Construction-based Cumulation and Adjunct Extraction

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Abstract

Previous HPSG accounts of extraction blur the distinction between valents and adjuncts by allowing verbs to lexically control the modifiers that combine with their phrasal projections. However, assuming that adjuncts are valents runs into various difficulties. This paper argues that the distinction between complements and adjuncts can be maintained, and that certain semantic phenomena that challenge traceless theories of extraction can be seen as an instance of a more general process. Finally, this paper also discusses a uniform mechanism for case assignment to valents and adverbial nominals.

1   Introduction

Pollard and Sag (1994) and others have noted that certain verbal adjuncts can be extracted, as in (1). Although extractable, these phrases behave like adjuncts in many other aspects (they are not semantic arguments of the verb that they modify, are optional, can be iterated, are canonically VP-final, pass the *do-so* test, and have a freer distribution than true arguments).

(1)   a. [Yesterday], it seems that [Kim arrived home very early _].

    b. [(On) that day], I think that [Kim went home very late _].

    c. [How often] do you think that [Fred was late this week _]?

    d. It was [with a stick] that [we killed the snake _].

The distinction between adjuncts and complements also appears to be blurred cross-linguistically, in extraction pathway marking phenomena (see Clements et al. (1983); McCloskey (1979); Hukari and Levine (1995) *inter alia*), in case assignment to adverbial nominals (see Maling (1989, 1993) *inter alia*), and in adverbial scope (van Noord and Bouma, 1994). Thus, it can be argued that at least some verbal adjuncts are selected or controlled by the verbal head. This poses various puzzles, and runs counter the standard distinction between arguments and adjuncts. §2 discusses previous accounts of these phenomena, and §3 proposes a new analysis that allows for a simpler view of the adverbial argument-adjunct puzzle.

2   Previous accounts

There are two main approaches to adjunct extraction that have been proposed within HPSG. One is lexical (the lexical entry of the verb hosts adverbial gaps in SLASH), and another is phrasal (adverbial gaps are introduced syntactically). Both run into problems in the presence of conjunction, as discussed below.

2.1 Lexical gap addition

Pollard and Sag (1994, 387) propose the lexical rule in (2), which adds one adjunct to the SLASH feature of verbs that subcategorize for clauses.

(2)
$$
V\begin{bmatrix} \text{COMPS } \langle \ldots \text{ S} \ldots \rangle \\ \text{SLASH}\{\} \end{bmatrix} \rightarrow V\begin{bmatrix} \text{COMPS } \langle \ldots \boxed{2}\text{S} \ldots \rangle \\ \text{SLASH}\left\{ \text{XP}\begin{bmatrix} \text{MOD } \boxed{2} \\ \text{INDEX } \boxed{3} \end{bmatrix} \right\} \\ \text{CONT} \mid \text{SOA-ARG } \boxed{3} \end{bmatrix}
$$

But as Hukari and Levine (1996) note, this account is problematic on various fronts. Not only adverbs can be extracted when verbs take VP complements, but there are a number of languages for which valent and modifier extraction triggers exactly the same morphophonological processes. This is the case of Kikuyu downstep suppression (Clements et al., 1983) and Irish complementizers (McCloskey, 1979), among many others. Since extraction pathway marking for valents and (some) modifiers triggers the same phenomena in these languages, van Noord and Bouma (1994) and Bouma et al. (2001) propose that such modifiers are in fact lexically selected by the verbal head, as dependents. Thus, adjunct extraction can be handled in the same way as valent extraction. The account in Bouma *et al.* is given in (3).

(3) ARGUMENT STRUCTURE EXTENSION
$$
\textit{verb} \Rightarrow \begin{bmatrix} \text{SYNSEM} \begin{bmatrix} \text{HEAD } \boxed{1} \\ \text{ARG-ST } \boxed{2} \\ \text{DEPS } \boxed{2} \oplus \textit{list}\left(\begin{bmatrix} \text{MOD} \begin{bmatrix} \text{HEAD } \boxed{1} \\ \text{CONT} \mid \text{KEY } \boxed{3} \end{bmatrix} \end{bmatrix} \right) \\ \text{CONT} \mid \text{KEY } \boxed{3} \end{bmatrix} \end{bmatrix}
$$

However, giving up adjunction is problematic, as Levine (2003) notes. First, further assumptions are needed in order to account for cases that would otherwise be taken care as standard VP adjunction, as in (4).

(4) Nobody can [[drink four beers and eat two hotdogs] [under fifteen seconds]].

If the PP is a complement, then something else must be assumed in order to capture this sentence. For example, one would have to assume that the PP is extraposed ATB or Right-Node Raised. But, as Levine and Hukari (2006) argue, these hypotheses are at odds with the semantic interpretation that the PP obtains, which ranges over the total time interval denoted by the two conjuncts. In contrast, this reading is trivially obtained if the PP simply adjoins to the conjoined VP.

It should be clear that plurality-forming conjunction operates beyond NPs, and can form *event pluralities* (Bach, 1986; Lasersohn, 1995; Link, 1998). For example, the sentence in (5a), adapted from Oehrle (1987), can describe the frequency of two joint event-types rather than independent frequencies of occurrence.

(5) a. Often, [[I go to the beach]$_{e_1}$ and [you go to the city]$_{e_2}$]$_{e_1+e_2}$.

    b. Sue [[[got dressed]$_{e_1}$ and [dried her hair]$_{e_2}$]$_{e_1+e_2}$, [in exactly twenty seconds]].

    c. You can't simultaneously [[drink]$_{e_1}$ and [drive]$_{e_2}$]$_{e_1+e_2}$.

Levine (2003) also points out that the cumulative reading can occur even when the adjunct is extracted, as in (6). Here, *In how many seconds flat* predicates the total of three events denoted by the embedded coordinate VP, not each conjunct.

(6) In how many seconds flat do you think that [Robin found a chair, sat down and took off her logging boots]?

This utterance is a query about the total time occupied by the occurrence of three (possibly overlapping) events. Such a reading suggests that the extracted constituent is not a complement of anything in the sentence. If it were, then the adjunct should be predicating over each of the conjuncts separately, not the higher VP coordination node. To address this problem, Sag (2005) proposes that the extracted phrase *in how many seconds flat* is a complement that can semantically outscope the verb structure that it modifies. In a coordinate structure, the PP extracted ATB is naturally required to simultaneously outscope each of the verbs heading the conjuncts, thus obtaining wide scope over the entire coordination.

However, there is no evidence that the modifier *in X seconds* is semantically scope-bearing. Compare the unambiguous examples in (7) with the examples in (8). Only the latter contain scope-bearing modifiers and trigger an ambiguity with respect to the wide or narrow scope interpretation of the indefinite NP.

(7) a. Someone died in the arena yesterday / under twelve seconds flat.

    b. Kim sang a song yesterday / in twelve seconds flat.

(8) a. Someone probably / usually died in the arena.

    b. Kim probably / usually / often sang a song.

Scope cannot in general solve the cumulation problem, but in §3 I will argue that the challenging phenomenon in (6) is the consequence of other semantic aspects.

2.2 Syntactic gap addition

Assuming that adjuncts are modifiers, Levine (2003) proposes that extraction paths are terminated by traces. Thus, a modifier can instantiate the trace in (9) and adjoin to VP as usual. When it does, it creates an unbounded dependency that is percolated and linked to a filler, like any other unbounded dependency. Cumulative readings arise as a consequence of adjuncts being able to adjoin to VPs, coordinate or not.

(9) $\begin{bmatrix} \text{PHON} \langle \rangle \\ \text{SYNSEM} \begin{bmatrix} \text{LOC} \; \boxed{1} \\ \text{SLASH} \left\{ \boxed{1} \right\} \end{bmatrix} \end{bmatrix}$

In order to deal with adverbial case assignment and extraction pathway marking, Levine and Hukari (2006) introduce a new feature ADJS, which allows the lexical entry of a verb to list adjuncts realized in arbitrarily high positions. This list is lexically underspecified, and becomes instantiated at the phrasal level, when modifiers adjoin to a VP projected by that verb. The verb can thus lexically access any gaps that may reside in an adjunct located in a higher position in the syntactic tree (see also Sato and Tam (2008)). With regard to scope ambiguities in Dutch that have been argued to follow from an adjuncts-as-complements analysis, Levine (2003) proposes that these can be captured with direct access to the relevant parts of semantic representation.[1]

There are however some concerns with the adjunct extraction account in Levine (2003). First, nothing prevents the adverb trace in (9) from being adjoined to each of the VP conjuncts, instead of the coordinate mother VP. Given the standard assumption that SLASH values are structure-shared between daughters and mother in coordination, then one would obtain an impossible interpretation where each conjunct event is the same. This is shown schematically in Figure 1; notice that both VPs become structure-shared in $\boxed{1}$). The problem is related to the one discussed in Levine and Hukari (2006, 159), where structure-sharing slashed event-modifying adjuncts originating in each conjunct yield a description that no sign can satisfy.
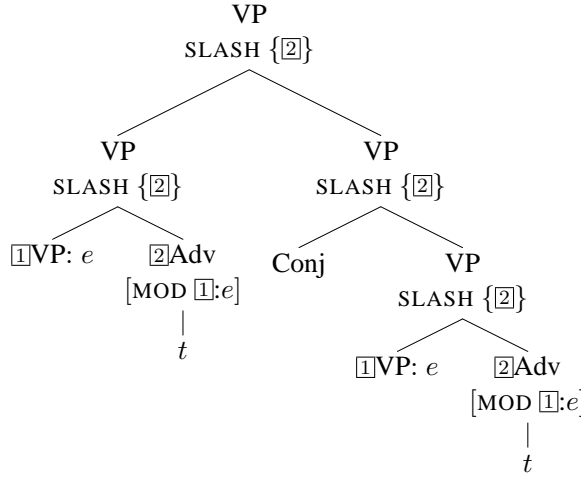

Figure 1: ATB adverbial extraction and impossible descriptions

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[1]This can be achieved in a number of different ways, for example, if KEY corresponds to the predication $\phi(v_1, ..., v_n)$ semantically heading a phrase, then other heads can access the predicate's argument slots. Thus, an adverb like *often* can either predicate the verb heading the phrase that it adjoins to, or the scopal argument of that verb. See also Crysmann (2004) and Sato and Tam (2008).

This is not the same as a distributive interpretation of the adverb. For example, *yesterday* is distributive in the sense that when applying to a sum of events such as e_1+e_2, it does not yield a collective predication *yesterday*(e_1+e_2), but rather, a distributive one: $\forall e(e \leq e_1+e_2 \rightarrow yesterday(e))$. In the latter, the adverb predicates over each mereological part e of the event sum e_1+e_2. A modifier like *for how long* on the other hand, can apply collectively to the entire sum. Which adverbs are distributive, which are collective, and which are ambiguous is a matter of lexical specification, similar to how verbs like *smile*, *meet*, and *hire* can interpret their pluralic NP arguments in different ways. This is what seems to be happening in the ambiguous example from Levine and Hukari (2006,186), shown below. Although the PP attaches to the higher VP coordination, it can either apply distributively to each event in the sum e_1+e_2, or apply collectively to the entire sum.

(10) Robin [stands on his head and falls off his chair]$_{e_1+e_2}$ in order to attract people's attention.

A second concern pertains to the assumption that extraction is terminated by traces. I will side with Sag and Fodor (1994) and Sag (2000) in assuming that extraction can be modelled without resorting to traces. The question is, of course, how can this be achieved parcimoniously. One possible alternative is explored in Müller (1999, 108–109,447) and Chaves (2007,Ch.7), who show that it is possible to formulate unary-branching traceless extraction rules. Consider (11), based on Chaves (2007), which allows an adjunct to become a member of the head's SLASH.

(11) ADJUNCT EXTRACTION RULE:

$$
adj\text{-}extr\text{-}phr \Rightarrow
\begin{bmatrix}
\text{SYNSEM} & \begin{bmatrix} \text{LOC } \boxed{1} \\ \text{SLASH } \boxed{2} \cup \left\{ \text{XP}\begin{bmatrix} \text{MOD } \boxed{3} \end{bmatrix} \right\} \end{bmatrix} \\
\text{HD-DTR } \boxed{4} \\
\text{DTRS } \left\langle \boxed{4} \begin{bmatrix} \text{SYNSEM } \boxed{3} \begin{bmatrix} \text{LOC } \boxed{1} \\ \text{SLASH } \boxed{2} \end{bmatrix} \end{bmatrix} \right\rangle
\end{bmatrix}
$$

Assuming a Ginzburg and Sag (2000) framework, the GENERALIZED HEAD FEATURE PRINCIPLE would ensure that valence and head features are percolated in the tree structure. The value of SLASH is percolated as dictated by the rule in (11), overriding the default percolation of the GENERALIZED HEAD FEATURE PRINCIPLE. Since (11) is independent from coordination, and adverbs are lexically select VPs, gap insertion can also arise in non-coordinate VPs. In other languages adverbs may select S nodes or even to V nodes instead.

This analysis can also be augmented with the ADJS feature, so that whenever the rule in (11) applies, the gap adjunct is identified with a member of the head's ADJS list. This way, a verb can access adjuncts higher up in the tree, for gap threading purposes. The account is illustrated in Figure 2. The VP daughter is

modified by an adverbial phrase located in SLASH. Thus, *yesterday* modifies the event plurality that the VP conjunction yields.
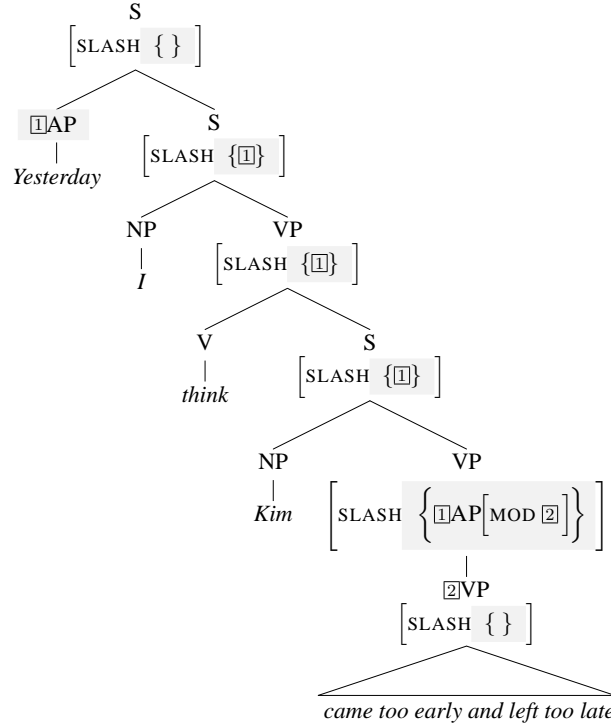

Figure 2: A modifier adjoining into SLASH

The ATB adjunct extraction in (12) can also be easily addressed. In Copestake et al. (2006), existentially quantification of events is often omitted for simplification purposes, but if one makes such quantification explicit – as in $\exists e\ \mathit{left}(e, kim)$ – then the adjunct extraction rule cannot apply to each VP conjunct because the resulting semantic structure is ill-formed. Consider the parse in (12).

(12) [Under how many seconds flat] did Kim [pack _ and escape _]?

Each adjunct is located in the SLASH value of each VP conjunct, and predicates over the respective event. The modifiers must be one and the same at the coordination level, because the coordination rule imposes identity of SYN values (as for example, in Beavers and Sag (2004)). Thus, the adverbial phrase filler has to predicate the very same event across conjuncts, and has to be simultaneously located under the scope of each existential quantifier. This yields an ill-formed MRS structure because the underspecified representation cannot describe a tree structure, as depicted in Figure 3. Arrows denote underspecified semantic subordination constraints. Here, k is the shared subject index of *Kim*, and $e' = e1 = e2$. This solution follows from the coordination rule, and is valid for extraction accounts with or without traces.

$$\exists \boxed{e}(\boxed{e} = \boxed{e_1} + \boxed{e_2} \ \wedge \ \exists \boxed{e_1}(...) \wedge \ \exists \boxed{e_2}(...)$$

$$pack(\boxed{e_1}, \boxed{k}) \qquad escape(\boxed{e_2}, \boxed{k})$$
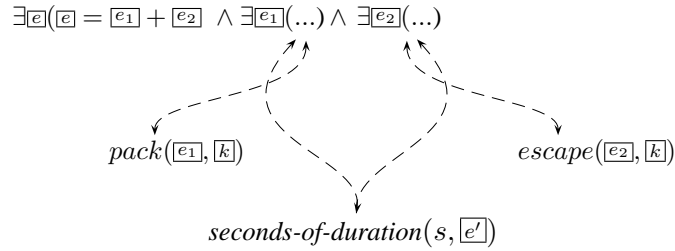
$$seconds\text{-}of\text{-}duration(s, \boxed{e'})$$

Figure 3: ATB adjunct extraction yielding an illegal MRS representation

2.3 Taking stock

All of the extraction accounts discussed so far – the adjuncts as complements analysis and the phrasal adjunction analyses – allow verbs to select for *in situ* adjuncts, blurring the distinction between adjuncts and valents. In one case this is done lexically, and in the other, via a special valence feature ADJS, so that gap threading phenomena can be dealt with.

However, there is in my view no semantic evidence that such adjuncts are complements. In fact, the semantic evidence observed in coordination indicates that adjuncts semantically combine with phrase structures. On the other hand, the feature ADJS seems to lack independent motivation because it is only relevant for a particular class of post-verbal adjuncts, and not, for example, adnominal modifiers.

In what follows I propose a simpler and more general analysis that maintains a strong distinction between adjuncts and valents, and dispenses the need for traces, new constructions, and ADJS. As in Pollard and Sag (1994), adjunct gaps start out lexically so that heads can only detect extracted adjuncts, not *in situ* ones, and cumulative phenomena are handled semantically in ways reminiscent of Sag (2005). By viewing the cumulative readings of extracted elements as an instance of a more general phenomenon, we will also be able to deal with other cases that arise beyond adjunct extraction.

3 A coordination-based proposal

Let us assume that there are no traces, and that adjuncts are not valents but rather modifiers in the usual sense. It could be that the cumulation of extracted adverbials is an instance of a more general phenomenon where the plurality-formation operation triggered by conjunction 'bleeds over' to certain unrealized dependents. Consider the data in (13), from Postal (1998, 136,160) and Kehler (2002, 125). Here, an extracted NP can denote a plurality composed of two individuals, each being linked to each verb in each conjunct. These data are relevant because each conjunct contains a different gap, and the two gaps are not fused together as a single entity. Rather, they might be cumulated into a complex entity (a conjoined NP) and permitted to percolate independently.

(13) a. [How many frogs]$_i$ and [how many toads]$_j$ did respectively Greg capture $\_i$ and Lucille train $\_j$?

b. [[Which pilot]$_i$ and [which sailor]$_j$] will Joan invite $\_i$ and Greta entertain $\_j$ (respectively)?

c. [[What book]$_i$ and [what magazine]$_j$] did John buy $\_i$ and Bill read $\_j$ respectively?

This is somewhat unexpected, because coordination is known to not allow different conjuncts to host different gaps, as shown in (14).

(14) *[A violin this well crafted]$_i$, even [the most difficult sonata]$_j$ will be easy to write $\_j$ and to play it on $\_i$.

One can argue that in (13) there is only one gap at the coordination level, and that this gap is linked to a pluralic filler. Each member of the plurality is predicated by a different VP conjunct. In (14) however, there are two fillers and thus each VP conjunct would have to contain a different gap. The latter is correctly ruled out if one assumes that SLASH values of conjuncts and mother node are structure-shared. Thus, it seems that as conjunction forms a plurality from the indices of the conjoined heads, the extracted dependents can be pluralized in a similar fashion. The cumulation of gaps is illustrated in Figure 4.[2]

$$\text{S[SLASH }\{[\text{INDEX } x + y]\}]$$

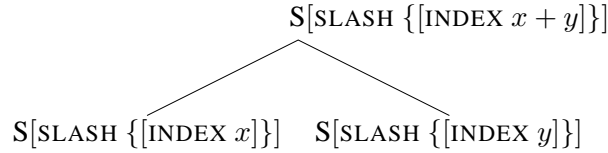$$\text{S[SLASH }\{[\text{INDEX } x]\}] \quad \text{S[SLASH }\{[\text{INDEX } y]\}]$$

Figure 4: Conjunct nominal gap sharing with cumulation

If this analysis is on the right track, then one would expect to find the same phenomenon in constructions without *respectively*. However, the detection of such data is not easy because the gaps in such examples are preferentially interpreted non-cumulatively. In (15) I provide such data. These sentences can be interpreted as conveying that the plural NP filler corresponds to the union X ∪ Y, where X and Y are the entities extracted from different conjuncts.

(15) a. Setting aside illegal poaching for a moment, how many sharks$_{X+Y}$ do you estimate [[$\_X$ died naturally] and [$\_Y$ were killed recreationally]]?

b. The [ships$_{x+y}$ that [[a U-boat destroyed $\_x$] and [a kamikaze blew up $\_y$]]]] were $\left\{\begin{array}{l}\text{not insured} \\ \text{the Laconia and the Callaghan}\end{array}\right\}$.

---

[2]Chaves (2009) proposes a direct account of *respectively* readings that does not resort to any form of 'conjunction reduction', syntactically or semantically. Further research is forthcoming.

c. The houses$_{X+Y}$ [[the fire reduced to ash$\_{X}$] and [the flood leveled down $\_{Y}$]] were near each other.

Now, the adjunct cumulation cases in Levine (2003) might be due to the same kind of phenomenon. This is illustrated in Figure 5. Each conjunct has a different adverbial gap, the index of each adverb matches the event that it modifies, and conjunction allows the indices of the adverbial gaps to be cumulated.
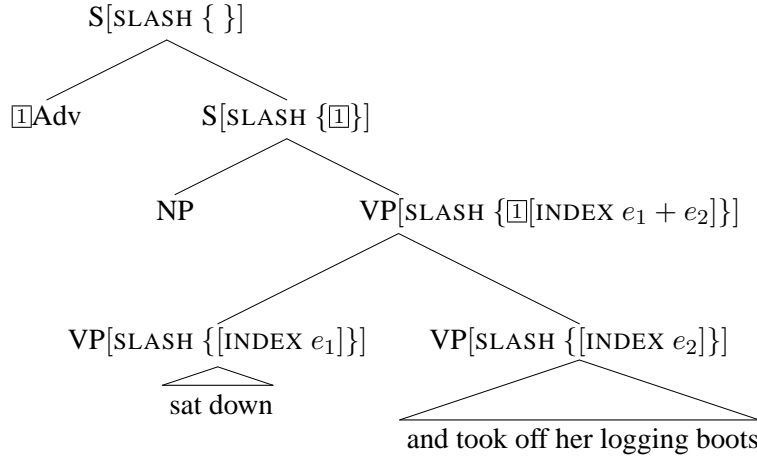
S[SLASH { }]
├── ①Adv
└── S[SLASH {①}]
    ├── NP
    └── VP[SLASH {①[INDEX $e_1 + e_2$]}]
        ├── VP[SLASH {[INDEX e_1]}]
        │   sat down
        └── VP[SLASH {[INDEX e_2]}]
                and took off her logging boots

Figure 5: Conjunct adverbial gap sharing with cumulation

Put more in more general terms, in a coordinate structure with n displaced structures with indices $\alpha_1, ..., \alpha_n$, these can either be combined into one and the same entity $\alpha_1 = ... = \alpha_n$ or combined cumulatively into a complex entity, for example, a Linkean sum: $\alpha_1 + ... + \alpha_n$. In other words, the plurality-formation bleeds over to certain dependents. Because this mechanism is observed beyond adjunct extraction, it begs for a general account.

In this view where shared gaps in coordination can be cumulated, adjunction can operate as usual, and the only adjuncts that verbs need to have control over are the ones in SLASH, because of extraction pathway marking phenomena.

3.1 Other possible cases of cumulation in conjunction

Perhaps the cumulation phenomena observed above also arises in other kinds of dependents. For example, Vergnaud (1974), Abbott (1976), Jackendoff (1977) and others have noted a phenomenon where the same structure is cumulatively connected to different clauses. For example, in (16a) the plural NP *very different opponents* denotes a set of individuals some of which were defeated by John and some of which beat Mary. Similarly, in (16b) we do not know how much Fred spent nor how much Mia lost, although we know the total amount that Fred spent and Mia lost. In other words, these sentences are not equivalent to their counterparts in

which the 'right node raised' NP is *in situ* after the first verb.[3]

(16)   a.   John DEFEATED and Mary LOST TO very different opponents.

     b.   Fred SPENT and Mia LOST a total of $10.000.

This process is sometimes not possible or highly marked. For example, reflexive expressions cannot be pluralized in this fashion:

(17)   *John LOVES and Mary HATES themselves / each other.

This process is unique to plurality-forming conjunction. As Beavers and Sag (2004,66) note, disjunction does not allow cumulative readings:

(18)   a.   *John DEFEATED $_i$ or Mary LOST TO $_j$ [very different opponents]$_{i+j}$.

     b.   *Either Fred SPENT $_i$ or Mia LOST $_j$ [a total of $10.000]$_{i+j}$.

Yatabe (2003) argues that there are two kinds of RNR. One is prosodic and has no semantic effect, and another which is linearization-based and has a semantic effect. This distinction may be responsible for the contrast shown in (19) and (20). Prosodic RNR can be long-distance and can apply in non-coordinate contexts (as in (19a) and (20a); see Chaves and Sag (2007) for a recent discussion), whereas linearization RNR cannot be long-distance as shown in (19b) and (20b), and is restricted to conjunction.

(19)   a.   One man said that he LIKED _ $_i$ and another even boasted that he ADORED _ $_i$ [the woman in the commercial]$_i$.

     b.   ?*One man said that he LIKED _ $_i$, and another even boasted that he ADORED _ $_j$ [different women]$_{i+j}$.

(20)   a.   One man said that he HATED _ $_i$ just because some other had boasted that he ADORED _ $_i$ [the woman in the commercial]$_i$.

     b.   ?*One man said that he HATED _ $_i$ just because some other had boasted that he ADORED _ $_i$ [different women]$_{i+j}$.

Finally, it could be that the same cumulation phenomenon also occurs in extraposition phenomena, in the form of split antecedent relative clauses. Consider the data in (21), based in Ross and Perlmutter (1970). The relative clause is semantically linked to both subject NPs. It is unlikely that these are instances of RNR of the extraposed clause (e.g. [S ~~RelC~~] & [S RelC]) because no conjunct-final prosodic contrast is needed for examples like (21a), and because reflexives can be linked to the pluralized noun, as shown in (21b) (confront with (16)).

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[3]Postal (1998) argues that cases like ?*the pilot claimed that the first nurse and the sailor proved that the second nurse were spies* also exhibit some form of summation/cumulation of the 'right-node raised' verbal structure. However, judgments are gradient and vary significantly, which lead Beavers and Sag (2004) to argue that these are quasi-sentences that result from performance effects. My account could in principle be extended to these data, along the lines pioneered by Yatabe (2002).

(21) a. A man entered the room and a woman left who were similar.

    b. A man came into the store and a woman left right after him who used be in love with each other.

    c.*A man entered the room or a woman left who were similar.

These cases can be accounted as follows. The nominal head that each extraposed relative clause is modifying is cumulated at the coordination level. One way to achieve this result is illustrated in Figure 6. Alternatively, one could also state this analysis in a more elegant way in terms of anchors (Kiss, 2005; Crysmann, 2004).

$$S[\text{EXTRA } \langle \text{RelC}[\text{MOD } x + y] \rangle]$$

$$S[\text{EXTRA } \langle \text{RelC}[\text{MOD } x] \rangle] \quad S[\text{EXTRA } \langle \text{RelC}[\text{MOD } y] \rangle]$$
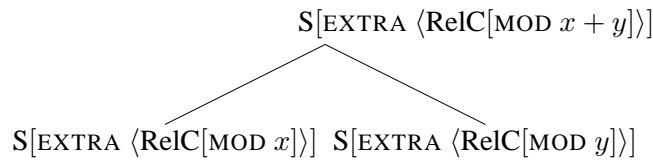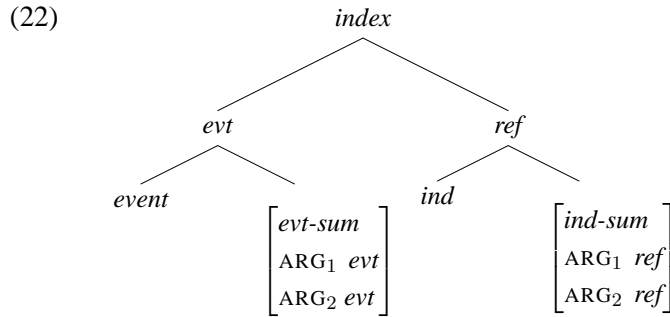
Figure 6: Conjunct relativized head sharing with cumulation

The remainder of the paper will flesh out an account of extraction that is compatible with gap cumulation, as well as with the cumulation of other delayed/displaced dependents such as RNR phrases and extraposed relative clauses.

3.2 HPSG formalization

The semantics of conjunction is a complex topic which I cannot address here fully, and so I will make the minimal assumptions needed for the purpose of this paper.[4] I start by allowing individual and event indices to be either Linkean sums '+' or atomic elements. The type hierarchy and signature are provided in (22).

(22)

$$
\begin{array}{c}
index \\
\diagdown \\
evt \qquad\qquad ref \\
\end{array}
$$

$$
event \qquad
\begin{bmatrix}
evt\text{-}sum \\
\text{ARG}_1 \; evt \\
\text{ARG}_2 \; evt
\end{bmatrix}
\qquad ind \qquad
\begin{bmatrix}
ind\text{-}sum \\
\text{ARG}_1 \; ref \\
\text{ARG}_2 \; ref
\end{bmatrix}
$$

Next, I define a non-deterministic relation '$\approx$' called *Integration* that maps a pair of lists onto one list. It allows for two different cases: in (23a) the arguments of the relation are simply structure-shared, and in (23b) we obtain the cumulation of two signs, by forming a new sign that denotes a plurality.

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[4]For a more comprehensive semantic account of conjunction see Chaves (2007, Ch.5).

(23) a. Direct Integration (structure-sharing equality)

$$(\boxed{1} \approx \boxed{1}) := \boxed{1}_{list}$$

b. Cumulative Integration (summation):

$$\left(\left\langle\begin{bmatrix} \text{SYN} \mid \text{LOC} & \boxed{0} \\ \text{SEM} \mid \text{INDEX} \boxed{1} \end{bmatrix}\right\rangle \approx \left\langle\begin{bmatrix} \text{SYN} \mid \text{LOC} & \boxed{0} \\ \text{SEM} \mid \text{INDEX} \boxed{2} \end{bmatrix}\right\rangle\right) := \left\langle\begin{bmatrix} \text{SYN} \mid \text{LOC} & \boxed{0} \\ \text{SEM} \begin{bmatrix} \text{INDEX} \begin{bmatrix} \text{ARG}_1 \boxed{1} \\ \text{ARG}_2 \boxed{2} \end{bmatrix} \end{bmatrix} \end{bmatrix}\right\rangle$$

If we adopt the extraction account Ginzburg and Sag (2000), then we need only extend the conjunction with gap Integration. Since adjunct gaps reside in SLASH we can dispense ADJS and obtain the cumulation phenomena straight away. The rule is given below, in (24). For reasons of uniformity to be discussed below, the set-valued SLASH is replaced by a list-valued GAP feature, and I will use the feature geometry of Sag (2001). I also omit the full specification of KEY due to lack of space, but I am assuming basically the same as Bouma et al. (2001).

(24) CONJUNCTION CONSTRUCTION

$$conj\text{-}cx \Rightarrow \begin{bmatrix} \text{MOTHER} \begin{bmatrix} \text{SYN} \mid \text{GAP} & \boxed{3} \approx \boxed{4} \\ \text{SEM} \begin{bmatrix} \text{INDEX} \begin{bmatrix} \text{ARG}_1 \boxed{1} \\ \text{ARG}_2 \boxed{2} \end{bmatrix} \end{bmatrix} \end{bmatrix} \\ \text{DTRS} \left\langle \begin{bmatrix} \text{SYN} \mid \text{GAP} & \boxed{3} \\ \text{SEM} \mid \text{INDEX} \boxed{1} \end{bmatrix}, \begin{bmatrix} \text{SYN} \mid \text{GAP} & \boxed{4} \\ \text{SEM} \mid \text{INDEX} \boxed{2} \\ \text{CRD-MRK} & conj \end{bmatrix} \right\rangle \end{bmatrix}$$

I assume that the coordination construction is more general than the conjunction construction: the former requires LOCAL identity and has nothing to say about semantics, whereas the latter requires a right-marked conjunct with *and*, and yields a pluralic index from the indices of the conjuncts. Based on Beavers and Sag (2004), I assume coordination is binary branching and resorts to a feature CRD-MRK that identifies the coordination type (i.e. *conj, disj,* etc.).

We can, however, revise Ginzburg and Sag (2000) so that adjuncts are not complements. First, the SLASH-AMALGAMATION CONSTRAINT and the ARGUMENT STRUCTURE EXTENSION (see §2.1 above and Ginzburg and Sag 2000,169) are blended into a unique condition, in (25). Further constraints should pinpoint the exact class of extractable adjuncts. Then it will follow that $\boxed{h}$ has to be *verb* if the list of adjunct gaps is non-empty, ruling out adnominal adjunct extraction.

(25) GAP AMALGAMATION AND EXTENSION CONDITION

$$
word \Rightarrow \left[\begin{array}{l} \text{SYN} \left[\begin{array}{l} \text{LOC} \mid \text{HEAD } \boxed{h} \\[4pt] \text{GAP } \bigcup_{\oplus}(\boxed{1}\oplus...\oplus\boxed{m})\ominus\boxed{0}\oplus list\left(\left[\text{MOD}\left\langle\left[\begin{array}{l}\text{SYN}\mid\text{L}\mid\text{HEAD }\boxed{h}\\ \text{SEM}\mid\text{KEY }\boxed{k}\end{array}\right]\right\rangle\right]\right) \\[8pt] \text{BIND } \boxed{0} \end{array} \right] \\[10pt] \text{SEM} \mid \text{KEY } \boxed{k} \\[4pt] \text{ARG-ST} \left\langle \left[\text{SYN}\mid\text{GAP }\boxed{1}\right], ..., \left[\text{SYN}\mid\text{GAP }\boxed{m}\right] \right\rangle \end{array} \right]
$$

The relation $\bigcup_{\oplus}$ allows the amalgamation of gaps: $\bigcup_{\oplus}(\boxed{1}\bigcirc\boxed{2}\bigcirc\boxed{1}) = \boxed{1}\oplus\boxed{2}$. This operation takes as input a list, it splits the list nondeterministically into three sub-lists (two of which are structure-shared as $\boxed{1}$) and yields the append of the two remaining distinct lists. This allows some, all, or none of the gaps to be unified.

Non-scope bearing verb-modifying adjuncts possess an event index which is structure-shared with the event index of the verb they intersectively combine with. This is illustrated in (26a). Conjunction then is able to combine two such adjunct gaps into one gap with a summed event index. The cumulation of an ATB extracted PP adjunct is shown in Figure 7. I assume that the MRS representation of verbs includes an existentially quantified index, as discussed in §2.2.

This cumulation process occurs cross-categorially. With nominal gaps we obtain a sum of individual indices and with non-scope bearing verbal modifier gaps we obtain an event sum. As for extractable scope-bearing adverbs like *often*, I assume along with Sag (2005) that the adverb lexically outscopes the verb it modifies, as illustrated in (26b). Thus, in ATB extraction each verb heading each conjunct must be outscoped by the adjunct gap. See Bonami and Godard (2007) for other issues pertaining to scope surface order and scope ambiguities, as well as Crysmann (2004) for a more elaborate MRS account of intersective modification in German.

(26) a.
$$
\left[\begin{array}{l}\text{PHON }\langle in\rangle \\[4pt] \text{SYN } \left[\text{LOC}\left[\begin{array}{l}\text{HEAD }prep\\[4pt]\text{MOD}\left\langle\text{VP}\left[\begin{array}{l}\text{INDEX }\boxed{e}\\ \text{LBL }\boxed{l}\end{array}\right]\right\rangle\\[8pt]\text{SUBJ }\langle\ \rangle\\ \text{COMPS }\langle\text{NP}[\text{INDEX }\boxed{x}]\rangle\end{array}\right]\right] \\[12pt] \text{SEM }\left[\begin{array}{l}\text{INDEX }\boxed{e}\\[4pt]\text{RELS}\left\langle\left[\begin{array}{l}\text{LBL }\boxed{l}\\ \text{RELN }in\\ \text{ARG}_1\ \boxed{e}\\ \text{ARG}_2\ \boxed{x}\end{array}\right]\right\rangle\end{array}\right]\end{array}\right]
$$

b.
$$
\left[\begin{array}{l}\text{PHON }\langle often\rangle\\[4pt]\text{SYN }\left[\text{LOC}\left[\begin{array}{l}\text{HEAD }adv\\ \text{MOD}\left\langle\text{VP}[\text{LBL }\boxed{l_1}]\right\rangle\end{array}\right]\right]\\[10pt]\text{SEM }\left[\begin{array}{l}\text{INDEX }none\\[4pt]\text{RELS}\left\langle\left[\begin{array}{l}\text{RELN }often\\ \text{ARG }\boxed{l_2}\end{array}\right]\right\rangle\\[8pt]\text{HCONS}\left\langle\left[\begin{array}{l}qeq\\ \text{HARG }\boxed{l_2}\\ \text{LARG }\boxed{l_1}\end{array}\right]\right\rangle\end{array}\right]\end{array}\right]
$$

We can also extend the conjunction rule as in (27), so that split antecedent relative clauses and cumulation in linearization-RNR are captured. I follow in general
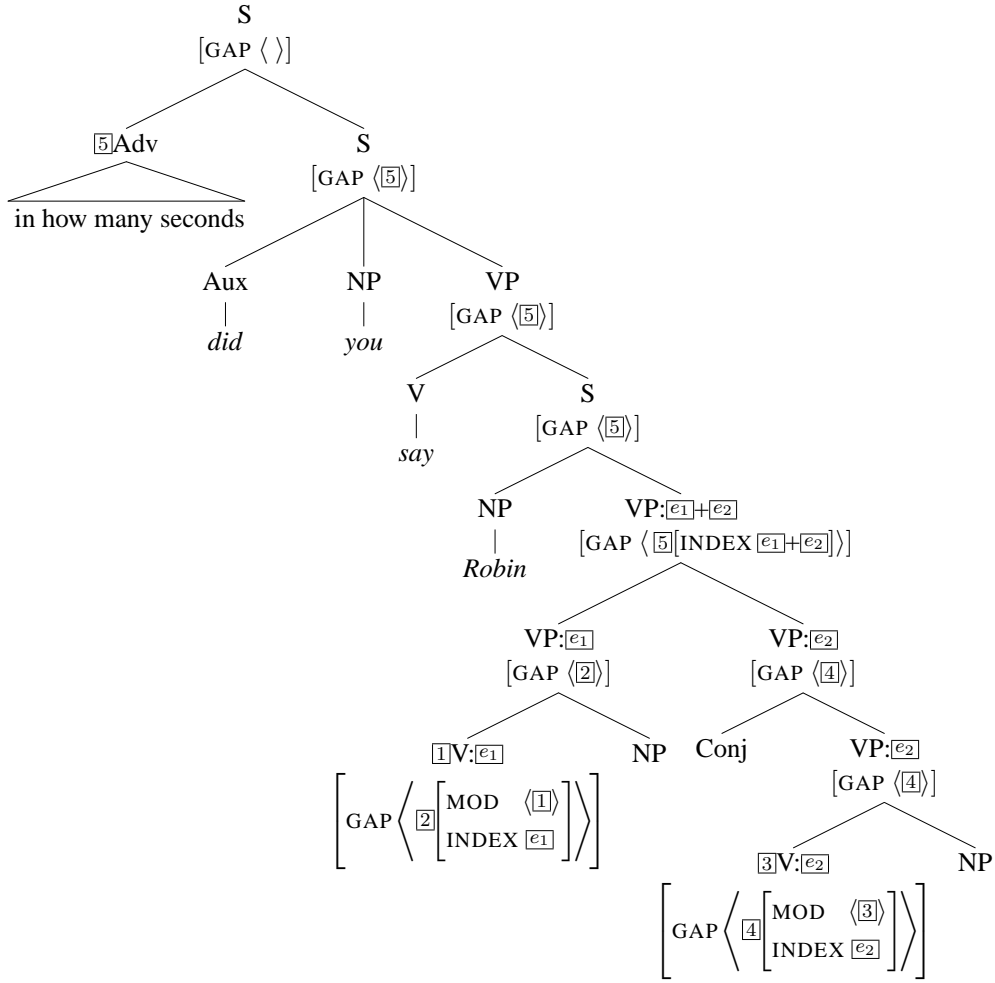
Figure 7: An example of VP conjunction with adverbial gap cumulation

terms Yatabe (2002) and Beavers and Sag (2004). Thus, the rightmost elements (if any) in DOM, and the MOD elements in extraposed structures can be cumulated.

(27) CONJUNCTION RULE (extended):

$$
conj\text{-}cx \Rightarrow \begin{bmatrix} \text{MOTHER} \begin{bmatrix} \text{SYN} \begin{bmatrix} \text{GAP} & \boxed{3} \approx \boxed{4} \\ \text{EXTRA} & \langle([\text{MOD } \boxed{5} \approx \boxed{6}])\rangle \end{bmatrix} \\ \text{SEM} \begin{bmatrix} \text{INDEX } \boxed{1}{+}\boxed{2} \end{bmatrix} \\ \text{DOM } \boxed{A}_{ne\text{-}list} \oplus \boxed{C} \oplus \boxed{D}_{ne\text{-}list} \oplus (\boxed{B} \approx \boxed{E}) \end{bmatrix} \\ \text{DTRS} \left\langle \begin{bmatrix} \text{SYN} \begin{bmatrix} \text{GAP} & \boxed{3} \\ \text{EXTRA} & \langle([\text{MOD } \boxed{5}])\rangle \end{bmatrix} \\ \text{SEM} \begin{bmatrix} \text{INDEX } \boxed{1} \end{bmatrix} \\ \text{DOM } \boxed{A} \oplus \boxed{B} \end{bmatrix}, \begin{bmatrix} \text{SYN} \begin{bmatrix} \text{GAP} & \boxed{4} \\ \text{EXTRA} & \langle([\text{MOD } \boxed{6}])\rangle \end{bmatrix} \\ \text{SEM} \begin{bmatrix} \text{INDEX } \boxed{2} \end{bmatrix} \\ \text{DOM } \boxed{C}\langle([and])\rangle \oplus \boxed{D} \oplus \boxed{E} \end{bmatrix} \right\rangle \end{bmatrix}
$$

4 Case marking of adverbial NPs

Adverbial NPs have been argued to receive case by essentially the same mechanism that assigns case to valents in a variety of languages. Przepiórkowski (1999) and others have argued that there is no satisfactory way to account for this unless adjuncts are taken to be complements. In this section I suggest an alternative that maintains the standard divide between arguments and modifiers.

Maling (1993) argues that case assignment in Finnish is structural, and that frequency adverbs pattern with arguments with regard to case. In a more recent and extensive study, Kiparsky (2001) argues that there is no direct way to determine the case marking of verbal dependents, and proposes to an Optimality Theory account where abstract and morphosyntactic case must be matched in an optimal way. Kiparsky (2001) uses features like H(IGHEST)R(OLE) $\pm$ and L(OWEST)R(OLE) $\pm$ to capture the various possible levels in the thematic hierarchy, in each level. Thus, in the morphological level case morphemes bear such features, at the syntactic level these features are assigned to the expressions according to the positions that they occupy, and finally, their abstract case reflects hierarchically organized theta-roles at Semantic Form. Case assignment is an optimal match between all three levels. In practice, abstract case features function as constraints on morphosyntactic case. A theta-role's abstract case must optimally match the morphosyntactic case. The account is centered around the idea that declarative sentences contain a 'pivot' position, which typically contains the grammatical subject (if there is one), or certain other elements in restricted conditions. The pivot is the highest direct argument that can be expressed. One of the most interesting aspects of pivots is that their effect is observed in arbitrary distances. If the matrix clause has a pivot, then a singular noun object of an infinitive complement is genitive whether the infinitive has a subject or not. The genitive object marking extends obligatorily down through a chain of such complements, and thus Kiparsky (2001,28) concludes that 'case marking constraints hold within the domain of finite clauses'.

One might import this account to HPSG by resorting to an ancillary function that computes the same conditions as the OT account. The phrasal rules specify the possible values for STRUCTURAL case while the value of LEXICAL case is specified by morphology. The question is, then, whether or not the mechanism that assigns structural case to complements can operate in the same way for adjuncts.[5]

(28)
$$\begin{bmatrix} \text{CASE} \begin{bmatrix} \text{ABSTRACT} & [...] \\ \text{LEXICAL} & [...] \\ \text{STRUCTURAL} & [...] \end{bmatrix} \end{bmatrix}$$

Possibly, a general principle like the one sketched in (29) would have access to all of the relevant information. In $\boxed{1}$ we have information about subjects (and more generally, external arguments via X-ARG), and about what kind of phrase is being

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[5]Alternatively, one could encode the three dimensions in (28) as a multi-inheritance hierarchy with at least three partitions (although the two are not equivalent, as discussed in Müller (2001)).

considered (VP, S, finite, nonfinite, etc.), in DOM we have access to the pivot when $\boxed{1}$ is a clause, and in particular, nothing seems to preclude this principle from computing the case of an adverbial nominal by essentially the same means that the case of a complement is computed. The actual order in DOM plays only a minor role, since as Kiparsky (2001,15) notes, positional case is mostly redundant in Finnish because morphological case suffices, with the exception of oblique possessors and experiencers as direct arguments.

$$(29) \quad phrase \Rightarrow \begin{bmatrix} \text{SYN} \begin{bmatrix} \text{LOC} \ \boxed{1} \end{bmatrix} \\ \text{DOM} \ \boxed{2} \end{bmatrix} \land \text{ASSIGN-CASE}_F(\boxed{1},\boxed{2})$$

The general rule in (29) can access the necessary ingredients and establish the mappings between abstract, lexical, and structural case without giving up locality, and without having to assume that adjuncts are selected for. Finnish does not allow more then one object in VPs, and so the DOM value should be straightforward, with at most one subject, at most one object, one head, and any number of adjuncts.

In the case of Korean there appears to be significant speaker variation, as already noted in Maling (1989, ft.3). More recently, Jae Eun Jung (p.c) reports that 26 non-linguist native speakers residing in Seoul, with ages between 20 and 25, do not agree with the judgments in Maling (1989) and Maling et al. (2001). In this study, 50% of the informants preferred accusative case in the *ci*-passive sentences from Maling (1989,369) rather than nominative case. Similar results were obtained for the passives in Maling (1989,371). This part of the grammar is in flux, which makes it very difficult to draw any conclusions about how exactly case is assigned to frequency and duration adverbials. In deed, the exact conditions that regulate case assignment to nominal adverbials are not yet understood. As Wechsler and Lee (1996,636) write, they 'do not yet understand the factors conditioning the nominative/accusative split on durative adverbials'.

Still, the literature has converged on the following basic observations, mostly drawn from Maling (1989) and Maling et al. (2001). If the frequency adverbial nominal bears case, then in active transitive verbs both the object and the modifier are accusative, in stative verbs both are nominative, and in *ci*-passives both are nominative (but durative adverbials are accusative). In the case of *toy*-passives and *hi*-passives these are held to be ambiguous between active and passives, and thus the case marking follows as in the previous cases. There are some special cases as well, for example, in unergative verbs the adverbs can only bear accusative, and in nonagentive unaccusative verbs frequency adverbials bear nominative and durative bear accusative. In weather verbs and intransitive motion verbs both nominative and accusative are possible for frequency adverbs, which Maling (1989) attributes to structural ambiguity (in one case the adverb modifies the subject, and in the other case in modifies the verbal structure, with scopal semantic contrast). Wechsler and Lee (1996,640) propose that 'accusative is assigned to any case-bearing dependent with an external co-argument, and that nominative is assigned to any case-bearing

dependent lacking an external co-argument' (an external argument in their terms is defined as the lexically distinguished argument that passivization suppresses).

The proper account of adverbial case assignment may hinge on semantic / pragmatic factors rather than on syntactic ones, but in what follows I will show how Wechsler and Lee's account can be formulated without giving up the distinction between adjuncts and valents. I start by assuming that Korean adverbial NPs adjoin to V – since their canonical position is immediately before the verb – and that scrambling is due to DOM linearization as in Kathol (2000). Given their position, these adjuncts have local access to all the relevant information for their case marking, namely, the VFORM and ARG-ST values. This is the same information that is needed at the word level to determine the case markings on valents.[6]

We can capture assignment conditions in a relation *Assign-Case$_K$* that encodes the account in Wechsler and Lee (1996) without giving up the distinction between valents and adjuncts. The rule in (30a) applies to all words and computes the case assignment of valents (if there are any able to bear case). The rule in (30b) computes the case assignment of adverbial nominals from the verbal head that they combine with. Both (30a) and (30b) resort to one and the same assignment relation.

(30) a. *word* $\Rightarrow$

$$\begin{bmatrix} \text{SYN} \begin{bmatrix} \text{LOC} \begin{bmatrix} \text{HEAD} \boxed{1} \end{bmatrix} \end{bmatrix} \\ \text{ARG-ST} \boxed{2} \end{bmatrix} \land \text{Assign-Case}_K(\boxed{1},\boxed{2})$$

b. *adv-noun-lxm* $\Rightarrow$

$$\begin{bmatrix} \text{SYN} \boxed{3} \begin{bmatrix} \text{LOC} \begin{bmatrix} \text{HEAD} \begin{bmatrix} noun \end{bmatrix} \\ \text{MOD} \begin{bmatrix} \text{HEAD} \boxed{1} verb \\ \text{ARG-ST} \boxed{2} \end{bmatrix} \end{bmatrix} \end{bmatrix} \land \text{Assign-Case}_K(\boxed{1},\boxed{2}\oplus\langle\boxed{3}\rangle)$$

For example, case assignment in active transitive verbs can be captured via a single condition (notice the accusative 'case spreading' from complements to adjuncts):

(31)
$$\text{Assign-Case}_K\left(\begin{bmatrix}\text{VFORM} \neg pass\end{bmatrix}, \left\langle \text{NP}\begin{bmatrix}\text{CASE } nom \\ \text{MOD } none\end{bmatrix}, \text{NP}\begin{bmatrix}\text{CASE } \boxed{0}acc \\ \text{MOD } none\end{bmatrix}\right\rangle \oplus list\left(\text{NP}\begin{bmatrix}\text{CASE } \boxed{0} \\ \text{MOD } verb\end{bmatrix}\right)\right)$$

5 Conclusion

One view of adjunct extraction and cumulation assumes that gaps are inserted phrasally (either by traces or by a construction) and that verbs control adjuncts via a special feature ADJS. Another view assumes that gaps are lexically inserted, and that shared displaced dependents can be cumulated. In this paper I argue that the

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[6]Some elements should be lexically unspecified and obtain structural case Kim and Sells (2007).

latter is done by coordination, and that cumulation is also observed in the extraction of nominal arguments. With minor modifications to Ginzburg and Sag (2000), my analysis dispenses traces, extra constructions, special assumptions about the scope of adjuncts, and the ADJS feature. Extraction pathway marking and case assignment to adverbial NPs can be done without blurring the distinction between complements and adjuncts, since verbs cannot access *in situ* adjuncts.

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