11 Bringing Back "Hierarchical Constituency": Multi-Modal Prosodic Calculus and Its Empirical Applications

Up to this point, we have assumed the associative variant of the Lambek calculus (**L**) as the underlying calculus that governs the behavior of the connectives $/$ and $\backslash$. As should already be clear by now, this effectively has the consequence of denying the significance of the notion of phrase structural constituency as a theoretically primitive notion that determines the "units" that grammatical operations or constraints directly target. We have seen in the preceding chapters that the flexibility of the combinatoric system that this architecture of grammar allows for has significant advantages in accounting for complex empirical phenomena in the domains of coordination and ellipsis.

However, if we are left with this all-or-nothing choice between either retaining or totally abandoning (the analogue of) the traditional notion of constituency, the flexibility gained by taking the latter option would be both a strength and a weakness for the purpose of accounting for a wider range of empirical phenomena. For example, the so-called complex predicate constructions are found in a variety of languages across typologically distinct language types (including Germanic, Romance, and East Asian languages such as Japanese and Korean). Roughly speaking, this is a type of phenomenon in which higher and lower verbs (most typically, in the raising and control constructions) form some sort of morpho-syntactic cluster in the "surface syntax," to the exclusion of their nominal arguments. It is unclear how verb clustering of this sort would be modeled in an architecture that totally dispenses with the traditional notion of syntactic constituency.

Since we have mostly focused on the grammar of English in this book, the fragment we have developed up to this point is not equipped with a mechanism that can handle this type of phenomenon appropriately. However, extensions of the Lambek calculus and related approaches with mechanisms for dealing with this type of complex phenomena pertaining to morpho-syntax have been proposed by various authors in the literature (Moortgat and Oehrle 1994; Kraak 1998; Baldridge 2002). In fact, the underlying architecture of Hybrid TLCG is perfectly compatible with an extension that is well suited for accounting for such additional complexities. This involves adding

more structure to the prosodic component of the tripartite representation of linguistic signs, thereby modeling morpho-syntactic constituency. The resultant system can capture both the flexibility of constituency and restrictions imposed on this flexibility exhibited by such phenomena. Kubota (2010, 2014) offers a detailed demonstration of the empirical advantage of such an architecture of grammar through an analysis of two types of complex predicate constructions in Japanese that exhibit different degrees of morpho-syntactic flexibility.

While empirical evidence for the need for such an elaborate architecture of the morpho-syntactic component is limited in English, a certain puzzling pattern in RNR, known as "medial Right-Node Raising" (or "Right-Node Wrapping"; Whitman 2009; Yatabe 2012), arguably constitutes one such case. Thus, in this chapter we sketch an analysis of medial RNR in an extended fragment of our system and thereby illustrate the theoretical toolkit that is available in CG for regulating flexibility of constituency appropriately. The medial RNR data are important theoretically as well, since some authors have claimed (see, e.g., Yatabe and Tam 2019) that it poses a threat to the nonconstituent-as-constituent analysis of coordination in CG of the sort we have developed and advocated in the preceding chapters. The fact that a natural solution for this problem becomes available once we extend the morpho-syntactic component (along lines that have considerable cross-linguistic support) provides support not only for such an extension but also for the basic analysis of nonconstituent coordination as constituent coordination that we have argued for in the preceding chapters.

11.1 Some Basic Facts about Medial Right-Node Raising

Several authors (Wilder 1999; Whitman 2009; Bachrach and Katzir 2008; Yatabe 2012, 2013) have noted a class of examples that at first sight appear to pose a serious challenge to this otherwise very successful analysis of coordination in CG of the sort we have argued for in the preceding chapters. The problem is illustrated by the following example from Wilder (1999):

(581) John should [fetch] and [give ***the book*** to Mary].

In this example, the material shared between the two conjuncts appears *inside* the second conjunct, rather than to its right (as would be the case in ordinary RNR), since the indirect object *to Mary* is an argument of *give* but not of *fetch*.

Similar examples from English are given in (582) (Whitman 2009).

(582) a. I've got friends in low places, where [the whiskey drowns] and [the beer chases ***my blues*** away].
b. The blast [upended] and [nearly slices ***an armored Chevrolet Suburban*** in half].

c. Please move from the exit rows if you are [unwilling] or [unable ***to perform the necessary actions*** without injury].
d. In the players' box was Tony Nadal, the [uncle] and [coach ***of Rafael Nadal*** since he started playing as a youngster].

Yatabe (2013) notes an even more vexing case from Japanese where the material shared between the two conjuncts is a discontinuous string, split in the middle by some element that belongs solely to the second conjunct.

(583) a. [Taroo-wa hidari-gawa-no manekin-ni makkuro-na], sosite [Hanako-wa
Taro-TOP left-side-GEN figure-DAT pitch.black and Hanako-TOP
awai pinku-iro-no ***boosi-o*** migi-gawa-no manekin-ni] **kabuse-ta**.
pale pink-color-GEN hat-ACC right-side-GEN figure-DAT put-PAST
'Taro put a pitch-black hat on the figure on the left and Hanako put a pale pink hat on the figure on the right.'

b. [Katate-nabe-de 1-rittoru-gurai-no], sosite [sore-to heikoo-si-te tyoodo
pan-with 1-liter-about-GEN and that-with in.parallel just
5-rittoru-no ***oyu-o*** huka-nabe-de] **wakasi-masu**.
5-liter-GEN water-ACC deep-pot-with boil-POL
'Boil about 1ℓ of water in a pan and exactly 5ℓ of water in a pot simultaneously.'

In (583a), the left conjunct is missing both the head noun for the prenominal modifier *makkuro-na* 'pitch-black' and the sentence-final verb *kabuse-ta* 'put.' While the shared verb appears to the right of the right conjunct, the shared head noun *boosi-o* 'hat' is buried inside the second conjunct, split from the right-peripheral shared verb by a dative NP belonging solely to the right conjunct. Following Yatabe (2012), we call this type of Right-Node Raising (RNR) (encompassing both the English examples in (581)–(582) and the more complex Japanese data in (583)) *medial RNR* (MRNR). As Yatabe (2012) notes, these examples pose a serious challenge to (at least the simplest formulation of) the CG-based analysis of RNR, since the second conjunct contains within itself what would have to be "factored out" to the right of both conjuncts as the RNR'ed material in order for such an analysis to succeed.

These facts have not been unnoticed in the CG literature. Whitman (2009) proposes an analysis for a subset of the data in (582) in terms of *wrapping* (Bach 1979). Wrapping is a mechanism proposed in the early literature of CG/Montague grammar which treats discontinuous constituency in verb-particle constructions and related phenomena via surface reordering. In a wrapping-based analysis, (584) is derived by first combining the verb and the particle to form an "underlying" constituent, and the direct object of this "complex transitive verb" is infixed right next to the verb in the surface string.

(584) The whiskey chases my blues away.

According to Whitman (2009), at least some of the examples in (582) can be subsumed under like-category coordination by taking into consideration this word order surface anomaly manifest in wrapping. Specifically, in (582a), the two conjuncts *the whiskey drowns* and *the beer chases away* form a coordinate structure before the shared NP is wrapped around by the verb-particle pair belonging to the second conjunct. After the shared NP is taken as an argument by the whole coordinated S/NP, surface restructuring induces the "infixation" of the direct object *my blues* between the verb and the particle of the second conjunct, just as in the simpler case of verb-particle construction in (584). Thus, Whitman's analysis reduces the apparent anomaly of (a certain subset of) MRNR to an independently motivated word order anomaly exhibited by expressions that induce the "wrapping" operation.

Thus, the key idea behind Whitman's proposal is that the apparently exceptional patterns of RNR in MRNR can be reduced to independent word order properties of the "offending" elements. Though this general idea seems essentially on the right track, attributing the word order variation to the wrapping operation specifically is too restrictive. Indeed, Whitman himself notes that his wrapping-based analysis does not extend to all of the data that he discusses. For example, (582c) is problematic since the adverbial phrase *without injury* modifies the lower verb *perform* rather than the adjective *unable*. Thus, a wrapping analysis that takes *unable without injury* to be a combinatoric unit that wraps around the infinitival VP is semantically implausible. In (582d), the *since* clause modifies the proposition that Tony Nadal is a coach of Rafael Nadal, and hence, Whitman argues, *coach since . . .* cannot be taken to be a discontinuous constituent that wraps around *of Rafael Nadal*. Moreover, as Yatabe (2012) notes, Whitman's approach does not extend to the more complex Japanese examples in (583), since there is no independent motivation that the word order variations in these examples are licensed by a mechanism analogous to the wrapping operation traditionally recognized in the CG literature for phenomena like verb-particle constructions.

Considerations of the above facts have led some authors (most notably, Yatabe 2012, 2013) to argue that the CG analysis of coordination is empirically inadequate and that other approaches (such as ones based on surface deletion [Yatabe 2001; Crysmann 2003; Beavers and Sag 2004; Chaves 2007] or multidominance [Bachrach and Katzir 2007, 2008]) are superior since they can accommodate such data more easily. In what follows, we offer an analysis of MRNR in an extension of Hybrid TLCG that incorporates the notion of "multi-modality" which is similar in spirit to Whitman's analysis but differs from it in specific implementational details. We argue that our approach improves over Whitman's proposal in overcoming its empirical inadequacies. We show that the MRNR pattern exemplified by the data in Japanese and English above actually falls out as an immediate consequence of the CG analysis of RNR, once the interac-

tion between RNR and independently motivated word order properties in the respective languages is properly taken into account.

11.2 Enriching the Morpho-Syntactic Component

In this section, we sketch an extension of Hybrid TLCG along the lines worked out in detail in Kubota (2010, 2014) and Kubota and Pollard (2010), which enriches the prosodic component with the notion of "multi-modality" from the TLCG work in the 1990s (Moortgat and Oehrle 1994; Moortgat 1997). The notion of "multi-modality" (which has nothing to do with the notion of modality as understood in the semantics literature) was first introduced in CG by Dowty (1996b) (written at the end of the 1980s). Dowty sketches an architecture of syntactic theory in which the combinatoric component pertaining to predicate-argument structure and semantic composition (called "tectogrammar" following Curry [1961]) is separated from a component that deals with surface word order ("phenogrammar").[1] Building on the proposals by Morrill and Solias (1993), Morrill (1994), Moortgat and Oehrle (1994), and Bernardi (2002), Kubota (2010, 2014) and Kubota and Pollard (2010) implement this idea explicitly within TLCG by positing different "modes of composition" in the prosodic component, where these modes essentially encode different degrees of tightness of bond between morphemes (as reflected in surface word order). Below, we present a simplified fragment embodying this architecture.

Unlike in the original Lambek calculus, in a multi-modal system, prosodic representations of linguistic expressions have richer structures than strings. We call such "enriched" prosodic representations *abstract phonologies*. In abstract phonologies, morphemes are combined with one another via one of the abstract modes of composition. For example, a mode called the *scrambling mode* ($\circ.$) is posited to account for the relative free order among dependents of a verb within a local clause in Japanese. Thus, the sentence *Taroo-ga Hanako-o mi-ta* ('Taro saw Hanako') is assigned the following abstract phonology:

(585) taroo-ga $\circ.$ (hanako-o $\circ.$ mi-ta)

To capture the property of the scrambling mode, we posit the following ordering relations:

(586) Scrambling
$A \circ. (B \circ. C) \leq B \circ. (A \circ. C)$

(587) Pronunciation
$A \circ_i B \leq A \circ B$ (where $\circ_i$ is any abstract mode)

1. The same basic idea has been implemented in HPSG by Reape (1996) and Kathol (1995, 2000).

Here, $\leq$ is to be understood as defining the "rewritability" relation between prosodic representations such that if $A \leq B$ holds, then A can be rewritten as B—this will be formally guaranteed by the Prosodic Interface rule (592). (586) essentially says that elements combined in the scrambling mode can be reordered with each other, except for the rightmost one (corresponding to the head verb). (587) converts an abstract phonology to an actually pronounceable string (where $\circ$ designates string concatenation).

From (586) and (587), it follows that (588) holds. That is, the underlying abstract phonology (585) can be rewritten as the pronounceable string *Hanako-o Taroo-ga mi-ta* corresponding to the OSV word order.

(588) taroo-ga $\circ_{\bullet}$ (hanako-o $\circ_{\bullet}$ mi-ta)
$\leq$ hanako-o $\circ_{\bullet}$ (taroo-ga $\circ_{\bullet}$ mi-ta) (by Scrambling (586))
$\leq$ hanako-o $\circ$ (taroo-ga $\circ$ mi-ta) (by Pronunciation (587))

Modality specifications are encoded as part of the lexical subcategorization properties of functor expressions, as in the following lexical entry for the transitive verb *mi-ta*, in which the slashes carry specific modality specifications:

(589) mi-ta; **see**; $\mathrm{NP}_{acc} \backslash_{\bullet} \mathrm{NP}_{nom} \backslash_{\bullet} \mathrm{S}$

The Introduction and Elimination rules for the slashes are modified accordingly to reflect this modality encoding on slashes. Specifically, both types of rules make sure that the modality encoded in the (used or derived) functor matches the modality employed in combining its phonology with the phonology of its argument. Thus, the Introduction and Elimination rules for the forward and backward slashes are redefined as follows:

(590) a. Forward Slash Elimination

$$\frac{a;\ \mathcal{F};\ A/_i B \qquad b;\ \mathcal{G};\ B}{a \circ_i b;\ \mathcal{F}(\mathcal{G});\ A}\ /_i\mathrm{E}$$

b. Backward Slash Elimination

$$\frac{b;\ \mathcal{G};\ B \qquad a;\ \mathcal{F};\ B\backslash_i A}{b \circ_i a;\ \mathcal{F}(\mathcal{G});\ A}\ \backslash_i\mathrm{E}$$

(591) a. Forward Slash Introduction

$$\frac{\begin{array}{c}\vdots\ \underline{[\varphi;\ x;\ A]^n}\ \vdots \\ \vdots \qquad \vdots \qquad \vdots \\ b \circ_i \varphi;\ \mathcal{F};\ B\end{array}}{b;\ \lambda x.\mathcal{F};\ B/_i A}\ /_i\mathrm{I}^n$$

b. Backward Slash Introduction

$$\frac{\begin{array}{c}\vdots\ \underline{[\varphi;\ x;\ A]^n}\ \vdots \\ \vdots \qquad \vdots \qquad \vdots \\ \varphi \circ_i b;\ \mathcal{F};\ B\end{array}}{b;\ \lambda x.\mathcal{F};\ A\backslash_i B}\ \backslash_i\mathrm{I}^n$$

Finally, the following *Prosodic-Interface (PI) rule* is posited so that syntactic derivations can make reference to the "rewriting" relation between prosodic representations:

(592) Prosodic-Interface (PI) rule

$$\frac{\varphi_0;\ \mathcal{F};\ A}{\varphi_1;\ \mathcal{F};\ A}\text{PI}$$

——where $\varphi_0 \leq \varphi_1$ holds in the prosodic calculus

The following derivation illustrates how the grammar licenses the OSV word order with the lexical entry for the transitive verb given in (589) (here and below, we omit parentheses for string phonologies since hierarchical structures are irrelevant for them):

(593)
$$\dfrac{\text{taroo-ga};\ \mathbf{t};\ \text{NP}_{nom} \qquad \dfrac{\text{hanako-o};\ \mathbf{h};\ \text{NP}_{acc} \quad \text{mi-ta};\ \mathbf{saw};\ \text{NP}_{acc}\backslash\!\cdot\!\text{NP}_{nom}\backslash\!\cdot\!\text{S}}{\text{hanako-o} \circ\!\cdot \text{mi-ta};\ \mathbf{saw}(\mathbf{h});\ \text{NP}_{nom}\backslash\!\cdot\!\text{S}}\backslash\!\cdot\text{E}}{\dfrac{\text{taroo-ga} \circ\!\cdot (\text{hanako-o} \circ\!\cdot \text{mi-ta});\ \mathbf{saw}(\mathbf{h})(\mathbf{t});\ \text{S}}{\text{hanako-o} \circ \text{taroo-ga} \circ \text{mi-ta};\ \mathbf{saw}(\mathbf{h})(\mathbf{t});\ \text{S}}\text{PI}}\backslash\!\cdot\text{E}$$

Combining the verb with its two arguments via Slash Elimination yields the abstract phonology in (585). This abstract phonology is then mapped to the surface string corresponding to the OSV order via the PI rule, which in turn is licensed by the rewritability relation in (588).

As an illustration of how the Introduction/Elimination rules and the PI rule interact in the present system, (594) shows how an alternative entry for a transitive verb that "directly" licenses the OSV order is obtained from the lexically specified entry in (589).

(594)
$$\dfrac{\dfrac{\dfrac{[\varphi_1;x;\text{NP}_{nom}]^1 \qquad \dfrac{[\varphi_2;y;\text{NP}_{acc}]^2 \quad \text{mi-ta};\ \mathbf{saw};\ \text{NP}_{acc}\backslash\!\cdot\!\text{NP}_{nom}\backslash\!\cdot\!\text{S}}{\varphi_2 \circ\!\cdot \text{mi-ta};\ \mathbf{saw}(y);\ \text{NP}_{nom}\backslash\!\cdot\!\text{S}}\backslash\!\cdot\text{E}}{\varphi_1 \circ\!\cdot (\varphi_2 \circ\!\cdot \text{mi-ta});\ \mathbf{saw}(y)(x);\ \text{S}}}{\varphi_2 \circ\!\cdot (\varphi_1 \circ\!\cdot \text{mi-ta});\ \mathbf{saw}(y)(x);\ \text{S}}\text{PI}}{\varphi_1 \circ\!\cdot \text{mi-ta};\ \lambda y.\mathbf{saw}(y)(x);\ \text{NP}_{acc}\backslash\!\cdot\!\text{S}}\backslash\!\cdot\text{I}^2}{\text{mi-ta};\ \lambda x\lambda y.\mathbf{saw}(y)(x);\ \text{NP}_{nom}\backslash\!\cdot\!\text{NP}_{acc}\backslash\!\cdot\!\text{S}}\backslash\!\cdot\text{I}^1$$

After the verb is combined with its (hypothetically assumed) two arguments, the PI rule reverses the order between the subject and the object. This has the effect of reversing the order of arguments in the "derived" entry, via the successive applications of the two Introduction rules. Importantly, since the Introduction and Elimination rules preserve the modality specifications, the scrambling mode lexically encoded in the original transitive verb entry in (589) is retained in the derived entry in (594) for both arguments.

11.3 Regulating the Flexibility of Constituency

One important difference between the associative fragment assumed up to the previous chapter and the extended, multi-modal fragment we are working with in the present chapter is that hypothetical reasoning involving the forward and backward slashes is

more tightly restricted in the latter. Specifically, the Introduction rules in (591) require the prosody of the hypothesized expression φ to appear at the (topmost) right or left edge of the hierarchically structured prosodic representation of the premise.[2] This has the consequence that nonstandard constituents that appear in NCC can be derived only if all of the modes of composition involved in putting together the relevant expressions are associative, thereby allowing for restructuring of the hierarchical structure. See the derivation in (599) below for a concrete demonstration on this point. Thus, we now have a way to control flexibility of constituency in the appropriate way.

Since argument clusters like *Taroo-ga Hanako-o* can be coordinated, we assume that the scrambling mode is associative, meaning that it (together with the *associative mode* $\circ_\diamond$ introduced below) satisfies the following two ordering relations:

(595) Right Association

$$A \circ_i (B \circ_j C) \leq (A \circ_i B) \circ_j C \qquad (\circ_i, \circ_j \in \{\circ_\bullet, \circ_\diamond\})$$

(596) Left Association

$$(A \circ_i B) \circ_j C \leq A \circ_i (B \circ_j C) \qquad (\circ_i, \circ_j \in \{\circ_\bullet, \circ_\diamond\})$$

For a reason that will become clear below, we posit a special mode of composition for coordination ($\circ_c$), called the *coordination mode*. Thus, the conjunction has the following lexical entry:

(597) sosite; $\sqcap$; $(X\backslash_c X)/_c X$

This enables an analysis of the DCC sentence in Japanese in (598) along the lines of (599) (where TV abbreviates $\mathrm{NP}_{acc}\backslash_\bullet \mathrm{NP}_{nom}\backslash_\bullet \mathrm{S}$).

(598) [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 (599), after the hypothetical transitive verb is combined with the two arguments it subcategorizes for, the PI rule applies to restructure the abstract phonology of the sentence so that the hypothetically assumed φ appears on the right periphery. Crucially, the restructuring is possible here since the two arguments of the verb are combined with the verb in a mode that satisfies Right Association (595). By this restructuring, Forward Slash Introduction becomes applicable to derive the string *Taroo-ga Hanako-o* in the category $\mathrm{S}/_\bullet(\mathrm{NP}_{acc}\backslash_\bullet \mathrm{NP}_{nom}\backslash_\bullet \mathrm{S})$. The rest of the derivation just involves coordinating the derived expression with another expression of the same type and combining it with the missing transitive verb.

2. In the simpler, non-modalized fragment in the previous chapters, in which prosodic representations were assumed to be completely flat, the prosodic variable of the hypothesis merely had to be on the left or right periphery stringwise in order for the Introduction rules to apply.

(599)

$$\dfrac{\text{hanako-o};\ \mathbf{h};\mathrm{NP}_{acc} \qquad \begin{bmatrix}\varphi; \\ P;\mathrm{TV}\end{bmatrix}^1}{\text{hanako-o} \circ_{\cdot} \varphi;\ P(\mathbf{h});\mathrm{NP}_{nom}\backslash_{\cdot}\mathrm{S}}\backslash_{\cdot}\mathrm{E}$$

$$\dfrac{\text{taroo-ga};\ \mathbf{t};\mathrm{NP}_{nom} \qquad \text{hanako-o} \circ_{\cdot} \varphi;\ P(\mathbf{h});\mathrm{NP}_{nom}\backslash_{\cdot}\mathrm{S}}{\text{taroo-ga} \circ_{\cdot} (\text{hanako-o} \circ_{\cdot} \varphi);\ P(\mathbf{h})(\mathbf{t});\mathrm{S}}\backslash_{\cdot}\mathrm{E}$$

$$\dfrac{\text{taroo-ga} \circ_{\cdot} (\text{hanako-o} \circ_{\cdot} \varphi);\ P(\mathbf{h})(\mathbf{t});\mathrm{S}}{(\text{taroo-ga} \circ_{\cdot} \text{hanako-o}) \circ_{\cdot} \varphi;\ P(\mathbf{h})(\mathbf{t});\mathrm{S}}\mathrm{PI}$$

$$\dfrac{(\text{taroo-ga} \circ_{\cdot} \text{hanako-o}) \circ_{\cdot} \varphi;\ P(\mathbf{h})(\mathbf{t});\mathrm{S}}{\text{taroo-ga} \circ_{\cdot} \text{hanako-o};\ \lambda P.P(\mathbf{h})(\mathbf{t});\mathrm{S}/_{\cdot}\mathrm{TV}}/_{\cdot}\mathrm{I}^1$$

$$\dfrac{\text{sosite};\ \sqcap;(X\backslash_{c}X)/_{c}X \qquad \begin{matrix}\vdots \\ \text{ziroo-ga} \circ_{\cdot} \text{mitiko-o};\ \lambda P.P(\mathbf{m})(\mathbf{j});\ \mathrm{S}/_{\cdot}\mathrm{TV}\end{matrix}}{\text{sosite} \circ_{c} (\text{ziroo-ga} \circ_{\cdot} \text{mitiko-o});\ \lambda G.G \sqcap \lambda P.P(\mathbf{m})(\mathbf{j});\ (\mathrm{S}/_{\cdot}\mathrm{TV})\backslash_{c}(\mathrm{S}/_{\cdot}\mathrm{TV})}/_{c}\mathrm{E}$$

$$\dfrac{\text{taroo-ga} \circ_{\cdot} \text{hanako-o};\ \lambda P.P(\mathbf{h})(\mathbf{t});\mathrm{S}/_{\cdot}\mathrm{TV} \qquad \text{sosite} \circ_{c} (\text{ziroo-ga} \circ_{\cdot} \text{mitiko-o});\ \ldots}{(\text{taroo-ga} \circ_{\cdot} \text{hanako-o}) \circ_{c} (\text{sosite} \circ_{c} (\text{ziroo-ga} \circ_{\cdot} \text{mitiko-o}));\ \lambda P.P(\mathbf{h})(\mathbf{t}) \sqcap \lambda P.P(\mathbf{m})(\mathbf{j});\mathrm{S}/_{\cdot}\mathrm{TV}}\backslash_{c}\mathrm{E}$$

$$\dfrac{\ldots;\ \mathrm{S}/_{\cdot}\mathrm{TV} \qquad \text{mi-ta};\ \mathbf{saw};\ \mathrm{TV}}{((\text{taroo-ga} \circ_{\cdot} \text{hanako-o}) \circ_{c} (\text{sosite} \circ_{c} (\text{ziroo-ga} \circ_{\cdot} \text{mitiko-o}))) \circ_{\cdot} \text{mi-ta};\ \mathbf{saw}(\mathbf{h})(\mathbf{t}) \wedge \mathbf{saw}(\mathbf{m})(\mathbf{j});\mathrm{S}}/_{\cdot}\mathrm{E}$$

$$\dfrac{\ldots;\ \mathbf{saw}(\mathbf{h})(\mathbf{t}) \wedge \mathbf{saw}(\mathbf{m})(\mathbf{j});\mathrm{S}}{\text{taroo-ga} \circ \text{hanako-o} \circ \text{sosite} \circ \text{ziroo-ga} \circ \text{mitiko-o} \circ \text{mi-ta};\ \mathbf{saw}(\mathbf{h})(\mathbf{t}) \wedge \mathbf{saw}(\mathbf{m})(\mathbf{j});\ \mathrm{S}}\mathrm{PI}$$

More complex examples such as (600) are derived in essentially the same way. In (600), the prenominal modifier is left stranded in each conjunct from the RNR'ed head noun. For this example, it suffices to assume that the mode of composition employed for putting together the prenominal modifier and the head noun is also associative.

(600) [Katate-nabe-de iti-rittoru-no], sosite [huka-nabe-de go-rittoru-no]
pan-with 1-liter-about-GEN and deep-pot-with 5-liter-GEN
oyu-o wakasi-masu.
water-ACC boil-POL
'Boil 1 liter of water in a pan and boil 5 liters of water in a deep pot.'

But since, unlike arguments of verbs, prenominal modifiers alone do not undergo scrambling, a separate mode $\circ_{\diamond}$ is posited, to which only Right (595) and Left (596) Association are applicable. The analysis of RNR, then, is essentially parallel to the case of (598) in (599) (here, VP abbreviates $\mathrm{NP}_{nom}\backslash_{\cdot}\mathrm{S}$, and in this and other derivations below, we omit the semantics).

(601)

$$\dfrac{\text{iti-rittoru-no};\ \mathrm{NP}/_{\diamond}\mathrm{NP} \qquad [\varphi_1;\mathrm{NP}_{acc}]^1}{\text{iti-rittoru-no} \circ_{\diamond} \varphi_1;\ \mathrm{NP}}/_{\diamond}\mathrm{E}$$

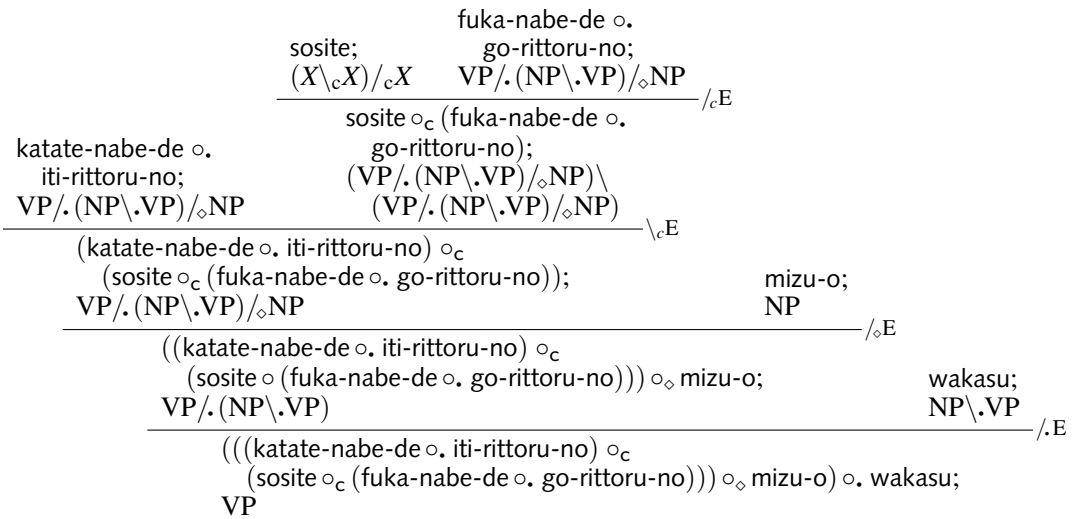
$$\dfrac{\text{iti-rittoru-no} \circ_{\diamond} \varphi_1;\ \mathrm{NP} \qquad [\varphi_2;\mathrm{NP}\backslash_{\cdot}\mathrm{VP}]^2}{(\text{iti-rittoru-no} \circ_{\diamond} \varphi_1) \circ_{\cdot} \varphi_2;\ \mathrm{VP}}\backslash_{\cdot}\mathrm{E}$$

$$\dfrac{\text{katate-nabe-de};\ \mathrm{VP}/_{\cdot}\mathrm{VP} \qquad (\text{iti-rittoru-no} \circ_{\diamond} \varphi_1) \circ_{\cdot} \varphi_2;\ \mathrm{VP}}{\text{katate-nabe-de} \circ_{\cdot} ((\text{iti-rittoru-no} \circ_{\diamond} \varphi_1) \circ_{\cdot} \varphi_2);\ \mathrm{VP}}/_{\cdot}\mathrm{E}$$

$$\dfrac{\text{katate-nabe-de} \circ_{\cdot} ((\text{iti-rittoru-no} \circ_{\diamond} \varphi_1) \circ_{\cdot} \varphi_2);\ \mathrm{VP}}{((\text{katate-nabe-de} \circ_{\cdot} \text{iti-rittoru-no}) \circ_{\diamond} \varphi_1) \circ_{\cdot} \varphi_2;\ \mathrm{VP}}\mathrm{PI}$$

$$\dfrac{((\text{katate-nabe-de} \circ_{\cdot} \text{iti-rittoru-no}) \circ_{\diamond} \varphi_1) \circ_{\cdot} \varphi_2;\ \mathrm{VP}}{(\text{katate-nabe-de} \circ_{\cdot} \text{iti-rittoru-no}) \circ_{\diamond} \varphi_1;\ \mathrm{VP}/_{\cdot}(\mathrm{NP}\backslash_{\cdot}\mathrm{VP})}/_{\cdot}\mathrm{I}^2$$

$$\dfrac{(\text{katate-nabe-de} \circ_{\cdot} \text{iti-rittoru-no}) \circ_{\diamond} \varphi_1;\ \mathrm{VP}/_{\cdot}(\mathrm{NP}\backslash_{\cdot}\mathrm{VP})}{\text{katate-nabe-de} \circ_{\cdot} \text{iti-rittoru-no};\ \mathrm{VP}/_{\cdot}(\mathrm{NP}\backslash_{\cdot}\mathrm{VP})/_{\diamond}\mathrm{NP}_{acc}}/_{\cdot}\mathrm{I}^1$$



Here again, the crucial step is the restructuring of the prosodic representation (shown on the fifth line of the first chunk). This restructuring enables assigning the category $\mathrm{VP}/.(\mathrm{NP}\backslash.\mathrm{VP})/_{\diamond}\mathrm{NP}$ to the "nonconstituent" conjuncts.

As should be clear from the above, in this multi-modal system, whether or not a particular substring of a sentence can be reanalyzed as a (nontraditional) constituent that can be coordinated depends on whether restructuring of the abstract phonology is possible. This predicts that in environments in which such restructuring is disallowed for independent reasons, NCC should be impossible. Kubota (2014, 2015) offers a detailed empirical demonstration that this architecture enables a principled account of the limited flexibility of constituency available in certain complex predicate constructions in Japanese.

11.4 Medial RNR via "Reanalysis" of Constituency

From the analysis of prenominal modifier stranding RNR in (601), it is only a small step to the medial RNR case in (583c). In fact, all we need to do is to allow for a restructuring possibility in which a substring of the whole coordinate structure corresponding to the right conjunct is "detached" from the coordinate structure and forms a unit with the RNR'ed material (after which further reordering of subconstituents takes place inside the right conjunct). For this purpose, we assume that the coordination mode allows for a restricted mode of restructuring whereby elements inside the coordinate structure are all allowed to move out of the coordinate structure. This can be achieved by recognizing the following Mixed Association rules ("mixed" in the sense that, unlike the

rules introduced above, these rules involve multiple modes in the specifications of the left-hand and right-hand expressions).

(602) Mixed Right Association
$A \circ_i (B \circ_c C) \leq (A \circ_i B) \circ_c C \qquad (\circ_i \in \{\circ_\diamond, \circ\!\!\cdot\})$

(603) Mixed Left Association
$(A \circ_c B) \circ_i C \leq A \circ_c (B \circ_i C) \qquad (\circ_i \in \{\circ_\diamond, \circ\!\!\cdot\})$

Importantly, there are no counterparts of these rules in which the modes $\circ_i$ and $\circ_c$ are switched from each other (e.g., $A \circ_c (B \circ_i C) \leq (A \circ_c B) \circ_i C$, with $\circ_i \in \{\circ_\diamond, \circ\!\!\cdot\}$). This effectively ensures that "extraction" out of a coordinate structure is allowed but "infixation" into a coordinate structure isn't.

With these rules in place, the prosodic representation obtained at the end of the derivation in (601) can be further restructured as follows, where, after restructuring, the right conjunct forms a unit with the RNR'ed material:

(604) (((katate-nabe-de $\circ\!\!\cdot$ iti-rittoru-no) $\circ_c$ (sosite $\circ_c$ (fuka-nabe-de $\circ\!\!\cdot$ go-rittoru-no))) $\circ_\diamond$ mizu-o) $\circ\!\!\cdot$ wakasu
$\leq$ (katate-nabe-de $\circ\!\!\cdot$ iti-rittoru-no) $\circ_c$ (sosite $\circ_c$ (fuka-nabe-de $\circ\!\!\cdot$ ((go-rittoru-no $\circ_\diamond$ mizu-o) $\circ\!\!\cdot$ wakasu))) (by Mixed Left Association (603), twice)

The string consisting of the right conjunct and the RNR'ed material is in effect "reanalyzed" as forming a full-fledged sentence by itself. Given this reanalysis, it straightforwardly follows that "co-arguments" of this reanalyzed sentence can be scrambled with each other, via the Scrambling rule (586).

(605) (katate-nabe-de $\circ\!\!\cdot$ iti-rittoru-no) $\circ_c$ (sosite $\circ_c$ (fuka-nabe-de $\circ\!\!\cdot$ ((go-rittoru-no $\circ_\diamond$ mizu-o) $\circ\!\!\cdot$ wakasu)))
$\leq$ (katate-nabe-de $\circ\!\!\cdot$ iti-rittoru-no) $\circ_c$ (sosite $\circ_c$ ((go-rittoru-no $\circ_\diamond$ mizu-o) $\circ\!\!\cdot$ (fuka-nabe-de $\circ\!\!\cdot$ wakasu)))
$\leq$ katate-nabe-de $\circ$ iti-rittoru-no $\circ$ sosite $\circ$ go-rittoru-no $\circ$ mizu-o $\circ$ fuka-nabe-de $\circ$ wakasu

We thus obtain the surface word order in (583c). The other examples in (583) can be derived analogously. In short, in the present multi-modal setup, the possibility of MRNR straightforwardly falls out from an interaction between independently motivated analyses of RNR and scrambling, once we allow for a possibility that the right conjunct is reanalyzed to form a unit with the RNR'ed material in the morpho-phonological representation.

A comparison is perhaps useful at this point with an ellipsis-based analysis of MRNR proposed by Yatabe (2012, 2013). In contrast to the "multi-modal" analysis sketched above, in which the existence of MRNR is almost an immediate prediction, the ellipsis-

based analysis Yatabe advocates captures the relevant empirical pattern essentially via a stipulation: in order to accommodate the MRNR pattern, Yatabe relaxes the condition on the relevant deletion operation so that the counterpart of the deleted string in the final conjunct can be discontinuous. However, unlike our analysis, such an account leaves unexplained why the matching string in the final conjunct and not the deleted string itself can be discontinuous. It then seems reasonable to conclude that, contrary to Yatabe's claim, the existence of MRNR actually provides additional support for the analysis of NCC in CG, rather than posing a challenge for it. The general architecture of grammar of the sort sketched above in which the restructuring operation in the prosodic component interacts with syntactic derivations in the combinatoric component finds independent support from the facts pertaining to the word order possibilities in complex predicate constructions in Japanese, as shown in detail in Kubota (2010, 2014). We take it that the MRNR pattern provides further empirical support for this architecture of grammar.

11.5 Extending the Analysis to English

The present proposal extends straightforwardly to English data that Whitman (2009) identifies as being problematic for his wrapping-based approach.[3] The relevant examples are repeated in (606)–(607).[4]

3. For examples like (582), we take it that Whitman's (2009) wrapping-based account (which can straightforwardly be adopted in our multi-modal setup) represents an adequate (and elegant) solution. Yatabe (2012, 2013) rejects Whitman's analysis based on an observation, originally due to Sabbagh (2014), that "right-node wrapped" quantifiers cannot scope over conjunction:

(i) a. The lieutenant will either arrest or shoot **every suspected arsonist** with his rifle. ($\vee > \forall$/* $\forall > \vee$)
b. The lieutenant will either arrest or shoot with his rifle, **every suspected arsonist**. ($\vee > \forall$/ $\forall > \vee$)

But such a scoping pattern is possible, at least with indefinites, in examples such as the following:

(ii) Picasso designed, built, and gave **a giant sculpture** to Chicago. (Whitman 2009)

We leave for future research to determine what principle governs the scopal interactions between quantifiers and Right-Node Wrapping.

4. Whitman (2009) additionally gives the following examples as potential problems for a wrapping-based approach to Right-Node Wrapping:

(i) a. [Mothers now cheerfully push strollers] and [kids dash] through his sculptures as if they were playgrounds.
b. We've got information on [where else] and [what else] he's wanted for.

For (ia), it seems possible to take the sentence-final modifier to be modifying both conjuncts, in which case it is not an instance of MRNR. (ib) involves an unlike category coordination of *wh* expressions, which is known to exhibit several idiosyncrasies (see Whitman [2004] for a detailed study of this construction). Since the exact licensing condition of this *wh* coordination pattern is itself currently not very well understood, we leave an analysis of (ib) for future research.

(606) . . . the right of governments to [safeguard], [promote], and even [protect] their cultures from outside competition.

(607) a. Please move from the exit rows if you are [unwilling] or [unable] to perform the necessary actions without injury.

b. In the players' box was Tony Nadal, the [uncle] and [coach] of Rafael Nadal since he started playing as a youngster.

(606) is an example in which both the first and the third (but not the second) conjuncts share a material which wraps around the direct object. This type of example is derivable in a multi-modal system by assuming a phonetically null conjunction between the first and second conjuncts (perhaps tied to the intonational break), conjoining *safeguard* and *promote and even protect* in the category $\mathrm{VP}/(\mathrm{VP}/_w\mathrm{NP})\backslash(\mathrm{VP}/_w\mathrm{NP})/_w\mathrm{NP}$ (where *w* stands for the "wrapping" mode and $(\mathrm{VP}/_w\mathrm{NP})\backslash(\mathrm{VP}/_w\mathrm{NP})$ is the category of *from outside competition*).[5]

For the examples in (607), there is an analytic possibility (which Whitman does not consider in detail, though he mentions in passing a related idea) according to which they essentially instantiate the same pattern as the Japanese medial RNR examples in (583). More specifically, given that there is a certain degree of freedom in word order for adverbs, it seems possible to take the examples in (607) as order variants of some ordinary RNR sentences. On this view, the word order in (607) is obtained by surface reordering of the adverb, which takes place in a "reanalyzed" constituent consisting of the right conjunct and the RNR'ed material, just as in the related Japanese examples in (583). Whitman (2009) takes surface restructuring in RNR to be possible only with expressions that combine in the wrapping mode, effectively limiting MRNR to cases where surface reordering is *obligatory* independently of RNR. This is why his approach does not extend to the examples in (607). But we do not see any reason for restricting the interaction between surface restructuring and RNR. Our suggestion here is essentially to generalize the approach due to Whitman (2009) to cases where surface restructuring is optional.

To see how this approach may work, note first that a shorter adverb such as *safely* can be placed either before or after the whole infinitival VP:

(608) a. . . . an employee is unable safely to perform a non-essential job function . . . https://law.resource.org/pub/us/case/reporter/F3/213/213.F3d.209.97-50367.html

5. Phonetically null conjunction is also needed in the analysis of certain nonconstituent coordination such as the following (Beavers and Sag 2004):

(i) Jan travels to Rome tomorrow, to Paris on Friday, and will fly to Tokyo on Sunday.

b. unable to perform a non-essential job function safely

With the expression *without injury*, as Whitman notes, the preverbal position is at best awkward.

(609) ??unable without injury to perform the necessary actions

But given the acceptability of (608a), we take the awkwardness of (609) to result from some extragrammatical factors (perhaps having something to do with disrupted prosodic alignment), and we take it that the grammar is equipped with a mechanism that derives both of the orders in (608) for (any type of) adverbial expressions modifying VPs. For this purpose, we assume that the adjective *unable* and the VP modifier *without injury* combine with the infinitive in the *reordering mode*, for which the following deducibility relation holds, as well as (both ordinary and Mixed) Left and Right Association:

(610) Reordering
$A \circ_r (B \circ_r C) \leq A \circ_r (C \circ_r B)$

This is somewhat similar to the Japanese *Scrambling* mode, but since English is head-initial, the element that stays in situ and which serves as the "pivot," as it were, of the reordering is on the left of the elements that actually undergo reordering.

With these assumptions, (607a) can be derived as follows:

(611)
$$\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{}{\mathsf{unable};\ \mathrm{Adj}/_r\mathrm{VP}_{inf}} \quad \dfrac{[\varphi;\mathrm{VP}_{inf}]^1 \quad \mathsf{without}\circ\mathsf{injury};\ \mathrm{VP}_{inf}\backslash_r\mathrm{VP}_{inf}}{\varphi\circ_r(\mathsf{without}\circ\mathsf{injury});\ \mathrm{VP}_{inf}}\backslash_r\mathrm{E}}{\mathsf{unable}\circ_r(\varphi\circ_r(\mathsf{without}\circ\mathsf{injury}));\ \mathrm{Adj}}\mathrm{PI}}{(\mathsf{unable}\circ_r(\mathsf{without}\circ\mathsf{injury}))\circ_r\varphi;\ \mathrm{Adj}}\mathrm{PI}}{\mathsf{unable}\circ_r(\mathsf{without}\circ\mathsf{injury});\ \mathrm{Adj}/_r\mathrm{VP}_{inf}}/_r\mathrm{I}^1 \quad \vdots \quad \vdots}{\mathsf{unwilling}\circ_c(\mathsf{or}\circ_c(\mathsf{unable}\circ_r(\mathsf{without}\circ\mathsf{injury})));\ \mathrm{Adj}/_r\mathrm{VP}_{inf} \quad (\mathsf{to}\circ\mathsf{perform}\circ\ldots);\ \mathrm{VP}_{inf}}/_r\mathrm{E}}{(\mathsf{unwilling}\circ_c(\mathsf{or}\circ_c(\mathsf{unable}\circ_r(\mathsf{without}\circ\mathsf{injury}))))\circ_r(\mathsf{to}\circ\mathsf{perform}\circ\ldots);\ \mathrm{Adj}/_r\mathrm{VP}_{inf}}\mathrm{PI}}{\mathsf{unwilling}\circ_c(\mathsf{or}\circ_c(\mathsf{unable}\circ_r((\mathsf{without}\circ\mathsf{injury})\circ_r(\mathsf{to}\circ\mathsf{perform}\circ\ldots))));\ \mathrm{Adj}/_r\mathrm{VP}_{inf}}\mathrm{PI}}{\mathsf{unwilling}\circ_c(\mathsf{or}\circ_c(\mathsf{unable}\circ_r((\mathsf{to}\circ\mathsf{perform}\circ\ldots)\circ_r(\mathsf{without}\circ\mathsf{injury}))));\ \mathrm{Adj}/_r\mathrm{VP}_{inf}}\mathrm{PI}}{\mathsf{unwilling}\circ\mathsf{or}\circ\mathsf{unable}\circ\mathsf{to}\circ\mathsf{perform}\circ\ldots\circ\mathsf{without}\circ\mathsf{injury};\ \mathrm{Adj}/_r\mathrm{VP}_{inf}}\mathrm{PI}$$

Here, by hypothesizing an embedded infinitival VP and then reordering it to the right periphery, *unable without injury* is derived as $\mathrm{Adj}/_r\mathrm{VP}_{inf}$. Since this is the same category as the left conjunct *unwilling*, the two are coordinated and then combined with the argument infinitival VP. Via restructuring which "incorporates" the RNR'ed material to the right conjunct, the VP modifier *without injury* can then be put back to

its sentence-final position, just as in the Japanese MRNR example in (583). In short, the grammaticality of (607a) is a predicted consequence of the relative free order of adverbs modifying VPs.

(607b) receives a similar treatment. Note first that appositive postnominal modifiers can appear with or without the definite article.

(612) a. Tony Nadal, the coach of Rafael Nadal, . . .
b. Tony Nadal, coach of Rafael Nadal, . . .

Given this, (607b) can be analyzed as a word order variant of the following:

(613) . . . was Tony Nadal, [the uncle] and, [since he started playing as a youngster, coach] of Rafael Nadal

In (613), the *since* clause is reordered to the beginning of the second conjunct from its conjunct-final position. (613) can be derived as a standard case of RNR, and, via further reordering after the incorporation of the RNR'ed material to the second conjunct, the surface order in (607b) is obtained.

To summarize, just as in the Japanese examples involving scrambling discussed above, in these English examples too, the apparently problematic MRNR pattern in fact receives a straightforward analysis in a multi-modal fragment, once independently motivated factors regulating relatively flexible word order possibilities of the relevant expressions are properly taken into account.

11.6 Conclusion

Medial RNR apparently poses a quite serious challenge to the like-category constituent coordination analysis of RNR standard in CG. Moreover, the phenomenon is not limited to just one language, nor is it linked to one specific type of word order variation (such as wrapping). We have shown in this chapter that, despite these apparent challenges, MRNR in fact receives a straightforward analysis in a multi-modal variant of CG. As demonstrated above, in a multi-modal system, the existence of this pattern of RNR essentially falls out from independently motivated analyses of RNR on the one hand and of phenomena (such as scrambling in Japanese) that pertain to surface word order on the other. Moreover, this analysis leads to a more principled account of the data than an ellipsis-based alternative due to Yatabe (2012, 2013); the latter type of approach leaves unexplained why the licensor string rather than the deleted string can be discontinuous. More generally, the phenomenon of MRNR is important since it provides yet another type of evidence for the architecture of grammar embodied in multi-modal variants of CG. The analysis presented above crucially exploits the multi-modal architecture in which grammatical inferences pertaining to surface word order are interspersed with inferences pertaining to the combinatoric component of grammar.

The conclusion of the present chapter thus reinforces the general conclusion in Kubota (2014) that such an architecture of grammar is essential in capturing complex interactions between phenomena pertaining to surface word order (such as scrambling) and those pertaining to the combinatoric component (such as coordination) found in natural language.

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By: Yusuke Kubota, Robert D. Levine

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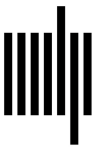

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