-ga} \circ_{.} (\text{yon-de} \circ_{<} \text{morat-ta})) \circ_{<} \text{no}) \circ_{<} \text{wa}) \circ_{.} ((\text{mari-ni} \circ_{.} \text{sono-hon-o}) \circ_{\star} \text{da}) ; ; S_{tns}} \backslash_{.}\text{E}$$

Thus, the grammatical cases are licensed due to the fact that the complex predicate mode allows for partial restructuring of constituency. It turns out that the ungrammatical cases are blocked because the flexibility is only partial. Specifically, the problem with (288c) and (288d) is that there is no way to analyze the topicalized sentence as a 'constituent' of the right syntactic category. (290) shows a failed derivation for (288c):

(290)

$$\dfrac{\dfrac{\dfrac{\text{ken-ga} ; ; NP_n \quad \dfrac{\text{mari-ni} ; ; NP_d \quad \dfrac{[p ; ; VP_{te}]^1 \quad \begin{matrix}\text{morat-ta} ; ; \\ VP_{te} \backslash_{<} NP_d \backslash_{.} VP_{tns}\end{matrix}}{p \circ_{<} \text{morat-ta} ; ; NP_d \backslash_{.} VP_{tns}} \backslash_{<}\text{E}}{\text{mari-ni} \circ_{.} (p \circ_{<} \text{morat-ta}) ; ; VP_{tns}} \backslash_{.}\text{E}}{\text{ken-ga} \circ_{.} (\text{mari-ni} \circ_{.} (p \circ_{<} \text{morat-ta})) ; ; S_{tns}} \backslash_{.}\text{E} \quad \begin{matrix}\text{no} ; ; \\ S_{tns} \backslash_{<} S_{no}\end{matrix}}{(\text{ken-ga} \circ_{.} (\text{mari-ni} \circ_{.} (p \circ_{<} \text{morat-ta}))) \circ_{<} \text{no} ; ; S_{no}} \backslash_{<}\text{E} \quad \begin{matrix}\text{wa} ; ; \\ S_{no} \backslash_{<} S_{wa}\end{matrix}}{((\text{ken-ga} \circ_{.} (\text{mari-ni} \circ_{.} (p \circ_{<} \text{morat-ta}))) \circ_{<} \text{no}) \circ_{<} \text{wa} ; ; S_{wa}} \backslash_{<}\text{E}$$

Since the missing element is the whole embedded VP in (288c), an embedded VP is hypothesized so that it can later be withdrawn and the topicalized sentence is assigned a category that is looking for a VP to become a full-fledged sentence. The derivation, however, fails at the point where the P-interface rule would need to apply to push the phonology of the embedded VP to the left periphery of the structured phonology of the topicalized sentence. In order for this restructuring to take place, Scrambling (107) and Intermodal Right Association (106) would need to be applicable. But neither of these rules is applicable since the embedded VP is combined with the matrix verb in the complex predicate mode $<$, which is only left associative. (288d) is blocked for the same reason. Even if the embedded verb is hypothesized, there is no way to restructure the structured phonology of the topicalized sentence to withdraw that hypothesis so that the right syntactic category is assigned to it.

Thus, we have seen above that the limited flexibility of the complex predicate mode plays a crucial role in ruling in and ruling out the grammatical and ungrammatical sentences respectively for cases in which the *-te* form complex predicate construction interacts with the two phenomena that potentially allow for flexible constituency, that is, coordination and clefting.

In this section, we have seen that the present analysis accounts for the apparently contradictory set of distributional properties of the *-te* form complex predicate straightforwardly. The key assumption of the proposed analysis is that V1 and V2 in the *-te* form complex predicate are put together in a way that is tighter than the way ordinary arguments and adjuncts are put together with the head. This idea is formally implemented by assigning a special mode of composition for putting together V1 and V2 in this construction, which is lexically specified in the syntactic category of V2.

CHAPTER 5: CONCLUSION

In this dissertation, I have proposed a theory of categorial grammar called Multi-Modal Categorial Grammar with Structured Phonology. The central feature that distinguishes this theory from the majority of contemporary syntactic theories is that it decouples (without completely segregating) two aspects of syntax—hierarchical organization (reflecting semantic combinatorics) and surface morpho-syntactic realization—which are conflated in the single notion of phrase structure in theories of syntax that take this notion as a theoretical primitive.

Our inquiry took the following form. In Chapter 2, I reviewed three phenomena in Japanese—nonconstituent coordination, nonconstituent clefting and the four kinds of complementation constructions—that present serious empirical challenges to PS-based theories of syntax, and argued that all existing analyses of these constructions in these theories are inadequate. Specifically, I pointed out that the problems of these previous approaches all stem from the fact that the empirical phenomena considered here constitute cases that deviate from what one might call the 'canonical' mode of phrasal composition, implicitly built into the notion of phrase structure, wherein the surface syntactic constituency transparently reflects the semantically-oriented combinatoric structure. In PS-based theories, such deviations can only be accommodated by means of some kind of extensions to the basic PS-component. However, such extensions are often *ad hoc* and fail to capture the systematic patterns that the phenomena in question exhibit, especially when they interact with one another and with other aspects of the grammar of the language.

This motivated us to abandon the PS-based perspective and instead adopt an architecture in which the combinatoric component and the surface morpho-syntactic component are separated, yet interact closely with one another. Chapter 3 presented the theory of Multi-Modal Categorial Grammar with Structured Phonology, a formal theory of syntax that embodies this architecture. The proposed theory emerged as a result of unifying and integrating two most notable features of categorial grammar as a linguistic theory, namely, flexibility of constituency and the separation of semantic combinatorics from surface morpho-syntax. The resulting theory resembles and borrows many ideas from certain recent variants of categorial grammar, all of which attempt to achieve a similar synthesis in one way or another. I have argued, however, that, at least as a linguistic theory, the present proposal improves on these alternatives in that it achieves this goal in the conceptually simplest and technically most explicit way. Most importantly, positing structured phonology as an interface component between syntax and phonology and working out its formal details precisely is the major contribution of the present work.

Then, in Chapter 4, I demonstrated that the present theory enables straightforward analyses of the phenomena from Chapter 2. Specifically, different degrees of flexibility in constituency and linear order found in different phenomena receive a natural account, with the component of structured phonology appropriately governing the properties of different modes of morpho-syntactic composition. Moreover, not only does the present approach account for the individual phenomena adequately, the analyses of these phenomena interact with one another (and with other aspects of Japanese syntax) to automatically predict the correct patterns in cases in which the relevant phenomena interact with one another.

To my knowledge, the degree to which such interactions are successfully captured is not precedented in any of the previous analyses. I thus take this result to strongly argue for the advantage of the present approach over its alternatives, at least until and unless comparable (or better) results are obtained in competing approaches.

But what is structured phonology, after all? And how exactly does the present theory differ from earlier proposals that similarly depart from the PS-based perspective? I would like to address these points briefly before closing the discussion. To start with the second question, the observation that the notion of phrase structure is a *de facto* standard (rather than a well-motivated theoretical primitive) in syntactic theorizing has been made from time to time in the literature (cf., e.g., McCawley 1982; Blevins 1990; Reape 1994; Dowty 1996; Kathol 2000). This is in fact the overarching theme of the ambitious and programmatic article by Dowty (1996), in which he lays out the conceptual and empirical underpinnings of what later developed into the so-called ‘multi-modal’ variants of CG that I have characterized as L-flexible CG. On the empirical side, however, (something close to) Dowty’s ideas were investigated much more thoroughly in a line of research employing a variant of HPSG called ‘linearization-based HPSG’ (starting with Reape (1993, 1994), who independently arrived at essentially the same idea as Dowty (1996) around the same time), which embodies within the framework of HPSG the separation of semantically-oriented combinatorics and surface morpho-syntax. The most thorough linguistic application of this linearization-based approach to date is Kathol (2000), which closely examines several aspects of German clause structure to argue for the advantage of the linearization-based architecture over the more standard PS-based one. In a sense, the present approach fully shares the spirit of this line of research in maintaining that the semantic combinatorics and surface morpho-syntactic should be separated.

What, however, crucially distinguishes the present approach from these earlier proposals is that it argues for the position that merely separating these two components of syntax from one another is empirically inadequate. Specifically, in order to deal with phenomena such as nonconstituent coordination and nonconstituent clefting, and in order to account for the interactions between these phenomena and other syntactic phenomena such as complex predicate formation (which, taken alone, would seem to justify the Dowty/Reape-Kathol style purely L-flexible architecture), we need a theory in which the combinatoric component and the surface morpho-syntactic component *interact* with one another. This was not achieved in the previous (purely L-flexible) variants of non-PS-based theories. And I have shown that a theory that embodies just such an architecture can be constructed by integrating the other (perhaps more salient) feature typically associated with CG, namely, flexibility of constituency (embodied in C-flexible variants of CG) with the perspective of L-flexible CG laid out by Dowty (1996). For this theoretical innovation, I have relied heavily on the recent developments in the literature of CG, where the latest variants from different camps seem to be coming to an interesting point of convergence which essentially amounts to an attempt of unifying C-flexible CG and L-flexible CG. I have provided empirical justification for this theoretical innovation that does not depend on any theory-internal considerations. For this reason, the present theory should not just be viewed as a new variant of CG but rather as an empirical linguistic theory that attempts to advance and further refine the non-PS-based architecture of syntactic theory that was initially envisioned by Dowty (1996) and whose empirical justification has later been adduced much more extensively in the body of literature of the linearization-based variant of HPSG.

And this brings us to the somewhat larger theoretical point. Structured phonology is an abstract level of representation posited in the grammar at the interface of syntax and phonology. Moreover, in the present theory, the semantics and structured phonology of linguistic expressions are computed in tandem so that the grammar in principle allows for access to the (abstract representations of) surface morpho-syntactic forms of linguistic expressions simultaneously as the semantic interpretation is built up. This is admittedly a rather powerful theoretical architecture. And, as should be evident from the analyses of specific phenomena in Chapter 4, in the present theory, the component of structured phonology is exploited in achieving the effects of both overt movement (e.g., 'verb raising' and 'scrambling') and covert movement (quantifier scope) in the more standard, derivational variants of generative syntax. Whether this kind of powerful theoretical architecture is really justified is of course an empirical question that needs to be asked seriously, and it is impossible to answer such a question fully in a single dissertation. However, there are two considerations that lend (at least initial) plausibility to the present theory. First, although the theoretical architecture itself is rather powerful, each of the components of the present theory has clear conceptual underpinnings and they are used to capture exactly the kinds of generalizations that they are designed to capture, leading to straightforward analyses of the rather recalcitrant set of data taken up in this dissertation. Second, these simple analyses interact with one another in a highly systematic manner and account correctly for the actually observed interactions of the respective phenomena. This gives us some reassurance that the systematicity and formal rigor of the present theory provides a general framework for uncovering the patterns and regularities that have only partially been captured in previous PS-based models of syntax.

Many questions, of course, remain to be investigated. Most importantly, there is the question of whether there is any universal inventory of modalities to be posited in the component of structured phonology so as to capture cross-linguistic variation and universals found at the level of morpho-syntax. Also, given that lambda binding in structured phonology is made use of in achieving (at least some of) the work that LF is used to achieve in models of syntax-semantics interface that recognize LF as an interface component between syntax and semantics, we need to ask the question of whether the flexibility introduced in the grammar with this mechanism should be constrained in any way (and if so, exactly in what way, and how to technically achieve that effect). These questions will profitably be answered by exploring further the consequences of the present approach with a wider set of empirical phenomena from a wide range of languages and by critically evaluating it against competing approaches with respect to this wider set of data, a fascinating project to undertake, but one that goes beyond the scope of this dissertation.

APPENDIX A: A FORMAL FRAGMENT OF JAPANESE IN MULTI-MODAL CATEGORIAL GRAMMAR WITH STRUCTURED PHONOLOGY

A.1 Syntactic Calculus

Logical rules

(120) a. **Forward Slash Elimination**

$$\frac{\mathsf{a}; \varphi; A/_i B \qquad \mathsf{b}; \psi; B}{\mathsf{a} \circ_i \mathsf{b}; \varphi(\psi); A}/_i\mathrm{E}$$

b. **Backward Slash Elimination**

$$\frac{\mathsf{b}; \psi; B \qquad \mathsf{a}; \varphi; B\backslash_i A}{\mathsf{b} \circ_i \mathsf{a}; \varphi(\psi); A}\backslash_i\mathrm{E}$$

(128) a. **Forward Slash Introduction**

$$\frac{\dfrac{\begin{matrix}\vdots\ \vdots & \underline{[\mathsf{p}\,; x; A]^n} & \vdots\ \vdots \\ \vdots\ \vdots & \vdots\ \vdots & \vdots\ \vdots\end{matrix}}{\mathsf{b} \circ_i \mathsf{p}\,; \varphi; B}}{\mathsf{b}; \lambda x.\varphi; B/_i A}/_i\mathrm{I}^n$$

b. **Backward Slash Introduction**

$$\frac{\dfrac{\begin{matrix}\vdots\ \vdots & \underline{[\mathsf{p}\,; x; A]^n} & \vdots\ \vdots \\ \vdots\ \vdots & \vdots\ \vdots & \vdots\ \vdots\end{matrix}}{\mathsf{p} \circ_i \mathsf{b}; \varphi; B}}{\mathsf{b}; \lambda x.\varphi; A\backslash_i B}\backslash_i\mathrm{I}^n$$

(99) a. **Vertical Slash Introduction**

$$\dfrac{\dfrac{\vdots \;\vdots \qquad \dfrac{[\mathsf{p}\,;x;A]^n}{\vdots \;\vdots} \qquad \vdots\;\vdots}{\mathsf{b};\varphi;B}}{\lambda p.\mathsf{b};\lambda x.\varphi;B|A}|\mathrm{I}^n$$

b. **Vertical Slash Elimination**

$$\dfrac{\mathsf{a};\varphi;A \quad \mathsf{b};\psi;B|A}{\mathsf{b}(\mathsf{a});\psi(\varphi);B}|\mathrm{E}$$

Non-logical rules

(118) **P-interface rule**

$$\dfrac{\mathsf{A};\sigma;A}{\mathsf{A}';\sigma;A}\mathrm{PI}$$

(where $\mathsf{A} \leq \mathsf{A}'$ is a theorem in the inequational logic for φ-terms)

(150) a. **Coordination rule I**

$$\dfrac{\mathsf{a};\varphi;X \quad \mathsf{b};\psi;X}{\mathsf{a} \circ_\star \mathsf{b};\varphi \sqcap \psi;X}\&_1$$

b. **Coordination rule II**

$$\dfrac{\mathsf{a};\varphi;X \quad \mathsf{b};\psi;X}{\mathsf{a} \circ_\star \mathsf{b};\varphi \oplus \psi;X}\&_2$$

A.2 φ-calculus

The φ-calculus is a calculus of φ-terms that denote structured phonologies of linguistic expressions. It has one basic type st together with its subtype cl and the following constants:

- type st: $\boldsymbol{\epsilon}$, ken, mari, piano, nagai, ...
- type cl: hiki, hazime-ta, ... (verb phonologies)
- type $st \to (st \to st)$: $\circ_\star$, $\circ_<$, $\circ_\times$, $\circ_\bullet$, $\circ_\diamond$, $\circ_\ll$, $\circ_\blacklozenge$, $\bullet$ (written infix)

Complex φ-terms of type cl are formed out of constants of type cl according to the following rule:

(231) If a and b are terms of type cl, then so is $a \bullet b$.

A.2.1 Inequational logic for φ-terms

We define an 'inequational logic' for φ-terms in which formulas are of the form $\phi \leq \psi$ (with ϕ and ψ both φ-terms of type st) and that has the following inference rules:

Basic rules

(102) Structured phonologies form a preorder.

$$\frac{}{A \leq A}\text{REF}$$

$$\frac{A \leq B \quad B \leq C}{A \leq C}\text{TR}$$

(103) The $\circ_i$ are monotonic in both arguments.

$$\frac{A \leq A' \quad B \leq B'}{A \circ_i B \leq A' \circ_i B'}\text{MON}$$

$$(\circ_i \in \{\circ_\star, \circ_<, \circ_\times, \circ_\bullet, \circ_\diamond, \circ_\ll, \circ_\blacklozenge, \bullet\})$$

(104) ϵ is a two-sided identity for all the $\circ_i$.

$$\frac{}{\epsilon \circ_i A \leq A}\text{ID}_l$$

$$(\circ_i \in \{\circ_\star, \circ_<, \circ_\times, \circ_\bullet, \circ_\diamond, \circ_\ll, \circ_\blacklozenge, \bullet\})$$

$$\frac{}{A \circ_i \epsilon \leq A}\text{ID}_r$$

$$(\circ_i \in \{\circ_\star, \circ_<, \circ_\times, \circ_\bullet, \circ_\diamond, \circ_\ll, \circ_\blacklozenge, \bullet\})$$

Mode-specific rules

(105) (ILA; Intermodal Left Association)

$$\frac{}{(A \circ_i B) \circ_j C \leq A \circ_i (B \circ_j C)}\text{ILA}$$

$$(\circ_i, \circ_j \in \{\circ_{\ll}, \circ_{<}, \circ_{\diamond}, \circ_{\bullet}\})^{165}$$

(106) (IRA; Intermodal Right Association)

$$\frac{}{A \circ_i (B \circ_i C) \leq (A \circ_i B) \circ_i C}\text{IRA}$$

$$(\circ_i \in \{\circ_{\diamond}, \circ_{\bullet}\})$$

(107) (SCR; scrambling)

$$\frac{}{A \circ_i (B \circ_j C) \leq B \circ_i (A \circ_j C)}\text{SCR}$$

$$(\circ_i, \circ_j \in \{\circ_{\times}, \circ_{\bullet}\})$$

(108) (ULA; Unimodal Left Association)

$$\frac{}{(A \circ_{\blacklozenge} B) \circ_{\blacklozenge} C \leq A \circ_{\blacklozenge} (B \circ_{\blacklozenge} C)}\text{ULA}$$

$$\frac{}{(A \bullet B) \bullet C \leq A \bullet (B \bullet C)}\text{ULA}$$

(109) (URA; Unimodal Right Association)

$$\frac{}{A \circ_{\blacklozenge} (B \circ_{\blacklozenge} C) \leq (A \circ_{\blacklozenge} B) \circ_{\blacklozenge} C}\text{URA}$$

$$\frac{}{A \bullet (B \bullet C) \leq (A \bullet B) \bullet C}\text{URA}$$

(110) VP Flattening

$$\frac{}{A \circ_{\times} B \leq A \circ_{\diamond} B}\text{VPF}$$

(111) Verb Clustering I

$$\frac{}{A \circ_{\ll} B \leq A \bullet B}\text{VC1}$$

(where both A and B are terms of type cl)

[165] Note about notation: the modes i and j can (but do not need to) be identical.

(112) Verb Clustering II

$$\overline{A \circ_< B \leq A \bullet B}^{\text{VC2}}$$

(113) Clustering

$$\overline{A \circ_\star B \leq A \bullet B}^{\text{CL}}$$

(114) Semi-Pronunciation

$$\overline{A \circ_i B \leq A \circ_\blacklozenge B}^{\text{SPN}}$$

$$(\circ_i \in \{\circ_\times, \circ_\bullet, \circ_\diamond\})$$

(115) Pronunciation

$$\overline{A \circ_\blacklozenge B \leq A \bullet B}^{\text{PN}}$$

A.3 Model-theoretic interpretation of φ-terms

The model-theoretic interpretations of the constants in the φ-calculus have the following metalanguage names:

- $[\![\boldsymbol{\epsilon}]\!] = \varepsilon$
- $[\![\mathsf{ken}]\!]$ = /kᴇɴ/, etc. for all constants of type st
- $[\![\circ_i]\!] = {}^\frown i$ $\quad (\circ_i \in \{\circ_\star, \circ_<, \circ_\times, \circ_\bullet, \circ_\diamond, \circ_\ll, \circ_\blacklozenge\})$
- $[\![\bullet]\!] = +$

In addition, the interpretation function $[\![\cdot]\!]$ is extended in such a way that it interprets the $\leq$ relation in the inequational logic as the preorder $\sqsubseteq$ in the P-algebra:

- $[\![\leq]\!] = \sqsubseteq$

A.4 Lexicon

(291) ken; **m**; N

mari; **m**; N

akira; **a**; N

piano; **the-piano**; N

gitaa; **the-guitar**; N

uta; **the-song**; N

ga; $\lambda f.f$; $\mathrm{N}\backslash_{\blacklozenge}\mathrm{NP}_n$

o; $\lambda f.f$; $\mathrm{N}\backslash_{\blacklozenge}\mathrm{NP}_a$

ni; $\lambda f.f$; $\mathrm{N}\backslash_{\blacklozenge}\mathrm{NP}_d$

no; $\lambda f.f$; $\mathrm{S}_{tns}\backslash_{<}\mathrm{S}_{no}$

wa; $\lambda f.f$; $\mathrm{S}_{no}\backslash_{<}\mathrm{S}_{wa}$

da; $\lambda f.f$; $(\mathrm{S}_{wa}/_i Y)\backslash_{\star}(Y\backslash_i \mathrm{S}_{tns})$

$(\circ_i \in \{\circ_{\bullet}, \circ_{\diamond}\})$

nagai; **long**; $\mathrm{NP}/_{\blacklozenge}\mathrm{NP}$

hii-te; **play**; $\mathrm{NP}_a\backslash_{\bullet}\mathrm{NP}_n\backslash_{\bullet}\mathrm{S}_{te}$

utat-te; **sing**; $\mathrm{NP}_a\backslash_{\bullet}\mathrm{NP}_n\backslash_{\bullet}\mathrm{S}_{te}$

muri-ni; **forcibly**; $(\mathrm{NP}_n\backslash_{\bullet}S)/_{\bullet}(\mathrm{NP}_n\backslash_{\bullet}S)$

$(S \in \{\mathrm{S}_{nl}, \mathrm{S}_{te}, \mathrm{S}_{tns}\})$

koi-ni; **on-purpose**; $(\mathrm{NP}_n\backslash_{\bullet}S)/_{\bullet}(\mathrm{NP}_n\backslash_{\bullet}S)$

$(S \in \{\mathrm{S}_{nl}, \mathrm{S}_{te}, \mathrm{S}_{tns}\})$

utat-ta; **sang**; $\mathrm{NP}_a\backslash_{\bullet}\mathrm{NP}_n\backslash_{\bullet}\mathrm{S}_{tns}$

morat-ta; **benef**;

$(\mathrm{NP}_n\backslash_{\bullet}\mathrm{S}_{te})\backslash_{<}(\mathrm{NP}_d\backslash_{\bullet}\mathrm{NP}_n\backslash_{\bullet}\mathrm{S}_{tns})$

(s)ase-ta; $\lambda P.\lambda x\lambda y.\mathbf{cause}(y, P(x))$;

$(\mathrm{NP}_n\backslash_{\bullet}\mathrm{S}_{nl})\backslash_{\ll}\mathrm{NP}_d\backslash_{\bullet}\mathrm{NP}_n\backslash_{\bullet}\mathrm{S}_{tns}$

it-ta; **say**; $\mathrm{S}_{to}\backslash_{\bullet}\mathrm{NP}_d\backslash_{\bullet}\mathrm{NP}_n\backslash_{\bullet}\mathrm{S}_{tns}$

tanon-da; **ask** ;

$(\mathrm{NP}_n\backslash_{\bullet}\mathrm{S}_{yooni})\backslash_{\times}\mathrm{NP}_d\backslash_{\bullet}\mathrm{NP}_n\backslash_{\bullet}\mathrm{S}_{tns}$

yomi; **read**; $\mathrm{NP}_a\backslash_{\bullet}\mathrm{NP}_n\backslash_{\bullet}\mathrm{S}_{lex}$

yomi; **read**; $\mathrm{NP}_a\backslash_{\bullet}\mathrm{NP}_n\backslash_{\bullet}\mathrm{S}_{nl}$

tuuhoo-si; **report**; $\mathrm{NP}_a\backslash_{\bullet}\mathrm{NP}_n\backslash_{\bullet}\mathrm{S}_{lex}$

tuuhoo-si; **report**; $\mathrm{NP}_a\backslash_{\bullet}\mathrm{NP}_n\backslash_{\bullet}\mathrm{S}_{nl}$

tuduke-ta; **continue**; $\mathrm{VP}_{nl}\backslash_{\ll}\mathrm{VP}_{tns}$

naosi-ta; **redo**; $\mathrm{VP}_{lex}\backslash_{\ll}\mathrm{VP}_{tns}$

to; $\lambda f.f$; $\mathrm{S}_{tns}\backslash_{\blacklozenge}\mathrm{S}_{to}$

yooni; $\lambda f.f$; $(\mathrm{NP}_n\backslash_{\bullet}\mathrm{S}_{tns})\backslash_{<}(\mathrm{NP}_n\backslash_{\bullet}\mathrm{S}_{yooni})$

$\lambda q\ \lambda P.P$ (onazi $\circ_{\star}$ q); **same**;

$((S|\mathrm{X})|((S|\mathrm{X})|\mathrm{NP}))|\mathrm{N}$

$(S \in \{\mathrm{S}_{nl}, \mathrm{S}_{te}, \mathrm{S}_{tns}\})$

$\lambda P\ \lambda p\ \lambda Q.\ Q\ (P\ (p)\ \circ_{\blacklozenge}$ dake); **only**;

$((S|(S|Y))|X)|(Y|X)$

$(S \in \{\mathrm{S}_{nl}, \mathrm{S}_{te}, \mathrm{S}_{tns}\})$

$\lambda P.P$ (zibun); $\lambda R\lambda x.R(x)(x)$;

$(\mathrm{NP}_n\backslash_{\bullet}S)|((\mathrm{NP}_n\backslash_{\bullet}S)|\mathrm{N})$

$(S \in \{\mathrm{S}_{nl}, \mathrm{S}_{te}, \mathrm{S}_{tns}\})$

BIBLIOGRAPHY

Abbott, Barbara. 1976. Right node raising as a test for constituenthood. *Linguistic Inquiry* 7:639–642.

Abe, Jun and Hiroto Hoshi. 1997. Gapping and P-stranding. *Journal of East Asian Linguistics* 6(1):101–136.

Ades, Anthony F. and Mark J. Steedman. 1982. On the order of words. *Linguistics and Philosophy* 4(4):517–558.

Aissen, Judith and David Perlmutter. 1983. Clause reduction in Spanish. In D. Perlmutter, ed., *Studies in Relational Grammar*, vol. 1, 360–403. University of Chicago Press.

Ajdukiewicz, Kazimierz. 1935. Die syntaktische Konnexität. In S. McCall, ed., *Polish Logic 1920–1939*, 207–231. Oxford University Press. Translated from *Studia Philosophica*, 1, 1–27.

Bach, Emmon. 1979. Control in Montague grammar. *Linguistic Inquiry* 10:515–531.

Bach, Emmon and Barbara Partee. 1980. Anaphora and semantic structure. In K. Kreiman and A. Ojeda, eds., *Papers From the Parasession on Pronouns and Anaphora*, 1–28. Chicago University, Chicago, Illinois: Chicago Linguistics Society.

Baker, Mark. 1988. *Incorporation. A Theory of Grammatical Function Changing*. The University of Chicago Press.

Baldridge, Jason. 2002. *Lexically Specified Derivational Control in Combinatory Categorial Grammar*. Ph.D. thesis, University of Edinburgh. [Available at http://comp.ling.utexas.edu/jbaldrid/papers/dissertation.html].

Bar-Hillel, Yehoshua. 1953. A quasi-arithmetic notation for syntactic descriptions. *Language* 29:47–58.

Barker, Chris. 2002. Continuations and the nature of quantification. *Natural Language Semantics* 10(3):211–242.

Barker, Chris. 2004. Continuations in natural language. In H. Thielecke, ed., *Proceedings of the Fourth ACM SIGPLAN Continuations Workshop (CW'04)*, 1–11.

Barker, Chris. 2007. Parasitic scope. *Linguistics and Philosophy* 30:407–444.

Beavers, John and Ivan A. Sag. 2004. Coordinate ellipsis and apparent non-constituent coordination. In S. Müller, ed., *The Proceedings of the 11th International Conference on Head-Driven Phrase Structure Grammar*, 48–69. Stanford: CSLI.

Bernardi, Raffaella. 2002. *Reasoning with Polarity in Categorial Type Logic*. Ph.D. thesis, University of Utrecht. [Available at http://www.inf.unibz.it/ ~bernardi/finalthesis.html].

Blevins, James. 1990. *Syntactic Complexity: Evidence for Discontinuity and Multidomination*. Ph.D. thesis, University of Massachusetts.

Bošković, Željko and Steven Franks. 2000. Across-the-board movement and LF. *Syntax* 3:107–128.

Carlson, Greg N. 1987. Same and different: Some consequences for syntax and semantics. *Linguistics and Philosophy* 10(4):531–565.

Carpenter, Bob. 1997. *Type-Logical Semantics*. Cambridge, Massachusetts: MIT Press.

Chomsky, Noam. 1955. *The Logical Structure of Linguistic Theory*. Published (in part) 1975 by Plenum Press.

Chomsky, Noam. 1965. *Aspects of the Theory of Syntax.* Cambridge, Massachusetts: The MIT Press.

Chomsky, Noam. 1981. *Lectures on Government and Binding*. Dordrecht: Foris Publications.

Chomsky, Noam. 1995. *The Minimalist Program*. Cambridge, Massachusetts: The MIT Press.

Chung, Chan. 1998. Argument composition and long-distance scrambling in Korean: An extension of the complex predicates analysis. In Hinrichs et al. (1998), 159–220.

Citko, Barbara. 2000. *Parallel Merge and the Syntax of Free Relatives*. Ph.D. thesis, SUNY.

Curry, Haskell B. 1961. Some logical aspects of grammatical structure. In R. O. Jacobson, ed., *Structure of Language and its Mathematical Aspects*, vol. 12 of *Symposia on Applied Mathematics*, 56–68. Providence: American Mathematical Society.

Curry, Haskell B. and Robert Feys. 1958. *Combinatory Logic I*. North-Holland.

de Groote, Philippe. 2001. Towards abstract categorial grammars. In *Association for Computational Linguistics, 39th Annual Meeting and 10th Conference of the European Chapter, Proceedings of the Conference*, 148–155.

de Groote, Philippe and Sarah Maarek. 2007. Type-theoretic extensions of abstract categorial grammars. In R. Muskens, ed., *Proceedings of Workshop on New Directions in Type-theoretic Grammars*, 19–30.

Dowty, David. 1982. Grammatical relations and Montague Grammar. In P. Jacobson and G. K. Pullum, eds., *The Nature of Syntactic Representation*, 79–130. Dordrecht: Reidel.

Dowty, David. 1988. Type raising, functional composition, and non-constituent coordination. In R. T. Oehrle, E. Bach, and D. Wheeler, eds., *Categorial Grammars and Natural Language Structures*, 153–198. Dordrecht: D. Reidel Publishing Company.

Dowty, David. 2007. Compositionality as an empirical problem. In C. Barker and P. Jacobson, eds., *Direct Compositionality*, 23–101. Oxford: Oxford University Press.

Dowty, David R. 1996. Toward a minimalist theory of syntactic structure. In H. Bunt and A. van Horck, eds., *Discontinuous Constituency*, No. 6 in Natural Language Processing, 11–62. Berlin, New York: Mouton de Gruyter.

Fujino, Takeshi. 2008. Coordination and backward ellipsis in Japanese. MS., University of Tokyo.

Fukui, Naoki and Hiromu Sakai. 2003. The visibility guideline for functional categories: Verb raising in Japanese and related issues. *Lingua* 113:321–375.

Fukushima, Kazuhiko. 2003. Verb-raising and numeral classifiers in Japanese: Incompatible bedfellows. *Journal of East Asian Linguistics* 12:317–347.

Gabbay, Dov M. 1996. *Labelled Deductive Systems*, vol. 1. Oxford: Oxford University Press.

Gazdar, Gerald. 1981. Unbounded dependencies and coordinate structure. *Linguistic Inquiry* 12(2):155–184.

Gazdar, Gerald, Ewan Klein, Geoffrey K. Pullum, and Ivan A. Sag. 1985. *Generalized Phrase Structure Grammar*. Cambridge, Massachusetts: Harvard University Press.

Heim, Irene and Angelika Kratzer. 1998. *Semantics in Generative Grammar*. Oxford: Blackwell Publishers.

Hinrichs, Erhard W., Andreas Kathol, and Tsuneko Nakazawa, eds. 1998. *Complex Predicates in Nonderivational Syntax*, vol. 30 of *Syntax and Semantics*. San Diego: Academic Press.

Hinrichs, Erhard W. and Tsuneko Nakazawa. 1994. Linearizing AUXs in German verbal complexes. In Nerbonne et al. (1994), 11–38.

Hoeksema, Jack. 1991. Complex predicates and liberation in Dutch and English. *Linguistics and Philosophy* 14(6):661–710.

Hoyt, Frederick and Jason Baldridge. 2008. A logical basis for the D combinator and normal form in CCG. In *Proceedings of ACL-08: HLT*, 326–334. Columbus, Ohio: Association for Computational Linguistics.

Ito, Chizuru and Rui P. Chaves. 2008. Apparent non-constituent coordination in Japanese. In S. Müller, ed., *The Proceedings of the 15th International Conference on Head-Driven Phrase Structure Grammar*, 95–115. Stanford: CSLI Publications.

Kageyama, Taro. 1993. *Bunpoo to Go-Keisei (Grammar and Word Formation)*. Tokyo: Hituzi Syobo.

Kameyama, Megumi. 1985. *Zero Anaphora: The Case of Japanese*. Ph.D. thesis, Stanford University.

Kaplan, Ronald and Annie Zaenen. 1989. Long-distance dependencies, constituent structure, and functional uncertainty. In M. Baltin and A. Kroch, eds., *Alternative Conceptions of Phrase Structure*, 17–42. Chicago: The University of Chicago Press.

Kaplan, Ronald M. and Joan Bresnan. 1982. Lexical-Functional Grammar: A formal system for grammatical representation. In J. Bresnan, ed., *The Mental Representation of Grammatical Relations*, 173–281. Cambridge, MA: The MIT Press.

Kartunnen, Lauri and Stanley Peters. 1979. Conventional implicature. In C.-K. Oh and D. Dinnens, eds., *Syntax and Semantics*, vol. 11, 1–56. Academic Press.

Kathol, Andreas. 2000. *Linear Syntax.* New York and Oxford: Oxford University Press.

Kehler, Andrew. 2002. *Coherence, Reference and the Theory of Grammar*. Stanford, California: CSLI Publications.

Kizu, Mika. 2005. *Cleft Constructions in Japanese Syntax*. Houndmills, England and New York: Palgrave Macmillan.

Koizumi, Masatoshi. 1995. *Phrase Structure in Minimalist Syntax.* Ph.D. thesis, MIT.

Koizumi, Masatoshi. 2000. String vacuous overt verb raising. *Journal of East Asian Linguistics* 9:227–285.

Kraak, Esther. 1998. A deductive account of french object clitics. In Hinrichs et al. (1998), 271–312.

Kubota, Yusuke. 2008. Solving the morpho-syntactic puzzle of the Japanese *-te* form complex predicate: A Multi-Modal Combinatory Categorial Grammar analysis. In O. Bonami and P. C. Hofherr, eds., *Empirical Issues in Syntax and Semantics*, vol. 7, 283–306.

Kubota, Yusuke and Jungmee Lee. 2008. Reconsidering the Coordinate Structure Constraint in Japanese and Korean: Syntactic constraint or pragmatic principle? In S. Müller, ed., *Proceedings of the 15th International Conference on Head-Driven Phrase Structure Grammar*, 417–435. Stanford: CSLI Publications.

Kubota, Yusuke and E. Allyn Smith. 2006. Syntax and semantics of Japanese nonconstituent clefting in Combinatory Categorial Grammar. In C. Davis, A. R. Deal, and Y. Zabbal, eds., *Proceedings of the Thirty-Sixth Annual Meeting of the North East Linguistic Society*, 413–426. Amherst, MA: GLSA Publications.

Kubota, Yusuke and E. Allyn Smith. 2007. A Multi-Modal Combinatory Categorial Grammar analysis of Japanese nonconstituent clefting. In V. Nurmi and D. Sustretov, eds., *Proceedings of the Twelfth ESSLLI Student Session*, 161–172.

Kuno, Susumu. 1973. *The Structure of the Japanese Language*. Cambridge, Massachusetts: The MIT Press.

Kuno, Susumu. 1978. Japanese: A characteristic OV language. In W. Lehmann, ed., *Syntactic Typology: Studies on the Phenomenonology of Language*, 57–138. Austin: University of Texas Press.

Kuroda, S.-Y. 1965. Causative forms in Japanese. *Foundations of Language* 1:20–40.

Lakoff, George. 1986. Frame semantic control of the Coordinate Structure Constraint. In A. M. Farley, P. T. Farley, and K.-E. McCullough, eds., *CLS 22 Part 2: Papers from the Parasession on Pragmatics and Grammatical Theory*, 152–167. Chicago: Chicago Linguistic Society.

Lambek, Joachim. 1958. The mathematics of sentence structure. *American Mathematical Monthly* 65:154–170.

Lambek, Joachim. 1961. On the calculus of syntactic types. In *Structure of Language and Its Mathematical Aspects*, 166–178. American Mathematical Society.

Link, Godehard. 1983. The logical analysis of plurals and mass terms: A lattice-theoretical approach. In R. Bäuerle, C. Schwarze, and A. von Stechow, eds., *Meaning, Use, and Interpretation of Language*, 302–323. Berlin: Walter de Gruyter.

Martin, Samuel E. 1975/1983. *A Reference Grammar of Japanese*. New Haven and London: Yale University Press.

Matsumoto, Yo. 1996. *Complex Predicates in Japanese.* Stanford/Tokyo: CSLI Publications/Kurosio Publishers.

McCawley, James D. 1982. Parentheticals and discontinuous constituent structure. *Linguistic Inquiry* 13(1):91–106.

McCawley, James D. and Katsuhiko Momoi. 1986. The constituent structure of *-te* complements. *Papers in Japanese Linguistics* 11:1–60.

McConville, Mark. 2006. Inheritance and the CCG lexicon. In *Proceedings of the 11th Conference of the European Chapter of the Association for Computational Linguistics (EACL 2006)*.

Montague, Richard. 1973. The proper treatment of quantification in ordinary English. In J. Hintikka, J. M. Moravcsik, and P. Suppes, eds., *Approaches to Natural Language: Proceedings of the 1970 Stanford Workshop on Grammar and Semantics*, 221–242. Dordrecht, Holland: D. Reidel.

Moortgat, Michael. 1988. *Categorial Investigations: Logical and Linguistic Aspects of the Lambek Calculus*. Dordrecht: Foris.

Moortgat, Michael. 1990. The quantification calculus. In H. Hendriks and M. Moortgat, eds., *Theory of Flexible Interpretation: Esprit DYANA Deliverable R.1.2.A*. Institute for Language, Logic and Information, University of Amsterdam.

Moortgat, Michael. 1996. Generalized quantification and discontinuous type constructors. In H. Bunt and A. van Horck, eds., *Discontinuous Constituency*, No. 6 in Natural Language Processing, 181–207. Berlin, New York: Mouton de Gruyter.

Moortgat, Michael. 1997. Categorial Type Logics. In J. van Benthem and A. ter Meulen, eds., *Handbook of Logic and Language*, 93–177. Amsterdam: Elsevier.

Moortgat, Michael and Richard T. Oehrle. 1994. Adjacency, dependence, and order. In P. Dekker and M. Stokhof, eds., *Proceedings of the Ninth Amsterdam Colloquium*, 447–466. Universiteit van Amsterdam: Instituut voor Taal, Logica, en Informatica.

Morrill, Glyn, Mario Fadda, and Oriol Valentín. 2007. Nondeterministic discontinuous lambek calculus. In *Proceedings of the Seventh International Workshop on Computational Semantics, IWCS7, Tilburg*.

Morrill, Glyn and Teresa Solias. 1993. Tuples, discontinuity, and gapping in categorial grammar. In *Proceedings of the Sixth Conference on European Chapter of the Association for Computational Linguistics*, 287–296. Morristown, NJ, USA: Association for Computational Linguistics.

Morrill, Glyn V. 1994. *Type Logical Grammar: Categorial Logic of Signs*. Dordrecht: Kluwer Academic Publishers.

Mukai, Emi. 2003. On verbless conjunction in Japanese. In M. Kadowaki and S. Kawahara, eds., *Proceedings of NELS 33*, 205–224. University of Massachusetts, Amherst: GLSA.

Muskens, Reinhard. 2001. Categorial Grammar and Lexical-Functional Grammar. In M. Butt and T. H. King, eds., *The Proceedings of the LFG '01 Conference*. University of Hong Kong.

Muskens, Reinhard. 2003. Language, lambdas, and logic. In G.-J. Kruijff and R. Oehrle, eds., *Resource Sensitivity in Binding and Anaphora*, Studies in Linguistics and Philosophy, 23–54. Kluwer.

Muskens, Reinhard. 2007. Separating syntax and combinatorics in categorial grammar. *Research on Language and Computation* 5(3):267–285.

Nakau, Minoru. 1973. *Sentential complementation in Japanese*. Tokyo: Kaitakusha.

Nerbonne, John, Klaus Netter, and Carl J. Pollard, eds. 1994. *German in Head-Driven Phrase Structure Grammar*. No. 46 in CSLI Lecture Notes. Stanford: CSLI Publications.

Oehrle, Richard T. 1994. Term-labeled categorial type systems. *Linguistics and Philosophy* 17(6):633–678.

Oehrle, Richard T. and Shi Zhang. 1989. Lambek calculus and preposing of embedded subjects. In *Papers from the 25th Annual Regionl Meeting of the Chicago Linguistic Society, Part One: The General Session*, 328–341. Chicago: Chicago Linguistic Society.

Partee, Barbara and Mats Rooth. 1983. Generalized quantifiers and type ambiguity. In R. Bäuerle, C. Schwarze, and A. von Stechow, eds., *Meaning, Use, and Interpretation of Language*, 361–383. Berlin: Walter de Gruyter.

Plotkin, Gordon. 1975. Call-by-name, call-by-value and the lambda-calculus. *Theoretical Computer Science* 1(2):125–159.

Plotkin, Gordon D. 1977. LCF considered as a programming language. *Theoretical Computer Science* 5(3):223–255.

Pollard, Carl. 2009. [Presentation on a treatment of parasitic scope in a categorial grammar with φ-labelling]. Presentation at Synners meeting, May 27, 2009.

Pollard, Carl J. and Ivan A. Sag. 1994. *Head-Driven Phrase Structure Grammar*. Studies in Contemporary Linguistics. Chicago and London: University of Chicago Press.

Ranta, Aarne. 2004. Grammatical framework: A type-theoretical grammar formalism. *Journal of Functional Programming* 14(2):145–189.

Reape, Mike. 1993. *A Formal Theory of Word Order: A Case Study in West Germanic*. Ph.D. thesis, University of Edinburgh.

Reape, Mike. 1994. Domain union and word order variation in German. In Nerbonne et al. (1994), 151–197.

Rooth, Mats. 1985. *Association with Focus*. Ph.D. thesis, University of Massachusetts, Amherst.

Rooth, Mats. 1992. A theory of focus interpretation. *Natural Language Semantics* 1:75–116.

Ross, John Robert. 1967. *Constraints on Variables in Syntax.* Ph.D. thesis, MIT. Reproduced by the Indiana University Linguistics Club.

Sabbagh, Joseph. 2007. Ordering and linearizing rightward movement. *Natural Language and Linguistic Theory* 25:349–401.

Sag, Ivan and Rui Chaves. 2008. Left- and right-periphery ellipsis in coordinate and non-coordinate structures. MS., Stanford University and University at Buffalo, The State University of New York.

Saito, Mamoru. 1985. *Some Asymmetries in Japanese and Their Theoretical Implications*. Ph.D. thesis, MIT.

Saito, Mamoru. 1987. Three notes on syntactic movement in Japanese. In T. Imai and M. Saito, eds., *Issues in Japanese Linguistics*, 301–350. Dordrecht: Kluwer.

Saito, Mamoru. 1994. Additional -*wh* effects and the adjunction site theory. *Journal of East Asian Linguistics* 3:195–240.

Sato, Yosuke. 2009. Coordination, dependency and gapping in Japanese at the interface. MS., University of British Columbia.

Scott, Dana S. 1993. A type-theoretical alternative to ISWIM, CUCH, OWHY. *Theoretical Computer Science* 121:411–440. Revision of unpublished 1969 manuscript.

Sells, Peter. 1990. VP in Japanese: Evidence from *-te* complements. In H. Hoji, ed., *Japanese/Korean Linguistics*, 319–333. Stanford: The Center for the Study of Language and Information.

Shibatani, Masayoshi. 1976. Causativization. In M. Shibatani, ed., *Japanese Generative Grammar*, vol. 5 of *Syntax and Semantics*, 239–294. New York and Tokyo: Academic Press.

Shibatani, Masayoshi. 1978. *Nihongo no Bunseki (Analysis of Japanese)*. Tokyo: Taishukan.

Sohn, Keun-Won. 1994. Adjunction to argument, free ride and a minimalist program. In M. Koizumi and H. Ura, eds., *Formal Approaches to Japanese Linguistics 1*, vol. 24 of *MIT Working Papers in Linguistics*, 315–334. MITWPL.

Steedman, Mark. 1985. Dependency and coordination in the grammar of Dutch and English. *Language* 61(3):523–568.

Steedman, Mark. 1987. Combinatory grammars and parasitic gaps. *Natural Language and Linguistic Theory* 5(3):403–439.

Steedman, Mark. 1990. Gapping as constituent coordination. *Linguistics and Philosophy* 13(2):207–263.

Steedman, Mark. 1996. *Surface Structure and Interpretation*. Cambridge, Massachusetts: The MIT Press.

Steedman, Mark. 2000a. Information structure and the syntax-phonology interface. *Linguistic Inquiry* 31(4):649–689.

Steedman, Mark. 2000b. *The Syntactic Process*. Cambridge, Massachusetts: The MIT Press.

Steedman, Mark and Jason Baldridge. 2007. Combinatory Categorial Grammar. Draft 5.0, April 19, 2007. [Available at http://groups.inf.ed.ac.uk/ccg/publications.html].

Takano, Yuji. 2002. Surprising constituents. *Journal of East Asian Linguistics* 11:243–301.

Tokashiki, Kyoko. 1989. *On Japanese Coordinate Structures: An Investigation of Structural Differences between the -Te Form and the -I Form*. Master's thesis, The Ohio State University.

Vermaat, Willemijn. 2005. *The Logic of Variation. A Cross-Linguistic Account of Wh-Question Formation*. Ph.D. thesis, Utrecht Institute of Linguistics OTS, Utrecht University.

Williams, Edwin. 1997. Blocking and anaphora. *Linguistic Inquiry* 28:577–628.

Yatabe, Shûichi. 2003. Does scrambling in Japanese obey the Coordinate Structure Constraint? In *Nihon Gengogakkai Dai-126-Kai Taikai Yokôshû*, 262–267. Linguistics Society of Japan.

Yuasa, Etsuyo and Jerry M. Sadock. 2002. Pseudo-subordination: A mismatch between syntax and semantics. *Journal of Linguistics* 38(1):87–111.

Yumoto, Yoko. 2005. *Fukugoo Doosi, Hasei Doosi no Imi to Toogo (Semantics and Syntax of Compound Verbs and Derived Verbs)*. Tokyo: Hituzi Syobo.