The scope anomaly of Gapping*

Yusuke Kubota and Robert Levine

Ohio State University, JSPS and Ohio State University

1. Introduction

Gapping has resisted a successful analysis in both transformational and non-transformational variants of generative grammar. In this paper, we review representative approaches in both camps, and discuss the problems for each. The arguments mostly center around the complex interactions between Gapping and scopal operators noted by Siegel (1984) Oehrle (1987), and McCawley (1993), of the sort exemplified by the following data:

- (1) a. Mrs. J can't live in Boston and Mr. J \emptyset in LA.
 - b. Kim didn't play bingo and Sandy \emptyset sit at home all evening.
- (2) No dog eats Whiskas or \emptyset cat \emptyset Alpo.

These sentences all have readings in which the scopal operator (the negated auxiliary in (1) and the determiner in (2)) scopes over the whole coordinated sentence (for (1a), this corresponds to the paraphrase 'it's not possible for Mrs. J to live in Boston and Mr. J to live in LA at the same time'). These sentences in addition have (perhaps less salient) readings where the scopal operator distributes to each conjunct ('Mrs. J can't live in Boston and Mr. J can't live in LA'). The existence of the first, auxiliary/quantifier wide scope reading has posed a particularly difficult challenge to previous attempts.

We suggest that a satisfactory solution becomes available only by taking a totally different approach, where Gapping is taken to be coordination of sentences missing verbs (and sometimes other elements as well) in the middle. While such an analysis is not easy (and perhaps impossible) to formulate in either transformational or non-transformational frameworks, it emerges as the simplest analysis of (and thus the null hypothesis about) the structure of Gapping in a certain type of categorial grammar. We will sketch the form of the analysis and how it solves the problems for previous approaches at the end of the paper.

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2. Previous approaches to Gapping

(3)

2.1 The Gapping problem in phrase structure grammar

Non-canonical coordinations (such as argument cluster coordination (Dowty 1988) and right-node raising) reflect operations on strings that are not licensed as constituents in phrase structure grammar (PSG), and present perhaps the greatest empirical challenges such frameworks face. Gapping, in which the conjuncts are not even structurally parallel (with the initial conjunct being a complete clause and the non-initial conjunct(s) consisting of a sequence of constituents from which a main predicate is missing), is particularly troublesome.

Sag et al. 1985 The first PSG speculations about Gapping, and, implicitly, other forms of non-canonical coordination, appear in Sag et al. (1985) (SGWW), where the structure in (3) is offered as an account of the sentence *Terry likes Stacy, and Tracy Lee*:



This analysis immediately raises the question of how the semantic interpretation of the whole sentence is obtained. Sag et al. (1985) state that the interpretation for the second conjunct of this structure is given 'by uniformly substituting its immediate constituents into some immediately preceding structure, and computing the interpretation of the results' (p. 162). Besides being stated in only very vague terms, such an analysis, requiring a global comparison of the two conjuncts, breaks sharply with the strictly local compositional interpretation mechanism assumed in GPSG (cf. Gazdar et al. (1985)).

Still more important are the empirical consequences: the SGWW account mispredicts the modal scope ambiguity facts outlined in section 1. For (1a), for example, there appears little basis for any other correlation between the two conjuncts than that in (4):

(4)	Mrs J	can't	live	in	Boston
	\uparrow	\uparrow	\uparrow	\uparrow	\uparrow
	Mr J	Ø	Ø	in	LA

But this gives us only the distributive reading of the sentence as in the following:



Abeillé et al. 2013 Abeillé et al. (2013), the only extant HPSG treatment of Gapping, essentially replicates the SGWW analysis in a construction grammar format. In their account, the 'Gapping construction' is licensed by a nonbranching phrase consisting of an arbitrary cluster of constituents. To regulate the possible forms this cluster can take, they further stipulate a detailed morphosyntactic match between the two conjuncts such that the cluster of constituents in the second conjunct 'must match *synsem* objects on the ARG-ST list of some verbal predicate in' the first conjunct. Their analysis is illustrated in (6):



Note that Abeillé et al. crucially assume that the gapped conjunct consists of a cluster of (full-fledged, phrasal) dependents of the verb. But then, determiner gapping like (2) above becomes a problem. In (2), *cat* is not a full NP, but only a determiner-less noun, so it does not appear on the subcategorization frame of the verb. Data such as *No dog's father likes Whiskas or cat's mother Alpo* (where the determiner is embedded) are still more problematic. Thus, this analysis is incomplete just as a syntactic description of Gapping.

Matters are no better on the semantic side, where Abeillé et al. refer to a possible application of higher-order unification (Dalrymple et al. 1991) as a promising, explicit approach to interpretation in Gapping. As an illustration, they give the following example:

- (7) a. John invited Sue and Bill Mary.
 - b. John invited Sue = invited(j, s)
 - c. $\mathscr{F} = U(invited(j,s), P(j,s)) = \lambda x \lambda y.invited(x, y)$
 - d. Bill Mary = $\mathscr{F}(\mathbf{b})(\mathbf{m}) = \lambda x \lambda y$. [invited(x, y)](b)(m) = invited(b, m)

(5)

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Higher-order unification (U) resolves the meaning of the missing verb (P) in the second conjunct as the meaning of the verb in the first conjunct (identified as \mathscr{F}). Then, supplying \mathscr{F} to the second conjunct, we obtain a complete proposition with the desired meaning.

But this approach immediately runs into trouble in more complex cases involving scopal interactions with auxiliaries and quantifiers, of the sort reviewed in the previous section:

- (8) a. John can't invite Sue and Bill Mary.
 - b. John can't invite Sue = $\neg \Diamond invite(j, s)$
 - c. $\mathscr{F} = U(\neg \Diamond invite(j,s), P(j,s)) = \lambda x \lambda y. \neg \Diamond invite(x, y)$

The only reading we obtain is the distributive reading, just as in SGWW's account.

Thus, PSG approaches have failed to produce an empirically adequate analysis of Gapping. The source of this failure is inherent in the very architecture of PSG frameworks. In PSG, there is no way to analyze the second conjunct as a constituent that systematically relates to the 'corresponding parts' of the first conjunct. But then, specifying an explicit compositional semantics which systematically interacts with the semantics of scope-taking expressions becomes a virtually intractable problem.

2.2 Gapping as low VP coordination: the transformational approach

Movement-based approaches fare better than PSG approaches in the analysis of Gapping; there are several related approaches in the recent literature that attempt to solve precisely this problem (Johnson 2000, 2009; Lin 2000, 2002; Toosarvandani 2013). These proposals differ in some details, but they all share the assumption that Gapping sentences are derived from underlying structures involving coordination at the lower VP level. For expository ease, we take up Johnson's (2000) proposal below, but our critique is applicable to other movement-based approaches by Lin and Toosarvandani as well.

The low VP coordination analysis The starting point of Johnson (2000) is the assumption that examples in which only the auxiliary is missing (e.g. (1b) from section 1) have syntactic structures like the following involving coordination of the lower VP:



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The auxiliary is base-generated in a position above the coordinated VP, so no deletion or movement is involved so far as this apparently gapped auxiliary is concerned. The subject of the first conjunct moves (in a non-ATB fashion) to a syntactically higher position c-commanding the tensed auxiliary, but the subject of the non-initial conjunct stays in the VP internal position. (Note this asymmetry between the subjects of the two clauses; our critique below essentially consists in questioning the plausibility of this asymmetrical syntactic structure.) Crucially, since the auxiliary appears outside the coordinate structure in this analysis, the auxiliary wide-scope reading is correctly obtained.

Examples like (1a) in which both the auxiliary and the verb are missing are licensed by moving the verb out of the two conjuncts in an ATB fashion along the following lines:



Finally, for cases involving negative determiners, Johnson adopts the split scope analysis (Jacobs 1980; Penka 2011) in which these determiners are decomposed into a higher sentential negation and a lower indefinite at LF.



The ATB movement of the verb is licensed in the same way as (10) above. The only extra complication involved in this example is the split scope of the subject negative quantifier.

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The subject in the two conjuncts both have a phonologically empty indefinite article ϕ_{\exists} as their determiners. This DP moves out of its VP internal position in the first conjunct (just as in other examples) and attaches to a higher adverbial negation so that this negation and the indefinite ϕ_{\exists} fuse at PF to be spelled out as the morpheme *no*. ϕ_{\exists} and the head noun are reconstructed to its base position at LF for the purpose of semantic interpretation. Thus, just as in the example above involving an auxiliary, the scopal relation between the quantifier and the coordinate structure is captured by assuming that the negation which is part of the negative quantifier is syntactically outside of the coordinate structure.

Contraindications for the low VP coordination analysis As should be clear from the above, the key component of Johnson's analysis are low VP coordination and the asymmetrical non-ATB movement of the first conjunct subject out of its VP-internal position. But apart from resolving the scope mismatch, there does not seem to be any independent motivation for these assumptions. Below, we discuss two types of problems for the low VP coordination analysis: (i) its inability to license the distributive readings for auxiliaries and quantifiers; (ii) the non-VP-hood of the coordinated low VP involved in this analysis.

We start with the problem of distributive readings. Johnson himself, alluding to such data, says only that 'these cases might arise because gapping has removed the negation from the second conjunct' (Johnson 2009:298, footnote 10), without further explication. Given his treatment of the basic cases of Gapping, (12) (on its distributive reading) must be analyzed along the lines of (13), where it contains a token of both the modal *can* and the negation marker *not* in addition to the verb *live* in both conjuncts.

(12) Mrs. J cannot live in LA and Mr. J in Boston.



These three elements then need to undergo ATB movement so that only a single token of each appears in the surface string. But it is not clear where the landing sites for these

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movements are supposed to be, and how the separate movements are made so that they yield the one way out of the six possible orderings among *can*, *not* and *live* that gives us the right surface order.¹

Perhaps still more problematic (as acknowledged by Johnson (2009:298) himself) are cases such as (14), first noted by Repp (2006, 2009), where negation scopes over the first conjunct only.²

(14) PETE wasn't called by VANESSA, but (rather) JOHN by JESSE

As Repp (2009:31) notes, in the low VP coordination analysis, 'negation can either be interpreted above the coordination (= wide scope) or inside both conjuncts (= distributed scope) but it cannot scope over the first conjunct only'.

Thus, both the ordinary distributive readings of auxiliaries and Repp's $\neg A \land B$ examples pose serious empirical problems for the low VP coordination approach.

Turning now to the non-VP-hood of the low coordinated VP node, note that the non-ATB movement of the first conjunct subject creates a spurious surface VP (or TP) asymmetrically containing the subject of the second conjunct. Thus, in the following example (containing an auxiliary):

(15) No positron can occupy the INner shell and electron $\begin{cases} a. \emptyset \\ b. sit in \end{cases}$ the OUTer shell of the same atom.

the subject moves to a higher position, and the verb remains in either the T (in (15a)) or V (in (15b)) head below:

- (16) a. $[AgrP No positron_i [Agr' can [TP occupy_j [VP [VP t_i t_j the INner shell]] and [VP <math>\phi_{\exists}$ electron t_j the OUTer shell]]]]]
 - b. $[_{AgrP} \text{ No positron}_i [_{Agr'} \text{ can } [_{TP} [_{VP} t_i \text{ occupy the INner shell}] \text{ and } [_{VP} \phi_{\exists} \text{ electron sit in the OUTer shell}]]]]$

But neither the TP nor the VP exhibits the typical properties of complements of auxiliaries (we omit the VP data for (18) and (19)):

- (17) a. No positron can $[_{TP_i}$ occupy the INner shell and electron the OUTer shell of the same atom]. #Not only that, no neutron can do so_i. (*do so*)
 - b. No positron can $[VP_i]$ occupy the INner shell and electron sit in the OUTer shell of the same atom]. #Not only that, no neutron can do so_i.

¹Johnson (2009:315) makes a vague allusion to the so-called 'linearization conditions' (Takahashi 2004; Fox and Pesetsky 2005) on a similar word order problem arising in a somewhat different context. But making recourse to these conditions does not solve the problem since the linearization conditions themselves are nothing more than a restatement of an empirical generalization and do not follow from any general principle of the grammar.

²Repp's (2006, 2009) own analysis is also problematic. The core idea of her proposal is that wide scope negation readings arise as instances of 'illocutionary negation', a kind of negation corresponding to a speech act. But Tomioka (2011) gives examples exhibiting auxiliary wide-scope interpretations within conditional and relative clauses, contexts in which the illocutionary negation-based account is unlikely to be tenable.

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- (18) *[$_{\text{TP}_i}$ Occupy the INner shell and electron the OUTer shell of the same atom], no positron can t_i . (fronting)
- (19) *No positron can [TP occupy the INner shell and electron the OUTer shell of the same atom], or [TP occupy the inner shell of an atom with another positron]. (coordination)

If phenomena like *do so* replacement, VP fronting and coordination target TPs, the unacceptability of (17a), (18) and (19) remains unaccounted for; if they target VPs, then (17b) and its counterparts for the VP fronting and coordination data turn out to be problematic. Thus, either way, the analysis fails. Johnson's analysis is primarily motivated by semantic considerations. But the above data strongly suggest that it mischaracterizes the syntax of Gapping. The misprediction is essentially due to the fact that it analyzes Gapping via coordination at the VP level.³

Moreover, just from the basic syntactic patterns of Gapping, we see evidence that the low VP coordination analysis is not on the right track. The relevant data come from Gapping sentences involving various fronted elements, such as the following:

- (20) a. At our house we play poker, and at Betsy's house, bridge.
 - b. To Leslie I want to write a letter, and to Robin, a short note.
 - c. Tweedledee, I intend to argue with, and Tweedledum, to negotiate with.

There does not seem to be any straightforward way to accommodate these data with the low VP coordination analysis of Gapping. By assumption, the second conjunct contains only an untensed lower VP projection, but then, there is no landing site for the fronted elements which are standardly taken to be somewhere above the T node. Assuming that there is an adjunction site for these elements just above the lower VP is highly implausible, given that examples like the following are unacceptable:

(21) a. *I want [to Robin]_i to write a letter
$$t_i$$
. (cf. (20b))

³One might think that the VP fronting data in (18) could be ruled out by assuming that reconstruction of the subject of the first conjunct to a VP-internal position (which one might motivate either from the CSC (Lin 2001) or perhaps just for the purpose of semantic interpretation) is blocked for fronted VPs. Such an assumption might in turn be taken to receive independent support from the fact that the object quantifier cannot scope over the subject quantifier in such an environment:

(i) See everyone, (I am sure) someone did. $(\exists > \forall, * \forall > \exists; Huang 1993)$

But the argument that (i) motivates this assumption is decisively undermined by contrasts such as that between (iia) and (iib).

(ii)	a.	Some student (or other) wants to hear stories about every physicist.	$(\exists > \forall, \forall > \exists)$
	b.	Stories about every physicist, some student (or other) wants to hear.	$(\exists > \forall, * \forall > \exists)$

In (iib) there is no question of the existentially quantified subject reconstructing to a position within the fronted constituent, since it did not originate within that constituent to begin with. Yet just as in (i), we find that the wide scope available to the in situ universal is unavailable when the universal is part of a topicalized constituent. Hence the claim that subjects cannot reconstruct back into fronted VPs gains no support from the scopal facts about (i), and appealing to such a claim to explain the pattern in (18) must therefore be purely stipulative.

b. *I intend_i [VP Tweedledee_k [VP t_i to negotiate with t_k]] (cf. (20c))

To rule out these examples, one would need to invoke some constraint prohibiting the (future) fronted element to stay in the lower VP adjunction site if the subject moves out of its VP internal position. But such an interdependency between movement operations is not only theoretically dubious but also lacks any empirical motivation.

The evidence just outlined above against the low VP coordination analysis uses a particular syntactic behavior characteristic of clauses but not of VPs as a diagnostic probe. A second argument of the same kind can be made based on a property characteristic of VPs as opposed to clauses: the distribution of the adverb *merely* is a case in point. As shown in (22), *merely* is a strictly VP adjunct; it cannot adjoin to S.

- (22) a. Robin $\begin{cases} merely \ said \\ said \ merely \end{cases}$ that our footnotes were too long.
 - b. *Merely, Robin said that our footnotes were too long.

Merely should then be able to appear preceding the putative VP which the second conjunct consists of in Johnson's analysis. But this prediction is not borne out.

(23) Robin commented only that our margins were too small, and {a. Leslie merely b*merely Leslie}

The badness of (23b) follows directly from the fact, exemplified in (22b), that *merely* is strictly a VP modifier, if we assume that the Gapped conjunct is clausal. But it is completely unexpected if we take the Gapped conjunct to be a VP.

We thus have two diagnostics which independently sort VPs from Ss converging on the identification of the Gapped conjunct as an S, not a VP. Ordinary methodological considerations therefore suggest that, like the data in (17)–(19), these facts impose a very heavy buden of proof onto the low VP coordination analysis.

Finally, Johnson's low VP coordination analysis of Gapping and his decomposition of a negative determiner into a higher adverbial and a lower existential leads to the prediction that a determiner can be gapped from the second conjunct only if it is a 'split determiner' and if the verb (or at least the auxiliary) is also gapped (see Johnson (2000) for details). Johnson takes this to be a welcome prediction, since at first sight determiner gapping does indeed appear to be dependent on verb gapping:

(24) a. *Too many setters are named Kelly, and \emptyset shepherds are named Fritz.

b. *Your daughter is 16 and \emptyset son is 17-1/2. (McCawley 1993)

But we believe that a fully representative set of data from this domain invalidates this supposed generalization.⁴ Note, for example, the following (Carl Pollard, p.c.):⁵

⁴It should also be noted that Johnson's approach has nothing to say about the well-formedness of nonnegative determiner gapping examples noted by McCawley (1993) (e.g. *Your daughter is 16 and* \emptyset *son* \emptyset *17 1/2*). Johnson (2000) speculates on a possibility that these determiners as well might involve a 'hidden adverbial part'. But such an assumption cannot be accepted unless there is an independent motivation for it of a kind which, so far as we know, has never been provided or defended in the literature.

⁵Johnson (2014) claims that the pattern exhibited by (25) is limited to cases in which the two conjuncts have the same tense, based on his judgments on the following:

- (25) a. Some dog barked and \emptyset donkey brayed last night.
 - b. No dog barked or \emptyset donkey brayed last night.

Note in particular that (25b) exhibits the same scope anomaly as examples like (2). Given Johnson's predicted dependency of determiner gapping on ordinary Gapping, there seems no straightforward way of accounting for the parallel scopal behavior of negative quantifiers in these two types of cases in his approach.

3. An alternative perspective

Gapping thus continues to pose a serious challenge to both phrase structure-based and derivational theories of syntax. In either strand of research, there is currently no successful analysis of the apparently anomalous scopal properties of auxiliaries and quantifiers that is free from major empirical problems. In this final section, we sketch an outline of an analysis of Gapping in Hybrid Type-Logical Categorial Grammar (Hybrid TLCG; Kubota 2010, to appear) that does not suffer from these empirical shortcomings of previous proposals. The key feature of this variant of categorial grammar (CG) is that it combines the directionality-sensitive logic of the Lambek calculus with a separate logic dealing with operations on string representations that enables modelling movement-like operations in CG (such as Steedman (1990) and Oehrle (1987)) and formulate a conceptually simple and empirical adequate analysis of Gapping. For a full-fledged analysis which works out the relevant details explicitly, see Kubota and Levine (2012, 2013a, 2014).

We take it, contra Johnson, that Gapping involves coordination at the S level, but that what gets coordinated are simply two sentences missing the verb. In Hybrid TLCG, such an analysis is straightforwardly available, with the new, order-insensitive slash | tied to λ -binding in the phonological component. (Theoretically, | corresponds to the implication connective in intuitionistic linear logic, and its independent empirical motivation comes from analyses of quantification and extraction (Oehrle 1994; Muskens 2003).) In this approach, a sentence missing a TV (= (NP\S)/NP for transitive verbs) in the middle can be characterized via hypothetical reasoning as a discontinuous constituent with a *functional* phonology of type **st** \rightarrow **st** (with **st** the type for strings):

(26) $\frac{\frac{\text{robin}; \mathbf{r}; NP}{\text{robin} \circ \varphi \circ \text{bill}; P(\mathbf{b}); VP}}{\frac{\text{robin} \circ \varphi \circ \text{bill}; P(\mathbf{b}); VP}{\lambda \varphi. \text{robin} \circ \varphi \circ \text{bill}; \lambda P.P(\mathbf{b})(\mathbf{r}); S} |I^{1}|^{I^{1}}}$

(i) a. *No dog barked or donkey brays.

b. *No dog barks or donkey brayed.

We do not think that this is a syntactic constraint. Note that the following minimally different example improves over (i) significantly:

(ii) No dinosaurs ate wheat (then) or crocodiles eat cabbage (now).

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Here, the lambda-bound variable φ in phonology keeps track of the position of the TV-type gap. Such S|TV categories are directly coordinated by a Gapping specific conjunction of type (S|TV)|(S|TV)|(S|TV):

(27)		$\begin{array}{l} \lambda \sigma_2 \lambda \sigma_1 \lambda \phi[\sigma_1(\phi) \circ and \circ \sigma_2(\varepsilon)];\\ \lambda \mathscr{W} \lambda \mathscr{V} . \mathscr{V} \sqcap \mathscr{W}; (S TV) (S TV) (S TV) \end{array}$	$\lambda \phi.peter \circ \phi \circ sue; \\ \lambda P.P(\mathbf{s})(\mathbf{p}); S TV$	
saw; see;TV	$\lambda \phi. robin \circ \phi \circ bill; \\ \lambda P.P(\mathbf{b})(\mathbf{r}); S TV$	$ \begin{array}{c} \lambda \sigma_1 \lambda \varphi[\sigma_1(\varphi) \circ and \circ peter \circ \varepsilon \circ sue]; \\ \lambda \mathscr{V} \cdot \mathscr{V} \sqcap \lambda P.P(\mathbf{s})(\mathbf{p}); (S TV) (S TV) \end{array} $		
	$\lambda \varphi[robin \circ \varphi \circ bill \circ z]$	$\overline{(); S TV}$		
	$robin \circ saw \circ bill \circ and$	E		

This Gapping-type conjunction instantiates standard generalized conjunction for syntax and semantics, but the surface asymmetry of the two conjuncts of Gapping is directly encoded in the phonological specification: as in (27), the first conjunct's gap is inherited to the larger coordinated expression, but the corresponding second conjunct's gap is filled in with the empty string ε .

In this like-category coordination analysis of Gapping with |, what gets gapped appears in a *higher* position than the coordinate structure in the combinatoric syntax. This immediately predicts the availability of wide scope readings of auxiliaries and quantifiers in Gapping, as discussed in Kubota and Levine (2012, 2013a, 2014). Furthermore, the distributive readings follow automatically as well, since in Hybrid TLCG, there is a set of theorems which lower the types of scopal expressions so that they can be given as arguments to the gapped sentence and distributed to each conjunct.

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kubota@ling.osu.edu, levine@ling.osu.edu