Nonconstituent coordination in Japanese as constituent coordination: An analysis in Hybrid Type-Logical Categorial Grammar

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Abstract

Nonconstituent coordination poses a particularly challenging problem for standard kinds of syntactic theories in which the notion of phrase structure (or constituency) is taken to be a primitive in some way or other. Previous approaches within such theories essentially equate nonconstituent coordination with coordination of full-fledged clauses at some level of grammatical representation. I present data from Japanese that pose problems for such approaches and argue for an alternative analysis in which the apparent nonconstituents are in fact surface constituents having full-fledged meanings, couched in a framework called *Hybrid Type-Logical Categorial Grammar* (Kubota 2010; Kubota and Levine 2012; Kubota to appear).

Keywords: nonconstituent coordination, categorial grammar, Hybrid Type-Logical Categorial Grammar, parasitic scope, Late Merge, Japanese

1 Introduction

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* (NCC). A typical example is given in (1).[1]

(1) [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 (1), strings of words consisting of the subject and the object are coordinated. The conjunction *sosite* is optional. I call the rightmost string (here, the verb *mi-ta*) shared by the conjuncts the *pivot* (borrowing Sabbagh's (2007) term).

NCC has turned out to be a rather recalcitrant problem. In the literature, there are two competing strands of analysis of this construction: *deletion-based approaches* and *movement-based approaches*. These approaches have in common the property that they assimilate NCC to coordination of full-fledged clauses at some level of grammatical representation (be it surface structure or LF) that ultimately feeds into semantic interpretation. However, as I discuss in section 2, both approaches suffer from several problems precisely due to this assumption of equating NCC with clausal coordination. This suggests that the right solution for the problem comes from taking an entirely different approach. I argue in this paper that what is needed is to analyze the apparent "nonconstituents" as surface constituents and directly assign to them full-fledged meanings. From the viewpoint of most standard theories of syntax, such an analysis would seem to be difficult (or almost impossible) to formulate; it turns out that categorial grammar (CG), wherein the notion of constituency is radically reconceptualized, provides exactly the right theoretical architecture to formulate an analysis along these lines. From the work by Steedman (1985) and Dowty (1988), it is already well-known that the basic syntactic patterns of NCC can be elegantly captured in CG. The novel contribution of the present paper lies in extending this line of work and demonstrating that the real advantage of this reconceptualization of constituency becomes fully apparent when embedded in a flexible and systematic framework of syntax-semantics interface—a feature lacking (or available only to a limited degree) in previous variants of CG. The framework that I propose in this paper, called *Hybrid Type-Logical Categorial Grammar*, integrates several strands of development of contemporary CG and overcomes the limitations of its predecessors. I show that the novel hybrid implication architecture of the proposed framework enables a straightforward solution for a range of empirical problems that turn out to be highly problematic for both of the two types of previous approaches.

While this paper focuses on NCC in Japanese, it should be noted that the flexibility of constituency and a straightforward and explicit mapping between syntax and semantics underlying CG-based theories are justified by a much wider range of empirical phenomena. For example, as discussed by Steedman (1985) and Kubota (to appear), it yields successful analyses of the morpho-syntactic clustering of complex predicate constructions in languages like Dutch and Japanese, where surface (essentially monoclausal) syntactic structure does not directly reflect the deep biclausal (or complex) semantic structure involved in those predicates. A pattern that is perhaps more directly related to the problem of NCC is found in the cleft construction in Japanese. As discussed by Koizumi (1995) and Takano (2002), the Japanese cleft construction allows for multiple constituents to appear in the focus position (the italicized part), as exemplified by the following example:

(2) 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.'

Examples like (2) pose a rather vexed issue for many syntactic theories and have provoked much discussion in the recent literature (cf., e.g., Koizumi 1995; Takano 2002; Fukui and Sakai 2003; Fukushima 2003; Kubota and Smith 2006). As shown by Kubota and Smith (2006), an analysis of such nonconstituents is straightforward (and is essentially parallel to the analysis of NCC) in CG-based theories that entertain flexibility of constituency.

The paper is structured as follows: section 2 presents the data and discusses previous approaches; section 3 introduces the framework of Hybrid Type-Logical Categorial Grammar and formulates the analysis of NCC in it; section 4 concludes the paper.

2 Data and Previous Analyses

The analysis of NCC in Japanese is a controversial issue 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). Previous proposals can roughly be classified into two types: *deletion-based* approaches and *movement-based* approaches. Below, I first review arguments for the two types of approaches respectively, and then point out three kinds of data that pose problems for all existing analyses of NCC, whether deletion-based or movement-based.

2.1 Arguments for Deletion-Based Analyses

Kageyama (1993), Mukai (2003), and Sato (2009) argue for deletion-based analyses of NCC. On this view, example (1) is analyzed in terms of some kind of deletion operation, which is generally assumed to take place in the phonological component (PF/SpellOut), as in (3).[2]

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

The condition for this deletion process 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 NCC does not seem to respect surface constituency. For example, as in (4), the nominal head can be left stranded from a prenominal adjective that modifies it in a nonfinal conjunct.

(4) [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.'

There are even cases, noted by Mukai (2003), where a relative clause is split in the middle, partly belonging to the coordinated string and partly belonging to the pivot, violating the complex NP constraint:

(5) [Ken-ga *tora-ni*], (sosite) [Jun-ga *kuma-ni*] ***osow-are-ta*** ***otoko*-o** **tasuke-ta**.
Ken-NOM tiger-DAT and Jun-NOM bear-DAT attack-PASS-PAST man-ACC save-PAST
'Ken saved a man who was attacked by a lion and Jun a man who was attacked by a bear.'

Importantly, leftward scrambling corresponding to (4) and (5) is strictly ungrammatical.

(6) *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.'

(7) *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, the flexible patterns of NCC in (4) and (5) would be mysterious if NCC were derived by movement. 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. Note especially the difficulty posed by examples like (5) in which an NP containing a relative clause is split in the middle of the relative clause. In movement-based approaches, NCC is reduced to constituent coordination by assuming that the coordinated apparent nonconstituents are remnants of a movement operation (or a series of movement operations) that moves the expressions that constitute the pivot to a syntactically higher position in an ATB fashion (see, e.g., Koopman and Szabolcsi 2000:225, and especially the discussion in Koizumi 1995, 2000 for Japanese NCC). At a very general level and at least for a certain subset of the data, such an approach can simulate Dowty's (1988) CG analysis of NCC within a movement-based setup (assuming that the relevant movement operations can be independently motivated). However, such an analysis does not generalize to examples like (4) and (5). In particular, for (5), a relative clause modifying a noun needs to be split in the middle, but a movement operation that enables such radical restructuring of constituency has not been proposed for any other construction and thus lacks independent motivation.

The data in (4) and (5) thus seem to favor a deletion-based approach very strongly. But it is important to note here that the flexibility of constituency found in NCC is not totally unconstrained. A case that shows this point particularly strikingly comes from the so-called "syntactic compounding" constructions (Shibatani and Kageyama 1988; Kageyama 1993), including the *-te* form complex predicate (McCawley and Momoi 1986) and what Kageyama (1993) calls the "S-structure nominal compounds."

The *-te* form complex predicate is a kind of complex predicate in which the embedded verb of the sentence-final verb cluster is marked with the suffix *-te* (*ki-te* 'come' in (8)).

(8) John-wa Mary-ni **ki-te** **morat-ta**.
John-TOP Mary-DAT come-te BENEF-PAST
'John had Mary come for him.'

This construction has long been regarded as a problem in the literature of Japanese syntax since it does not fit neatly in the classification of complementation constructions in Japanese (see Kubota 2008, to appear and references cited therein). In particular, it shows mixed evidence for the morphological wordhood of the sequence involving the lower verb (V1) and the higher verb (V2). In terms of the accentuation pattern, the two verbs behave like separate words since both V1 and V2 receive independent main accents of their own. The two verbs can moreover be separated by focus particles, as in (9).

(9) 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 her.'

The *-te* form complex predicate contrasts with the more typical, morphological complex predicates such as compound verbs (*tabe-hazime* 'eat-begin') and causative and passive predicates (*tabe-sase* 'east-cause', *tabe-rare* 'eat-PASS') in both of these respects.

There are, however, also pieces of evidence that suggest that the two verbs are not completely independent from each other syntactically, including the pattern in NCC. As shown by the following contrast, forming an argument cluster coordination with the arguments of both V1 and V2 (factoring out the entire verb cluster in the pivot) is possible, but forming NCC by factoring out V2 alone leads to ungrammaticality.

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

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

Intuitively, the reason that (10b) is bad is that the V1-V2 cluster is split apart via NCC. There are other phenomenon such as adverb placement that similarly suggest that there is some kind of adjacency requirement between V1 and V2 in this construction. What is relevant for the present discussion is that the contrast in (10) suggests that coordination is sensitive to certain kinds of constraints regulating syntactic flexibility, despite what might initially appear from the radically flexible patterns of NCC exemplified by (4) and (5) above. Note importantly that a purely phonological explanation is unlikely for the contrast in (10). In terms of the accentuation pattern (which is clearly phonological), the two verbs are treated as separate words. Thus, the relevant constraint that captures the difference between (10a) and (10b) has to be stated at some level of (morpho-)syntactic representation.

An essentially identical pattern is found with what Kageyama (1993) calls the "S-structure nominal compounds," which involve certain nouns and nominal suffixes such as *ori* 'occasion', *sai* 'occasion', *-tyuu* 'during', and *-go* 'after'.

(11) a. syusyoo-ga Tyuugoku-{o/no} { hoomon-go / hoomon-no ori }
prime.minister-NOM China-{ACC/GEN} visit-after visit-GEN occasion

'after/during the prime minister's visit to China'

b. syusyoo-ga Tyuugoku-{hoomon-go/hoomon-no ori}
prime.minister-NOM China-visit-after/visit-GEN occasion
'after/during the prime minister's visit to China'

(11a) shows the normal case-marking pattern for the Sino-Japanese verbal noun (VN) *hoomon* 'visit', which is syntactically a noun but semantically an event-denoting expression with a verb-like meaning. The accusative/genitive alternation in case marking reflects its mixed property. (11b) shows the "syntactic incorporation" option for this construction and is relevant for the present discussion. Here, the absence of the case marker on the argument NP *Tyuugoku* 'China' suggests that this argument is incorporated to the VN to form a single word. However, as discussed by Shibatani and Kageyama (1988) and Kageyama (1993), the compounding pattern here is significantly different from the more typical N-N compounds in Japanese in terms of a series of empirical tests, including insensitivity to anaphoric islands and the possibility of incorporating phrase-level expressions. Most importantly, as noted by Shibatani and Kageyama (1988), despite the lack of case marker, the accentuation patterns in (11a) and (11b) are indistinguishable, and the incorporated argument in (11b) receives its own main accent distinct from the one for the VN, suggesting that, even in (11b), the two morphemes still constitute distinct phonological words. This is in sharp contrast with typical N-N compounds where the whole compound receives a single main accent and is treated as a single word at the phonological level as well.

In view of this, note the contrast between the following examples:

(12) a. syusyoo-ga Rondon-ni, zoosyoo-ga Pari-ni taizai-tyuu
prime.minister-NOM London-DAT finance.minister-NOM Paris-DAT stay-during
'during the prime minister's stay in London and the minister of finance's stay in Paris'

b. *syusyoo-ga Rondon, zoosyoo-ga Pari-taizai-tyuu
prime.minister-NOM London finance.minister-NOM Paris-stay-during
intended: 'during the prime minister's stay in London and the minister of finance's stay in Paris'

As in (12), forming NCC by factoring out the VN alone in the pivot and thereby separating the incorporated argument and the VN leads to ungrammaticality, whereas the same pattern is fully acceptable if the same argument remains unincorporated. This again suggests that, just like the two verbs in the *-te* form complex predicate, the incorporated argument and the VN here form some sort of inseparable unit that blocks syntactic operations such as NCC. Note in particular that, as pointed out above, accentuation patterns point to the independent phonological wordhood of the two morphemes, again precluding the possibility of accounting for the contrast in (12) purely at the level of surface phonological representation.

2.2 Arguments for Movement-Based Analyses

The island insensitivity of NCC exhibited by data such as (4) and (5) seem to strongly support deletion-based analyses of NCC. In particular, from these data alone, it looks like the phenomenon takes place at the phonological component, without making reference to syntactic constituency at all. However, the patterns involving syntactic compounding constructions reviewed at the end of the previous section suggest that this view is too simple. Further problems (of a somewhat different nature) for purely deletion-based analyses come from a set of data in which the semantic identity of some shared material becomes relevant, which I review in this section. These cases turn out to be more amenable to movement-based analyses, either in terms of right-node raising (Kuno 1978; Saito 1987), LF-copying (Abe and Hoshi 1997), or NP adjunction (Takano 2002) (Koizumi (2000) proposes a verb raising analysis for *to*-coordination, which, if extended to NCC, belongs to this group as well).

The first piece of evidence against deletion-based analyses and for movement-based analyses involves a lexically polysemous word. As noted by Zwicky and Sadock (1975) and Zaenen and Karttunen (1984) ("Anti-Pun Ordinance"), ambiguous expressions cannot receive different interpretations across different conjuncts. Mukai (2003) (attributing the observation to Hajime Hoji (p.c.)) shows that this is indeed the case with NCC in Japanese as well. The word *kumo* in (13) is ambiguous between 'cloud' and 'spider'. When this word appears in the pivot, it cannot be understood in the two different meanings in different conjuncts.

(13) 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.'

This remains unexplained in an analysis in terms of deletion under phonological identity.[3]

Second, Fujino (2008) gives a similar example involving an idiom *sazi-o nage* (lit.) 'throw a spoon' whose idiomatic meaning is 'give up'. As shown in (14), if the sentence does not involve NCC, it is ambiguous between the idiomatic and the literal interpretations.

(14) 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 (15), the idiomatic interpretation is lost.

(15) [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 phonological deletion analysis fails to explain this fact.

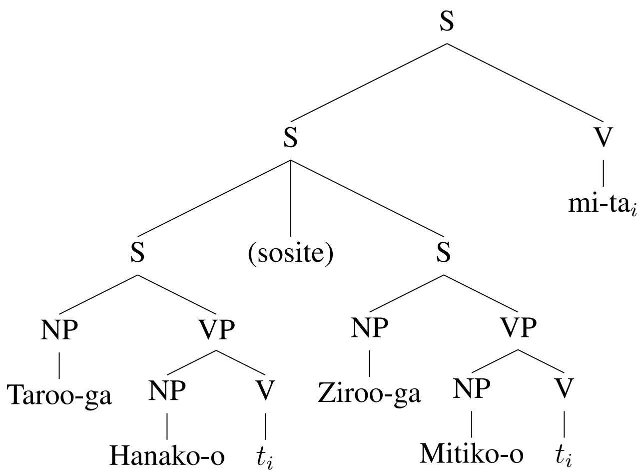
Finally, Sato (2009) notes cases like (16), involving semi-idiomatic collocations.

(16) *[John-ga kono kikaku-o], (sosite) [Bill-ga ano mokuhyoo-o] **tate-ta**.
John-NOM this plan-ACC and Bill-NOM that goal-ACC 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' (and the verb seems to share at least some core meaning in its two uses here), but, as shown by the ungrammaticality of (16), NCC cannot be formed in such a way that 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 (13), (15), and (16) 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 (1), where the pivot undergoes an across-the-board (ATB) rightward movement:

(17)



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, these examples are straightforwardly ruled out.

I hasten to add here that these examples do not constitute knockdown arguments against deletion-based approaches: if one takes semantic identity in addition to (or instead of) phonological identity as the licensing condition for deletion (as has been assumed by some), cases like above cease to pose problems for deletion-based analyses. But given that the main motivation for deletion-based approaches comes from the fact that the operation appears to target (completely unstructured) strings of words, as evidenced by the examples in (4) and (5), such an assumption (i.e. reference to a semantic property in a process that is taken to be purely phonological) is evidently *ad hoc*, as noted by Sato (2009). 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 problems that I discuss immediately below.

2.3 Problems for both Deletion-Based and Movement-Based Analyses

Here, I present three classes of data that pose problems for all previous analyses of NCC, whether deletion-based or movement-based. These all involve interactions between NCC and scopal phenomena at the syntax-semantics interface: (i) symmetrical, summative, and "respective" predicates; (ii) anaphoric expressions and (iii) biclausal complex predicates.

I start with the case involving symmetrical, summative, and "respective" predicates. Takano (2002) notes that the word *onazi* 'same', when it appears in the pivot of NCC, can induce the so-called *internal reading* (Carlson 1987). The same holds true of expressions such as *nita* 'similar' and *betu-no* 'different' as well. The relevant data are shown in (18).

(18) a. Ken-ga Mari-ni, (sosite) Jun-ga Nao-ni **onazi hon-o** kasi-ta.
Ken-NOM Mari-DAT and Jun-NOM Nao-DAT same book-ACC lend-PAST
'Ken lent Mari and Jun lent Nao, the same book.'

b. Ken-ga Mari-ni, (sosite) Jun-ga Nao-ni **betu-no hon-o** kasi-ta.
Ken-NOM Mari-DAT and Jun-NOM Nao-DAT different book-ACC lend-PAST
'Ken lent Mari and Jun lent Nao, different books.'

(18a) is ambiguous between two readings. On one reading, the word *onazi* anaphorically refers to some entity already salient in the discourse and identifies it with the book that Ken lent to Mari and Jun lent to Nao. This is the *external reading*. But there is another reading of the sentence in which it does not make reference to any discourse-salient entity. This is the reading where the sentence simply asserts the identity of the book that Ken lent to Mari and the one that Jun lent to Nao. This latter reading is called the *internal reading*. The same kind of ambiguity is found with (18b). On the internal reading, the sentence simply asserts the nonidentity of the books that Ken lent to Mari and Jun lent to Nao.

The availability of the internal reading for these sentences is problematic for deletion-based analyses since this interpretation is completely lacking in sentences in which the alleged deletion process does not take place. (19) has only the external reading.

(19) Ken-ga Mari-ni onazi hon-o kasi, Jun-ga Nao-ni onazi hon-o
Ken-NOM Mari-DAT same book-ACC lend Jun-NOM Nao-DAT same book-ACC
kasi-ta.
lend-PAST
'Ken lent the same book to Mari and Jun lent the same book to Nao.'

Movement-based analyses do not fare any better. All movement-based analyses except for Takano 2002 analyze NCC 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 each conjunct, 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.[4] But then, it remains a mystery why sentences involving NCC are not always synonymous with their clausal counterparts.[5] Note that essentially the same problem arises in the more recent Copy theory of movement (Chomsky 1995) that does away with reconstruction, since, so far as this problem is concerned, the Copy theory is a notational variant of the reconstruction-based approach. The only way to salvage the movement-based approach here seems to be to drop the assumption that the NP containing *onazi* is obligatorily reconstructed to its extraction sites in the two conjuncts at LF, and allow it to be interpreted at some higher node that it has been moved to. Such an analysis has in fact been suggested by Sabbagh (2007) for English right-node raising.[6] I will not explore this possibility further here since, as Koizumi (2000) points out (cf. footnote 2), given the data discussed in section 2.1, movement-based analyses of Japanese NCC are problematic on independent grounds.

The mismatch between NCCs and their alleged clausal counterparts in terms of semantic interpretation is not unique to symmetrical predicates such as *same*, but is found in a much wider domain. The classical examples involve scope mismatch with downwardentailing quantifiers like *no* and *few* (Partee 1970), but since it is not clear whether Japanese has truly quantificational expressions of the generalized quantifier type,[7] I will illustrate the point with expressions that bear a certain similarity with symmetrical predicates. The relevant data come from expressions like *gookei-de N* ‘N in total’, which I call “summative predicates,” and the so-called “respective” readings of coordinated and plural expressions.

(20) Ken-ga Mari-ni (sosite) Jun-ga Nao-ni **gookei-de 30,000-en** kasi-ta.
Ken-NOM Mari-DAT and Jun-NOM Nao-DAT in.total 30,000-yen lend-PAST
‘Ken lent Mari and Jun lent Nao a total of 30,000-yen.’

(21) Taroo-ga Hanako-ni, (sosite) Ziroo-ga Mitiko-ni **sorezore**
Taro-NOM Hanako-DAT and Jiro-NOM Michiko-DAT respectively
Syntactic Structures-to *LGB*-o kasi-ta.
Syntactic Structures-and *LGB*-ACC lend-PAST
‘Taro and Jiro lent Hanako and Michiko *Syntactic Structures* and *LGB*, respectively.’

Similar facts are noted for English right-node raising by Chaves (2012). These examples, together with the symmetrical predicate examples in (18), seem to share the property that something like a generalized notion of distributivity is involved, giving rise to interpretations that cannot be paraphrased by their clausal counterparts. However, no explicit analysis that accounts uniformly for the proper interactions between NCC and these phenomena have been proposed in the previous literature. In the next section, I formulate such an analysis by building on the analysis of *same* in terms of *parasitic scope* proposed by Barker (2007).

The second class of phenomena that pose problems for both kinds of previous approaches comes from the interaction of the interpretation of anaphoric expressions such as the reflexive *zibun*, the reciprocal *otagai* and the pronominal expression *sono* (similar facts are noted for German (von Stechow 1990) and English (Jacobson 1999; Dowty 2007; Steedman 2012)).

It is well-known that the subject-oriented reflexive *zibun* in Japanese 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 NCC is formed based on (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.[8]

(23) Ken-wa Mari-ni, (sosite) Jun-wa Nao-ni **zibun-no** heya-de odor-ase-ta.
Ken-TOP Mari-DAT and Jun-TOP Nao-DAT self-GEN room-in dance-cause-PAST
'Ken$_i$ made Mari dance in his$_i$ room and Jun$_j$ made Nao dance in his$_j$ room.'
'Ken made Mari$_i$ dance in her$_i$ room and Jun made Nao$_j$ dance in her$_j$ room.'

This fact remains mysterious in pure phonological deletion analyses, since the counterpart of (23) without the alleged deletion operation is ambiguous in all of the four ways.[9]

And again, movement-based analyses fare no better. In movement-based analyses, the surface structure cannot be taken to be the structure relevant for binding conditions, since, with the pivot displaced from the conjuncts, the potential binders do not even c-command the reflexive there (cf. the tree in (17)). 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 the exact details are—need to be stated in such a way as to account for the ambiguity of (22). But if so, it is difficult to see how the unavailable readings for (23) are blocked. If both NPs are possible binders when NCC is not involved (and they *are* possible binders in NCC as well, as long as the structural positions of the binders match in each conjunct), it remains mysterious why (23) lacks the mixed readings.

The parallel interpretation condition is not restricted to the reflexive, but is found with the reciprocal *otagai* and the pronominal *sono* as well, as shown in the following examples:

(24) Sensei-tati-ga seito-tati-ni, (sosite) seito-tati-ga sensei-tati-ni,
Teacher-PL-NOM student-PL-DAT and student-PL-NOM teacher-PL-DAT
otagai-no mondai-o sitekisi-ta.
each.other-GEN problem-ACC point.out-PAST
'The students and the teachers pointed out each other's problems.'

(25) Dono zidoosya-gaisya-ga dono kogaisya-ni (sosite) dono tekkoo-meekaa-ga
which auto-company-NOM which subsidiary-DAT and which steel-company-NOM
dono keiretu-gaisya-ni **soko-no** torihiki-saki-no kabu-o kaw-ase-ta-no?
which affiliate-company-DAT that-GEN client-GEN stock-ACC buy-cause-PAST-Q
'Which auto maker made which of its subsidiary companies buy the stocks of its clients and which steel maker made which of its affiliate company buy the stocks of its clients?'

The reciprocal *otagai* can either take the subject alone, the object alone or the subject and the object together as the antecedent. As might be expected, (24) is not nine-way ambiguous, but is only three-way ambiguous; all the nonparallel interpretations are impossible. Similarly, the pronominal *sono* can take either the subject or the object as the antecedent, but the grammatical relation of the antecedent has to match in the two conjuncts in (25).

Finally, certain subsets of the semantically biclausal complex predicates induce wide scope interpretations with respect to an argument cluster constituent when they interact with NCC. These data again pose problems for both deletion-based and movement-based approaches. The relevant data come from examples like those in (26).

(26) a. [John-ni kono hon-o] matawa [Bill-ni ano hon-o] mise-tai-none?
John-DAT this book-ACC or Bill-DAT that book-ACC show-want-PRT
'(You) want to show this book to John or that book to Bill, right?'

b. Nihon-wa [Amerika-kara komugi-o] matawa [Tyuugoku-kara daizu-o]
Japan-TOP America-from wheat-ACC or China-from soy.bean-ACC
maitosi yunyuu-si-tuzuke-ta.
every.year import-do-continue-PAST

'Japan continued to import wheat from the US or soy beans from China every year.'

(26a) involves the desiderative predicate *-tai*, which is a verbal suffix. The sentence has a reading in which the desiderative semantically scopes over the whole disjunction (want > $\vee$), where your desire can be satisfied either by showing this book to John or by showing that book to Bill. (It seems that the '$\vee$ > want' reading is marginally available as well, but is dispreferred for pragmatic reasons.) (26b), involving the raising verb *tuzuke* 'continue', similarly exhibits the disjunction-narrow scope interpretation that can be satisfied as long as either one of the two products was imported (from one of the two countries) each year. Note that this interpretation has weaker truth conditions than the disjunction-wide scope interpretation, which requires either one of the two products to be continuously imported throughout.

Deletion-based analyses of NCC fail to predict this fact. If (26a) is derived by deleting the entire verbal complex, then (26a) should be equivalent to its nonelided source in (27), but (27) is unambiguous in the disjunction-wide scope interpretation.

(27) [John-ni kono hon-o mise-tai] matawa [Bill-ni ano hon-o
John-DAT this book-ACC show-want or Bill-DAT that book-ACC
mise-tai]-none?
show-want-PRT
'(You) want to show this book to John or (you) want to show that book to Bill, right?'

To get the semantic scope right, the lower verb alone would have to undergo deletion (from a structure involving coordination of the embedded VP). However, the alleged nonelided source (28) again does not have the same meaning as (26a). It is at best awkward, and can only be interpreted as a coordination of full-fledged clauses at the matrix level rather than (the intended) coordination of the embedded VPs, as indicated in the English translation.

(28) ?[John-ni kono hon-o mise] matawa [Bill-ni ano hon-o mise]-tai-no-ne?
John-DAT this book-ACC show or Bill-DAT that book-ACC show-want-PRT
'(You) showed this book to John, or (you) want to show that book to Bill.'

Here again, movement-based approaches are no better, suffering from similar problems as in the two cases above. Examples like (26) in their auxiliary-wide scope interpretations are derived in movement-based approaches from an underlying structure like (28) via a verb-raising type ATB movement of the lower verb, which adjoins it to the higher verb to form a verbal complex. One has to then ensure that this lower verb is reconstructed to its extraction sites in the two conjuncts at LF. This complicates the syntax-semantics interface considerably, since it effectively means that one needs to distinguish between expressions (like the symmetrical predicate *onazi*) that do not undergo reconstruction at LF and those that do. However, there does not seem to be any general principle from which such a distinction can be made to falls out.[10]

3 Nonconstituent Coordination in Hybrid Type-Logical Categorial Grammar

In this section, I present the framework of *Hybrid Type-Logical Categorial Grammar* and formulate an analysis of NCC in Japanese in it.[11] The proposed approach, which can be thought of as a synthesis of two strands of research in the CG literature, results in a system that captures the complex empirical properties of NCC naturally, including phenomena that are highly problematic for the previous two types of analysis of this construction.

3.1 Brief Overview of the Framework

CG is perhaps best known to linguists for its ability to assign constituent status to strings of words that do not form constituents in the standard sense. This property is most salient in *Combinatory Categorial Grammar* (CCG) (Steedman 2000), and is applied to a wide range of phenomena such as long-distance dependencies (Ades and Steedman 1982), Dutch verbal complexes (Steedman 1985) (exhibiting notorious cross-serial dependency), and NCC (Dowty 1988). I call frameworks embodying this idea *directional CG*. In the logical tradition, the Lambek calculus (Lambek 1958) and its extensions in Type-Logical Categorial Grammar (TLCG) (Moortgat and Oehrle 1994; Morrill 1994; Moortgat 1997) belong to this group.

There is another important analytic idea found in some—perhaps less major—variants of CG, which I here call *nondirectional CG*. The central characteristic of this type of approach, which is closely tied to the straightforward syntax-semantics interface of CG, is that it sharply distinguishes semantically-oriented combinatorics (called "tectogrammar" by Curry (1961)) from surface morpho-phonological realization of linguistic expressions ("phenogrammar"). The basic idea was already implicitly present in Montague's (1973) separation of the "analysis tree" and the surface string (exploited in quantifying-in), and was later developed by Dowty (1982, 1996) and applied to a wider range of phenomena. An important technical breakthrough was offered by Oehrle (1994), who proposes to formalize this kind of grammar by modelling the phonological component via a full-fledged λ-calculus.

The present framework integrates these two traditions in a single coherent theory, and has a number of advantages both conceptually and empirically over its predecessors. Most importantly, it recognizes both the directional modes of implication (i.e. forward/backward slashes) familiar in directional CG and the nondirectional mode of implication tied to phonological λ-binding in nondirectional CG within a single calculus. As I demonstrate below, this innovation enables a straightforward analysis of complex interactions between NCC and phenomena pertaining to the syntax-semantics interface such as symmetrical predicates, datasets that have long been recognized as a perennial problem in the literature of coordination (Abbott 1976; Jackendoff 1977).

3.2 Nonconstituent Coordination with Directional Slashes

In CG, syntactic categories are constructed recursively out of atomic categories including at least NP, S, and N (for common nouns) with the binary connectives of *forward slash* (/) and *backward slash* (\), as illustrated in the sample lexicon (for Japanese) in (29). Here and elsewhere linguistic expressions are written as tuples $\langle \varphi; \sigma; \chi \rangle$ of phonological representation (by which I simply mean surface string, not the real phonology), semantic interpretation, and syntactic category. I assume a small number of syntactic features for atomic categories, notated as subscripts as in NP_n (for nominative NP) and NP_a (for accusative NP).

(29) taroo-ga; **t**; NP_n
hanako-o; **h**; NP_a
hasit-ta; **ran**; $\mathrm{NP}_n\backslash\mathrm{S}$
mi-ta; **saw**; $\mathrm{NP}_a\backslash\mathrm{NP}_n\backslash\mathrm{S}$
yukkuri; **slowly**; $(\mathrm{NP}_n\backslash\mathrm{S})/(\mathrm{NP}_n\backslash\mathrm{S})$

The intransitive verb *hasit-ta* 'ran' is assigned the category $\mathrm{NP}_n\backslash\mathrm{S}$ involving the backward slash. Expressions with complex syntactic categories like this are said to be *functors* (or functions) taking *arguments* to return *results*. This verb takes a nominative NP to its *left* as an argument and returns an S. Transitive verbs like *mi-ta* 'saw' ($\mathrm{NP}_a\backslash\mathrm{NP}_n\backslash\mathrm{S}$) additionally take an accusative NP as an argument. The adverb *yukkuri* 'slowly' has the category $(\mathrm{NP}_n\backslash\mathrm{S})/(\mathrm{NP}_n\backslash\mathrm{S})$, which means that it combines with a VP (i.e. $\mathrm{NP}_n\backslash\mathrm{S}$) to its *right* to return a VP. The distinction between the forward and backward slashes indicates the direction (reflected in surface word order) in which the functor looks for its argument.

One important feature of CG (which will be relevant for the analysis of NCC bellow) is its straightforward syntax-semantics interface. Corresponding to the recursive specification of syntactic categories, there is a functional mapping from syntactic categories to semantic types as in (30) (due to Montague 1973), together with the familiar assignment of semantic types to atomic categories Sem(NP) = e, Sem(S) = t, and Sem(N) = $e \to t$ (with e and t respectively the types of individuals and truth values; I ignore intensionality since it is not central to any of the phenomena I analyze below).[12]

(30) For any complex syntactic category of the form α/β ($\beta\backslash\alpha$, $\alpha|\beta$),
Sem(α/β) (= Sem($\beta\backslash\alpha$) = Sem($\alpha|\beta$)) = Sem(β) $\to$ Sem(α)

Thus, for example, an intransitive verb (of category $\mathrm{NP}_n\backslash\mathrm{S}$) is of semantic type $e \to t$, and an adverb (of category $(\mathrm{NP}_n\backslash\mathrm{S})/(\mathrm{NP}_n\backslash\mathrm{S})$) is of type $(e \to t) \to (e \to t)$.

Syntactic rules take the form of inference rules. I first introduce two rules that roughly correspond to rules of subcategorization cancellation in other theories (Merge in Minimalist syntax and Head-Complement rules in HPSG). The *Slash Elimination* rules (31), formulated in the so-called *labelled deduction* format of natural deduction (Morrill 1994; Oehrle 1994), are responsible for putting together functors with the arguments that they are looking for.

(31) a. *Forward Slash Elimination*

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

b. *Backward Slash Elimination*

$$\frac{\mathsf{b}; \mathcal{G}; B \qquad \mathsf{a}; \mathcal{F}; B\backslash A}{\mathsf{b} \circ \mathsf{a}; \mathcal{F}(\mathcal{G}); A}\backslash\mathrm{E}$$

These rules are called *Slash Elimination* rules since the slashes that appear in the functor categories (*A*/*B* and *B**A*) in the input are eliminated in the output categories. Intuitively, (31a) says that applying a functor *A*/*B* (with phonology a) to its argument *B* (with phonology b) yields a category *A* (with phonology $\mathsf{a} \circ \mathsf{b}$, string concatenation of a and b). This is function application, and, correspondingly, the semantics is that of function application. (31b) is a directional counterpart of (31a) with the backward slash (thus, the functor phonology appears on the right in the output). Note that the order of the two premises in (31) does not have any formal significance, since the linear order is explicitly encoded in the phonological representations of the derived expressions. In this sense, the proof trees in the present system are different from ordinary linguistic trees (and derivation trees in CCG).

The following derivation for the sentence *Taroo-ga yukkuri hasit-ta* 'Taro ran slowly' illustrates the way in which these rules are used in an actual linguistic analysis.

(32)

$$\frac{\mathsf{taroo\text{-}ga}; \mathbf{t}; \mathrm{NP}_n \qquad \dfrac{\mathsf{yukkuri}; \mathbf{slowly}; (\mathrm{NP}_n\backslash\mathrm{S})/(\mathrm{NP}_n\backslash\mathrm{S}) \qquad \mathsf{hasit\text{-}ta}; \mathbf{ran}; \mathrm{NP}_n\backslash\mathrm{S}}{\mathsf{yukkuri} \circ \mathsf{hasit\text{-}ta}; \mathbf{slowly}(\mathbf{ran}); \mathrm{NP}_n\backslash\mathrm{S}}/\mathrm{E}}{\mathsf{taroo\text{-}ga} \circ \mathsf{yukkuri} \circ \mathsf{hasit\text{-}ta}; \mathbf{slowly}(\mathbf{ran})(\mathbf{t}); \mathrm{S}}\backslash\mathrm{E}$$

In CG, a derivation like this should be thought of as a proof showing that some string of words is a well-formed sentence given the lexicon (to be thought of as a set of axioms) and the rules of grammar (to be thought of as inference rules). In this connection, note that Slash Introduction rules above are essentially rules of modus ponens ($B \rightarrow A, B \vdash A$), in which the conclusion A is derived based on the premises of *A*/*B* (or *B**A*) and B. Correspondingly, the forward and backward slashes are directed variants of the logical connective of implication (that is, A/B and $B\backslash A$ both mean that, if there is a B, then there is an A).

The underlying correspondence to logic in CG is brought out fully with the *Slash Introduction* rules, which are essentially rules of implication introduction (or *hypothetical reasoning*), where the form of the reasoning involves drawing the conclusion $A \to B$ given a proof of B by hypothetically assuming A. In the present labelled natural deduction presentation, the rules are formulated as in (33) (in what follows I use upright Greek letters for variables of phonological entities: φ, ψ (type **st** for strings); σ (type $\textbf{st} \to \textbf{st}$ and $\textbf{st} \to \textbf{st} \to \textbf{st}$)).[13]

(33) a. *Forward Slash Introduction*

$$\cfrac{\cfrac{\begin{array}{ccc}\vdots\;\vdots & \underline{[\varphi\,; x; A]^n} & \vdots\;\vdots \\ \vdots\;\vdots & \vdots\;\vdots & \vdots\;\vdots\end{array}}{\textsf{b} \circ \varphi\,; \mathcal{F}\,; B}}{\textsf{b}; \lambda x.\mathcal{F}\,; B/A}\,/\mathrm{I}^n$$

b. *Backward Slash Introduction*

$$\cfrac{\cfrac{\begin{array}{ccc}\vdots\;\vdots & \underline{[\varphi\,; x; A]^n} & \vdots\;\vdots \\ \vdots\;\vdots & \vdots\;\vdots & \vdots\;\vdots\end{array}}{\varphi \circ \textsf{b}; \mathcal{F}\,; B}}{\textsf{b}; \lambda x.\mathcal{F}\,; A\backslash B}\,\backslash\mathrm{I}^n$$

In the rules in (33), the brackets designate a hypothetically assumed expression. (The index n is for keeping track of which hypothesis is withdrawn at which step in the proof.) Thus, *Forward Slash Introduction* (33a) says that one can conclude that the string of words $\textsf{b}$ alone is of category B/A, given the proof that $\textsf{b}$ concatenated with a hypothetically assumed φ (with syntactic category A) to its right is of category B (note the parallel to the rule of implication introduction in standard propositional logic). *Backward Slash Introduction* (33b) is a directional counterpart of Forward Slash Introduction, where the conclusion $A\backslash B$ is drawn based on the proof of B with hypothesis A, whose phonology appears on the left edge, instead of the right edge. The semantics for the Slash Introduction rules is lambda abstraction: the variable x for the semantics of the hypothesized expression A is bound by the lambda operator at the step where the hypothesis is withdrawn.

In actual linguistic analysis, the point of the Slash Introduction rules is that they allow us to analyze any substring of a sentence as a genuine constituent, by first combining the overt material with one or more hypothetical expressions by the Elimination rules and then withdrawing them after a larger constituent (typically S) is formed. This already enables an analysis of the basic syntactic patterns of NCC in examples like the following:

(34) [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.'

Hypothetical reasoning with Slash Introduction enables us to prove that *Taroo-ga Hanako-o* in (34) is a full-fledged "constituent" (in an extended sense) that has the combinatorial property of returning a sentence when combined with a transitive verb to its right.[14]

Since the conjunction word is optional in Japanese, I posit the following coordination rule to analyze coordination,[15] with $\sqcap$ for *generalized conjunction* (Partee and Rooth 1983):

(35)
$$\dfrac{\mathsf{a};\ \mathcal{F};\ X \quad \mathsf{b};\ \mathcal{G};\ X}{\mathsf{a} \circ \mathsf{b};\ \mathcal{F} \sqcap \mathcal{G};\ X}\&$$

With this coordination rule, the analysis for (34) goes as in (36) (here, and in all Japanese examples below, VP abbreviates $\mathrm{NP}_n\backslash\mathrm{S}$; the translation on the second to last line is equivalent to $\lambda f.f(\mathbf{h})(\mathbf{t}) \wedge f(\mathbf{m})(\mathbf{j})$ via the definition of generalized conjunction).

(36)
$$\dfrac{\dfrac{\dfrac{\dfrac{\begin{array}{c}\mathsf{taroo\text{-}ga};\\ \mathbf{t}; \mathrm{NP}_n\end{array} \quad \dfrac{\begin{array}{c}\mathsf{hanako\text{-}o};\\ \mathbf{h}; \mathrm{NP}_a\end{array} \quad [\varphi;\ f;\ \mathrm{NP}_a\backslash\mathrm{VP}]^1}{\mathsf{hanako\text{-}o} \circ \varphi;\ f(\mathbf{h});\ \mathrm{VP}}\backslash\mathrm{E}}{\mathsf{taroo\text{-}ga} \circ \mathsf{hanako\text{-}o} \circ \varphi;\ f(\mathbf{h})(\mathbf{t});\ \mathrm{S}}\backslash\mathrm{E}}{\mathsf{taroo\text{-}ga} \circ \mathsf{hanako\text{-}o};\ \lambda f.f(\mathbf{h})(\mathbf{t});\ \mathrm{S}/(\mathrm{NP}_a\backslash\mathrm{VP})}/\mathrm{I}^1 \quad \begin{array}{c}\vdots\ \vdots\\ \mathsf{ziroo\text{-}ga} \circ \mathsf{mitiko\text{-}o};\\ \lambda f.f(\mathbf{m})(\mathbf{j}); \mathrm{S}/(\mathrm{NP}_a\backslash\mathrm{VP})\end{array}}{\mathsf{taroo\text{-}ga} \circ \mathsf{hanako\text{-}o} \circ \mathsf{ziroo\text{-}ga} \circ \mathsf{mitiko\text{-}o};\ \lambda f.f(\mathbf{h})(\mathbf{t}) \sqcap \lambda f.f(\mathbf{m})(\mathbf{j});\ \mathrm{S}/(\mathrm{NP}_a\backslash\mathrm{VP})}\& \quad \begin{array}{c}\mathsf{mi\text{-}ta};\\ \mathbf{saw}; \mathrm{NP}_a\backslash\mathrm{VP}\end{array}}{\mathsf{taroo\text{-}ga} \circ \mathsf{hanako\text{-}o} \circ \mathsf{ziroo\text{-}ga} \circ \mathsf{mitiko\text{-}o} \circ \mathsf{mi\text{-}ta};\ \mathbf{saw}(\mathbf{h})(\mathbf{t}) \wedge \mathbf{see}(\mathbf{m})(\mathbf{j});\ \mathrm{S}}/\mathrm{E}$$

The key step here is the hypothetical assumption of a transitive verb, which combines with the two argument NPs just like ordinary verbs to form a sentence. Then, the hypothesis is withdrawn to assign the category $\mathrm{S}/(\mathrm{NP}_a\backslash\mathrm{VP})$ (a sentence missing a transitive verb to its right) to the argument cluster *Taroo-ga Hanako-o*. The rest of the derivation just involves coordinating two such argument clusters (of the same category), and then combining the resultant expression with the missing transitive verb. Note that the right meaning (conjunction of two propositions) is compositionally assigned to the whole sentence.

This analysis of NCC already makes some welcome predictions. Note first that it does not suffer from the problems for deletion-based analyses from section 2.2. Since each syntactic rule explicitly specifies how the meaning of the derived expression is obtained from those of the inputs, the shared element in the pivot has to be assigned some unique interpretation and cannot be construed differently with respect to different conjuncts. This correctly rules out the unavailable zeugmatic interpretations in the examples in (13), (14) and (16).

The data that provide apparent evidence for deletion-based approaches require a more sophisticated treatment. As observed in section 2.1, NCC exhibits a surprising degree of flexibility, but at the same time, there are certain restrictions on what can and cannot be coordinated, as reflected in the data involving the "syntactic compounding" constructions (cf. (10) and (12)). That is, what can be coordinated in NCC is a proper superset of (traditional) constituents, but it is also a proper subset of any arbitrary substring of a sentence.

To capture such a generalization appropriately requires a setup in which the structures of surface morpho-phonological forms of linguistic expressions are represented in a more nuanced way than I have been assuming above (which involves only string concatenation). There is a well-established tradition in CG that extends the grammar precisely in this direction, where the notion of "multi-modality" (which has nothing to do with the notion of modality in the semantic literature) is posited to capture different degrees of tightness of bond between morphemes in the surface morpho-phonological component (Oehrle and Zhang 1989; Morrill 1994; Moortgat and Oehrle 1994; Dowty 1996; Moortgat 1999; Baldridge 2002; Muskens 2007; Kubota 2010). This approach receives extensive cross-linguistic support from a wide range of word order-related phenomena such as scrambling and extraposition (see especially Dowty 1996 and Baldridge 2002 for work in CG and Kathol 2000 for a closely related approach in HPSG known as Linearization-Based HPSG). Though space considerations do not allow me to show this point here, the present framework is in fact fully compatible with this line of research, and once extended this way, does indeed make exactly the right predictions for the relevant data (such as interactions with the *-te* form complex predicate in (10)), as demonstrated in detail in Kubota (to appear).

What remains to be accounted for is the complex interactions between NCC and phenomena pertaining to the syntax-semantics interfere from section 2.3. These are the most problematic, and pose most serious challenges to existing accounts. In the next subsection, I show that the fragment above can be extended naturally to handle scope-taking phenomena (construed broadly), by adding one connective dealing with order-insensitive inference. The extended system enables a flexible and systematic interaction between the order-sensitive mode of inference involving directional slashes (responsible for the syntax of NCC) and the order-insensitive mode of inference involving this new connective (responsible for the semantics of scopal phenomena), and offers a uniform account of this whole class of data.

3.3 Nondirectional Slash for "Covert Movement"

As should be clear from the above, hypothetical reasoning involving forward and backward slashes enables "restructuring" of surface constituency so that apparent nonconstituents are analyzed as full-fledged meaning-bearing constituents. The notion of hypothetical reasoning in (at least certain variants of) CG is actually more general and has other linguistic applications as well. In particular, by introducing a slightly different kind of slash that does not encode directionality in itself, it becomes possible to provide a straightforward treatment of phenomena such as quantifier scope.

The key idea involved in this extension, which is due to Oehrle 1994 (and adopted in Muskens 2003, de Groote 2001, Mihaliček and Pollard 2012, and Pollard and Smith 2012), is to introduce λ-binding in the phonological representation of linguistic expressions. As will become clear immediately below, this enables a formalization of Montague's (1973) quantifying-in that illuminates the fundamental nature of scope-taking expressions from a logical perspective, by capturing the tight correlation between λ-binding in semantics and the corresponding binding of the "gap" in phonology via an order-insensitive mode of inference. (For alternative approaches to quantification in CG, see Hendriks 1993; Morrill 1994; Moortgat 1996.) See Muskens (2003) for a lucid discussion of how this approach avoids the problem of quantification/extraction out of sentence-medial positions, a perennial problem in directional CG (including variants of TLCG based on the Lambek calculus).

I implement this approach by introducing a third type of slash called the *vertical slash* (|). For the vertical slash, the argument is written to the right of the slash and the result to the left. Thus, $B|A$ is the category for an expression that is looking for (or missing) an A to become a B. The Introduction and Elimination rules for the vertical slash are given as follows (note that there is only one rule for Introduction and Elimination respectively here since directionality is not encoded in the slash itself):

(37) a. *Vertical Slash Introduction*

$$\dfrac{\dfrac{\begin{matrix}\vdots\ \vdots & \dfrac{[\varphi\,;x;A]^n}{\vdots\ \vdots} & \vdots\ \vdots\end{matrix}}{\mathsf{b};\mathcal{F};B}}{\lambda\varphi.\mathsf{b};\lambda x.\mathcal{F};B|A}|\mathrm{I}^n$$

b. *Vertical Slash Elimination*

$$\dfrac{\mathsf{a};\mathcal{G};A \quad \mathsf{b};\mathcal{F};B|A}{\mathsf{b}(\mathsf{a});\mathcal{F}(\mathcal{G});B}|\mathrm{E}$$

Vertical Slash Introduction (37a) is different from the Introduction rules for forward and backward slashes in that the missing position of A inside $B|A$ is kept track of by a variable in the phonology. This is made possible by introducing complex, functional expressions in the phonology with the use of lambda-binding. Assuming that b is of type **st** (string), $\lambda\varphi.\mathsf{b}$ in the conclusion in (37a) is a function from strings to strings (type **st** $\rightarrow$ **st**). Correspondingly, *Vertical Slash Elimination* (37b) does function application both in semantics and phonology. I assume that, just like the forward and backward slashes, the vertical slash is a type of *linear implication*, meaning that the Vertical Slash Introduction rule can bind exactly one occurrence of any given hypothesis at a time.

The key difference between hypothetical reasoning involving the forward/backward slashes and the vertical slash is that while the former is used for the reanalysis of "surface constituency" (as illustrated above), the latter has a purely semantic effect, modelling what (roughly) corresponds to covert movement in the LF-based framework (but note that what corresponds to QR is modelled here by a lowering operation).[16] This is illustrated in the analysis of the inverse scope reading for *Someone loves everyone* in (38). (Quantifiers are lexically specified in the category $\mathrm{S}|(\mathrm{S}|\mathrm{NP})$, with the GQ-type meanings and phonology of type ($\mathsf{st} \to \mathsf{st}$) $\to$ st; $\forall_{\mathbf{person}}$ abbreviates $\lambda P.\forall x[\mathbf{person}(x) \to P(x)]$ (of type $et \to t$).)

(38)

$$\dfrac{\begin{matrix}\lambda\sigma.\sigma(\mathsf{everyone});\\ \forall_{\mathbf{person}};\mathrm{S}|(\mathrm{S}|\mathrm{NP})\end{matrix} \quad \dfrac{\dfrac{\begin{matrix}\lambda\sigma.\sigma(\mathsf{someone});\\ \exists_{\mathbf{person}};\mathrm{S}|(\mathrm{S}|\mathrm{NP})\end{matrix} \quad \dfrac{\dfrac{[\psi;\ y;\ \mathrm{NP}]^2 \quad \dfrac{\begin{matrix}\mathsf{loves};\\ \mathbf{love};(\mathrm{NP}\backslash\mathrm{S})/\mathrm{NP}\end{matrix} \quad [\varphi;\ x;\ \mathrm{NP}]^1}{\mathsf{loves}\circ\varphi;\ \mathbf{love}(x);\ (\mathrm{NP}\backslash\mathrm{S})}/\mathrm{E}}{\psi\circ\mathsf{loves}\circ\varphi;\ \mathbf{love}(x)(y);\ \mathrm{S}}\backslash\mathrm{E}}{\lambda\psi.\psi\circ\mathsf{loves}\circ\varphi;\ \lambda y.\mathbf{love}(x)(y);\ \mathrm{S}|\mathrm{NP}}|\mathrm{I}^2}{\mathsf{someone}\circ\mathsf{loves}\circ\varphi;\ \exists_{\mathbf{person}}(\lambda y.\mathbf{love}(x)(y));\ \mathrm{S}}|\mathrm{E}}{\lambda\varphi.\mathsf{someone}\circ\mathsf{loves}\circ\varphi;\ \lambda x.\exists_{\mathbf{person}}(\lambda y.\mathbf{love}(x)(y));\ \mathrm{S}|\mathrm{NP}}|\mathrm{I}^1}{\mathsf{someone}\circ\mathsf{loves}\circ\mathsf{everyone};\ \forall_{\mathbf{person}}(\lambda x.\exists_{\mathbf{person}}(\lambda y.\mathbf{love}(x)(y)));\ \mathrm{S}}|\mathrm{E}$$

The key idea here is to model quantification via hypothetical reasoning. Thus, after hypothesizing the subject and the object NPs, the subject quantifier *someone* first takes scope with the Vertical Slash Introduction rule binding the variable in the subject position and the Vertical Slash Elimination rule applying the quantifier meaning and phonology to the lambda-abstracted meaning and phonology of the sentence. The lexical entry for the quantifier says that it semantically scopes over the whole expression that the quantifier takes as its argument, but its phonology is embedded in the variable position bound by the λ-operator in its argument string as a consequence of β-reduction. Thus, the string *someone* is lowered (in much the same way as Montague's (1973) quantifying-in) to the preverbal subject position occupied by the variable ψ. Note that in this analysis by Oehrle (1994), the purpose-built syncategorematic rule in Montague (1973) is replaced by a formally precise operation of variable binding in phonology, thus capturing the parallel between semantics and phonology in quantification much more neatly. The derivation is completed by applying the same steps for the object quantifier, which yields the surface string *Someone loves everyone* paired with the inverse scope interpretation ($\forall > \exists$) reflecting the combinatoric history of the derivation.[17]

3.4 Accounting for the Empirical Patterns of NCC

With the vertical slash in place, it is now possible to account for the set of data from section 2.3, which remain problematic for both types of previous approaches to NCC.

3.4.1 Nonconstituent Coordination and Symmetrical, Summative, and "Respective" Predicates

The vertical slash introduced above enables a uniform analysis of the interaction between NCC and symmetrical predicates, summative predicates, and respective readings discussed in section 2.3. For these phenomena, I build on and extend Barker's (2007) analysis of *same*.

The internal readings of *onazi* in sentences like (18), repeated here as (39), can be straightforwardly accounted for by adopting Barker's (2007) analysis of *same* in terms of *parasitic scope*, a technique that makes it possible to capture the interdependence between the expressions containing symmetrical predicates and the plural terms in the sentence with respect to which the internal reading of symmetrical predicates is invoked.

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

Barker's analysis is formulated in terms of continuations, but I recast it in the present framework with the use of lambda-binding in phonology following the proposal by Pollard (2009) (reproduced in Pollard and Smith 2012).[18] The details of implementation are somewhat different, but the key analytic idea (explained below) is due to Barker (2007).

In the present fragment, quantifiers are assigned the GQ-type semantically, namely, $(e \to t) \to t$ (recall the discussion of quantifier scope ambiguity in the previous section). The innovative aspect of Barker's (2007) analysis that enables a simple and explicit 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 (hence the term "parasitic scope").[19]

Specifically, on this analysis, the expression *the same N* is semantically a (pseudo-)quantifier of type $(e \to (e \to t)) \to (e \to t)$.[20] This is different from ordinary quantifier meanings in that, unlike ordinary quantifiers, which take singly abstracted propositions (of type $e \to t$) as arguments to return nonabstracted propositions, *same* takes a doubly abstracted proposition and returns a singly abstracted proposition. The extra slot 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:[21]

(40) $\lambda P \lambda Q \lambda X. \exists ! y[P(y) \wedge \forall x[x <_a X \to Q(y)(x)]]$

I now illustrate how this analysis works for the example in (41).

(41) The same waiter served John and Bill.

The first argument of the semantic translation of *the same* in (40) is the noun that *same* "modifies," the second argument is the doubly abstracted sentence of type $e \to (e \to t)$, and the third argument is the plural expression that the interpretation of *same* is parasitic on (or, distributes over). (40) asserts the existence of an entity that satisfies the property denoted by the noun modified by *same* (i.e. *waiter* in (41)) such that for each of the atomic part of the plural object that *same* distributes over (i.e. *John and Bill*), the relevant relation (the denotation of *served*) holds of that entity and the atomic part of the plural object.

The derivation for (41), which assigns the interpretation (43) for this sentence, goes as in (42) (with X instantiated as NP).

(42)

$$
\text{④}\!\to\dfrac{
\begin{array}{l}\vdots\quad\vdots\\ \textsf{john}\circ\textsf{and}\circ\textsf{bill};\\ \mathbf{j}\oplus\mathbf{b};\mathrm{NP}\end{array}
\quad
\text{③}\!\to\dfrac{
\dfrac{\begin{array}{l}\lambda\psi\lambda\sigma.\sigma(\textsf{the}\circ\textsf{same}\circ\psi);\\ \mathbf{same};\\ ((\mathrm{S}|X)|((\mathrm{S}|X)|\mathrm{NP}))|\mathrm{N}\end{array}\quad\begin{array}{l}\textsf{waiter};\\ \mathbf{waiter};\\ \mathrm{N}\end{array}}{\begin{array}{l}\lambda\sigma.\sigma(\textsf{the}\circ\textsf{same}\circ\textsf{waiter});\\ \mathbf{same}(\mathbf{waiter});(\mathrm{S}|X)|((\mathrm{S}|X)|\mathrm{NP})\end{array}}|\mathrm{E}
\quad
\text{②}\!\to\dfrac{\text{①}\!\to\dfrac{\dfrac{\begin{bmatrix}\psi;\\ y;\mathrm{NP}\end{bmatrix}^2\quad\dfrac{\begin{array}{l}\textsf{served};\\ \mathbf{served};\mathrm{VP}/\mathrm{NP}\end{array}\quad\begin{bmatrix}\varphi;\\ x;\mathrm{NP}\end{bmatrix}^1}{\textsf{served}\circ\varphi;\mathbf{served}(x);\mathrm{VP}}/\mathrm{E}}{\psi\circ\textsf{served}\circ\varphi;\mathbf{served}(x)(y);\mathrm{S}}\backslash\mathrm{E}}{\lambda\varphi.\psi\circ\textsf{served}\circ\varphi;\lambda x.\mathbf{served}(x)(y);\mathrm{S}|\mathrm{NP}}|\mathrm{I}^1}{\lambda\psi\lambda\varphi.\psi\circ\textsf{served}\circ\varphi;\lambda x.\mathbf{served}(x)(y);\mathrm{S}|\mathrm{NP}|\mathrm{NP}}|\mathrm{I}^2
}{\lambda\varphi.\textsf{the}\circ\textsf{same}\circ\textsf{waiter}\circ\textsf{served}\circ\varphi;\mathbf{same}(\mathbf{waiter})(\lambda y\lambda x.\mathbf{served}(x)(y));\mathrm{S}|\mathrm{NP}}|\mathrm{E}
}{\textsf{the}\circ\textsf{same}\circ\textsf{waiter}\circ\textsf{served}\circ\textsf{john}\circ\textsf{and}\circ\textsf{bill};\mathbf{same}(\mathbf{waiter})(\lambda y\lambda x.\mathbf{served}(x)(y))(\mathbf{j}\oplus\mathbf{b});\mathrm{S}}|\mathrm{E}
$$

(43) $\mathbf{same}(\mathbf{waiter})(\lambda y\lambda x.\mathbf{served}(x)(y))(\mathbf{j}\oplus\mathbf{b}) = \exists! y[\mathbf{waiter}(y) \wedge \forall x.x <_a \mathbf{j}\oplus\mathbf{b} \rightarrow \mathbf{served}(x)(y)]$

The translation in (43) says that there is unique waiter who served both John and Bill. This correctly captures the meaning of the sentence on the relevant reading.

The key assumption in the derivation in (42) is the syntactic category and the corresponding phonological term for the expression *the same*, which enables it to take its three semantic arguments as specified in (40) and produce a string of words corresponding to (41). In particular, the Vertical Slash Introduction and Elimination steps (② and ③) for the parasitic quantifier *the same waiter* are nested inside the Vertical Slash Introduction and Elimination steps (① and ④) for the plural *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 TLCG derivation in Barker's (2007) original account.) In other words, the crucial insight of Barker's (2007) analysis here, which enables a fully explicit compositional analysis of the internal reading of *same*, is that the meaning of *same* has access to the meaning of the plural expression that it is semantically dependent on, by first abstracting over the position corresponding to the plural expression and then over the position corresponding to the NP containing *same*.

It turns out that in the present Hybrid TLCG setup, this analysis of symmetrical predicate by Barker straightforwardly interacts with the standard analysis of NCC in CG (which assigns fully explicit compositional semantics to "nonconstituent" strings as shown above) to yield the internal readings of sentences like the following, long known to be problematic for virtually all existing analyses of right-node raising in any framework (the problem is essentially analogous to the Japanese data discussed in the previous section):

(44) Ann read and Bill reviewed the same book.

The internal reading of (44) is 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 NCC, the grammar automatically assigns the right meanings to the coordinated expressions. The only extra assumption needed is the generalization of the notion of sum from individual-type entities to model-theoretic entities of any general type (see Krifka 1990 and Gawron and Kehler 2004 for independent empirical motivations for generalizing the notion of sum to nonindividual types). With this assumption in place, the strings *Ann read* and *Bill reviewed* are each analyzed as denoting properties of individuals (of type $e \to t$) via hypothetical reasoning, and the sum-forming meaning for the conjunction assigns the sum of these properties as the meaning of the coordinated string. The derivation is given in (45) (with X and Y instantiated as $\mathrm{S/NP}$).

(45)

$$\dfrac{\dfrac{\dfrac{\begin{matrix}\text{ann;}\\ \mathbf{a}; \mathrm{NP}\end{matrix} \quad \dfrac{\begin{matrix}\text{read;}\\ \mathbf{read}; \mathrm{VP/NP}\end{matrix} \quad [\varphi;\ x;\ \mathrm{NP}]^1}{\text{read} \circ \varphi;\ \mathbf{read}(x);\ \mathrm{VP}}/\mathrm{E}}{\text{ann} \circ \text{read} \circ \varphi;\ \mathbf{read}(x)(\mathbf{a});\ \mathrm{S}}\backslash\mathrm{E}}{\text{ann} \circ \text{read};\ \lambda x.\mathbf{read}(x)(\mathbf{a});\ \mathrm{S/NP}}/\mathrm{I}^1 \quad \dfrac{\begin{matrix}\text{and;}\\ \lambda f \lambda g.f \oplus g; (Y\backslash Y)/Y\end{matrix} \quad \begin{matrix}\vdots\ \vdots\\ \text{bill} \circ \text{reviewed;}\\ \lambda x.\mathbf{reviewed}(x)(\mathbf{b}); \mathrm{S/NP}\end{matrix}}{\text{and} \circ \text{bill} \circ \text{reviewed};\ \lambda g.[\lambda x.\mathbf{reviewed}(x)(\mathbf{b})] \oplus g;\ (\mathrm{S/NP})\backslash(\mathrm{S/NP})}/\mathrm{E}}{\text{ann} \circ \text{read} \circ \text{and} \circ \text{bill} \circ \text{reviewed};\ \lambda x.\mathbf{reviewed}(x)(\mathbf{b}) \oplus \lambda x.\mathbf{read}(x)(\mathbf{a});\ \mathrm{S/NP}}\backslash\mathrm{E}$$

$$\dfrac{\dfrac{\begin{matrix}\lambda\psi\lambda\sigma.\sigma(\text{the} \circ \text{same} \circ \psi);\\ \mathbf{same}; ((\mathrm{S}|X)|((\mathrm{S}|X)|\mathrm{NP}))|\mathrm{N}\end{matrix} \quad \text{book}; \mathbf{book}; \mathrm{N}}{\lambda\sigma.\sigma(\text{the} \circ \text{same} \circ \text{book});\ \mathbf{same}(\mathbf{book});\ (\mathrm{S}|X)|((\mathrm{S}|X)|\mathrm{NP})}/\mathrm{E} \quad \dfrac{\dfrac{\dfrac{[\varphi;\ f;\ \mathrm{S/NP}]^1 \quad [\psi;\ g;\ \mathrm{NP}]^2}{\varphi \circ \psi;\ f(g);\ \mathrm{S}}/\mathrm{E}}{\lambda\varphi.\varphi \circ \psi;\ \lambda f.f(g);\ \mathrm{S}|(\mathrm{S/NP})}|\mathrm{I}^1}{\lambda\psi\lambda\varphi.\varphi \circ \psi;\ \lambda g \lambda f.f(g);\ (\mathrm{S}|(\mathrm{S/NP}))|\mathrm{NP}}|\mathrm{I}^2}{\lambda\varphi.\varphi \circ \text{the} \circ \text{same} \circ \text{book};\ \mathbf{same}(\mathbf{book})(\lambda g \lambda f.f(g));\ \mathrm{S}|(\mathrm{S/NP})}|\mathrm{E}$$

$$\dfrac{\begin{matrix}\vdots\ \vdots\\ \text{ann} \circ \text{read} \circ \text{and} \circ \text{bill} \circ \text{reviewed;}\\ \lambda x.\mathbf{reviewed}(x)(\mathbf{b}) \oplus \lambda x.\mathbf{read}(x)(\mathbf{a}); \mathrm{S/NP}\end{matrix} \quad \begin{matrix}\vdots\ \vdots\\ \lambda\varphi.\varphi \circ \text{the} \circ \text{same} \circ \text{book;}\\ \mathbf{same}(\lambda g \lambda f.g(\iota(f(\mathbf{book})))); \mathrm{S}|(\mathrm{S/NP})\end{matrix}}{\begin{matrix}\text{ann} \circ \text{read} \circ \text{and} \circ \text{bill} \circ \text{reviewed} \circ \text{the} \circ \text{same} \circ \text{book;}\\ \mathbf{same}(\mathbf{book})(\lambda g \lambda f.f(g))(\lambda x.\mathbf{reviewed}(x)(\mathbf{b}) \oplus \lambda x.\mathbf{read}(x)(\mathbf{a})); \mathrm{S}\end{matrix}}|\mathrm{E}$$

In examples like this in which the coordinated sum is a nonstandard constituent, two types of hypothetical reasoning are involved: one for forming such nonstandard constituents as syntactic constituents (with the directional slashes; shown in the first chunk of (45)), and the other for type-raising the relational argument for *same* (Q in (40)) for the argument position corresponding to the higher-order sum (with the vertical slash; shown in the right-hand side of the second chunk of (45)). Once these components are derived, they are given as arguments to *same*, in the same way as in the simpler example (42).

The final translation in (45) can be unpacked as follows (note here that the denotation for *the same* in (40) is polymorphic and that the variables Q and X can be instantiated to arbitrarily complex semantic types).

(46)
$$\begin{aligned}&\mathbf{same}(\mathbf{book})(\lambda g \lambda f.f(g))(\lambda x.\mathbf{reviewed}(x)(\mathbf{b}) \oplus \lambda x.\mathbf{read}(x)(\mathbf{a}))\\ &= \exists ! y[\mathbf{book}(y) \wedge \forall P.P <_a (\lambda x.\mathbf{reviewed}(x)(\mathbf{b}) \oplus \lambda x.\mathbf{read}(x)(\mathbf{a})) \rightarrow P(y)]\end{aligned}$$

(46) asserts the existence of a unique book that satisfies the two properties $\lambda x.\mathbf{reviewed}(x)(\mathbf{b})$ and $\lambda x.\mathbf{read}(x)(\mathbf{a})$; there is a unique book that was read by Ann and reviewed by Bill.[22]

I now illustrate how the internal readings of *onazi* in sentences like (39) are licensed in the present fragment. Essentially the same analysis in terms of parasitic scope works for both the English *same* and the Japanese *onazi*. Thus, I assume that the word *onazi* receives the same translation as *the same* in (40). The only difference between the specific examples of English right-node raising (44) analyzed in (45) and Japanese NCC in (39) is the semantic type of the coordinated string: instead of a sum of one-place properties, this example involves a sum of properties of transitive verb meanings, which is of type $(e \rightarrow et) \rightarrow t$. But assuming the generalized sum meaning for conjunction, this difference is not significant. The derivation for (39) goes through straightforwardly as in (47) (here, DTV and TVd abbreviate $\mathrm{NP}_a\backslash\mathrm{NP}_d\backslash\mathrm{NP}_n\backslash\mathrm{S}$ and $\mathrm{NP}_a\backslash\mathrm{NP}_n\backslash\mathrm{S}$, respectively, and X is instantiated as S/TVd).

(47)
$$\dfrac{\dfrac{\dfrac{\dfrac{\text{taroo-ga};\ \mathbf{t};\ \mathrm{NP}_n \quad \dfrac{\text{hanako-ni};\ \mathbf{h};\ \mathrm{NP}_d \quad [\varphi;\ f;\ \mathrm{TV}_d]^1}{\text{hanako-ni} \circ \varphi;\ f(\mathbf{h});\ \mathrm{VP}}\backslash\mathrm{E}}{\text{taroo-ga} \circ \text{hanako-ni} \circ \varphi;\ f(\mathbf{h})(\mathbf{t});\ \mathrm{S}}\backslash\mathrm{E}}{\text{taroo-ga} \circ \text{hanako-ni} \circ \varphi;\ f(\mathbf{h})(\mathbf{t});\ \mathrm{S}}\mathrm{PI}}{\text{taroo-ga} \circ \text{hanako-ni};\ \lambda f.f(\mathbf{h})(\mathbf{t});\ \mathrm{S}/\mathrm{TV}_d}/\mathrm{I}^1 \quad \begin{array}{c}\vdots\ \ \vdots\\ \text{ziroo-ga} \circ \text{mitiko-ni};\ \lambda f.f(\mathbf{m})(\mathbf{j});\ \mathrm{S}/\mathrm{TV}_d\end{array}}{\text{taroo-ga} \circ \text{hanako-ni} \circ \text{ziroo-ga} \circ \text{mitiko-ni};\ \lambda f.f(\mathbf{h})(\mathbf{t}) \oplus \lambda f.f(\mathbf{m})(\mathbf{j});\ \mathrm{S}/\mathrm{TV}_d}\&$$

$$
\dfrac{\dfrac{\begin{matrix}\lambda\psi\lambda\sigma.\sigma(\text{onazi} \circ \psi);\\ \textbf{same};((\mathrm{S}|X)|((\mathrm{S}|X)|\mathrm{NP}))|\mathrm{N}\end{matrix} \quad \begin{matrix}\text{hon-o};\\ \textbf{book};\mathrm{N}\end{matrix}}{\lambda\sigma.\sigma(\text{onazi} \circ \text{hon-o});\ \textbf{same}(\textbf{book});\ (\mathrm{S}|X)|((\mathrm{S}|X)|\mathrm{NP})}/\mathrm{E} \quad \dfrac{\dfrac{\dfrac{[\varphi;\ f;\ \mathrm{S}/\mathrm{TV}_d]^1 \quad \dfrac{[\psi;\ x;\ \mathrm{NP}]^2 \quad \text{kasi-ta};\ \textbf{lent};\ \mathrm{DTV}}{\psi \circ \text{kasi-ta};\ \textbf{lent}(x);\ \mathrm{TV}_d}\backslash\mathrm{E}}{\varphi \circ \psi \circ \text{kasi-ta};\ f(\textbf{lent}(x));\ \mathrm{S}}/\mathrm{E}}{\lambda\varphi.\varphi \circ \psi \circ \text{kasi-ta};\ \lambda f.f(\textbf{lent}(x));\ \mathrm{S}|(\mathrm{S}/\mathrm{TVd})}|\mathrm{I}^1}{\lambda\psi\lambda\varphi.\varphi \circ \psi \circ \text{kasi-ta};\ \lambda x\lambda f.f(\textbf{lent}(x));\ (\mathrm{S}|(\mathrm{S}/\mathrm{TVd}))|\mathrm{NP}}|\mathrm{I}^2}{\lambda\varphi.\varphi \circ \text{onazi} \circ \text{hon-o} \circ \text{kasi-ta};\ \textbf{same}(\textbf{book})(\lambda x\lambda f.f(\textbf{lent}(x)));\ \mathrm{S}|(\mathrm{S}/\mathrm{TVd})}|\mathrm{E}
$$

$$
\dfrac{\begin{matrix}\vdots\ \vdots\\ \text{taroo-ga} \circ \text{hanako-ni} \circ \text{ziroo-ga} \circ \text{mitiko-ni};\\ \lambda f.f(\textbf{h})(\textbf{t}) \oplus \lambda f.f(\textbf{m})(\textbf{j});\mathrm{S}/\mathrm{TV}_d\end{matrix} \quad \begin{matrix}\vdots\ \vdots\\ \lambda\varphi.\varphi \circ \text{onazi} \circ \text{hon-o} \circ \text{kasi-ta};\\ \textbf{same}(\lambda f\lambda g.g(\textbf{lent}(x)));\mathrm{S}|(\mathrm{S}/\mathrm{TVd})\end{matrix}}{\begin{matrix}\text{taroo-ga} \circ \text{hanako-ni} \circ \text{ziroo-ga} \circ \text{mitiko-ni} \circ \text{onazi} \circ \text{hon-o} \circ \text{kasi-ta};\\ \textbf{same}(\textbf{book})(\lambda x\lambda f.f(\textbf{lent}(x)))(\lambda f.f(\textbf{h})(\textbf{t}) \oplus \lambda f.f(\textbf{m})(\textbf{j}));\mathrm{S}\end{matrix}}|\mathrm{E}
$$

Note here again that, in the derivation in (47), two kinds of type-raising are involved, one for forming a nonstandard constituent with the directional slashes, and the other for creating a higher-order relation over generalized sums (to be given as an argument to *onazi*) with the vertical slash. The final translation can be unpacked as in (48):

(48) $\textbf{same}(\textbf{book})(\lambda x\lambda f.f(\textbf{lent}(x)))(\lambda f.f(\textbf{h})(\textbf{t}) \oplus \lambda f.f(\textbf{m})(\textbf{j}))$
$= \exists! y[[\textbf{book}(y) \wedge \forall \Re <_a (\lambda f.f(\textbf{h})(\textbf{t}) \oplus \lambda f.f(\textbf{m})(\textbf{j})) \to \Re(\textbf{lent}(y))]$

This says that there is a unique book y such that, for each of the properties over two-place relations $\lambda f.f(\textbf{h})(\textbf{t})$ and $\lambda f.f(\textbf{m})(\textbf{j})$, the relation $\textbf{lent}(y)$ (i.e. the relation 'lending y to') satisfies that property. 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.

I would like to note here one important difference between the present analysis of NCC/symmetrical predicate interaction and its movement-based analog along the lines of Sabbagh (2007) (see footnote 6). In the present framework, the coordination rule (35) is defined in such a way that, as far as phonology is concerned, it simply concatenates the strings corresponding to the conjuncts. This means that coordination of expressions with functional phonologies is not allowed (in fact, it is not clear how such a rule could even be formulated within the present framework). From this and from the standard assumption in CG that all syntactic modes of implication (i.e., /, $\backslash$, and $|$) are linear (which prohibits multiple occurrences of the same bound variable in a proof), it immediately follows that nothing analogous to covert ATB movement is allowed. In the present framework, covert ATB movement would correspond to a situation in which a quantifier (or a quantifier-like expression such as a symmetrical predicate) is lowered to two clauses simultaneously via the "quantifying-in" mechanism described above, but for such a situation to arise, the quantifier needs to bind the same variable in the two conjuncts. Via the linearity of the calculus and the way the coordination rule is defined, this is possible only when the quantifier string appears *outside* the coordinate structure and only once. Thus, the danger of overgenerating the internal reading for sentences like (19) does not arise in the present account.

The technique of parasitic scope extends straightforwardly to the cases of summative predicates and respective readings. For the symmetrical predicate *same*, the key step in the analysis is the distributive operator lexically encoded in the meaning of *same* that distributes over each part of the sum denoted by the coordinated expression. The cases of summative predicates and respective readings are only slightly more complex in that they involve two sums (rather than a single sum) such that parts of them are related to each other in the "respective" manner in terms of the relation denoted by the doubly abstracted proposition.

I illustrate this point first with the analysis of respective readings for (49) (= (21)).

(49) Taroo-ga Hanako-ni, (sosite) Ziroo-ga Mitiko-ni sorezore
Taro-NOM Hanako-DAT and Jiro-NOM Michiko-DAT respectively
Syntactic Structures-to *LGB*-o kasi-ta.
Syntactic Structures-and *LGB*-ACC lend-PAST
'Taro and Jiro lent Hanako and Michiko *Syntactic Structures* and *LGB*, respectively.'

For the analysis of respective readings, I implement Gawron and Kehler's (2004) approach in terms of generalized sums via the parasitic scope mechanism of the present framework. The use of parasitic scope simplifies the analysis somewhat since it makes it possible to establish the relevant relation between the two sums directly in the combinatoric component.

Gawron and Kehler's analysis employs the sequencing function f_{seq} that refers to the contextually established order between subparts of a sum to access these subparts. For any sum X and an index i, $f_{seq}(X)(i)$ is the i-th element of the sum according to the contextual ordering in question. In sentences like (49) involving overt conjunction, f_{seq} simply refers to the order of mention. With this sequencing function f_{seq}, the lexical entry for *sorezore* can be formulated as in (50).

(50) $\lambda\sigma\lambda\varphi_1\lambda\varphi_2.\sigma(\mathsf{sorezore} \circ \varphi_1)(\varphi_2); \lambda P\lambda X\lambda Y. \bigwedge_i P(f_{seq}(X)(i))(f_{seq}(Y)(i)); (Z|X|Y)|(Z|X|Y)$

As in (50), *sorezore* takes three arguments, a relation and two sums, and relates the two sums in the "respective" manner with respect to the relation in question.

The structure of the derivation for (49) is essentially parallel to the symmetrical predicate case in (47) above. By applying the "respective" operator in (50) to a doubly abstracted proposition (of type $\mathrm{S}|(\mathrm{S/TVd})|\mathrm{NP}$), and then further to its two other arguments (i.e., the two conjoined expressions of types NP and $\mathrm{S/TV}_d$, respectively, both of which denote sums), the following semantic translation paired with the surface string in (49) is obtained (where **resp** abbreviates the semantic term in (50)):

(51) $\mathbf{resp}(\lambda x\lambda f.f(\mathbf{lent}(x)))(\mathbf{ss} \oplus \mathbf{lgb})(\lambda f.f(\mathbf{h})(\mathbf{t}) \oplus \lambda f.f(\mathbf{m})(\mathbf{j}))$
$= \mathbf{lent}(\mathbf{ss})(\mathbf{h})(\mathbf{t}) \wedge \mathbf{lent}(\mathbf{lgb})(\mathbf{m})(\mathbf{j})$

The analysis also extends straightforwardly to the case of summative predicates like *gookei-de 30,000-en* '30,000-yen in total' in (52).

(52) Ken-ga Mari-ni (sosite) Jun-ga Nao-ni gookei-de 30,000-en kasi-ta.
Ken-NOM Mari-DAT and Jun-NOM Nao-DAT in.total 30,000-yen lend-PAST
'Ken lent Mari and Jun lent Nao a total of 30,000-yen.'

In fact, the same "respective" operator in (50) can be used to assign the right truth conditions for this sentence by assuming that summative predicates refer to individual sums (i-sums) whose each member is a mass object and where the material fusion of the whole i-sum amounts to the named quantity. The idea behind this analysis is that *gookei-de* presupposes the existence of some "parts" (represented by the atomic subparts of the i-sum) of a whole where each part may itself be (materially) further broken down to subparts.

Technically, I treat the expression *gookei-de 30,000-en* as an existential quantifier over such i-sums (here, μ is the material fusion operator of Link 1983 that takes a sum S and returns an individual that corresponds to an aggregate of all the components of S):

(53) $\lambda\sigma.\sigma(\textsf{gookei-de} \circ 30,000\textsf{en}); \lambda P \exists X[\mathbf{amount}(\mu(X)) = \textbf{30,000-yen} \wedge P(X)]; \mathrm{S}|(\mathrm{S}|\mathrm{NP})$

This existential quantifier binds a sum-type variable that is given as one of the arguments of the **resp** operator. This yields the following translation for (52), which captures its truth conditions correctly:

(54)
$$\begin{aligned}
&\lambda P \exists X[\mathbf{amount}(\mu(X)) = \textbf{30,000-yen} \wedge P(X)] \\
&\qquad (\lambda X.\mathbf{resp}(\lambda x \lambda f.f(\mathbf{lent}(x)))(X)(\lambda f.f(\mathbf{m})(\mathbf{k}) \oplus \lambda f.f(\mathbf{n})(\mathbf{j}))) \\
&= \exists X[\mathbf{amount}(\mu(X)) = \textbf{30,000-yen} \wedge \mathbf{resp}(\lambda x \lambda f.f(\mathbf{lent}(x)))(X)(\lambda f.f(\mathbf{m})(\mathbf{k}) \oplus \lambda f.f(\mathbf{n})(\mathbf{j}))] \\
&= \exists X[\mathbf{amount}(\mu(X)) = \textbf{30,000-yen} \wedge \exists y, z[y \oplus z = X \wedge \mathbf{lent}(y)(\mathbf{m})(\mathbf{k}) \wedge \mathbf{lent}(z)(\mathbf{n})(\mathbf{j})]]
\end{aligned}$$

3.4.2 Nonconstituent Coordination and Anaphoric Binding

I now sketch how the data involving anaphoric binding can be handled in the present approach. 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 sentences in (23), (24) and (25) fall out immediately. To review the relevant facts observed in section 2, sentences like the following are ambiguous only in two ways instead of four, as indicated in the English translations:

(55) Ken-wa Mari-ni, (sosite) Jun-wa Nao-ni **zibun-no** heya-de odor-ase-ta.
Ken-TOP Mari-DAT and Jun-TOP Nao-DAT self-GEN room-in 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.'

With a suitable account of binding in place, the pattern observed in (55) falls out immediately in the present analysis. For the sake of concreteness, I adopt the "quantificational" analysis of reflexives and pronouns originally due to Bach and Partee 1980 and which has been implemented in several different ways by subsequent authors in the CG literature (cf., e.g., Morrill 1994; Carpenter 1997, and the Moortgat-Szabolcsi-Dowty approach described in Dowty (2007)).[23] As will become clear below, the use of parasitic scope via phonological variable binding enables a straightforward implementation of the key analytic idea here as well. 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 scope-taking elements. Specifically, a bound pronoun (or reflexive) takes scope immediately below its antecedent and (semantically) binds the "trace" that it has left behind to its antecedent. Within the present framework, this scope-taking behavior of pronouns and reflexives can be treated by means of lambda binding in phonology with the vertical slash in a way analogous to the parasitic scope treatment of symmetrical predicates (that is, the scope of the pronoun is created by abstracting over two gaps, one corresponding to the pronoun itself and the other the antecedent). 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*:

(56) $\lambda\sigma.\sigma(\mathsf{zibun})$; $\lambda R\lambda x.R(x)(x)$; $(\mathrm{NP}_n\backslash \mathrm{S})|((\mathrm{NP}_n\backslash \mathrm{S})|\mathrm{NP})$

The syntactic category says that *zibun* takes scope at the "VP node" ($\mathrm{NP}_n\backslash \mathrm{S}$) and binds its "trace" (i.e. the hypothesized NP sought via |). When *zibun* takes scope, what it does semantically is take the relation denoted by its scope and identify 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 to the subject antecedent. Phonologically, *zibun* lowers itself into its trace position just like ordinary quantifiers.

This analysis immediately predicts the reflexive ambiguity in causatives.

(57) 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 morpho-phonologically monoclausal (but semantically biclausal) complex predicates in Japanese (cf., e.g., Kuroda 1965; Shibatani 1976; Matsumoto 1996). The verb stem and the causative suffix together behave as a single word morphologically, but semantically, the construction has biclausal properties with respect to phenomena such as binding, quantifier scope and adverb scope. Since all that is needed is to demonstrate that biclausal interpretations can be derived for the case of binding, I assume a somewhat simplified analysis (which, for the sake of exposition, does not take into account the surface morpho-phonological monoclausality; for a more complete analysis, see Kubota, to appear) with the following lexical entry for the causative suffix:

(58) (s)ase-ta; $\lambda P.\lambda x\lambda y.\textbf{caused}(y, P(x))$; $\mathrm{VP}\backslash\mathrm{NP}_d\backslash\mathrm{NP}_n\backslash\mathrm{S}$

This says that *sase* takes a VP headed by the verb stem, semantically identifies the subject of that VP with its dative argument designating the causee (via the variable x) and adds a new subject argument designating the causer. The ambiguity of sentences like (57) follows since there are two steps in the derivation at which *zibun* can take scope: the step at which the embedded VP is formed and the step at which the matrix VP is formed. In the former case, the embedded subject binding reading results, as shown in (59):

(59)

$$\dfrac{\dfrac{\begin{matrix}\lambda\sigma.\sigma(\mathsf{zibun});\\ \lambda R\lambda x.R(x)(x);\\ \mathrm{VP}|(\mathrm{VP}|\mathrm{NP})\end{matrix} \quad \dfrac{\dfrac{\begin{matrix}\vdots\ \vdots\\ \vdots\ \vdots\end{matrix} \quad \dfrac{[\varphi;\ x;\ \mathrm{NP}]^1}{\vdots\ \vdots} \quad \begin{matrix}\vdots\ \vdots\\ \vdots\ \vdots\end{matrix}}{\begin{matrix}\varphi\text{-}\mathsf{no\text{-}heya\text{-}de} \circ \mathsf{odor};\\ \lambda y.\textbf{dance-in-the-room-of}(y, x);\ \mathrm{VP}\end{matrix}}\,|\mathrm{I}^1}{\begin{matrix}\lambda\varphi.\varphi\text{-}\mathsf{no\text{-}heya\text{-}de} \circ \mathsf{odor};\\ \lambda x\lambda y.\textbf{dance-in-the-room-of}(y, x);\ \mathrm{VP}|\mathrm{NP}\end{matrix}}}{\mathsf{zibun\text{-}no\text{-}heya\text{-}de} \circ \mathsf{odor};\ \lambda x.\textbf{dance-in-the-room-of}(x, x);\ \mathrm{VP}}\,|\mathrm{E} \quad \begin{matrix}\mathsf{ase\text{-}ta};\\ \lambda P.\lambda x\lambda y.\textbf{caused}(y, P(x));\\ \mathrm{VP}\backslash\mathrm{NP}_d\backslash\mathrm{VP}\end{matrix}}{\mathsf{zibun\text{-}no\text{-}heya\text{-}de} \circ \mathsf{odor} \circ \mathsf{ase\text{-}ta};\ \lambda x\lambda y.\textbf{caused}(y, \textbf{dance-in-the-room-of}(x, x));\ \mathrm{NP}_d\backslash\mathrm{VP}}\,\backslash\mathrm{E}$$

There is an alternative derivation in which the reflexive takes scope at the matrix VP level. This yields the following sign for the matrix VP, for the matrix subject binding reading:

(60) hanako-ni ∘ zibun-no-heya-de ∘ odor ∘ ase-ta; $\lambda x.\textbf{caused}(x, \textbf{dance-in-the-room-of}(\textbf{h}, x))$; VP

Assuming this approach to binding, the present analysis predicts the two-way ambiguity of NCC examples like (55). Specifically, the embedded subject binding reading is derived by taking the part of the derivation for (57) shown in (59), which corresponds to the pivot *zibun-no heya-de odor-ase-ta* 'made dance in self's room' in (55), and putting it together with the coordinated argument cluster that can be formed in the usual manner. Note that in this case, the denotation of the pivot:

(61) $\lambda x \lambda y.\mathbf{caused}(y, \mathbf{dance\text{-}in\text{-}the\text{-}room\text{-}of}(x, x))$

already specifies the embedded subject to be the binder. Thus, this analysis yields the reading in which the embedded subject is the binder in both conjuncts.

The matrix subject binding reading is obtained by hypothesizing a matrix dative NP and then letting *zibun* take scope at the matrix VP and withdrawing the hypothetical dative.

(62)

$$\dfrac{\dfrac{\begin{array}{c}\lambda\sigma.\sigma(\mathsf{zibun});\\ \lambda R\lambda x.R(x)(x);\\ \mathrm{VP}|(\mathrm{VP}|\mathrm{NP})\end{array} \quad \dfrac{\dfrac{[\psi;\ y;\ \mathrm{NP}]^2 \quad \dfrac{\vdots\ \vdots \quad \dfrac{[\varphi;\ x;\ \mathrm{NP}]^1}{\vdots\ \vdots} \quad \vdots\ \vdots}{\begin{array}{c}\varphi\text{-}\mathsf{no\text{-}heya\text{-}de} \circ \mathsf{odor} \circ \mathsf{ase\text{-}ta};\\ \lambda y\lambda z.\mathbf{caused}(z, \mathbf{dance\text{-}in\text{-}the\text{-}room\text{-}of}(y, x)); \mathrm{NP}_d\backslash\mathrm{VP}\end{array}}}{\begin{array}{c}\psi \circ \varphi\text{-}\mathsf{no\text{-}heya\text{-}de} \circ \mathsf{odor} \circ \mathsf{ase\text{-}ta};\\ \lambda z.\mathbf{caused}(z, \mathbf{dance\text{-}in\text{-}the\text{-}room\text{-}of}(y, x)); \mathrm{VP}\end{array}}\backslash\mathrm{E}}{\begin{array}{c}\lambda\varphi.\psi \circ \varphi\text{-}\mathsf{no\text{-}heya\text{-}de} \circ \mathsf{odor} \circ \mathsf{ase\text{-}ta};\\ \lambda x\lambda z.\mathbf{caused}(z, \mathbf{dance\text{-}in\text{-}the\text{-}room\text{-}of}(y, x)); \mathrm{VP}|\mathrm{NP}\end{array}}|\mathrm{I}^1}{\psi \circ \mathsf{zibun\text{-}no\text{-}heya\text{-}de} \circ \mathsf{odor} \circ \mathsf{ase\text{-}ta};\ \lambda x.\mathbf{caused}(x, \mathbf{dance\text{-}in\text{-}the\text{-}room\text{-}of}(y, x));\ \mathrm{VP}}|\mathrm{E}}{\mathsf{zibun\text{-}no\text{-}heya\text{-}de} \circ \mathsf{odor} \circ \mathsf{ase\text{-}ta};\ \lambda y\lambda x.\mathbf{caused}(x, \mathbf{dance\text{-}in\text{-}the\text{-}room\text{-}of}(y, x));\ \mathrm{NP}_d\backslash\mathrm{VP}}\backslash\mathrm{I}^2$$

This assigns the following denotation to the pivot:

(63) $\lambda y \lambda x.\mathbf{caused}(x, \mathbf{dance\text{-}in\text{-}the\text{-}room\text{-}of}(y, x))$

Again, since the denotation of the pivot (63) 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 NCC, 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 derivation needs to be assigned either (61) or (63) as its denotation. In the former case, the embedded subject ends up being the binder in both conjuncts, whereas in the latter case, the matrix subject binds the reflexive in both conjuncts. Since these are the only readings derivable, the other two impossible readings are correctly blocked. The cases involving other anaphoric expressions receive a parallel account, since the mechanism for semantic variable binding is the same in all cases of anaphoric binding.

3.4.3 Nonconstituent Coordination and the Scope of Complex Predicates

The disjunction-narrow scope interpretations of examples like (64) (= (26a)) are also unproblematic in the present approach.

(64) [John-ni kono hon-o] matawa [Bill-ni ano hon-o] mise-tai-none?
John-DAT this book-ACC or Bill-DAT that book-ACC show-want-PRT
'(You) want to show this book to John or that book to Bill, right?'

I assume that the desiderative predicate *-tai* is a verb that takes a VP complement like the causative suffix. But unlike the causative, the desiderative simply identifies the matrix and embedded subjects, without taking an extra argument. The derivation for (64) is given in (65) (here, DTV is an abbreviation for $\mathrm{NP}_a\backslash\mathrm{NP}_d\backslash\mathrm{NP}_n\backslash\mathrm{S}$).

(65)

$\vdots\ \vdots$
bill-ni ∘ kono-hon-o; $\lambda f.f(\mathbf{b})(\mathbf{this\text{-}bk})$; $\mathrm{VP/DTV}$

matawa; $\lambda f f \lambda g \lambda h.f(h) \sqcup g(h)$; $(X\backslash X)/X$

$\vdots\ \vdots$
sue-ni ∘ ano-hon-o; $\lambda f.f(\mathbf{s})(\mathbf{that\text{-}bk})$; $\mathrm{VP/DTV}$

—— /E
matawa ∘ sue-ni ∘ ano-hon-o; $\lambda g \lambda h.h(\mathbf{s})(\mathbf{that\text{-}bk}) \sqcup g(h)$; $(\mathrm{VP/DTV})\backslash(\mathrm{VP/DTV})$

—— \E
bill-ni ∘ kono-hon-o ∘ matawa ∘ sue-ni ∘ ano-hon-o; $\lambda h.h(\mathbf{s})(\mathbf{that\text{-}bk}) \sqcup h(\mathbf{b})(\mathbf{this\text{-}bk})$; $\mathrm{VP/DTV}$

mise; $\mathbf{show}$; DTV

—— /E
bill-ni ∘ kono-hon-o ∘ matawa ∘ sue-ni ∘ ano-hon-o ∘ mise; $\mathbf{show}(\mathbf{s})(\mathbf{that\text{-}bk}) \sqcup \mathbf{show}(\mathbf{b})(\mathbf{this\text{-}bk})$; VP

tai; $\lambda P \lambda x.\mathbf{want}(x, P(x))$; $\mathrm{VP}\backslash\mathrm{VP}$

—— \E
bill-ni ∘ kono-hon-o ∘ matawa ∘ sue-ni ∘ ano-hon-o ∘ mise ∘ tai; $\lambda x.\mathbf{want}(x, \mathbf{show}(\mathbf{s})(\mathbf{that\text{-}bk})(x) \vee \mathbf{show}(\mathbf{b})(\mathbf{this\text{-}bk})(x))$; VP

Argument cluster constituents are first coordinated via the usual process of NCC and the whole coordinate structure is combined with the lower and higher verbs successively. Since the whole coordinate structure appears inside an argument of the higher predicate *-tai* ‘want’ in the combinatoric structure, the desired disjunction-narrow scope reading is obtained.[24]

3.5 On the Properties of the Hybrid Calculus

As should be clear from the above, the crucial property of the present framework that enables a straightforward analysis of the complex interactions between scopal and anaphoric expressions and NCC is that it allows for inferences involving the directional mode of implication (i.e. forward and backward slashes) and those involving the nondirectional mode of implication (i.e. the vertical slash) to interact with one another in a systematic manner. This is achieved by setting up the deductive system as a kind of “hybrid” calculus that simultaneously recognizes three different modes of implication ($/$, $\backslash$, and $|$) and in which the Introduction and Elimination rules for these connectives can apply freely one after another. A particularly illustrative example in this connection is (62). Here, we start with the category $\mathrm{NP}_d\backslash\mathrm{VP}$ and saturate the dative argument (with a hypothesis) via $\backslash$E to produce a VP. This is then followed by a sequence of $|$I and $|$E steps (VP $\rightarrow$ VP$|$NP $\rightarrow$ VP). And finally $\backslash$I takes us back to the original category $\mathrm{NP}_d\backslash\mathrm{VP}$. The sequence of $|$I and $|$E is for the purpose of binding the reflexive to the matrix subject, and the outer pair of $\backslash$E and $\backslash$I is for the purpose of creating a “VP constituent” that the reflexive can take as an argument. Crucially, the systematic interaction between the two modes of implication makes it clear that the inference steps relevant for semantic purposes (here, binding of the reflexive) do not affect the combinatoric property of the whole linguistic expression.

This hybrid implication architecture of the present framework extends previous work in CG in a significant way. One might think that the extensions of the Lambek calculus in the TLCG literature (e.g., Moortgat 1990; Hepple 1990; Morrill 1994; Carpenter 1997; Jäger 2005; Morrill, Valentín, and Fadda 2011) that augment the base logic of directional implication with various discontinuity operators would serve similar purposes. There is, however, an important difference between these previous systems and the present one. The extensions to the Lambek calculus proposed by these authors are essentially add-ons to the inherently directionality-sensitive architecture of the Lambek calculus, and, for that reason, are insufficiently general. Building on Oehrle's (1994) pioneering work, the present system departs from these precursors in modelling the phonological component in terms of a full-fledged λ-calculus (a familiar technique whose formal properties are well-understood). This enables a systematic and transparent treatment of the more complex scope-taking behaviors of expressions such as symmetrical predicates, which are known to be irreducible to generalized quantifiers (Keenan 1992). It remains to be seen whether the discontinuity operators proposed in the previous TLCG literature for the treatment of generalized quantifiers would extend equally straightforwardly to these more complex cases.

And this brings up a somewhat more general point of comparison with a certain line of thinking in the current Minimalist literature. Given the rough analogy between the Elimination and Introduction rules for the directional slashes and the operations of Merge and Move (for overt movement), and between hypothetical reasoning for the vertical slash and covert movement, the present architecture in which deductive inferences involving the directional slashes and those involving the nondirectional slash are freely interspersed with one another resembles the idea of "Late Merge" suggested in the recent Minimalist literature by Bhatt and Pancheva (2004) (see also Fox and Nissenbaum 1999 for a closely related proposal). Roughly speaking, the idea behind Late Merge is that certain linguistic expressions can be merged in the derivation after Move has applied and moved some constituent to a higher position in the tree at which it takes scope at LF. Compared to the traditional T-model (in which manipulating LF representations for the purpose of semantic interpretation is restricted to the post-SpellOut component), Late Merge is thus meant to introduce a greater degree of freedom in mediating the mapping between form and meaning by allowing for form manipulation (surface combinatorics) and meaning-manipulation (LF movement) to be carried out in tandem. Bhatt and Pancheva motivate this kind of architecture in terms of the correlation between the semantic scope of the comparative operator and the surface position of the *than*-clause in comparatives in English. The empirical argument that Bhatt and Pancheva adduce to their case is convincing, but they remain silent on the precise formulation of the operation of Late Merge, which sharply goes against the standard assumptions about the form-meaning mapping in derivational variants of generative grammar since at least May 1985.

The following sample derivation from Bhatt and Pancheva 2004 (their (21), p. 13) illustrates this point succinctly:

(66) Nicole made more money last year than Tom did.

a. 'Nicole made more money last year' is generated.

b. QR moves *-er* to the matrix clause. The lower copy is pronounced, and so this step is "covert".

   Overt structure: [[Nicole made more money last year] -er]

   LF structure: [[λd Nicole made d-much money last year] -er]

c. The degree complement is merged with *-er*.

   Overt structure: [[Nicole made more money last year] [-er than Tom did Δ]]

   LF structure: [[λd Nicole made d-much money last year] [-er [λd Tom made d-much money last year]]]

As should be clear from this derivation, Bhatt and Pancheva assume an architecture in which the grammar operates on a pair of "overt structure" and "LF structure" at each step of syntactic derivation. Their proposal is thus inconsistent with the traditional T-model, and, in a sense, is more in line with the architecture of Hybrid TLCG. There is, however, one crucial difference between the present proposal and the assumptions underlying Bhatt and Pancheva's proposal. In Hybrid TLCG, each inference rule in the deductive system explicitly specifies how the semantics of the derived expression is obtained from those of the inputs. Thus, at each step in the derivation, a full-fledged model-theoretic interpretation is assigned to the derived expression. However, in Bhatt and Pancheva's proposal, this is not the case since some of their LF structures are uninterpretable abstract representations, just like the pre-QR LF structures in the standard T-model. For example, Bhatt and Pancheva assume that the comparative morpheme *-er* is semantically of type $(d \to t) \to (d \to t) \to t$ (i.e. a "generalized quantifier" of degrees) and that it leaves a trace of type d. But then, before the QR of *-er* in step b. in (66), the derivation proceeds by explicitly keeping track of a pair of overt string and uninterpretable LF at each step of structure building. The grammar thus allows for much greater freedom in manipulating uninterpretable meaning representations; to see this, note that, given the same lexicon and grammar rules, the set of form-meaning pairs derivable in a T-model-type grammar is a proper subset of the set of form-meaning pairs derivable in a model that accommodates Late Merge. To the extent that one cares about compositionality, this added degree of noncompositionality (within a framework that already countenances very powerful operations on meaning representations) merits further scrutiny.

It is then interesting to see that a fully compositional implementation of the key idea underlying Late Merge becomes possible in the present Hybrid TLCG framework. As a demonstration, I sketch here how the above analysis of comparatives by Bhatt and Pancheva (2004) can be recast in Hybrid TLCG. Pollard and Smith (2012) propose an analysis of comparatives in an Oehrle-style system that we can more or less directly adopt for this purpose. In this analysis, the comparative operator is assigned the following lexical entry:

(67) $\lambda\sigma.\sigma(\mathsf{more})$; **more**; $(\mathrm{S}/\mathrm{S}_{\mathrm{than}})|(\mathrm{S}|\mathrm{Deg})$

Phonologically, the comparative operator embeds the comparative form of the amount expression *much* (i.e. the string *more*) in the gap position of the matrix clause and then the resultant string looks for the *than*-clause to its right.[25] The semantics involves comparing the maximum degrees satisfying the two degree predicates that the comparative operator takes as arguments, as standardly assumed.

(68) **more** = $\lambda P \lambda Q.\mathbf{max}(P) > \mathbf{max}(Q)$

The analysis for the sentence in (66) then goes as follows:

(69)
$$\dfrac{\dfrac{\begin{array}{l}\lambda\sigma.\sigma(\textsf{more});\\ \textbf{more};\\ (\mathrm{S}/\mathrm{S}_{\mathrm{than}})|(\mathrm{S}|\mathrm{Deg})\end{array} \quad \begin{array}{c}\vdots \quad \vdots\\ \lambda\varphi.\textsf{nicole} \circ \textsf{made} \circ \varphi \circ \textsf{money} \circ \textsf{last} \circ \textsf{year};\\ \lambda d.\textbf{n-made-}d\textbf{-much-money-last-year}; \mathrm{S}|\mathrm{Deg}\end{array}}{\begin{array}{l}\textsf{nicole} \circ \textsf{made} \circ \textsf{more} \circ \textsf{money} \circ \textsf{last} \circ \textsf{year};\\ \textbf{more}(\lambda d.\textbf{n-made-}d\textbf{-much-money-last-year}); \mathrm{S}/\mathrm{S}_{\mathrm{than}}\end{array}}{|\mathrm{E}} \quad \begin{array}{l}\vdots \quad \vdots\\ \textsf{than} \circ \textsf{tom} \circ \textsf{did};\\ \lambda d.\textbf{t-made-}d\textbf{-much-}\\ \textbf{money-last-year}; \mathrm{S}_{\mathrm{than}}\end{array}}{\begin{array}{l}\textsf{nicole} \circ \textsf{made} \circ \textsf{more} \circ \textsf{money} \circ \textsf{last} \circ \textsf{year} \circ \textsf{than} \circ \textsf{tom} \circ \textsf{did};\\ \textbf{more}(\lambda d.\textbf{n-made-}d\textbf{-much-money-last-year})(\lambda d.\textbf{t-made-}d\textbf{-much-money-last-year}); \mathrm{S}\end{array}}{/\mathrm{E}}$$

Thus, by assigning functional phonologies to certain linguistic expressions, a straightforward compositional analysis of a complex empirical phenomenon like comparatives becomes available that retains the key insight of Bhatt and Pancheva's Late Merge.

To the extent that an operation like Late Merge is empirically motivated, it is important to see what consequences ensue by formalizing the notion rigorously within some explicit model of grammar. Hybrid TLCG turns out to provide just such a formal framework. And what is particularly illuminating in this connection is that the advantage of taking a logical perspective on natural language syntax becomes highly relevant at least in two respects here. First, it leads to a fully compositional implementation of the idea behind Late Merge. Second, and perhaps more significantly, by formalizing grammatical composition as a kind of inference in a deductive system, the effect of "Late Merge" automatically emerges as a by-product of the hybrid implication architecture of grammar (rather than being stipulated as a special additional mechanism), where structure building "leading up to" the surface form and that pertaining to semantic interpretation are taken to constitute connected but independent reasoning steps (for which no inherent relative ordering is imposed), rather than separate components of grammar.

4 Conclusion

In a sense, the analysis of NCC in Japanese that I have proposed above can be thought of as a synthesis of deletion-based approaches and movement-based approaches. It shares the spirit of deletion-based approaches in treating NCC as a phenomenon that targets surface (morpho-)phonological representations of linguistic expressions rather than "syntactic constituents" (in the traditional sense). However, unlike in previous deletion-based approaches, the hybrid calculus underlying the present framework enables a more nuanced communication between the combinatoric and the morpho-phonological components, thus incorporating the essential insight of movement-based approaches.

While the proposed framework owes a lot to previous work in the CG literature, the specific way in which it integrates ideas from its predecessors is unique, and has a number of advantages both empirically and theoretically. Most importantly, the hybrid implication architecture adopted here makes possible a straightforward treatment of complex interactions between NCC and phenomena pertaining to the syntax-semantics interface such as symmetrical predicates (and related phenomena) and anaphoric binding. It is not clear whether the same range of empirical facts can be captured equally straightforwardly in more standard variants of TLCG, which are inherently directional in nature by taking the Lambek calculus as the starting point. More generally, the proposed framework has interesting implications in relation to the current Minimalist approach as well. In particular, in the hybrid implication architecture of the present framework, a totally explicit and precise characterization of the notion of Late Merge automatically emerges as a natural consequence of the general setup of the theory. I take this to be a distinct advantage of adopting a logical perspective on the syntax of natural language. The merit of working out the details of each component and their interfaces explicitly as was done in the present work is that tangible and falsifiable predictions can be made. I hope to have shown that the explicit syntax-semantics interface framework that I have proposed above has the potential of shedding a new light on a number of empirically and theoretically important problems both in the literature of CG and in the literature of generative syntax more generally.

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Footnotes

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[1]The following glosses are used: ACC = accusative, BENEF = benefactive, CL = classifier, COP = copula, DAT = dative, GEN = genitive, LOC = locative, NMLZ = nominalizer, NOM = nominative, PAST = past, PL = plural, POL = polite form, PROG = progressive, PRT = sentence-final particle, TE = *-te* form (nonfinite verbal form), TOP = topic.

[2]There is another construction superficially similar to sentences like (1) 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]
Taro-NOM Hanako-DAT apple-ACC three-CL-and Mitiko-DAT banana-ACC two-CL
age-ta.
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 numerals at the end of each conjunct (as 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 NCC in not allowing island violation (of the sort exemplified by

(4) and (5) below). Thus, I assume, following Koizumi, that this is a separate construction from ordinary NCC and leave a detailed study of it for future research.

[3]In (i) (Shûichi Yatabe, p.c.), it appears as if *kumo* is interpreted in different meanings across conjuncts.

(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.'						

But given the highly marked status of (ii), (i) is arguably a case of metalinguistic interpretation, where *kumo* essentially means "referent of a word pronounced as *kumo*," and is irrelevant for the issue under discussion.

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

Examples like (ii) are acceptable only in a situation where the speaker intends to forestall a potential confusion due to the existence of the homophonous word (and the disambiguating expression *musi-no* typically receives a contrastive pitch accent).

[4]Saito's (1987) proposal is somewhat different in that RNR applies somewhere between surface structure and PF. Note that, by adopting this position, the problematic equivalence of NCC sentences with their clausal coordination counterparts is still entailed, essentially in the same way as in deletion-based approaches.

[5]Takano's (2002) own quite different approach, which involves the operation of NP-adjunction wherein two NPs are merged together to form a complex, bipartite NP constituent derivationally, entails a radical departure from the standard syntax-semantics interface in derivational theories (which, as noted by Koopman and Szabolcsi (2000:225), is crucial for assigning the right compositional meanings for NCC structures in such theories). It is therefore unlikely to lead to a successful analysis of the internal reading for (18).

[6]It is worth noting that fundamental issues remain unresolved in Sabbagh's proposal, including, most importantly, the question of why ATB movement is possible only for overt movement and not for covert movement (which is necessary for Sabbagh to circumvent the predicted synonymy of (the English equivalents of) (19) and (18a)). This is one of the key differences between the CG analysis that I propose in the next section and its movement-based analog. As I discuss in the next section (see p. 32), an analog of ATB covert movement simply does not exist in the CG-based architecture of grammar proposed below, given independently motivated analyses of coordination and quantification. However, in order to rule out this possibility, Sabbagh (2007:366, footnote 13) needs to stipulate a constraint regarding the identity of constituents in linearization, a component whose exact details (within the overall derivational architecture) seem somewhat unclear.

[7]See Steedman (2012:158, footnote 8) for a conjecture that all of the apparently quantificational expressions in Japanese might be dealt with in terms of distributivity encoded in the lexical meanings of verbs.

[8]One might think that the pattern observed here could be explained away in terms of nonsyntactic factors, such as Kuno's (1987) principle of Parallel Interpretation Tendency, which dictates that parallel structures like coordination receive parallel interpretations. Such an account is dubious for the following reasons. First, if the unacceptability of the mixed binding pattern is due to a pragmatic principle favoring a parallel interpretation, contextual information should be able to override the default tendency. However, no amount of contextual manipulation improves the robust unacceptability of the mixed readings in (23).

Second, in NCC sentences, the availability and unavailability of the mixed readings strictly correlates with whether the reflexive *zibun* overtly appears in the two conjuncts separately or not. Thus, in the following pair, even though the focus particle *mo* 'also' attached to the subject of the second conjunct should equally have the effect of enhancing a parallel interpretation, the two sentences contrast with one another sharply in that (ia) allows a mixed interpretation whereas (ib) doesn't:

(i) a. Taroo-wa gakusei-ni **zibun-no** kenkyuusitu-de, (sosite) Ziroo-mo
Taro-TOP student-DAT self-GEN office-LOC and Jiro-also
dooryoo-ni **zibun-no** ie-de kossori arubaito-o s-ase-ta.
colleague-DAT self-GEN home-LOC secretly part.time.job-ACC do-cause-PAST
'Taro$_i$ secretly made his students work part-time in his$_i$ office and Jiro also secretly made his colleagues$_j$ work part-time at their$_j$ home.'

b. Taroo-wa gakusei-ni, (sosite) Ziroo-mo dooryoo-ni **zibun-no**
Taro-TOP student-DAT and Jiro-also colleague-DAT self-GEN
kenkyuusitu-de kossori arubaito-o s-ase-ta.
office-LOC secretly part.time.job-ACC do-cause-PAST
'Taro$_i$ secretly made his students work part-time in his$_i$ office and Jiro$_j$ also secretly made his colleagues work part-time in his$_j$ office.'

For these reasons, I take the unacceptability of the mixed binding patterns in (23) to be a syntactic fact.

[9]A deletion-based approach that takes into account semantic identity as well might be able to capture the binding pattern in (23). For example, by adopting the anaphoric approach to deletion proposed by Sag (1976) and Williams (1977) for VP ellipsis, the relevant constraint is statable by ensuring strict semantic identity of the antecedent and the phonologically empty anaphoric expression in the deletion site.

Such an approach does not seem plausible for the following two reasons. First, coordination is not a configuration that allows for cataphora in Japanese, but the anaphoric link needs to be established backwards (and only backwards) in this analysis of NCC. Second, such an approach presupposes that there is a unique and unambiguous way of identifying the LF structure that "corresponds" (in a sense that needs to be made precise) to the surface string that undergoes ellipsis. This so-called "correspondence problem" was already noted by Sag (1976:102), but in the literature (after more than 30 years of the recognition of the problem) there is still no explicit proposal that works out the relevant details adequately, suggesting that this is indeed an intractable problem within a derivational architecture. See section 3.5 below for a more extended discussion on a related point.

[10]Note also that, while reconstruction of an ATB-moved material is not exactly identical to covert ATB movement out of conjuncts, they are similar in that both are LF movement involving ATB coordinate structures. Given this, ruling out the latter (which one needs to do in order to prevent the overgeneration of the internal reading for sentences like (19); see footnote 6) while still admitting the former on some principled basis seems to be a challenging task.

[11]Readers familiar with CG may want to skip section 3.2 (and perhaps 3.3 as well). A few comments are in order for readers who choose to do so. First, the present calculus consists of a total of six rules, Introduction and Elimination rules for each of the three syntactic connectives $/$, $\backslash$ and $|$ ((31), (33) and (37)). A subsystem consisting of only the rules for $/$ and $\backslash$ is equivalent to the (associative) Lambek calculus **L**. Note however that the rules are written in the labelled deduction notation for natural deduction, following Morrill's (1994) reformulation of **L** in a labelled deduction setting. This means that the directionality that governs the inferences involving $/$ and $\backslash$ are encoded in the phonological terms of the derived linguistic expressions (rather than via contexts or (less explicitly) in the structural positions of the premises in the global structures of proof trees, as in more standard formulations of **L**). In particular, the Introduction rules for $/$ and $\backslash$ in (33) are sensitive to the forms of phonological terms of the input expressions. If the calculus instead had only the rules for $|$ (i.e., (37)) it is essentially equivalent to the "nondirectional" variants of CG proposed by Oehrle (1994), de Groote (2001) and Muskens (2003), where λ-binding in the prosodic component takes care of word order. The uniqueness of the present framework lies in recognizing both the directional and nondirectional modes of implication simultaneously within a single calculus.

[12]The vertical slash $|$ will be introduced below in section 3.3.

[13]To extend the analogy to Minimalist syntax, these rules might be taken to loosely corre-

spond to Move. But caution should be taken that this is just a rough and crude comparison. In fact, one important property of Slash Introduction rules is that, as inference rules in the logical deductive system, they *define* the properties of the forward and backward slashes together with the Slash Elimination rules. For this reason, the grammar rules in CG have very different statuses conceptually from "corresponding" rules in other theories.

[14]The basic idea here is due to Dowty (1988) and Steedman (1985), originally formulated in CCG with the rules of function composition and type-raising. Authors such as Morrill (1994) later showed that by recognizing hypothetical reasoning fully generally, a more straightforward analysis becomes possible.

[15]Readers who wonder about the formal status of the rule in (35) (which is neither a standard kind of logical rule or a structural rule) can think of it as an abbreviation of a sequence of two Elimination steps involving a phonetically null conjunction category $(X\backslash X)/X$.

[16]A comment is in order regarding the Coordinate Structure Constraint (CSC). For leftward extraction such as *wh*-movement in English, I assume, pace Postal (1998), that (the element constraint of) the CSC is a pragmatic constraint. In the present approach, extraction can be handled via the vertical slash (cf. Muskens 2003). (Note that this is different from the analysis of extraction in CCG, which employs directional slashes for this purpose as well.) Unlike the directional slashes, the vertical slash can bind a gap in a medial position. Thus, examples like **This is the book that [[John bought __] and [Mary bought the magazine]]* are licensed in the syntax, just like the so-called asymmetrical coordination cases such as *This is the stuff that people in the Caucasus [drink __] and [live to be a hundred].* Following authors such as Lakoff (1986) and Kehler (2002), I take the unacceptability of the former to follow from a violation of a pragmatic coherence condition.

The ungrammaticality of ATB violation in the RNR environment, on the other hand, seems more robust:

(i) *Ann read __ and Bill reviewed papers for LI, the Bible.

The present approach predicts this fact straightforwardly (just like other approaches in CG).

Note that NCC (including right-node raising) is handled via reanalysis of constituency involving the directional slashes. Thus, with the directional slashes alone, the derivation crashes at the point where the coordinate structure is built (S/NP cannot be conjoined with S). With the vertical slash, it is possible to analyze a sentence containing a gap in the first conjunct as a constituent, as in (ii).

(ii) $\lambda\varphi.\textsf{ann} \circ \textsf{read} \circ \varphi \circ \textsf{and} \circ \textsf{bill} \circ \textsf{reviewed} \circ \textsf{papers} \circ \textsf{for} \circ \textsf{LI}; \mathrm{S|NP}$

However, the functional phonological term of this expression explicitly keeps track of the gap via lambda binding. Thus, applying this functor to an argument NP *the Bible* produces coordination of two full-fledged sentences (where *the Bible* replaces the variable φ in (ii)), rather than the ungrammatical string in (i). Thus, even with the order-insensitive vertical slash, no ATB violation arises in the context of NCC.

[17]One might wonder at this point whether/how the interaction between quantifier scope and right-node raising in examples like the following is accounted for in the present setup:

(i) Some man likes and some boy hates, every novel by Henry James.

In particular, it might appear that the reading in which the right-node raised universal quantifier scopes below the existential quantifier in each conjunct is underivable, since the quantifier will have to be tectogrammatically outside the two conjuncts in the CG analysis of right-node raising.

It turns out that the relevant reading *is* actually derivable in the present fragment without any additional mechanisms. To see this point, note first that a type specification for quantifiers involving only the directional slashes can be derived from the basic entry involving the vertical slash as in (ii).

(ii)
$$\dfrac{\lambda\sigma.\sigma(\textsf{every} \circ \textsf{novel}); \forall_{\mathbf{novel}}; \mathrm{S|(S|NP)} \quad \dfrac{\dfrac{[\varphi_2;\ P;\ \mathrm{S/NP}]^2 \quad [\varphi_1;\ x;\ \mathrm{NP}]^1}{\varphi_2 \circ \varphi_1; P(x); \mathrm{S}}\backslash\mathrm{E}}{\lambda\varphi_1.\varphi_2 \circ \varphi_1; \lambda x.P(x); \mathrm{S|NP}}|\mathrm{I}^1}{\dfrac{\varphi_2 \circ \textsf{every} \circ \textsf{novel}; \forall_{\mathbf{novel}}(\lambda x.P(x)); \mathrm{S}}{\textsf{every} \circ \textsf{novel}; \lambda P.\forall_{\mathbf{novel}}(\lambda x.P(x)); \mathrm{(S/NP)\backslash S}}/\mathrm{I}^2}|\mathrm{E}$$

With this derived quantifier entry, the narrow scope reading for the object position quantifier can be derived.

(iii)

$$\dfrac{\dfrac{\text{some} \circ \text{man};\ \exists_{\textbf{man}};\ \mathrm{S}|(\mathrm{S}|\mathrm{NP}) \qquad \dfrac{\dfrac{\dfrac{\vdots \quad \vdots}{\varphi_2 \circ \text{likes};\ \lambda x.\textbf{like}(x)(y);\ \mathrm{S}/\mathrm{NP}} \quad [\varphi_1;\ \mathscr{P};\ (\mathrm{S}/\mathrm{NP})\backslash\mathrm{S}]^1}{\varphi_2 \circ \text{likes} \circ \varphi_1;\ \mathscr{P}(\lambda x.\textbf{like}(x)(y));\ \mathrm{S}}}{\lambda\varphi_2.\varphi_2 \circ \text{likes} \circ \varphi_1;\ \lambda y.\mathscr{P}(\lambda x.\textbf{like}(x)(y));\ \mathrm{S}|\mathrm{NP}}}{\text{some} \circ \text{man} \circ \text{likes} \circ \varphi_1;\ \exists_{\textbf{man}}(\lambda y.\mathscr{P}(\lambda x.\textbf{like}(x)(y)));\ \mathrm{S}}}{\text{some} \circ \text{man} \circ \text{likes};\ \lambda\mathscr{P}.\exists_{\textbf{man}}(\lambda y.\mathscr{P}(\lambda x.\textbf{like}(x)(y)));\ \mathrm{S}/((\mathrm{S}/\mathrm{NP})\backslash\mathrm{S})}$$

$$\dfrac{\begin{array}{c}\vdots \quad \vdots \\ \text{some} \circ \text{man} \circ \text{likes} \circ \text{and} \circ \text{some} \circ \text{boy} \circ \text{hates}; \\ \lambda\mathscr{P}.\exists_{\textbf{man}}(\lambda y.\mathscr{P}(\lambda x.\textbf{like}(x)(y))) \wedge \exists_{\textbf{boy}}(\lambda y.\mathscr{P}(\lambda x.\textbf{hate}(x)(y)));\ \mathrm{S}/((\mathrm{S}/\mathrm{NP})\backslash\mathrm{S})\end{array} \quad \begin{array}{c}\vdots \quad \vdots \\ \text{every} \circ \text{novel}; \\ \forall_{\textbf{novel}};\ (\mathrm{S}/\mathrm{NP})\backslash\mathrm{S}\end{array}}{\begin{array}{c}\text{some} \circ \text{man} \circ \text{likes} \circ \text{and} \circ \text{some} \circ \text{boy} \circ \text{hates} \circ \text{every} \circ \text{novel}; \\ \exists_{\textbf{man}}(\lambda y.\forall_{\textbf{novel}}(\lambda x.\textbf{like}(x)(y))) \wedge \exists_{\textbf{boy}}(\lambda y.\forall_{\textbf{novel}}(\lambda x.\textbf{hate}(x)(y)));\ \mathrm{S}\end{array}}$$

The key point here is the hypothetical assumption of the "lowered" quantifier of category $(\mathrm{S}/\mathrm{NP})\backslash\mathrm{S}$ in the object position in each conjunct, which scopes below the subject quantifier (thus $\exists > \forall$ in each conjunct).

[18]See Barker 2002, 2004 for linguistic motivations of continuations. The main reason that I depart from Barker's (2007) original analysis here is the unclarity of the formal and ontological status of the key structural rule that he posits in TLCG, which contains symbols that look like lambda operators and bound variables.

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

The rule is intended to manipulate the structured antecedents of sequents in a standard TLCG setup, which govern the abstract modes of composition (indirectly) reflecting constituent structures of the derived linguistic expressions. The use of lambdas in structured antecedents is unprecedented, and Barker does not clarify whether these symbols are meant to be interpreted as real lambda operators and bound variables or they are uninterpreted symbols that effectively mimic LF movement in derivational theories within the TLCG setup.

[19]Since *same* can distribute over non-NP meanings, the notion of plurality here should be understood in a generalized sense. I assume, following Barker (2007), that non-NP

meanings can also be pluralized using the generalized sum forming operation denoted by the symbol $\oplus$.

[20]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.

[21]$<_a$ denotes the 'atomic part of' relation, such that $x <_a X$ iff $x < X \wedge \neg\exists y.y < x$; $\exists!$ is the unique existential quantifier defined as $\exists! x P(x) =_{def} \exists x[P(x) \wedge \forall y[P(y) \rightarrow y = x]]$.

[22]A reviewer notes that the sentence *A different professor liked every student and hated the dean* lacks the internal reading for *different* and that this fact has been attributed to the CSC on certain accounts. As it is, the present analysis overgenerates the internal reading for this sentence if the universal quantifier is allowed to scope over the symmetrical predicate *different*. The derivation involves a step at which *different* distributes over a sum of the form **liked**$(x) \oplus$ **hated**(**the-dean**), where x is to be later bound by the universal quantifier. By disallowing the sum that a symmetrical predicate distributes over to contain an unbound variable, this can be ruled out. Such a constraint may follow from some sort of processing-oriented principle or an independently needed semantic parallelism constraint requiring the quantifier scope relations between the two conjuncts to be parallel. I leave further investigation of this issue for future research.

[23]Other approaches to binding and anaphora in CG such as those proposed by Jacobson (1999) and Steedman (2012) are also compatible with the present proposal.

[24]For a more complete treatment that takes into account the morpho-phonological clustering of the higher and lower verbs, see Kubota, to appear.

[25]The comparative operator should really be specified to take a noncomparative form of an amount expression or an adjective as an argument and embed the appropriate comparative form of it in the gap position of the matrix clause. But I gloss over this detail here since it is orthogonal to the main point under discussion.