Cumulativity in Right Node Raising Construction*

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Abstract

This paper investigates how *right node raising* constructions (RNR, Ross 1967) derive *cumulative readings*, as a diagnosis of the syntactic structure of RNR. The previous literature points out that RNR is expected to receive cumulative readings if it can have a so-called *movement parse* (e.g., Postal 1974, Hirsch and Wagner 2015). However, such an argument for the movement parse is based only on a subset of cases of RNR with cumulative readings. As a result, the previous analysis of cumulativity in RNR undergenerates if one observes a wider range of RNR data. Given this, this paper presents a new analysis of cumulativity, following Schmitt (2019). The proposed analysis solves the undergeneration problem, and further supports the claim that the movement parse must be a possible parse of RNR, in light of the availability of cumulativity in a wider range of RNR.

1 Introduction

This paper argues for a so-called *movement parse* of *right node raising* construction (RNR, Ross 1967). RNR is typically a coordination construction which features a rightmost constituent shared by the two coordinates (1).[1]

(1) Abe boiled and Bert fried, **these 50 dumplings**.

In (1), *these 50 dumplings* is understood to be shared by *Abe boiled* and *Bert fried* in the sense that its referent is construed as objects that Abe boiled and Bert fried. This paper calls such expressions the *shared items*.

The movement parse of RNR posits rightward across-the-board (ATB) movement of the shared item, as shown in (2) for (1) (e.g., Bresnan 1974, Postal 1974, Sabbagh 2007).

(2) [[Abe boiled t_1] and [Bert fried t_1]] [these 50 dumplings]$_1$.

The literature provides mainly two types of arguments for the movement parse. The first type of arguments have come from observations that various movement constraints are operative in RNR formation (e.g., Bresnan 1974, Postal 1998, Sabbagh 2007). The second type of arguments show that the shared item can be interpreted as outscoping the coordination (e.g., Jackendoff 1977, Sabbagh 2007). One example of the second type of arguments is concerned with RNR with a relational modifier such as *different* in the shared item (3).

*I would like to thank {Names withheld} for their insightful comments and questions on this paper and its related work.

[1] The acceptability judgements for the original data reported on this paper are those of several native speakers I consulted through questionnaires and informal interviews.

(3) Bob and Sally brought their partners over for dinner. Their partners did not get along. *Bob dates and Sally married, two quite* ***different*** *people.*

(Hirsch and Wagner 2015, 192)

Sentence (3) has a so-called *sentence-internal reading* of *different*, where a sentence internal NPs (i.e., *Bob* and *Sally*) determine what is compared with *different* (i.e., the people Bob dates and Sally married); the sentence can mean that Bob dates one person, Sally married one person, and the person Bob dates is quite different from the person Sally married.

Based on RNR as in (3), previous RNR literature supports the movement parse by claiming that other parses of RNR cannot predict the availability of sentence internal readings (e.g., Abbott 1976, Jackendoff 1977, Gazdar 1981, Postal 1998, Sabbagh 2007, Bachrach and Katzir 2009, Hirsch and Wagner 2015, Overfelt 2016).[2] For example, the literature claims that the other parses predict the RNR in (3) to have the same meaning as sentence (4), where the shared item occurs in two conjuncts.

(4) Bob dates **two quite different people** and Sally married **two quite different people**.

Since sentence (4) cannot receive the sentence internal reading of (3), the other parses undergenerate. Thus, the availability of sentence internal readings supports the movement parse.

A subset of literature providing the above support for the movement parse elaborates why only the movement parse can derive sentence internal readings (e.g., Sabbagh 2007, Hirsch and Wagner 2015, Overfelt 2016). The literature in question follows Carlson (1987) and Moltmann (1992) (explicitly or implicitly) in assuming that sentence internal readings are available only when the "*different* NP" outscopes a plural. Given this, notice that under the movement parse, the shared item with *different* in (3) appears in a right periphery in which it can outscope the conjunction *Bob dates and Sally married*. However, in other parses, where the shared item does not move, it does not outscope the conjunction. The literature claims this is why only the movement parse can derive sentence internal readings, and thus, RNR as in (3) supports the movement parse.

However, this paper disagrees with the previous literature as to why only the movement parse can derive sentence internal readings, following Beck (2000). Beck (2000) demonstrates that the availability of sentence internal readings of *different* in non-RNR sentences has little to do with the scope relation between *different* and a plural. Instead, she observes that the availability of that reading depends on whether a sentence can derive a so-called *cumulative* relation/*cumulativity*.[3] Then, the crucial question to be asked concerns whether only the movement parse can derive cumulativity in RNR. Essentially, this paper positively answer this question by investigating RNR without a relational modifier as in (1). The answer itself (that only the movement parse can derive cumulativity) supports the movement parse. But the answer also supports that only the movement parse can derive sentence internal readings, not because of the scope or meaning of a relational modifier *per se*, but because the reading requires a sentence to derive a cumulation and only the movement parse can derive cumulations.

It should be noted that while this paper argues that the movement parse must be a possible parse of RNR in light of cumulativity in RNR, the paper does *not* argue against the availability of other parses. Note also that this paper is not the first attempt to explain how cumulativity

[2] Section 3 introduces other parses of RNR.

[3] Section 2 defines *cumulativity*, and Section 6 provides some key data that support Beck's claim.

is derived in RNR. Hirsch and Wagner (2015) sketch how cumulativity is derived in RNR. But their analysis turns out to undergenerate with respect to a particular RNR with cumulativity. Given this, this paper follows Schmitt (2019) and presents a new analysis of cumulativity/plurals that can capture the cumulativity in a wider range of RNR than Hirsch and Wagner's analysis.[4]

This paper is organized as follows. Section 2 elaborates the notion of *cumulativity.* Section 3 introduces two additional parses of RNR, and shows that they do not seem to derive cumulativity in RNR unlike the movement parse. Section 4 illustrates Hirsch and Wagner's compositional analysis of cumulativity in RNR. The section shows that the movement parse can derive cumulativity in principle but their analysis must be revised due to undergeneration problems. In Section 5, I propose this paper's analysis of cumulativity with non-RNR sentences. Based on this, Section 6 demonstrates that the movement parse can derive cumulativity in various types of RNR, including the one Hirsch and Wagner's analysis cannot. Finally, Section 7 concludes.

2 Cumulativity

This section defines cumulativity, and show that RNR as in (1) has a reading characterized as a cumulative reading.

Schmitt (2019) shows that cumulativity can be observed in sentences with two plurals of various semantic types. The one that is most relevant to this paper is the cumulativity in sentences that involve a plural individual and predicate conjunction, as in (5). The two plurals in (5) are labeled as *A* and *B*.

(5) $[_A$ Abe and Bert$]$ $[_B$ sank and fell$]$

Sentence (5) has a cumulative reading: each of Abe and Bert sank or fell and each incident (i.e., sinking and falling) happened to Abe or Bert. Formally, cumulative readings can be characterized by sentences' truth conditions that refer to particular binary relations between two plurals (see Scha 1981, Link 1983, Krifka 1986 a.o.). Schmitt (2019) defines such a truth condition for the cumulation between a plural individual and predicate conjunction, as in (6).

(6) 1 iff $\forall x \in S_A\ \exists f \in S_B\ f(x)=1 \wedge \forall f \in S_B\ \exists x \in S_A\ f(x)=1$
where S_A and S_B are sets of objects that plurals A and B consist of intuitively.
(Schmitt 2019, 8)

What S_A and S_B in (6) correspond to in (5) is the set of individual {Abe, Bert} and set of properties {sank', fell'}. Note that the cumulative reading of (5) mentioned above refers to such a binary relation between {Abe, Bert} and {sank', fell'} as schematized in (6).

Sentence (5) has another reading: each of Abe and Bert *both* sank and fell. I call this reading the *distributive reading* given that the reading can be gained by *distributing* the predicate conjunction *sank and fell* to the two conjuncts in A; the reading is equivalent to saying Abe

[4]The proposed analysis of plurals yields an insight into how disjunctions can be analyzed, and this paper presents an analysis of disjunctions in Appendix A. Crucially, it will be shown that under the proposed analysis of disjunctions, only the movement parse can derive some reading of previously unobserved RNR with a disjunction as in (1). Thus, Appendix A further supports this paper's claim that the movement parse must be possible.

(1) Abe will boil **or** Bert will fry, these 50 dumplings.

sank and fell, and Bert sank and fell. The distinction between the cumulative and distributive readings will be important as it turns out that RNR can have those two readings, and the movement parse will be supported by the fact that it can derive both readings.

With (6) in mind, consider again the RNR in (1), repeated below as (7).

(7) [$_A$ Abe boiled and Bert fried], [$_B$ these 50 dumplings].

One of the readings of (7) is that Abe boiled some of these 50 dumplings, Bert fried some of these 50 dumplings, and each of these 50 dumplings was boiled by Abe or fried by Bert. In this reading, the referent of *these 50 dumplings* is the "cumulation" of dumplings boiled by Abe and fried by Bert. Notice that this reading refers to the cumulation between a conjunction of properties A (i.e., the property of being boiled by Abe and property of being fried by Bert) and plural DP B; the truth condition of the reading can be represented in the form of (6) as shown in (8) (*Abe-boiled'* and *Bert-fried'* represent the two properties that A consists of intuitively. $D_1, \ldots, D_{50}$ represents the contextually salient 50 dumplings that B consists of intuitively).

(8) 1 iff $\forall x \in \{D_1, \ldots, D_{50}\}\ \exists f \in \{\text{Abe-boiled'}, \text{Bert-fried}\}\ f(x)=1 \wedge$
$\forall f \in \{\text{Abe-boiled'}, \text{Bert-fried}\}\ \exists x \in \{D_1, \ldots, D_{50}\}\ f(x)=1$

Thus, I call the above reading of (7) the cumulative reading.

Sentence (7) also has another reading: Abe boiled all of these 50 dumplings, and Bert fried all of these 50 dumplings. I call this reading the distributive reading given that the reading can be gained by distributing the plural DP to the two conjuncts in A; the reading is equivalent to saying Abe boiled these 50 dumplings and Bert fried these 50 dumplings.

While the RNR in (7) allows both the cumulative and distributive readings, the former can be forced by appending *between them* in the sentence. This is true of other RNR as well (9).

(9) a. Greg captured and Lucille trained, 312 frogs (between them). (Postal 1998, 137)
b. (Between them) My brother bought and my sister rented these power tools.
c. (Between them) Abe will recycle and Bert will discard these plastic bottles.

To sum up, this section defined cumulativity, and demonstrated that RNR as in (7) shows cumulativity as non-RNR sentences as in (5) do.

3 Three parses of RNR

This section introduces two parses of RNR other than the movement parse, and demonstrates that they do not seem to derive cumulativity in RNR unlike the movement parse.

We start with a so-called *ellipsis parse* of RNR. The ellipsis parse posits backwards PF deletion in the first conjunct, as shown in (10) for (7) (e.g., Wexler and Culicover 1980, Hartmann 2001, An 2007, Ha 2008). The strikethrough indicates ellipsis.

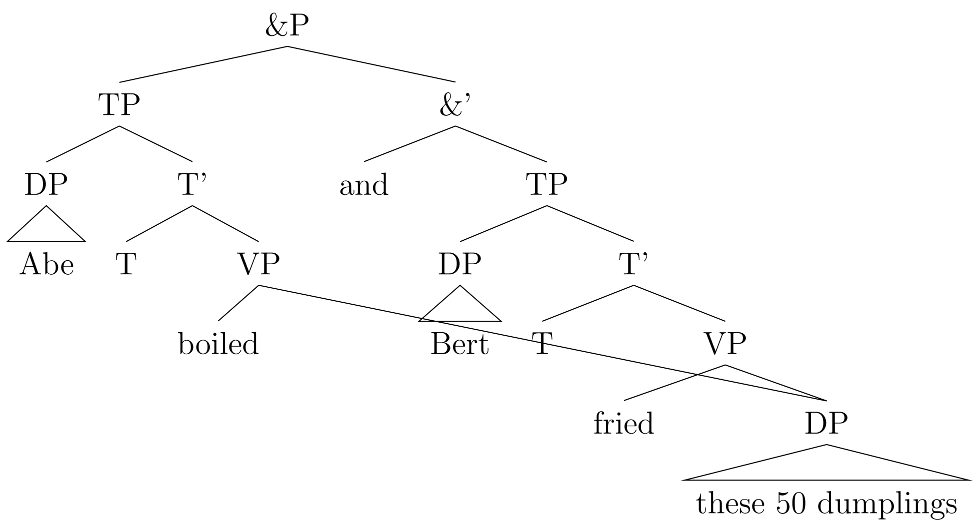
(10) Abe boiled ~~these 50 dumplings~~ and Bert fried these 50 dumplings.

In (10), each conjunct involves a copy of the shared item at LF. The ellipsis parse is therefore limited to deriving the distributive reading just as its pre-elided source *Abe boiled these 50 dumplings and Bert fried these 50 dumplings* does. Note that in this pre-elided source, *these*

50 dumplings does not have a plural to compose with to yield the cumulation. This is why the ellipsis parse does not seem to derive cumulativity.

Another parse of RNR is known as *multi-dominance parse*, in which the shared item is literally shared by two conjunct (e.g., Wilder 1999, Bachrach and Katzir 2009, Grosz 2015). The multi-dominance parse of (7) is given in (11).

(11)



In (11), if the shared item is interpreted as an object of *boiled* and *fried* in each conjunct *separately*, the multi-dominance parse derives only the distributive reading, just as the ellipsis parse does. In fact, Grosz (2015) assumes that the shared item is interpreted in each conjunct separately. He has this assumption to explain a phenomenon, which he calls the *anticollectivity effect*. The anticollectivity effect is a phenomenon that RNR sounds unnatural when its shared item is a *collective predicate*, namely predicates which require a plural subject.[5] Three examples of the anticollectivity effect are provided in (12).

(12)
a. *[Sue's proud that *Bill* _] and [Mary's glad that *John* _] **have finally met**.
b. *[Bill is proud that *Hilary* _] and [Michelle is glad that *Barack* _] **support each other**.
c. *[Bill was glad that *Sue* _], [George was relieved that *Jane* _] and [Jim was reassured that *Mary* _] **outnumbered the gangsters**.

(Grosz 2015, 11)

The sentences in (12) have a collective predicate as their shared item, and they are all unnatural sentences.[6,7] To explain the unnaturalness of those sentences, Grosz (2015) proposes that the

[5]Here, plural expressions can be taken to be individual conjunctions such as *Bill and John*, for ease of exposition. However, the notion of plurality with respect to the use of collective predicate is more complicated. See Winter (2002) among others for the discussion of collective predicates.

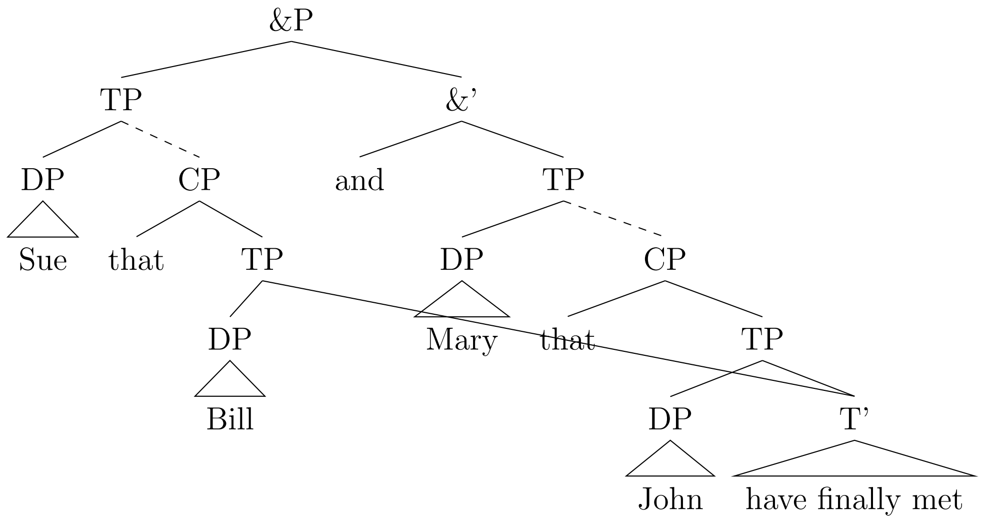
[6]The form of *have/support* in the shared item (as opposed to *has/supports*) is not the reason for the unnaturalness. Grosz (2015) reports that around half of his consultants accepts RNR with a shared item that involves a lexical word showing the syntactic plural agreement.

[7]Whereas the shared T' cannot involve a verb-*each other* sequence (12b), when it involves a verb-*each other's*-NP sequence, the RNR sounds better (1).

(1) [Bill is proud that *Hilary* _] and [Michelle is glad that *Barack* _] **support each other's proposals**.

shared item in RNR is interpreted in each conjunct separately. Consider the multi-dominance parse of (12a) below (The dashed line abbreviates projections between TP and CP).

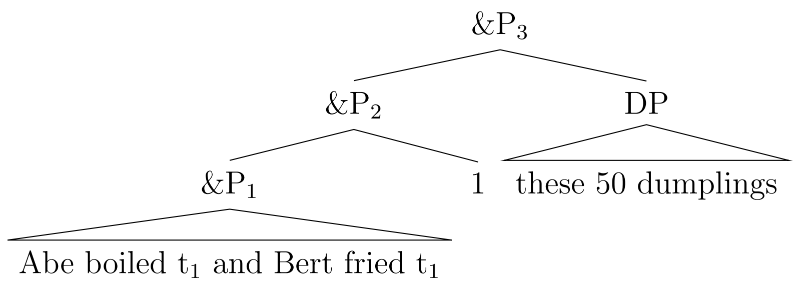
(13)



Note that the collective predicate *have finally met* takes *Bill* and *John* as its subject. Nevertheless, sentence (12a) sounds unnatural unlike sentences such as *Bill and John have finally met*. Thus, Grosz (2015) claims that the shared item takes *Bill* and *John* as its subject in each conjunct *separately*, and sentence (12a) is semantically identical to the sentence *Sue's proud that Bill has finally met and Mary's glad that John has finally met*, which also sounds unnatural. This is how Grosz (2015) explains the anticollectivity effect, and this is why at least his multi-dominance analysis does not predict the availability of cumulativity in RNR. For example, his analysis predicts that the RNR in (7) has the same meaning as the sentence *Abe boiled these 50 dumplings and Bert boiled these 50 dumplings* as the ellipsis analysis does.

Finally, we turn to the movement parse again, which is sketched in (14) for (7).

(14)



Given (14), it is not immediately obvious how the movement parse can derive cumulativity. Instead, the movement pare seems *prima facie* to derive only the distributive reading as the other two parses do. For example, under the Boolean analysis of English *and*, &P_1 in (14) denotes the truth value *1 iff Abe boiled g(1)* $\wedge$ *Bert fried g(1)*, where g is any assignment with *1* in its domain. The predicate abstraction then applies to &P_1, deriving &P_2's denotation: λx_e.*Abe boiled x* $\wedge$ *Bert fried x*. This function applies to the shared DP, and the DP is semantically

The grammaticality of (1) may not be surprising since it is known that anaphors that appear within an NP are exempt from Binding Condition A (e.g., Pollard and Sag 1992, Bruening 2006). But further study seems to be required to conclude whether data as in (1) cause a problem with the analyses of anticollectivity effect in this paper. I put such data aside in this paper.

reconstructed into an argument position of *boiled* and *fried*. Thus, the movement parse also seems to predict that sentence (7) has the same meaning as the sentence *Abe boiled these 50 dumplings, and Bert fried these 50 dumplings.*

However, it is worth noting that there is a type of non-RNR sentences with cumulativity whose structure resembles the movement parse of RNR. An example of such non-RNR sentences is given in (15a) with the RNR in (7) with the movement parse (15b).

(15) a. [Abe and Bert]$_1$ [[$_{VP}$ sank t$_1$] and [$_{VP}$ fell t$_1$]] **non-RNR**
b. [[Abe boiled t$_1$] and [Bert fried t$_1$]] [these 50 dumplings]$_1$ **RNR**

In (15a), the subject has ATB moved from the object position of the unaccusative verbs. Notice that both sentences in (15) involve a propositional conjunction and a plural DP that has ATB moved from the conjuncts. So one would expect whatever mechanism derives the cumulativity in non-RNR sentences as in (15a) also derives the one in RNR as in (15b).[8]

To sum up, this section illustrated that while the three parses of RNR can all derive distributive readings, only the movement parse seems to be compatible with the availability of cumulative readings. Then, the question concerns whether the movement parse can indeed derive cumulativity in RNR. Essentially, this paper positively answers this question, and provide a compositional analysis which can predict the availability of cumulativity while it can also make the correct semantic predictions that the other two parses can (i.e., distributive readings and anticollectivity effect). But Section 4 first discusses a previous compositional analysis of cumulativity in RNR. The previous analysis clarifies some important components that are required for any analyses of cumulativity, based on which I later present this paper's analysis.

4 Hirsch and Wagner (2015)

This section first illustrates Hirsch and Wagner's account of how the movement parse can derive cumulativity in RNR as in (15b). Afterwards, I present a different type of RNR with cumulativity, and demonstrate that their analysis does not capture cumulativity in those RNR. In addition, this section also introduces Schmitt's (2019) argument against a meaning of English *and*, which Hirsch and Wagner (2015) adopt in their analysis of cumulativity in RNR. The illustration of these facts and argument will call for an alternative analysis of cumulativity in RNR, which will be proposed in the next section.

Hirsch and Wagner (2015) show that the movement parse can derive cumulativity in RNR based on two assumptions. They first assume that English *and* is optionally analyzed as a non-Boolean *and*. The non-Boolean *and* can be defined as the type-polymorphous $\sqcup$ in (17), which is based on the notion of *e-conjoinable types* (16).

[8] Another type of sentences that structurally resembles the movement parse of RNR is topic sentences. For example, compare the topic sentence in (1a) with the RNR in (1b).

(1) a. **These 50 dumplings**, Abe boiled and Bert fried. **Topic**
b. Abe boiled and Bert fried, **these 50 dumplings**. **RNR**

Descriptively speaking, the sentences in (1) differ only in whether *these 50 dumplings* appears in the left or right periphery. However, most of my consultants report that topic sentences as in (1a) do not show cumulative readings unlike their RNR counterparts. I leave the lack of cumulativity in topic sentences for future research.

(16) ***e*-conjoinable types**
e is an e-conjoinable type and if $a_1,...,a_n$ are e-conjoinable types, then $((a_1)...(a_n)t)$ is an *e*-conjoinable type.

(Schmitt 2019, 12)

(17) $$X\sqcup Y=\begin{cases} X\oplus Y \text{ if } X,Y \in D_e \\ \\ \lambda Z_a.\exists Z', Z" \; [Z = Z'\sqcup Z" \wedge X(Z') \wedge Y(Z")\;] \\ \text{if } X,Y \in D_{<a,t>} \text{and } <a,t> \text{ is e-conjoinable} \\ \\ \lambda Z^1, ...,Z^n.\; \exists Z^1,\; Z^{1"},\; ...,\; Z^{n'},\; Z^{n"} [Z^1 = Z^{1'}\sqcup Z^{1"} \;\wedge...\wedge\; Z^n = Z^{n'}\sqcup Z^{n"} \\ \wedge X(Z^{1'})...(Z^{n'}) \wedge Y(Z^{1"})...(Z^{n"})] \\ \text{if } X,Y \in D_{<a_1<...<a_n,t>...>>} \text{ and } <a_1<...<a_n,t>...>> \text{ is e-conjoinable.} \end{cases}$$

(Schmitt 2019, 12)

In (17), what is relevant in this section is the meanings of individual conjunctions and conjunctions of properties of type $<a,t>$ such as type <e,t>. First, individual conjunctions such as *Abe and Bert* denote *sums* of denotations of their conjuncts such as *Abe*$\oplus$*Bert*; it suffices to say as the meaning of the sum operator $\oplus$ that *Abe*$\oplus$*Bert* is semantically identical to $[\![$the two boys$]\!]$ when Abe and Bert are the only contextually salient boys.

When *and* takes two properties of type <e,t>, it returns a property of type <e,t>. Importantly, such *and* encodes cumulativity in its meaning. To explain this point, consider (18).

(18) $[_A$ Abe and Bert$]$ $[_B$ sank and fell$]$

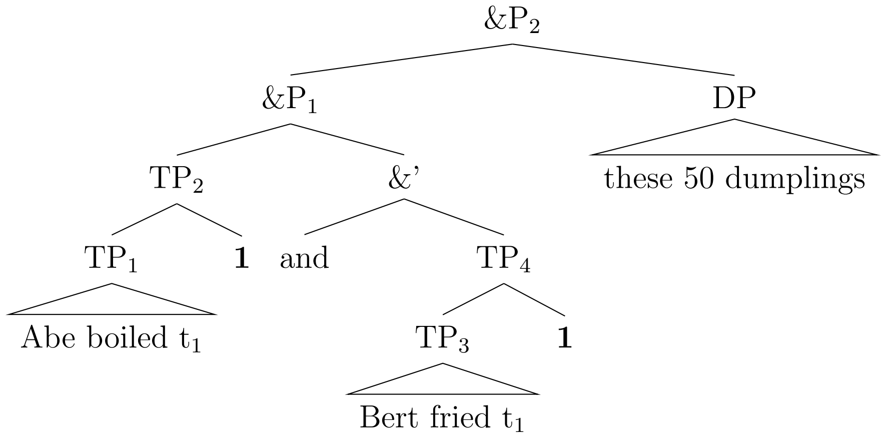
In (18), *sank* and *fell* are of type *et*, which is *e*-conjoinable, so their conjunction denotes: $\lambda x_e.\exists y,z[x = y\oplus z \wedge sank'(y) \wedge fell'(z)]$. Then, applying this function to *Abe*$\oplus$*Bert* results in: 1 *iff* $\exists y,z[Abe\oplus Bert = y\oplus z \wedge sank'(y) \wedge fell'(z)]$. In other words, sentence (18) is true iff there are y and z such that each of y and z refers to *Abe*, *Bert*, or *Abe*$\oplus$*Bert*, and they are in the extension of *sank'* and *fell'* respectively.[9] In this way, the meaning of the non-Boolean *and* encodes a cumulation that happens between a plural DP and predicate conjunction.

The second assumption of Hirsch and Wagner's analysis of cumulativity in RNR is that the movement of the shared item in RNR introduces one binder index in each conjunct. Under this assumption, the movement parse of the RNR in (19a) can be illustrated as in (19b).

(19) a. Abe boiled and Bert fried these 50 dumplings.

[9] If y and/or z are sums of individuals instead of individuals, some mechanism that allows the composition of a function and sum is required. For such a mechanism, see Link (1983) among others.

b.



Notice that there is a binder index *1* under TP_2 and TP_4.

With the above assumptions about the non-Boolean *and* and introduction of binder indexes, Hirsch and Wagner's analysis can explain how cumulativity is derived in (19a). First, TP_1 denotes: *1 iff Abe boiled g(1)*. The predicate abstraction then applies to TP_1, and TP_2 denotes $\lambda x_e.Abe\ boiled\ x$ or *Abe-boiled'* for short. Likewise, TP_4 denotes *Bert-fried'*. The non-Boolean *and* takes TP_2 and TP_4, and returns $\&P_1$'s denotation: $\lambda x_e.\exists y,z[x = y\oplus z \wedge Abe\text{-}boiled'(y) \wedge Bert\text{-}fried'(z)]$. This function applies to the denotation of the shared item, namely the sum of 50 dumplings $D_1\oplus...\oplus D_{50}$. As a result, $\&P_2$ denotes: 1 iff $\exists y,z[D_1\oplus...\oplus D_{50} = y\oplus z \wedge Abe\text{-}boiled'(y) \wedge Bert\text{-}fried'(z)]$. In this way, the movement parse can derive cumulativity in RNR.

However, Hirsch and Wagner's analysis do not appear to derive cumulativity in RNR as in (20), where the shared item itself is not a plural but *involves* a plural.

(20) a. John says [[that Friederike must t_1] and [that Konrad may t_1]], [record **two quite different songs**]$_1$.

(Abels 2004, 9)

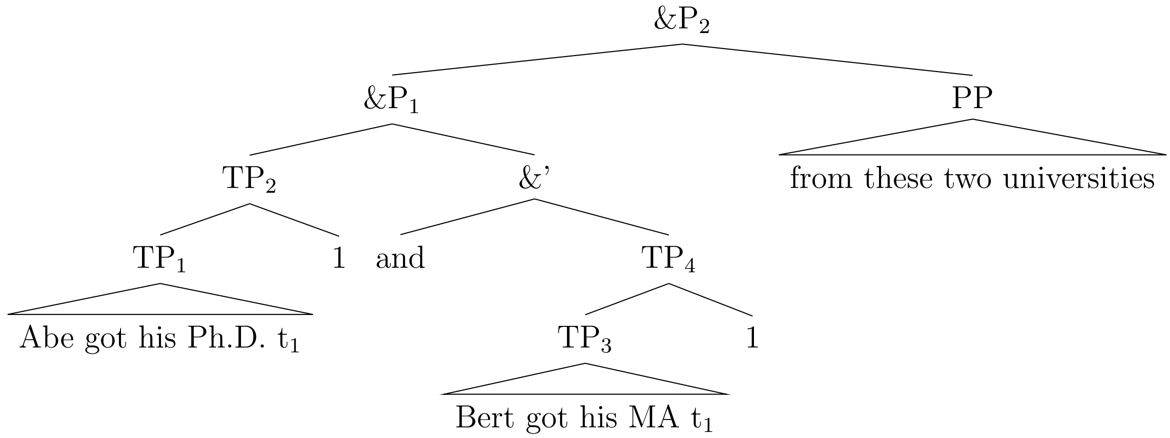
b. [[Abe got his Ph.D. t_1] and [Bert got his MA t_1]] [from **these two universities**]$_1$

The RNR in (20) seems to cumulate the propositional coordination and a plural *inside* the shared item. For instance, in (20a), *two quite different songs* intuitively consists of two songs that are quite different from each other, and the sentence can mean: John says that Friederike must record one of the two songs, and John says that Konrad may record the other song.[10] Likewise, (20b) can mean that Abe got his Ph.D. from one of these two universities and Bert got his MA from the other university.

Hirsch and Wagner's analysis predicts that the RNR in (20) is limited to denoting a distributive reading. To show this point, we can consider the semantic composition of (20b) under their analysis. First, they predict the sentence to have the structure in (21).

[10] This reading is essentially a sentence internal reading. Abels (2004) observes this reading to claim that the support for the movement parse based on the availability of sentence internal readings of *different* is only superficial. However, his argument against the movement parse is based on a "wrong" assumption given Beck's analysis of sentence internal readings; he assumes that sentence internal readings are available only when an expression modified by *different* outscopes a plural. But Beck (2000) demonstrates that the availability of sentence internal readings has little to do with the scope of *different*. See Section 6.

(21)



In (21), suppose that *these two university* refers to two universities A and B. Then, *these two university* denotes $A \oplus B$, and the shared PP denotes the atomic property in (22a). On the other hand, TP_1 denotes: *1 iff got' (his Ph.D.)(g(1))(Abe) =1*. Given that the shared PP is of type <e,t>, it can be assumed that t_1 is a trace of type <e,t>, and that the predicate abstraction abstracts over the value of the trace. Thus, TP_2 can be assumed to denote (22b). Likewise, TP_4 can be assumed to denote (22c). Then, the conjunction of TP_2 and TP_4 (i.e., $\&P_1$) denotes (22d). Finally, the function in (22d) applies to the denotation in (22a), and $\&P_2$ derives (22e).

(22)
a. $[\![\text{PP}]\!] = \text{from-A}\oplus\text{B'}$
b. $[\![\text{TP}_2]\!] = \lambda f_{et}.\text{got' (his Ph.D.)(f)(Abe)} = 1$
c. $[\![\text{TP}_4]\!] = \lambda f_{et}.\text{got' (his MA)(f)(Bert)} = 1$
d. $[\![\&\text{P}_1]\!] = \lambda f_{et}.\exists \text{P,Q}[\text{f} = \text{P}\oplus\text{Q} \wedge \text{got'(his Ph.D.)(P)(Abe)} \wedge \text{got'(his MA)(Q)(Bert)}]$
e. $[\![\&\text{P}_2]\!] = 1 \text{ iff } \exists \text{P,Q}[\text{from-A}\oplus\text{B'} = \text{P}\oplus\text{Q} \wedge \text{got'(his Ph.D.)(P)(Abe)} \wedge \text{got'(his MA)(Q)(Bert)}]$

Note that in (22e), both P and Q are the same property *from-A⊕B'*, which is the argument of the function *got'*. Thus, Hirsch and Wagner's analysis predicts that (20b) denotes the distributive reading to the effect that Abe got his Ph.D from A and B, and Bert got his MA from A and B. Therefore, their analysis does not predict the availability of cumulativity in RNR as in (20).

As mentioned above, the crucial property of the RNR in (20) is the shared item itself being *not* a plural. Thus, the shared item does not denote a sum even if it involves a plural such as *these two universities* which denotes a sum. As a result, P and Q in $[\![\&\text{P}_2]\!]$ above end up having the same meaning, leading to the distributive reading. Given that the shared item *involves* a plural expression, a straightforward solution to derive cumulativity in RNR in (20) is to devise a mechanism by which a plurality (e.g., *these two university* in (20b)) "projects" to its embedding expression (e.g., *from these two university* in (20b)). In fact, Schmitt (2019) proposes such a mechanism. Thus, adopting her mechanism, the next section proposes an analysis that can explain how cumulativity is derived in RNR, including the one in (20).

The analysis to be proposed in the next section departs from Hirsch and Wagner's analysis in another respect; it does not attribute the derivation of cumulativity to the meaning of the non-Boolean *and*. This is because Schmitt (2019) demonstrates that such an analysis of cumulativity based on the non-Boolean *and* undergenerates. Consider (23).[11]

[11] Beck and Sauerland (2000) claim that a cumulation cannot be made if there is a finite-clause boundary

(23) Diplomacy is useless! The French ambassador called this morning and the German one this afternoon. *[$_A$ **The ambassadors**] think that the president should [$_B$ [$_P$ **take a walk in Versailles**] **and** [$_Q$ **build a golf club in Bavaria**]* but neither of them said anything about the really pressing issue — the trade agreement with the EU.

(Schmitt 2019, 13-14)

The italic sentence in (23) can yield a cumulation between A and B; the sentence can mean that each ambassador thinks that the president should at least take a walk in Versailles or build a golf club in Bavaria, and each activity (i.e., taking a walk in Versailles and building a golf club in Bavaria) is what at least one of the ambassadors thinks that the president should do.

Sentence (23) differs from the cumulative sentences we have observed so far in that the two plurals do not appear in the same local domain; the argument of the predicate conjunction is not A but *the president*. Crucially, this kind of *long-distance cumulativity* cannot be captured by the analysis of cumulativity based on the non-Boolean *and* because the meaning of non-Boolean *and* encodes the semantic locality. Recall that the non-Boolean *and* that takes two predicates as its arguments denotes: $\lambda f_{et}.\lambda g_{et}.\lambda x_e.\exists y_e,z_e\ [x = y\oplus z \wedge f(y) \wedge g(z)])$. The denotation indicates that the predicate conjunction can have a cumulative relation with a plural DP only if the DP is the argument of the predicate conjunction. Therefore, the analysis of cumulativity using the non-Boolean *and* cannot explain how long distance cumulativity is derived. Thus, the analysis of cumulativity to be proposed in the next section does not make use of it.

To sum up, this section demonstrated that (i) Hirsch and Wagner's analysis can explain how cumulativity is derived in RNR with a shared item *being* a plural expression, but (ii) it cannot capture the cumulativity in RNR with a shared item just *involving* a plural expression or (iii) the long-distance cumulativity. The undergeneration problems in (ii) and (iii) reasonably call for mechanisms (a) that enable a plurality denoted by an expression to be projected to its embedding expression and (b) that can derive cumulativity between a plural DP and predicate conjunction *without* making use of the non-Boolean *and*. In fact, Schmitt (2019) devises such mechanisms for her analysis of cumulative readings of non-RNR sentences. Thus, this paper proposes an analysis of cumulativity based on the mechanisms Schmitt (2019) devises. Given that the analysis to be proposed makes use of her mechanisms, it can capture the same range of cumulative data as her analysis. But the proposed analysis differs from her analysis in compositional details, and would capture cumulativity more straightforwardly.[12]

5 Analysis of cumulativity

This section presents a new analysis of cumulativity following Schmitt (2019). Given that cumulativity is a particular binary relation between two plurals, an analysis of cumulativity can be divided into analyses of plurals and how they compose together to yield cumulativity. This section presents those analyses in turn.

between the two plural expressions, as in (23). But Schmitt (2019) argues that such a cumulation is available given an appropriate utterance context.

[12]Moreover, the proposed analysis contributes to formulating this paper's analysis of disjunction in Appendix A, which provides a support for the movement parse.

5.1 Plural set derivation

This paper adopts the central tenet of Schmitt's (2019) analysis of plural expressions called *cross-categorical plurality*. Unlike Schmitt (2019), however, the paper makes use of an intensional semantics and a Hamblin semantics (Hamblin 1976). Thus, this section explains this paper's version of the cross-categorical plurality.

This paper makes use of an intensional semantic system (e.g., Lewis 1976). The system allows linguistic expressions to be directly mapped to their intensions except for the words whose extensions are constant across worlds such as proper names and functional items (e.g., *the*, *every*). For example, the intransitive verb *sink* denotes $\lambda x_e.\lambda w_s.x$ *sinks in w*, and the transitive verb *boil* denotes $\lambda x_e.\lambda y_e.\lambda w_s.y$ *boils x in w*.

This paper also makes use of a Hamblin semantics, where expressions of any semantic type denote *sets* of "traditional" denotations, which refer to intensions in this paper. For example, *Abe* denotes {*Abe*}, and the verbs *sink* and *boil* denote $\{\lambda x_e.\lambda w_s.x$ *sinks in w*} and $\{\lambda x_e.\lambda y_e.\lambda w_s.y$ *boils x in w*}, or {*sink'*} and {*boil'*} for short, respectively. While these expressions denote singleton sets, there are some expressions that denote non-singleton/plural sets such as wh-items and so-called indeterminate pronouns in Japanese (e.g., Kratzer and Shimoyama 2017). In addition to those expressions, this paper assumes that plural expressions also denote plural sets (e.g., Schwarzschild (1996)). For example, I assume that the individual conjunction *Abe and Bert* and plural DP *the two students* both denote {Abe, Bert} if the contextually salient students are only Abe and Bert.

Based on the above assumptions, this paper adopts Schmitt's cross-categorical plurality; I assume that conjunctions of any semantic types denote plural sets just like plural individuals.[13] For instance, the predicate conjunction *sink and fall* denotes {sink', fall'} and the propositional conjunction *Abe sinks and Bert falls* denote {λw$_s$.Abe sinks in w, λw$_s$.Bert falls in w}, or {Abe sinks, Bert falls} for short.[14] I accordingly assume that any semantic domain D_a (where a ranges over a semantic type) not only involves singleton sets but also all possible plural sets which include members in the singleton sets in D_a (24). More formally, the proposed D_a contains all the non-empty subsets of the "traditional" D_a (e.g., traditional D_e = {Abe, Bert, ...}).

(24) a. D_e = {{Abe}, {Bert},..., **{Abe, Bert}**, ...}
b. $D_{<e,<st>>}$ = {{sink'}, {fall'},..., **{sink', fall'}**, ...}
c. D_{st} = {{Abe sinks}, {Abe falls},..., **{Abe sings, Abe falls}**, ...}

As mentioned above, plural sets such as {Abe, Bert} can be denotations of either plural expressions such as *the two students* or coordinated expressions such as *Abe and Bert*. As for coordinated constructions, I assume that *and* functions as a union operator defined in (25).

(25) $[\![\text{and}_{<\{a\},<\{a\},\{a\}>>}]\!] = \lambda X_{\{a\}}.\lambda Y_{\{a\}}.X\cup Y$

In (25), the semantic type $<\{a\},<\{a\},\{a\}>>$ means that *and* takes and returns *sets* of elements of type *a*. For example, *and* in *Abe and Bert* composes with two singleton sets denoted by *Abe* and *Bert* by functional application (FA), and returns a doubleton set (26).

[13] The ontology of pluralities other than plural individuals is proposed for different semantic types by several linguists (e.g., Landman 2000, Beck and Sharvit 2002, Schlenker 2004, Gawron and Kehler 2004).

[14] One of the motivations for Schmitt (2019) to propose the cross-categorical plurality is to capture long-distance cumulativity as in (23). See Schmitt (2019) for other motivations.

(26) $[\![\text{Abe and Bert}]\!]$ = {Abe}∪{Bert} = {Abe, Bert}

It should be noted that plural sets themselves are not accurate representations of plurals as some linguists use them to denote disjunctions such as *Abe or Bert* (e.g., Simons 2005, Schmitt 2019).[15] So this paper ascribes the conjunctive effect of *and* to an operator that makes use of members in plural sets, as shown in the next subsection (see Winter 1995 for a related analysis).

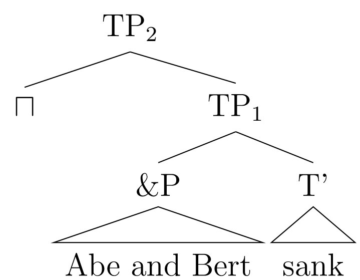
To sum up, this subsection introduced this paper's version of cross-categorical plurality; (i) semantic domain D_a contains not only singleton sets but also all possible plural sets which include the members in those singleton sets, and (ii) conjunctions with conjunct expressions of any semantic types denote plural sets through the union operation triggered by *and*.

5.2 Plural set composition

This section explains how sets in a Hamblin semantics undergo semantic compositions, and how cumulativity is derived in non-RNR sentences. Consider first the simple sentence with a DP conjunction in (27a) and its structure in (27b) (⊓ will be defined shortly).

(27) a. Abe **and** Bert sank.

b.

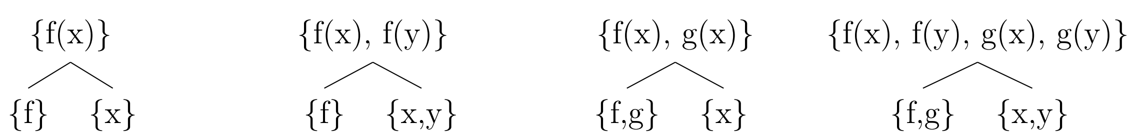


In (27), &P denotes {Abe, Bert} and T' denotes {sank'}. We wish to compose &P and T' by FA given their semantic types, but they denotes a *set*, so I adopt the compositional rule in (28).

(28) **Point-wise Functional Application (PFA)**
If α is a branching node whose daughters are a β and γ, and $[\![\beta]\!]^g \subseteq D_\sigma$ and $[\![\gamma]\!]^g \subseteq D_{\sigma\iota}$, then $[\![\alpha]\!]^g = \{f(x)\text{: } f \in [\![\gamma]\!]^g \text{ and } x \in [\![\beta]\!]^g\}$
(adapted from Kratzer and Shimoyama 2017, 127)

When two sets compose together by PFA, a function or functions in one of the sets apply *point-wise* to their argument(s) in the other set, as exemplified in a schematic form in (29) (f and g are functions of type $<\sigma\iota>$ and x and y are their arguments of type $<\sigma>$).

(29)



Given (28), in (27b), the function *sank'* in {sank'} applies point-wise to *Abe* and *Bert* in {Abe, Bert}, and TP_1 denotes the doubleton set {Abe sank, Bert sank}. Note that the doubleton set itself does not represent the meaning of the sentence; it does not assert as the meaning of the

[15] See Appendix A for this paper's analysis of disjunctions.

sentence that each proposition in the set is true in an evaluation world. Thus, I assume that sentences with a plural involve a sentential universal operator $\sqcap$ defined in (30).[16]

(30) $\sqcap$ **operator**
$[\![\sqcap]\!] = \lambda p_{\{st\}}.\{\lambda w_s.\forall q_{st}{\in}p\ q(w) = 1\}$

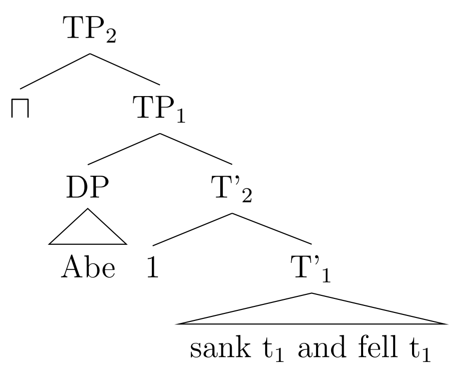
In (27b), $\sqcap$ composes with TP_1, which denotes {Abe sank, Bert sank}, by FA, and returns a singleton set $\{\lambda w_s.\forall p{\in}$\{Abe sank, Bert sank\} $p(w) = 1\}$. The proposition in the set asserts that all the propositions in {Abe sang, Bert sang} are true in an evaluation world, which is what sentence (27a) means.

Note that PFA enables the plurality of an expression to be projected to its embedding expression; in (27a), the composition of a plural set {Abe, Bert} and a singleton set {sank'} derives the plural set {Abe sank, Bert sank}. Thus, PFA enables to derive cumulativity in RNR whose shared item is *not* a plural but *involves* a plural. Section 6 elaborates on this point.

Next, we turn to the sentence with a predicate conjunction in (31a). In the previous examples, I made use of a simplified structure where the subject base-generates in Spec TP. However, in (31), following the VP-Internal Subject Hypothesis (e.g., Fukui 1986, Kitagawa 1986, Kuroda 1988, Koopman and Sportiche 1991), I assume that *Abe* in (31a) has ATB moved from the object position of unaccusative verbs to Spec TP as shown in (31b).[17]

(31) a. Abe sank **and** fell.

b.



First, we need to revise the traditional traces and pronouns rule as in (32) so that t_1 denotes a set of the traditional denotation, namely {g(1)} (rather than just g(1)).

(32) **Hamblin Traces and Pronouns Rule (HTPR)**
If α_1 is a trace or a pronoun, then for any g, $[\![\alpha_1]\!]^g = \{g(1)\}$.

Given (32), t_1 denotes {g(1)}, which composes with {sank'} by PFA, and *sank* t_1 denotes {g(1) sank}. Likewise, *fell* t_1 denotes {g(1) fell}. Then, T' denotes their union set {g(1) sank, g(1) fell}. We wish to abstract over the value of g(1) in {g(1) sank, g(1) fell}. So we need to revise the traditional predicate abstraction rule as in (33) so that the rule can apply to a set.[18]

[16] Kratzer and Shimoyama (2017) assumes a similar operator MO in a Hamblin semantics to analyze Japanese indeterminate pronouns.

[17] (31b) is one of the possible structures. For instance, it is possible that $\sqcap$ applies to &P instead of TP_1.

[18] See Shan (2004), Romero and Novel (2013), Charlow (2019) among others for discussion about the point-wise predicate abstraction defined in (33).

(33) **Point-wise Predicate Abstraction (PPA)**
If α is a branching node whose daughters are an index i and β, where $[\![\beta]\!]^g \subseteq D_\sigma$, then $[\![\alpha]\!]^g = \{f\text{: } f \in D_{<e\sigma>}\ \&\ \forall a\ [f(a) \in [\![\beta]\!]^{g[a/i]}]\}$

(Kratzer and Shimoyama 2017, 127)

In this paper, PPA always applies to a set of propositions, and thus it always returns a set of properties, as schematized in (34).

(34) $\{\underline{\lambda \mathbf{x}_e}.\lambda w_s.\ ...\underline{\mathbf{x}}...,\ \underline{\lambda \mathbf{x}_e}.\lambda w_s.\ ...\underline{\mathbf{x}}...,\ ...\}$

1 $\{\lambda w_s.\ ...\underline{\mathbf{g(1)}}...,\ \lambda w_s.\ ...\underline{\mathbf{g(1)}}...,\ ...\}$

As PFA allows functions in a set to apply point-wise to arguments in another set, PPA allows a single binder index to apply to each member in a propositional set. As a result, despite the presence of a single binder index *1*, the set in the top node in (34) has λ_x for each of its members, which binds the variable x replacing g(1) in the original set.

In (31b), when PPA applies to T'$_1$, T'$_2$ denotes a set of properties, as shown below (the sets to the right of the slash are the short forms of the sets to the left of the slash).

(35) $\{\underline{\lambda \mathbf{x}_e}.\lambda w_s.\underline{\mathbf{x}}$ sank in w, $\underline{\lambda \mathbf{x}_e}.\lambda w_s.\underline{\mathbf{x}}$ fell in w$\}$/{sank', fell'}

1 $\{\lambda w_s.\underline{\mathbf{g(1)}}$ sank in w, $\lambda w_s.\underline{\mathbf{g(1)}}$ fell in w$\}$/{g(1) sank, g(1) fell}

Under the definition of PPA, the propositions in the set in (35) can become the properties via PPA because the following statements in (36) and (37) are true; (36) indicates that the set in the top node in (35) involves $\lambda x_e.\lambda w_s.x$ ***sank*** *in w*, and (37) indicates that the set involves $\lambda x_e.\lambda w_s.x$ ***fell*** *in w* (in (36-37), the denotation of T'$_1$ is the propositional set in (35), and the underlined function is a member of the set in the top node in (35)).

(36) $\forall a[[\underline{\lambda x_e.\lambda w_s.\text{x sank in w}}](a) \in [\![\text{T'}_1]\!]^{g[a/1]}] \Leftrightarrow$
λ-notation
$\forall a[\lambda w_s.\boldsymbol{a}$ sank in w $\in [\![\text{T'}_1]\!]^{g[a/1]}] \Leftrightarrow$
assignment modification
$\forall a[\lambda w_s.a$ sank in w $\in [\![\text{T'}_1]\!]^{[\mathbf{1}\rightarrow\ \mathbf{a}]}] \Leftrightarrow$
HTPR
$\forall a[\lambda w_s.a$ sank in w $\in\boldsymbol{\{\lambda w_s.[1\rightarrow a](1)\ \text{sank in w},\ \lambda w_s.[1\rightarrow a](1)\ \text{fell in w}\}}] \Leftrightarrow$
Simplification
$\forall a[\lambda w_s.a$ sank in w $\in\{\lambda w_s.\boldsymbol{a}$ sank in w, $\lambda w_s.\boldsymbol{a}$ fell in w$\}]$

(37) $\forall a[[\underline{\lambda x_e.\lambda w_s.\text{x}\ \textbf{fell}\ \text{in w}}](a) \in [\![\text{T'}_1]\!]^{g[a/1]}] \Leftrightarrow$
Same process as in (36)
$\forall a[\lambda w_s.a$ **fell** in w $\in\{\lambda w_s.a$ sank in w, $\lambda w_s.a$ fell in w$\}]$

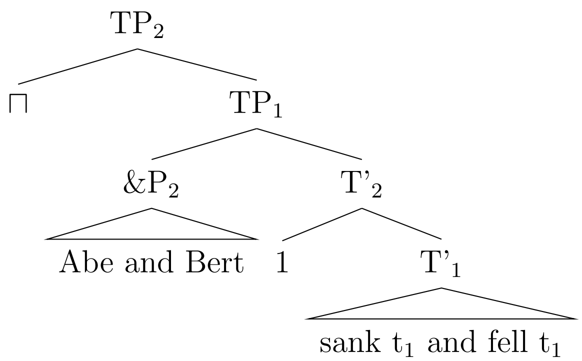
After {sank', fell'} is derived as the denotation of T'$_2$ in (31b), the set composes with {Abe} by PFA, and TP$_1$ denotes {Abe sank, Abe fell}. Finally, $\sqcap$ applies to the doubleton set, and TP$_2$ denotes a singleton set: $\{\lambda w_s.\forall p\in\{\text{Abe sank, Abe fell}\}\ p(w) =1]\}$. The proposition in the set asserts that Abe sank and Abe fell in an evaluation world.

Finally, we turn to a non-RNR sentence with cumulativity (38).

(38) Abe and Bert sank and fell.

As mentioned in the previous sections, sentence (38) has both the cumulative and distributive readings. First, I demonstrate that if we analyze the sentence as we analyzed the previous sentences in this subsection (39), the sentence derives the distributive reading.[19]

(39)



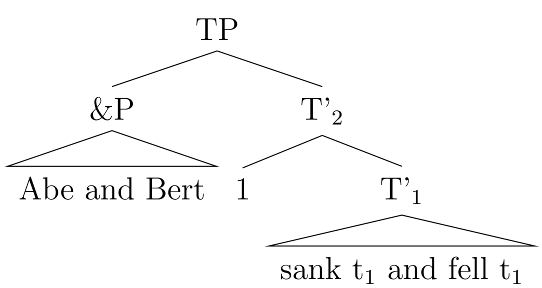
In (39), $\&P_2$ denotes {Abe, Bert} and T'_2 denotes {sank', fell'}. These two plural sets then compose together by PFA, deriving the denotation of TP_1: {Abe sank, Abe fell, Bert sank, Bert fell}. Finally, $\sqcap$ applies to TP_1, deriving a singleton set $\{\lambda w_s.\forall p\in\{$Abe sank, Abe fell, Bert sank, Bert fell$\}\ p(w)=1]\}$. The proposition in the set asserts that Abe sank, Abe fell, Bert sank, and Bert fell in an evaluation world, which is the distributive reading of (38).

In contrast to the distributive reading, the cumulative reading of (38) is not derived from the tools we have adopted so far. Thus, I assume an operator *Cuml* defined in (40) in the same line with Schmitt (2019).[20]

(40) **Cuml operator**
$[\![\text{Cuml}]\!] = \lambda X.\lambda Y.\{\lambda w_s.\forall x\in X\ \exists y\in Y\ x(y)(w) = 1\ \&\ \forall y\in Y\ \exists x\in X\ x(y)(w) = 1\}$

The operator Cuml takes two sets — one of them involves functions and the other their arguments — and returns a singleton set of a proposition which asserts the cumulation between those two sets. For example, in (38), the structure in (41) is first derived after the subject has ATB moved from the object position of unaccusative verbs to Spec TP.

(41)

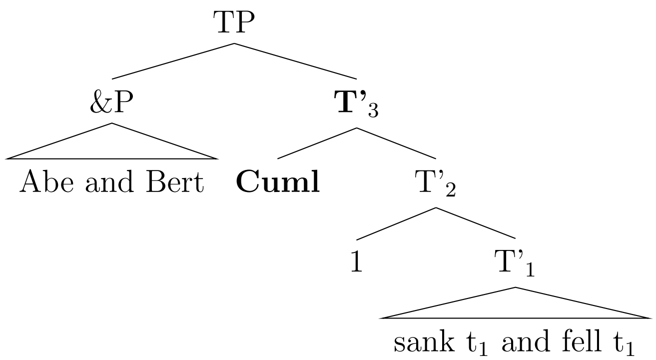


After that, the Cuml is inserted as in (42).

[19]The tree in (39) represents one possible structure for the distributive reading. There is another possible structure which is identical to (39) except that it involves another $\sqcap$ which attaches to $\&P_1$.

[20]Schmitt (2019) does not attribute cumulativity to the presence of an operator but a new compositional rule. But the implementation of Cuml resembles that of her compositional rule in that both approaches derive cumulativity through the composition of two plural sets.

(42)



In (42), Cuml takes the plural sets denoted by T'$_2$ and &P (i.e., {sank', fell'} and {Abe, Bert}) in turn, and derives the denotation of TP in (43).

(43) $[\![\text{TP}]\!] = \{\lambda w_s.\forall x\in\{\text{sank', fell'}\}\ \exists y\in\{\text{Abe, Bert}\}\ x(y)(w) = 1\ \&\ \forall y\in\{\text{Abe, Bert}\}\ \exists x\in\{\text{sank', fell'}\}\ x(y)(w) = 1\}$

In (43), the proposition in the singleton set asserts that in an evaluation world, (i) each incident (i.e., sinking and falling) happened to Abe or Bert and (ii) each of Abe and Bert sank or fell. Finally, $\sqcap$ operator applies to TP in (43), returning a singleton set of a proposition, which asserts that the proposition in the set in (43) is true in an evaluation world. In this way, the proposed analysis of pluralities with Cuml can derive cumulativity in non-RNR sentences.

It should be noted that the structure in (42) does not appear to follow Heim and Kratzer's mechanism of how movements introduce a binder index; the binder index *1* does not appear immediately below the moved phrase *Abe and Bert*. However, the apparent departure from their mechanism is only superficial, as is clear from (41). The structure in (41) shows that the movement of the subject does introduce *1* immediately below it, which just ends up being interrupted by the inserted Cuml. This mechanism of Cuml applying to the predicate derived by a movement is based on Beck and Sauerland's (2000) analysis of cumulativity.[21]

To sum up, this section demonstrated how plurals compose with other elements. I proposed that plurals are used with $\sqcap$, and whether sentences derive distributivity or cumulativity depends on whether two plurals compose via the Cuml operator. Crucially, the proposed analysis of cumulativity does not make use of the non-Boolean *and*, but it could still capture the cumulativity in a non-RNR sentence which structurally resembles the movement parse of RNR. It is therefore predicted that this paper's analysis of cumulativity enables the movement parse to derive cumulativity in RNR. The next section demonstrates that this prediction is born out.

[21] There is another way of making this paper's analysis of cumulativity consistent with Heim and Kratzer's mechanism; that is, we assume that Cuml takes a subject and predicate in turn, as shown in (1).

(1) [**Cuml** [Abe and Bert]] [1 sank t_1 and fell t_1]

However, such an assumption seems to cause a problem in analyzing sentences as in (2).

(2) Abe and Bert met and cooked these 50 dumplings together.

Sentence (2) can yield a cumulation between *Abe and Bert* and *cooked these 50 dumplings*, but should not yield one between *Abe and Bert* and *met*. But if one assumes *Abe and Bert* to have the structure *[**Cuml** [Abe and Bert]]* as in (1), the sentence has to let *Abe and Bert* cumulatively compose with *met*. On the other hand, if one assumes Cuml to take a predicate first as assumed in (42), the above problem does not arise. (see a related discussion about distributivity in Dowty (1987), Roberts (1987), Lasersohn (1995) among others). Thus, this paper assumes that Cuml takes a predicate and subject in turn as shown in (42).

6 Cumulativity in RNR

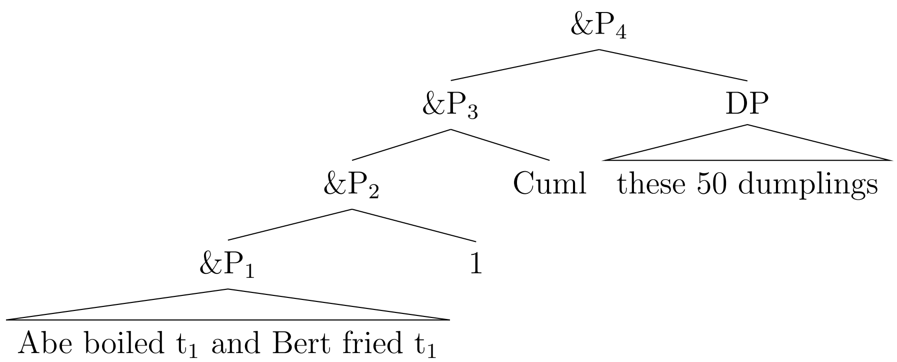
This section consists of five subsections. Based on the analysis of plurals in Section 5, Section 6.1 demonstrates that the movement parse can derive distributive and cumulative readings of RNR. Section 6.2 shows that the movement parse predicts the anticollectivity effect, which makes Grosz's (2015) multi-dominance parse unable to derive cumulativity in RNR. After it is established that only the movement parse can derive cumulativity in RNR, Section 6.3 shows that RNR with sentence internal readings supports the movement parse because the reading requires a sentence to derive cumulativity and only the movement parse can derive cumulativity. Finally, the remaining two subsections demonstrate that this paper's analysis of cumulativity can derive cumulativity in RNR with an indefinite DP in the shared item position (Section 6.4) and correctly predict the *lack* of cumulativity in RNR without a coordination (Section 6.5).

6.1 RNR under the movement parse

This section demonstrates that the movement parse can derive both the cumulativity and distributivity in RNR using the analysis of plurality in Section 5. First, I demonstrate how the RNR in (44a) derives cumulativity under the movement parse shown in (44b).[22]

(44) a. Abe boiled and Bert fried these 50 dumplings.

b.



In (44b), $\&P_1$ denotes {Abe boiled g(1), Bert fried g(1)}. After PPA applies to $\&P_1$, $\&P_2$ denotes $\{\lambda x_e.\lambda w_s.$Abe boiled x in w, $\lambda x_e.\lambda w_s.$Bert fried x in w$\}$ or {Abe-boiled', Bert-fried'} for short. Finally, Cuml takes this set and the set of 50 dumplings, and returns a set of a proposition in (45), which encodes a cumulation between the two input sets.

(45) $\{\lambda w_s.\forall x\in\{\text{Abe-boiled, Bert-fried}\}\ \exists y\in\{D_1,...,D_{50}\}\ x(y)(w) = 1\ \&$
$\forall y\in\{D_1,...,D_{50}\}\ \exists x\in\{\text{Abe-boiled, Bert-fried}\}\ x(y)(w) = 1\}$

In this way, the movement parse can derive cumulativity in RNR.[23]

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[22] From this example, I omit ⊓ in the derivation of cumulativity since it is not crucial in the derivation.

[23] Whereas Section 3 claimed that the ellipsis parse does not appear to derive cumulativity in RNR, Ha (2008) provides an analysis that potentially explains the availability of that reading under the ellipsis parse. Following Fox's (2000) *multidimentional view* of coordinate structure constraint, he proposes that the shared item in the second conjunct in RNR *covertly* moves to the left periphery. In this analysis, sentence (44a) has the LF in (1) where <*these 50 dumplings*> is an expression to be elided at PF.

(1) [these 50 dumplings]$_1$ [[Abe boiled <these 50 dumplings>] and [Bert fried t$_1$]]

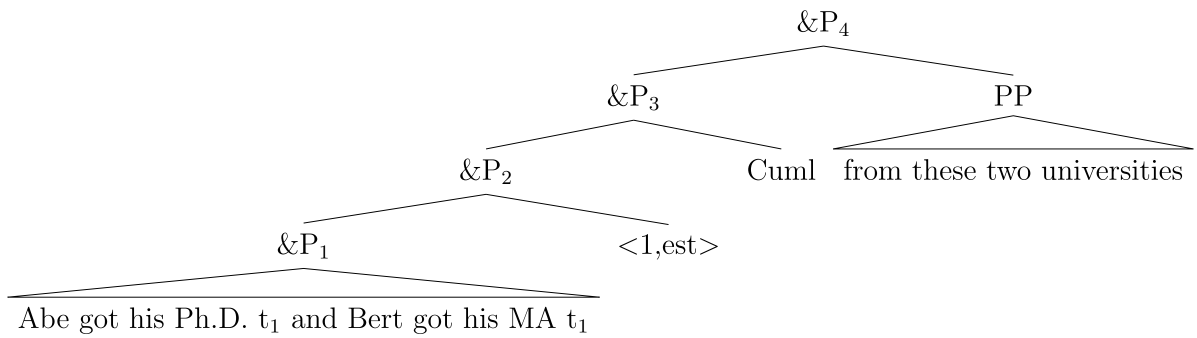
Section 3 sketched how the movement parse may derive distributive readings of RNR. But the analysis of plurals in Section 5 can provide an alternative compositional analysis. For example, in (44a), *Abe boiled and Bert fried* and *these 50 dumplings* denote a set of properties {Abe-boiled', Bert-fried'} and a set of individuals {D_1, ..., D_{50}}. These plural sets compose by PFA, deriving a set of 100 propositions {Abe boiled D_1, Bert fried D_1, ..., Abe boiled D_{50}, Bert fried D_{50}}. Finally, $\sqcap$ takes this set, and returns a singleton set of a proposition, which states that the 100 propositions mentioned above are all true in an evaluation world. In this way, the movement parse can also derive distributivity in RNR under this paper's analysis of plurals.

Next, we turn to the RNR in (46).

(46) [[Abe got his Ph.D. t_1] and [Bert got his MA t_1]] [from these two universities]$_1$

Section 4 showed that Hirsch and Wagner's analysis cannot capture the cumulativity in (46) because their analysis cannot treat the shared item in (46) as a plural even if it *involves* a plural. But this paper's analysis of plurals enables the plurality of an expression embedded in the shared item (e.g., *these two universities* in (46)) to be projected to the shared item. Thus, this paper's analysis can capture the cumulativity in (46). The rest of this section illustrates how. First, when (46) denotes a cumulative reading, it has the LF structure in (47).

(47)



Suppose that *these two universities* refers to two universities *A* and *B*. Then the shared item denotes a plural set of properties {from-A', from-B'}. I assume that the ATB movement of the shared item of type <e,st> introduces a higher type trace; that is, t_1 denotes {g(1)} where the assignment *g* gets *1* mapped to a property.[24] Given this, &P_1 denotes a set of propositions {got'(his Ph.D.)(g(1))(Abe), got'(his MA)(g(1))(Bert)}. Next, we wish to abstract over the value of g(1) in the plural set with a variable of type <e,st>, given that t_1 is a trace of type <e,st>. In order to enable this, I revise the PPA as follows.

(48) **Revised Point-wise Predicate Abstraction (Revised PPA)**
If α is a branching node whose daughters are an $<n,\sigma>$, where n is a natural number and σ is a semantic type, and β, where $[[\beta]]^{w,g} \subseteq D_\iota$, then $[[\alpha]]^{w,g} = \{f\text{: } f \in D_{<\sigma\iota>}\ \&\ \forall a\ [f(a) \in [[\beta]]^{w,g^{[a/<n,\sigma>]}}]\}$

Ha (2008) assumes that <*these 50 dumplings*> is interpreted as a variable bound by *these 50 dumplings* at LF. Under this assumption, this paper's analysis of cumulativity can be applied and the availability of cumulativity in RNR can be explained without assuming an overt ATB movement of the shared item. However, it is not trivial to assume that <*these 50 dumplings*> is interpreted as a bound variable because he assumes the ellipsis in RNR to be a PF phenomenon, and thus <*these 50 dumplings*> should have the same meaning at LF as *these 50 dumplings* that does not elide at PF.

[24] An alternative denotation of t_2 is $\{\lambda x_e.\lambda w_s.g(2)(x)(w){=}1\}$, which requires the modification of HTPR. Since both denotations give rise to the same compositional results throughout this paper, I adopt the simpler one used in the main text.

The revised PPA differs from PPA only in that it can abstract over the value of higher type traces. In (47), t_1 is of type <e,st>. So applying the revised PPA to the denotation of &P_1 results in the set {$\lambda f_{<e,st>}.\lambda w_s$. got'(his Ph.D.)(f)(Abe)(w), $\lambda f_{<e,st>}.\lambda w_s$. got'(his MA)(f)(Bert)(w)}, or {Abe-got-his-Ph.D.', Bert-got-his-MA'} for short. Finally, Cuml takes &P_2 and PP, and returns the value of &P_4:

(49) {$\lambda w_s.\forall x\in${Abe-got-his-Ph.D.', Bert-got-his-MA'} $\exists y\in${from-A', from-B'} x(y)(w) = 1 & $\forall y\in${from-A', from-B'} $\exists x\in${Abe-got-his-Ph.D.', Bert-got-his-MA'} x(y)(w) = 1}

In this way, under this paper's analysis of cumulativity, the movement parse can derive cumulativity in (46) as well.

To sum up, the movement parse can derive both distributivity and cumulativity, including the one Hirsch and Wagner's analysis cannot capture. In other words, the movement parse can derive the same interpretations of RNR (i.e., distributive readings) as the ellipsis and Grosz's multi-dominance parses, and it can additionally derive cumulativity.

6.2 Anticollectivity effect under the movement parse

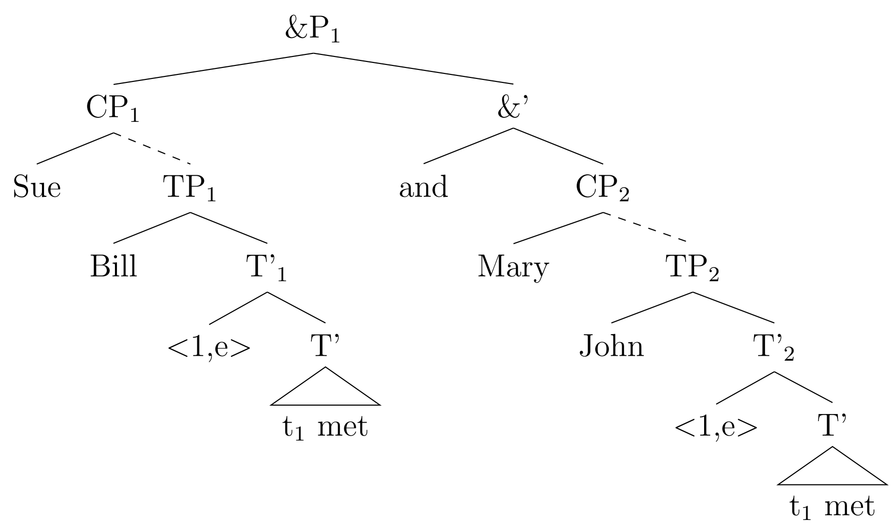
Section 3 illustrated that Grosz's multi-dominance analysis cannot explain the availability of cumulativity in RNR because it is formulated to predict the anticollectivity effect. Given this, a question arises as to whether the movement parse, which can derive cumulativity in RNR, can correctly predict the anticollectivity effect. Answering this question is the aim of this subsection, and I argue that the movement parse does predict the anticollectivity effect.

Consider first the RNR with anticollectivity effect in (50a), which differs from (12a) in that the shared item is *met* rather than *have finally met*.[25]

(50) *[Sue's proud that *Bill* _] and [Mary's glad that *John* _] **met**.

Under the movement analysis, sentence (50) has the structure in (51) before the movement of the shared item.

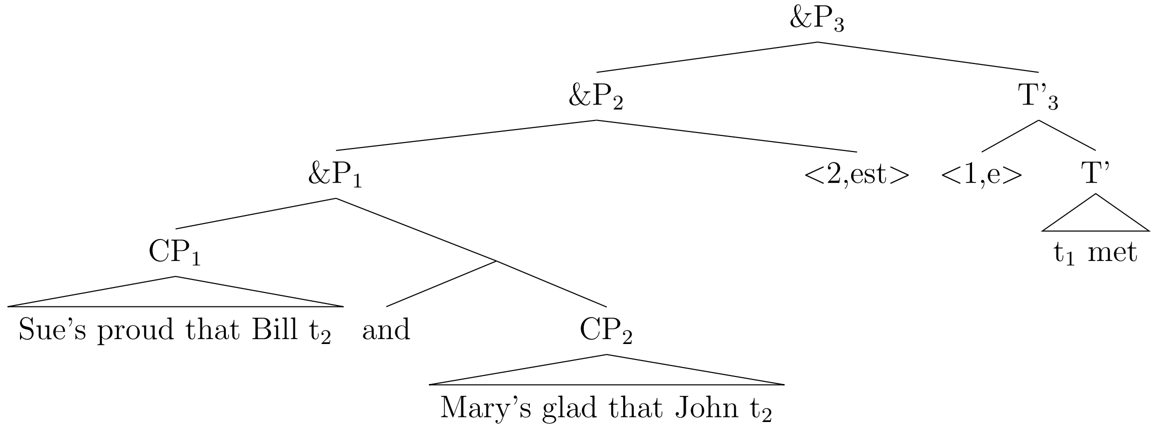
(51)



[25]RNR disprefers to have a short expression as a shared item (e.g., Bresnan 1974), but this subsection examines (50) for ease of exposition.

Then, T'_1 and T'_2 in (51) ATB move to the right periphery as shown in (52).

(52)

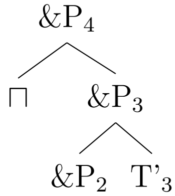


The next step is to insert Cuml between $\&P_2$ and $\&P_3$ if necessary, and adjoin $\sqcap$ to $\&P_3$. I will demonstrate that the structures with and without Cuml both correctly predict that sentence (50) is unnatural. To this end, I first provide the denotations of T'_3 and $\&P_2$ in (52). First, T'_3 denotes {met'} (53a). Given that T'_3 is of type <e,st>, I assume that the ATB movement of T'_3 introduces a higher type trace t_2; that is, t_2 denotes {g(2)} where the assignment g gets *2* mapped to a property. In CP_1, this set composes with {Bill} by PFA, deriving {g(2)(Bill)}. After this, the set {g(2)(Bill)} composes with the rest of the phrases in CP_1, deriving the denotation in (53b). Likewise, CP_2 denotes (53c). Afterwards, *and* takes CP_1 and CP_2, and returns the set in (53d). Finally, the revised PPA applies to $\&P_1$, and $\&P_2$ denotes (53e).

(53)
a. $[\![T'_3]\!]$ = {met'}
b. $[\![CP_1]\!]$ = {Sue's proud that g(2)(Bill)}
c. $[\![CP_2]\!]$ = {Mary's glad that g(2)(John)}
d. $[\![\&P_1]\!]$ = {Sue's proud that g(2)(Bill), Mary's glad that g(2)(John)}
e. $[\![\&P_2]\!]$ = {$\lambda f_{<e,st>}.\lambda w_s$.Sue's proud that f(Bill) in w, $\lambda f_{<e,st>}.\lambda w_s$.Mary's glad that f(John) in w}

Having provided the denotations of $\&P_2$ and T'_3 in (52), we examine the complete structure of (50) without and with Cuml in turn. First, the structure without Cuml looks as in (54).

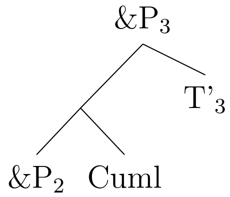
(54)



In (54), $\&P_2$ and T'_3 compose together by PFA, deriving the denotation of $\&P_3$: {Sue's proud that Bill met, Mary's glad that John met}. $\sqcap$ then applies to $\&P_3$, and $\&P_4$ denotes a singleton set of a proposition, which states that both propositions in the set denoted by $\&P_3$ are true in an evaluation world. Since those propositions (i.e., *Sue's proud that Bill met* and *Mary's glad that John met*) both sound unnatural in the actual world, the movement parse without Cuml correctly predicts that sentence (50) sounds unnatural.

Next, we turn to the structure of (50) with Cuml (55).

(55)



In (55), Cuml takes &P$_2$ and T'$_3$ in turn, and returns a set of a proposition. The set can be represented as in (56a) if we abbreviate the denotation of &P$_2$ as {P,Q}.

(56) $\{\lambda w_s.\forall f{\in}\{P,Q\}\ \exists x{\in}\{met'\}\ f(x)(w) = 1\ \&\ \forall x{\in}\{met'\}\ \exists f{\in}\{P, Q\}\ f(x)(w) = 1\}$

In (55), one of the arguments of Cuml is a singleton set {met'}. So the proposition in the set in (56) simply asserts that (i) P applies to *met'* and an evaluation world w, and returns the truth value of *1* iff Sue's proud that Bill met in w and (ii) Q applies to *met'* and w, and returns the truth value of *1* iff Mary's glad that John met in w. Notice that the truth conditions mentioned in (i) and (ii) above are unnatural since it does not make sense to say that *Bill met* or *John met*. Therefore, even if the movement parse of (50) involves Cuml as in (55), the movement parse can predict the unnaturalness of RNR with the anticollectivity effect.[26]

To sum up, this section demonstrated that the movement parse can also predict the anticollectivity effect in RNR. Therefore, the movement parse can make the same interpretive predictions as the other two parses (i.e., availability of distributive readings of RNR and anticollectivity effect), and it can additionally derive cumulativity.[27,28]

6.3 Sentence internal readings of RNR

Having demonstrated that only the movement parse can derive cumulative readings, I turn to RNR with a sentence internal reading of a relational modifier as in (57) again.

(57) Bob dates and Sally married, two quite **different** people.
≈ The person Bob dates is quite different from the person Sally married.
(Hirsch and Wagner 2015, 192)

This paper agrees with most of the previous RNR literature that the availability of sentence internal readings of RNR supports the movement parse. However, this paper provides a different account of why only the movement parse can derive the reading. Following Beck's (2000) analysis of *different*, Section 1 claimed that only the movement parse can derive the reading

[26] The discussion above also shows that when two sets compose by PFA or via Cuml, if at least one of the sets is a singleton set, the result will be identical.

[27] This section did not discuss the ellipsis parse, but it can predict the anticollectivity effect. For example, the pre-elided source of (50), *Sue's proud that Bill met and Mary's glad that John met*, is unnatural as well.

[28] Some of the anticollectivity examples show a syntactic plural agreement between the shared T' and the embedded subject in each conjunct (1).

(1) *[Sue's proud that ***Bill*** __] and [Mary's glad that ***John*** __] **have** finally met.

I mentioned in footnote 6 that the form of *have* is not the reason for the unnaturalness of (1). In fact, Grosz (2015) proposes a syntactic analysis to explain how *have* can receive the plural feature while maintaining his claim that the shared item is interpreted in each conjunct separately. I leave for future research how such plural agreements are made to be possible under the movement parse.

because (i) the reading is available only if the sentence can derive a cumulation, and (ii) only the movement parse can derive cumulations. The previous sections supported the statement in (ii) above. So this section briefly discusses how Beck (2000) supports the statement in (i).

Beck's supports for the claim in (i) come from observations that sentence internal readings are unavailable when some factors prevent a sentence deriving a cumulation. This section introduces two kinds of such observations. First, sentence internal readings are unavailable when the *different* NP has a singular form. Compare (58a-b).

(58) a. Sue and Penelope go to **different conferences**. (Beck 2000, 123)
b. Sue and Penelope go to **a different conference**.

Sentence (58a) with a plural DP allows a sentence internal reading that the conference that Sue goes to is different from the conference that Penelope goes to. In contrast, sentence (58b) with a singular DP does not allow that reading. Notice that whereas sentence (58a) can yield a cumulation between *Sue and Penelope* and *different conferences*, sentence (58b) cannot yield it between *Sue and Penelope* and *a different conference* (remember that cumulations are made between two plurals). Thus, the example in (58) is consistent with Beck's claim in (i) that sentence internal readings requires a sentence to be able to derive a cumulation.[29]

Another type of supports for the claim in (i) is that sentence internal readings are unavailable for sentences with a collective predicate. Compare the sentences in (59a-b).

(59) a. Different people **wrote *Emma* and *Hamlet***.
b. Different people **separated Mary and John**. (Beck 2000, 130)

Sentence (59a) with the non-collective predicate *wrote Emma and Hamlet* has a sentence internal reading that the person who wrote *Emma* is different from the person who wrote *Hamlet*. In contrast, sentence (59b) with the collective predicate *separated Mary and John* does not have a (unnatural) sentence internal reading such that the person who separated Mary is different from the person who separated John. Note that sentence (59b) cannot yield a cumulation unlike sentence (59a). The collective verb *separate* takes a plural object, and its metalanguage *separate'* needs to take the whole group of individuals/plural sets denoted by the expression as its argument. Thus, *separated Mary and John* is predicted to denote a *singleton* set {separated'({Mary, John})} rather than a doubleton set {separated'(Mary), separated'(John)} (as opposed to *wrote Emma and Hamlet* which is predicted to denote {wrote'(*Emma*), wrote'(*Hamlet*)}). This is why a plural set to be denoted by *different people* in (59b) does not have another plural set to yield a cumulation with. In this way, the example in (59) also supports the claim in (i).[30]

[29] Such a contrast as in (58) seems to be weaken in RNR; some literature reports that RNR with a singular NP with *different* allows a sentence internal reading (e.g., Jackendoff 1977, Sabbagh 2007, Overfelt 2016). But Hartmann (2001) reports that her consultants do not "like" a sentence internal reading of such an RNR (1).

(1) John hummed and Mary sang **a different tune**. (Hartmann 2001, 78)

It should be noted that Hartmann (2001) observes that sentence internal readings of RNR are difficult in general unlike the observations reported in other RNR literature. However, she also does admit that the following RNR with a relational modifier *similar* seems to have a sentence internal reading that the tunes that the pirates sang are similar to the tunes that the bandits whistled.

(2) The pirates sang and the bandits whistled **similar tunes.** (Hartmann 2001, 80)

[30] See also footnote 35 for another observation for the claim in (i).

To sum up, the availability of sentence internal readings of RNR supports the movement parse because they require a cumulation and only the movement parse can derive a cumulation in RNR.[31] What this means is that the presence of a relational modifier in RNR itself is not a crucial factor for supporting the movement parse; sentences as in (57) support the movement parse just for the same reason as the following sentences do, namely the presence of a cumulative relation. Note that (60a) involves a non-relational adjective *intelligent* instead of *different*, and (60b) does not involve any adjective, but both of them can yield a cumulation.

(60) a. Bob dates and Sally married, **two quite intelligent people**.
b. Bob dates and Sally married, **these two people**.

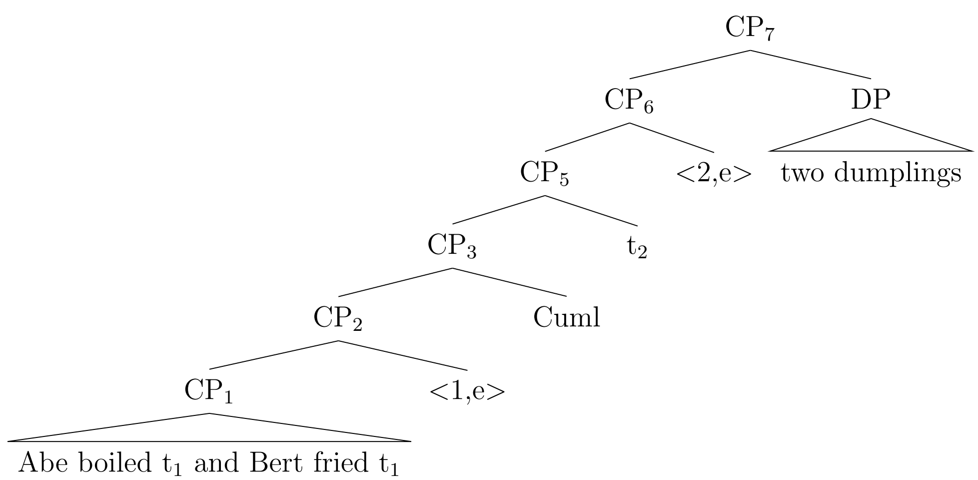
6.4 RNR with an indefinite DP

This section demonstrates that the proposed analysis of cumulativity can also explain how cumulativity is derived in RNR with an indefinite DP in the shared item position. We observed such an RNR in (9a), but here we examine the following RNR for sake of exposition.

(61) Abe boiled and Bert fried, **two dumplings**.

Sentence (61) raises a question about how to analyze the meaning of *two dumplings* so that it can yield a cumulation with *Abe boiled and Bert fried*. This section provides two possible analyses. The first analysis treats *two dumplings* as a generalized quantifier expression, and assumes that the sentence has the LF structure in (62).

(62)



In (62), *two dumplings* first ATB moved to the sister position of CP_3 overtly, and then covertly moved to the right periphery. On the assumption that the movement of a quantified expressions

[31]As mentioned in Section 1, the previous RNR literature assumes following Carlson (1987) and Moltmann (1992) that sentence internal readings are available only if an expression with a relation modifier can outscope a plural. However, Beck (2000) proposes an analysis of sentence internal readings which does not rely on the scope relation between *different* and a plural. She also shows that sentence internal readings are available when the *different* NP is embedded in a relative clause, and take scope under other plurals (1) ((1) is originally due to Dowty (1985)).

(1) Those two gorillas saw women who fed **different men**. (Beck 2000, 127)

introduces a trace of type e, CP_2 denotes a set of properties {Abe-boiled', Bert-fried'}. This set composes with the set {g(2)} denoted by t_2 via Cuml. Then, the value of g(2) is abstracted over by the revised PPA, and as a result, CP_6 denotes (63a).[32] *Two dumplings* is a generalized quantifier, and it can be assumed to denote (63b); *#(X)* means that X is a doubleton set. Finally, DP applies to CP_6, deriving a cumulative reading of (61). See (63c).

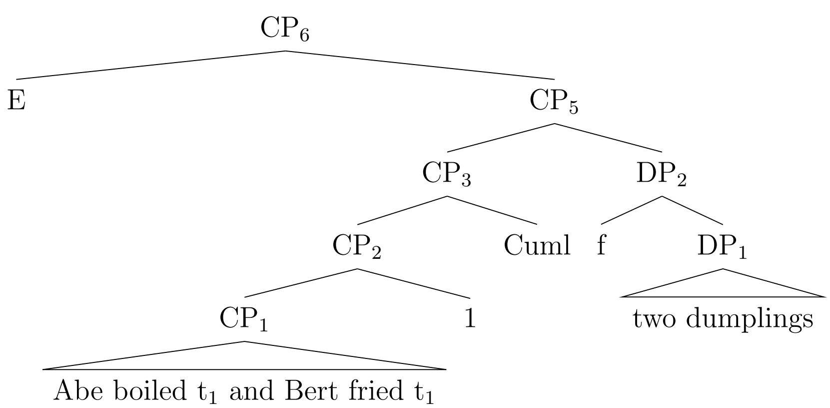
(63) a. $[\![CP_6]\!] = \{\lambda X_{\{e\}}.\lambda w_s.\forall f{\in}\{\text{Abe-boiled'},\text{Bert-fried'}\}\ \exists x{\in}X\ f(x)(w)=1\ \&$
$\forall x{\in}X\ \exists f{\in}\{\text{Abe-boiled'},\text{Bert-fried'}\}\ f(x)(w)=1\}$

b. $[\![DP]\!] = \{\lambda P_{\{e\}st}.\lambda w_s.\exists X_{\{e\}}[\exists x{\in}X\ [\text{dumplings'}(x)]\ \&\#(X)=2\ \&\ P(X)(w)=1]\}$

c. $[\![CP_7]\!] = \{\lambda w_s.\exists X_{\{e\}}[\exists x{\in}X\ [\text{dumplings'}(x)]\ \&\#(X)=2\ \&$
$\lambda w_s.\forall f{\in}\{\text{Abe-boiled'},\text{Bert-fried'}\}\ \exists x{\in}X\ f(x)(w)=1\ \&$
$\forall x{\in}X\ \exists f{\in}\{\text{Abe-boiled'},\text{Bert-fried'}\}\ f(x)(w)=1]\}$

Another way of deriving a cumulative reading of (61) is to make use of choice functions for the analysis of indefinite DPs. I illustrate this approach by providing an informal analysis of choice functions proposed by Reinhart (1997) and Winter (1997). First, under this approach, *two dumplings* is considered *not* to have quantificational force on its own. Instead, on the assumption that numeral expressions are semantically adjective-like (e.g., Landman 2003), *two dumplings* itself is analyzed to denote a set of sets of two dumplings. For instance, suppose that there are only three contextually salient dumplings A, B, and C. Then, *two dumplings* denotes the set {{A,B}, {A,C}, {B,C}}. Essentially, this plural set becomes an argument of a choice function variable f, as shown in (64) for (61).

(64)



The primary function of f is to pick out a member from a (non-empty) set denoted by its sister expression. So in the case of (64), it may pick out {A,B} from {{A,B}, {A,C}, {B,C}} as the meaning of DP_2. Notice that this set (or any other member of the set denoted by DP_1) can yield a cumulation with the plural set denoted by CP_2. Finally, at the end of the derivation, f is existentially closed by an operator represented as E in (64). As a result, the sentence approximately means: there is a choice function such that it picks out a set from {{A,B}, {A,C}, {B,C}}, and the chosen set cumulatively composes with {Abe-boiled', Bert-fried'}.[33]

To sum up, this paper's analysis of cumulativity can explain how cumulativity can be derived in RNR with an indefinite DP as well.

[32] It is assumed here that the revised PPA can abstract over the value of g(2) with a variable $X_{\{e\}}$ which represents a *set* of individuals rather than x_e.

[33] When the function f is defined to allow the composition of f and {{A,B}, {A,C}, {B,C}} to derive {A,B}, an analysis of singular indefinites raises a question. For example, *one dumpling* can be assumed to denote a set of dumplings such as {A, B, C}. Then, if f picks out a member from the set as assumed in the text, it

6.5 RNR without a coordination

This paper so far discussed RNR as in (65a) which involves a conjunction. But the literature of RNR also discusses their counterparts without a conjunction as in (65b). To distinguish these two sentences descriptively, I call them the *conjunctive structure* and *adjunctive structure*.

(65) a. [Abe bought t_1] **and** [Bert borrowed t_1], different books. **Conjunctive structure**
b. [Abe bought t_1] **after** [Bert borrowed t_1], different books. **Adjunctive structure**

Overfelt (2016) observes that unlike conjunctive structures, adjunctive structures do not allow sentence internal readings of a relational modifier; sentence (65a) can mean that the book(s) that Abe bought and the one(s) Bert borrowed are different from each other. In contrast, sentence (65b) does not have that interpretation, and it means that books Abe bought and Bert borrowed are different from someone else's book. This section shows that the difference between conjunctive and adjunctive structures are expected under this paper's analysis of cumulativity, and consistent with Postal's (1994) claim about adjunctive structures; that is, they have the movement parse just like conjunctive structures.

Postal (1994) observes many similarities between conjunctive and adjunctive structures, and conclude that both of them involve the movement parse. However, Overfelt (2016) disagrees with Postal (1994). He claims that while adjunctive structures can be derived in the same way as conjunctive structures, they can also be derived in a different way.[34] His support for this claim comes from three differences between conjunctive and adjunctive structures, and one of them is the availability of sentence internal readings of a relational modifier.

However, at least his support based on the availability of sentence internal readings is not tenable given this paper's analysis of cumulativity. This is because the analysis of cumulativity can correctly predict the lack of sentence internal readings for adjunctive structure under the movement parse. Specifically, the analysis correctly predicts that adjunctive structures do not yield a cumulation. For instance, *Abe bought after Bert borrowed* in (65b) does not involve union operator *and* and thus does not denote a plural set. The fact that adjunctive structures cannot yield a cumulation can be empirically supported by the following example as well.

(66) a. [Abe boiled t_1] **and** [Bert fried t_1], these 50 dumplings. **Conjunctive structure**
b. [Abe boiled t_1] **after** [Bert fried t_1], these 50 dumplings. **Adjunctive structure**

Unlike the conjunctive structure in (66a), the adjunctive structure in (66b) cannot denote a cumulative reading.

Remember Beck's observation/analysis that sentence internal readings of *different* is available only when the sentence can yield a cumulation. In light of this analysis, this paper's analysis of cumulativity can explain that the adjunctive structure in (65b) lacks a sentence

picks out an atomic dumpling such as A instead of {A}. So the question concerns how an atomic element can be mapped to its singleton set counterpart so that it can undergo compositions in a Hamblin semantics. One possible solution is to assume a operator which enables it (e.g., Schmitt 2019). Another possible solution is to assume A = {A} following Schwarzschild (1996), who adopts Quine's (1937) version of set theory.

[34] Following Engdahl (1983) and Nissenbaum (2000), Overfelt (2016) suggests that whatever mechanism derives parasitic gap constructions as in (1) can in principle derive adjunctive structures.

(1) This is the book that Abe bought e_1 after Bert borrowed pg_1.

internal reading because it cannot yield a cumulation. Therefore, the presence/absence of sentence internal readings in conjunctive and adjunctive structures is consistent with Postal's (1994) claim that adjunctive structure are categorically derived via a single mechanism, namely a rightward ATB movement of the shared item.

7 Conclusion

This paper investigated cumulative readings of RNR, as a diagnosis of the syntactic parse of RNR. The paper addressed three parses of RNR, and demonstrated that only the movement parse can derive cumulativity in RNR. While the previous literature shows the movement parse can potentially derive cumulativity in RNR, this paper proposed a new analysis of cumulativity following Schmitt (2019). Crucially, the proposed analysis enabled the movement parse to derive cumulativity in a wider range of RNR than the previous analysis.

The paper also revised the previous literature's view of how the availability of sentence internal readings of RNR supports the movement parse. Following Beck's (2000) analysis of sentence internal readings, I argued that the availability of the reading supports the movement parse because the reading requires a sentence to derive a cumulation and only the movement parse can derive a cumulation.

The above observations about cumulative readings in RNR suggest that the movement parse must be a possible parse of RNR. However, it remains to be seen whether the other parses are still needed to explain why RNR appears not to be subject to certain movement constraints (e.g., McCloskey 1986, Bachrach and Katzir 2009). In fact, the preliminary study suggests that some parse of RNR other than the movement parse seems to be available for RNR that violates the movement constraints in question. The claim can be supported by observations that cumulative readings are not available in such an RNR. For example, one of the movement constraints that RNR does not seem to be subject to is a *right roof constraint* (Ross 1967). The constraint requires rightward movements such as heavy NP shift to be clause-bound, as exemplified in (67a-b).

(67) a. Sam saw $\mathbf{t}_1$ yesterday, **[the new headmaster]**$_1$.
b. *John claimed [that Sam loves $\mathbf{t}_1$] yesterday, **[the new headmaster]**$_1$.
(Bachrach and Katzir 2009, 3-4)

In contrast to (67b), the RNR in (68), which also violates the right roof constraint under the movement parse, is grammatical.

(68) [John claims [that Sam loves $\mathbf{t}_1$]] and [Mary claims [that Sam hates $\mathbf{t}_1$]], **[the new headmaster]**$_1$
(Bachrach and Katzir 2009, 4)

One possible interpretation of the grammaticality of (68) is that the rightward movement in RNR under the movement parse is not subject to the right roof constraint. However, it is important to note that RNR as in (68) cannot derive cumulative readings, as shown in (69b).

(69) a. [Abe boiled $\mathbf{t}_1$] and [Bert fried $\mathbf{t}_1$], **[these 50 dumplings]**$_1$
b. [I think [that Abe boiled $\mathbf{t}_1$]] and Carol thinks [that Bert fried $\mathbf{t}_1$], **[these 50 dumplings]**$_1$.

RNR as in (69b) is at least hard to derive cumulativity unlike RNR as in (69a).[35] The difficulty of the cumulative reading in (69b) is unexpected if the rightward movement is not subject to the right roof constraint. So the example in (69) seems to suggest that while RNR as in (69a) can have the movement parse and must have it when receiving a cumulative reading, RNR as in (69b) has a different parse, and thus, cannot show cumulativity.[36] In other words, it is possible that the rightward movement in RNR is indeed subject to right roof constraint, and there are multiple parses of RNR. However, further study is required to see how the movement constraints that RNR does not seem to respect interact with the availability of cumulative readings in more general, and to conclude whether other parses of RNR must be available.

A RNR with a disjunction

Based on this paper's analysis of plurals, this paper presents an analysis of disjunctions. Importantly, this section demonstrates that the combination of this paper's analyses of plurals and disjunctions can provide an additional support for the movement parse based on RNR with a disjunction as in (70).

(70) a. Abe will boil **or** Bert will fry, (each of) these 50 dumplings.
b. My brother bought **or** my sister rented, (each of) these power tools.
c. Abe will recycle **or** Bert will discard, (each of) these plastic bottles.

The sentences in (70) have two readings, as exemplified in (71) for (70a).

(71) a. For each of these 50 dumplings, Abe will boil it or Bert will fry it. $\sqcap{>}\sqcup$
b. Abe will boil these 50 dumplings or Bert will fry these 50 dumplings. $\sqcup{>}\sqcap$

To look ahead this paper's analysis of disjunction, I call the readings exemplified in (71a-b) the $\sqcap{>}\sqcup$ *reading* and $\sqcup{>}\sqcap$ *reading*, respectively.

Essentially, the ellipsis and Grosz's (2015) multi-dominance parse can derive only the $\sqcup{>}\sqcap$ reading because the shared item is interpreted in each conjunct separately in those parses. However, this section demonstrates that the movement parse can derive both readings, and concludes that RNR with a disjunction as in (70) also supports the movement parse. To this end, this section first presents an analysis of disjunctions (Section A.1). Then, I explain how the movement parse can derive two readings of RNR with a disjunction.

A.1 Disjunction

This subsection introduces this paper's analysis of disjunctions, and shows how non-RNR sentences with a plural and disjunction can be analyzed.

[35] The difficulty of cumulative readings of RNR as in (69b) can be confirmed by the difficulty of sentence internal readings of such an RNR (1); remember that sentence internal readings of *different* are available only if the sentence can derive cumulativity (see Section 6.3).

(1) [I think [that Abe boiled $\mathbf{t}_1$]] and Carol thinks [that Bert fried $\mathbf{t}_1$], **[different dumplings]**$_1$.

[36] See Abels (2004), Sabbagh (2007) and Hirsch and Wagner (2015) for related observations about the availability of cumulative readings and the presence of an island in RNR.

This paper assumes that the English *or* itself functions as a union operator as English *and* does. In other words, this paper assumes for example that *Abe or Bert* denotes {Abe, Bert} as *Abe and Bert* does. This analysis raises a question as to how the difference in meaning between sentences with conjunctions and disjunctions arises. As an answer to this question, this paper proposes that while sentences with a plural always involve $\sqcap$ or Cuml that c-commands the plural, sentences with disjunctions involve a different operator that c-commands *or*. I call the operator $\sqcup$ and defines it as in (72). It should be emphasized that $\sqcup$ in this section differs from $\sqcup$ used for the non-Boolean *and*. I still use $\sqcup$ here despite the potential confusion because $\sqcup$ in (72) can be taken to be an operator that corresponds to $\sqcap$.

(72) $\sqcup$ **operator**
$[\![\sqcup]\!] = \lambda \mathrm{p}_{\{st\}}.\{\lambda \mathrm{w}_s.\exists \mathrm{q}_{st}\in \mathrm{p}\ \mathrm{q(w)} = 1\}$

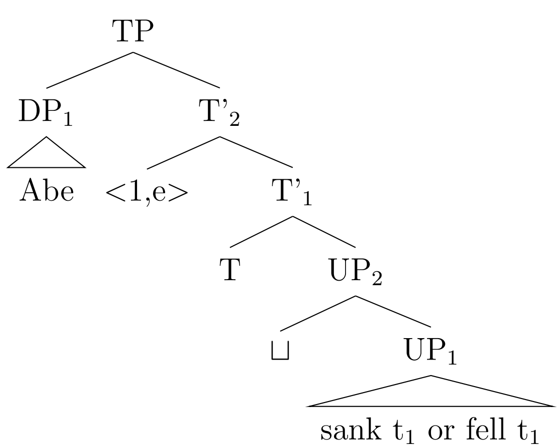
$\sqcup$ takes a set of propositions, and returns a singleton set of a proposition which states that one of the propositions in the input set is true in an evaluation world. In what follows, I explain how $\sqcup$ is used in sentences with disjunctions, and how $\sqcup$ co-occurs with $\sqcap$ in sentences with both a plural and disjunction.

Consider first the sentence with a predicate disjunction (73).

(73) Abe sank **or** fell.

When Section 5.2 explained how $\sqcap$ functions in sentences, footnote 17 and 19 mentioned that there are more than one position for $\sqcap$ to appear in sentences. The same is true of $\sqcup$. In (73), one possibility is that $\sqcup$ attaches to TP. But it can also attach to the disjunction of VPs, as shown in (74) (*UP* refers to a projection headed by a disjunction.)

(74)



In (74), UP_1 denotes a set of propositions {g(1) sank, g(1) fell}. Then, $\sqcup$ takes UP_1, returning the denotation of UP_2: $\{\lambda \mathrm{w}_s.\exists \mathrm{p}_{st}\in$ {g(1) sank, g(1) fell} p(w)=1}. $\mathrm{T'}_1$ inherits the value of UP_2, and the revised PPA applies to $\mathrm{T'}_1$. As a result, $\mathrm{T'}_2$ denotes $\{\lambda \mathrm{x}_e.\lambda \mathrm{w}_s.\exists \mathrm{p}_{st}\in$ {x sank, x fell} p(w)=1}. Finally, the set composes with {Abe} by PFA, deriving the denotation of sentence (73): $\{\lambda \mathrm{w}_s.\exists \mathrm{p}_{st}\in$ {Abe sank, Abe fell} p(w)=1}. In this way, the meaning of sentences with a disjunction can be derived by making use of a union operator and $\sqcup$.

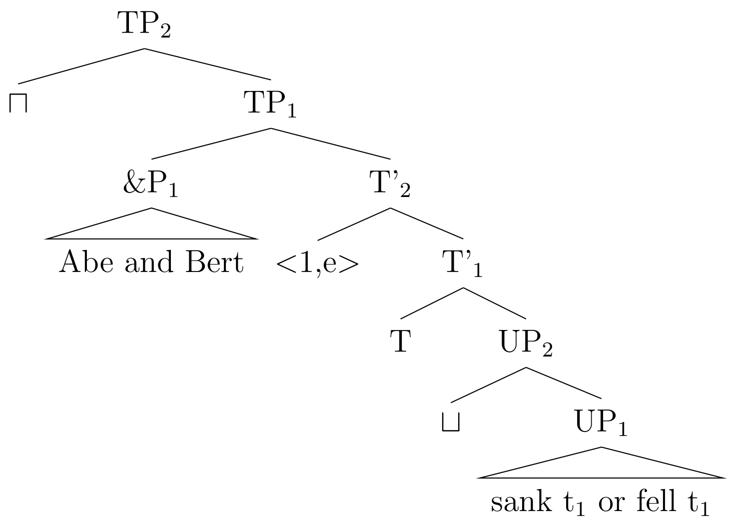
Next, we turn to a sentence with both a conjunction and disjunction. Consider (75b) as an example in comparison with the RNR with a disjunction in (75a). Notice that the non-RNR sentence in (75b) resembles the RNR in (75a) in two respects: (i) both sentences involves propositional coordination and a plural that has moved from the coordination, and (ii) sentence (75b) has the two interpretations in (75c-d) as sentence (75a) does (see (71a-b)).

(75) a. [Abe will boil t_1 **or** Bert will fry t_1] [these 50 dumplings]$_1$.
b. [Abe **and** Bert]$_1$ [sank t_1 **or** fell t_1].
c. Each of Abe and Bert sank or fell. $\sqcap > \sqcup$
d. Sinking or falling is an incident that happened to both Abe and Bert. $\sqcup > \sqcap$

I call the readings in (75c-d) $\sqcap > \sqcup$ and $\sqcup > \sqcap$ readings as I call so the readings in (71a-b). As the names of these readings suggest, which readings are derived depends on which operator (i.e., $\sqcap$ or $\sqcup$) outscopes the other at LF. Since the compositional analysis of the readings in (75c-d) can apply to the analysis of the two readings of (75a), the rest of this subsection describes how two readings are derived in a simpler non-RNR sentence in (75b).

First, when sentence (75b) receives the reading in (75c), the sentence is assumed to have the structure in (76), where $\sqcap$ outscopes $\sqcup$.

(76)



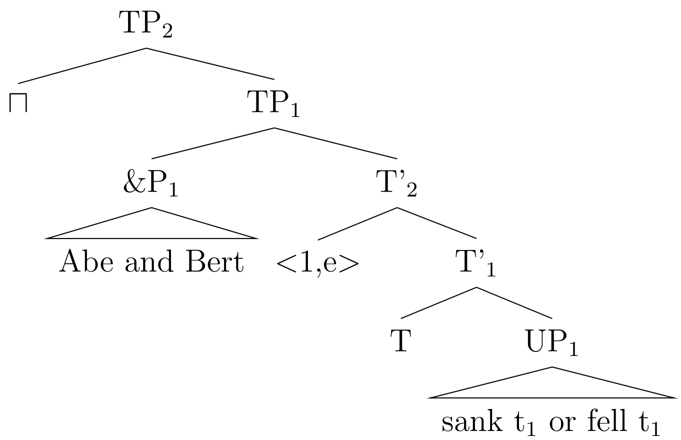
We know from the derivation of (74) that T'$_2$ in (76) denotes $\{\lambda x_e \lambda w_s.\exists p_{st} \in \{\text{x sank, x fell}\}\ p(w)=1\}$. We also know that *Abe and Bert* denotes {Abe, Bert}. When those two sets compose together by PFA, TP_1 derives a set of propositions:

(77) $\{\lambda w_s.\exists p_{st} \in \{\text{Abe sank, Abe fell}\}\ p(w)=1,\ \lambda w_s.\exists p_{st} \in \{\text{Bert sank, Bert fell}\}\ p(w)=1\}$.

Finally, $\sqcap$ takes the set in (77), and returns a singleton set of a proposition. The proposition states that the two propositions in the set in (77) are both true in an evaluation world. In other words, in an evaluation world, it is true that Abe sank or Abe fell, and it is true that Bert sank or Bert fell. In this way, the structure in (76) can derive the $\sqcap > \sqcup$ reading in (75c).

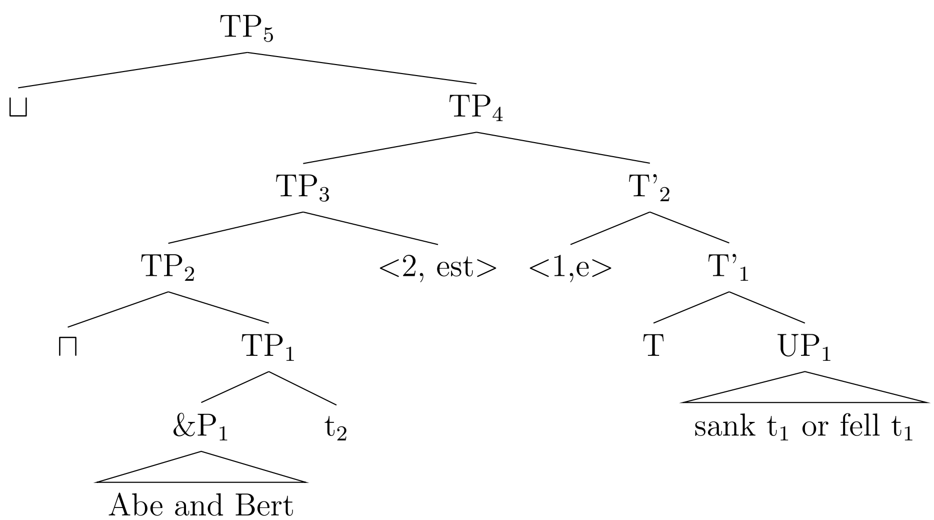
On the other hand, when $\sqcup$ outscopes $\sqcap$ in (75b), the sentence derives the reading in (75d). One of the ways of achieving such an inverse scope is that *sank or fell* in (75b) undergoes a rightward movement. In this analysis, sentence (75b) first has the structure in (78).

(78)



Afterwards, T'_2 in (78) moves to the right periphery, and $\sqcup$ attaches to the top node (79).

(79)



In (79), T'_2 denotes a set of properties (80a). Since the moved phrase is of type <e,st>, I assume that t_2 is a higher type trace; it denotes {g(2)} where *g* gets *2* mapped to a property. The set {g(2)} composes with {Abe, Bert}, and TP_1 denotes the set in (80b). Then, $\sqcap$ takes the set, returning the singleton set in (80c). The revised PPA applies to TP_2 and TP_3 derives (80d). This set composes with {sank', fell'} denoted by T'_2, and TP_4 derives (80e).

(80)
a. $[\![T'_2]\!]$ = {sank', fell'}
b. $[\![TP_1]\!]$ = {g(2)(Abe), g(2)(Bert)}
c. $[\![TP_2]\!]$ = $\{\lambda w_s.\forall p\in\{g(2)(Abe), g(2)(Bert)\}\ p(w) = 1\}$
d. $[\![TP_3]\!]$ = $\{\lambda f_{est}.\lambda w_s.\forall p\in\{f(Abe), f(Bert)\}\ p(w) = 1\}$
e. $[\![TP_4]\!]$ = $\{\lambda w_s.\forall p\in\{\text{Abe sank, Bert sank}\}\ p(w) = 1, \lambda w_s.\forall p\in\{\text{Abe fell, Bert fell}\}\ (w) = 1\}$

Finally, $\sqcup$ takes the set in (80e), and returns a set of a proposition, which states that one of the propositions in the set in (80e) is true in an evaluation world. In other words, it is true in an evaluation world that both Abe and Bert sank or that both Abe and Bert fell. In this way, this paper's analysis of plurals and disjunctions can predict the $\sqcup>\sqcap$ reading in (75d) as well.[37]

To sum up, this section explained how disjunctions are analyzed in light of this paper's analysis of plurals. Crucially, the proposed analyses of plurals and conjunctions can correctly predict the availability of $\sqcap>\sqcup$ and $\sqcup>\sqcap$ readings of the non-RNR sentence in (75b). The next subsection demonstrates that the analyses can derive those two readings in RNR as well.

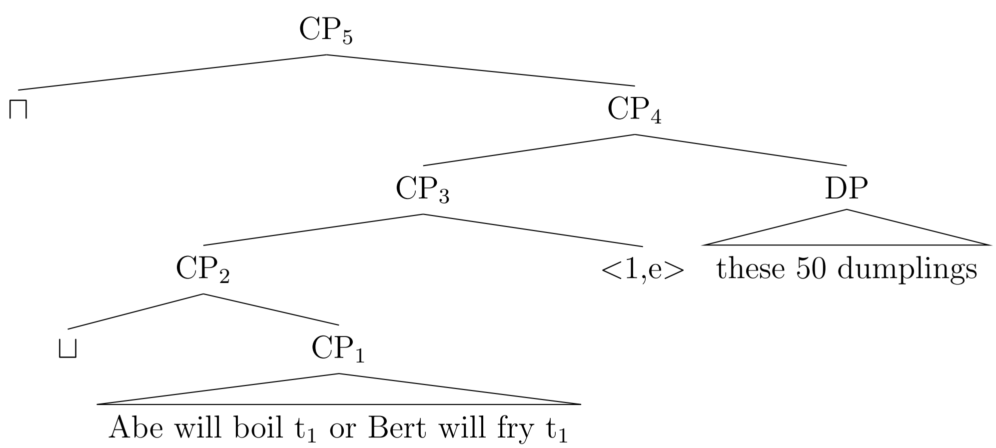
A.2 RNR with a disjunction under the movement parse

This subsection demonstrates that the movement parse can derive both the $\sqcap>\sqcup$ and $\sqcup>\sqcap$ readings of RNR with a disjunction by examining sentence (81a) and its readings in (81b-c).

(81) a. Abe will boil or Bert will fry, these 50 dumplings.
b. For each of these 50 dumplings, Abe will boil it or Bert will fry it. $\sqcap>\sqcup$
c. Abe will boil these 50 dumplings or Bert will fry these two dumplings. $\sqcup>\sqcap$

We start with the derivation of the $\sqcap>\sqcup$ reading, which neither ellipsis nor Grosz's multi-dominance parse seems to derive. First, when the sentence has the $\sqcap>\sqcup$ reading, it is assumed to have the following structure, where $\sqcap$ outscopes $\sqcup$.

(82)



In (82), CP_1 denotes (83a), and CP_2 existentially closes the set denoted by CP_1 (83b). Then, the revised PPA applies to the set denoted by CP_2, and CP_3 denotes (83c). The set in (83c) composes with a set of 50 dumplings by PFA, and CP_4 denotes a set of 50 propositions (83d).

(83) a. $[\![CP_1]\!] = \{\text{Abe will boil g(1), Bert will fry g(1)}\}$
b. $[\![CP_2]\!] = \{\lambda w_s.\exists p\in\{\text{Abe will boil g(1), Bert will fry g(1)}\}\ p(w)=1\}$
c. $[\![CP_3]\!] = \{\lambda x_e \lambda w_s.\exists p\in\{\text{Abe will boil x, Bert will fry x}\}\ p(w)=1\}$

[37] The $\sqcup>\sqcap$ reading in (75d) is an inverse scope reading, and this paper's analyses of plurals and disjunctions correctly predicts its availability. On the other hand, the inverse scope reading seems to be harder to obtain when $\sqcup$ outscopes $\sqcap$ superficially, as in (1) (see Hirsch et al. (2017) for a related observation).

(1) Abe **or** Bert sank **and** fell.

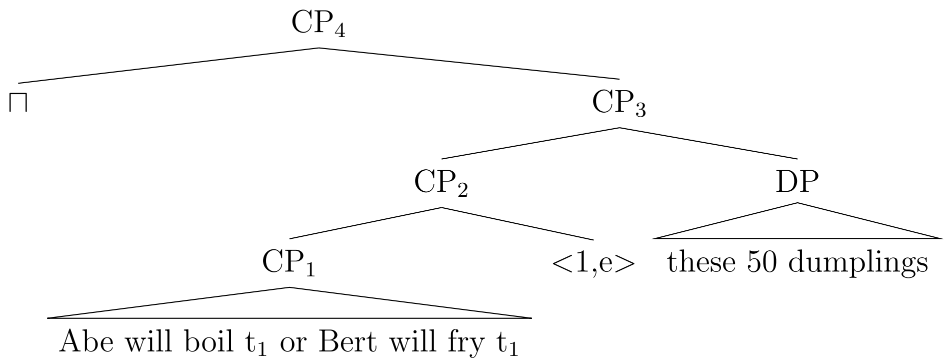
This paper's analysis predicts that sentence (1) allows an inverse scope reading (i.e., For each of the incidents, sinking and falling, it happened to Abe or Bert). Thus, sentences as in (1) potentially raise an overgeneration problem. However, there are individual and item variabilities for the acceptability of inverse scope readings of sentences as in (1). So I put those sentences aside in this paper.

d. $[\![\text{CP}_4]\!] = \{\lambda w_s.\exists p\in\{\text{Abe will boil D}_1\text{, Bert will fry D}_1\}\ p(w)=1,$
$\lambda w_s.\exists p\in\{\text{Abe will boil D}_2\text{, Bert will fry D}_2\}\ p(w)=1,$
...
$\lambda w_s.\exists p\in\{\text{Abe will boil D}_{50}\text{, Bert will fry D}_{50}\}\ p(w)=1\ \}$

Finally, $\sqcap$ applies to CP_4, and returns a singleton set of a proposition; the proposition asserts that all the 50 propositions in the set denoted by CP_4 are true. In this way, the structure in (82) can derive the $\sqcap>\sqcup$ reading.

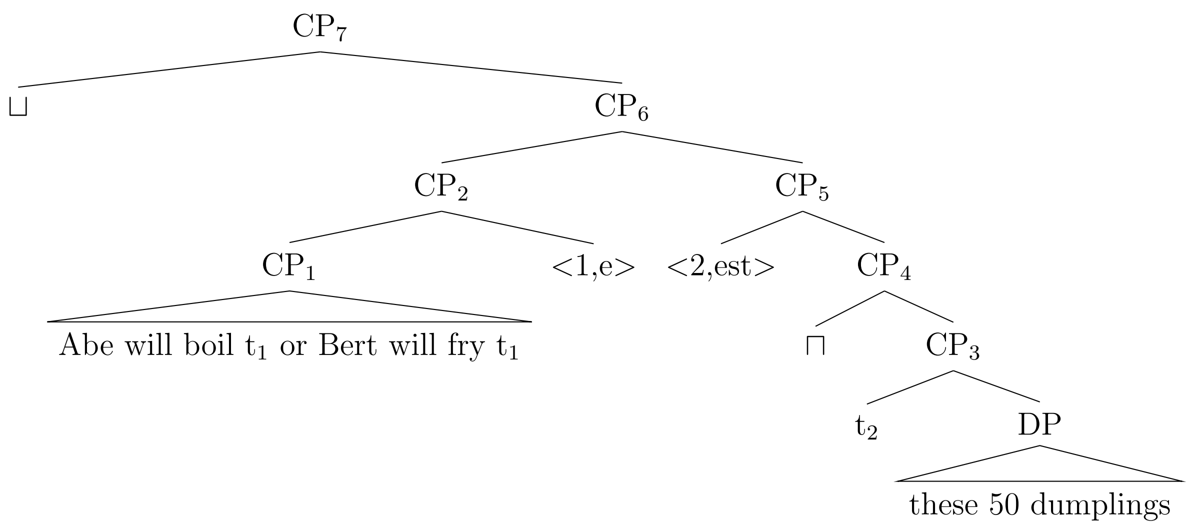
Next, we turn to the $\sqcup>\sqcap$ reading of (81a), which seems to be the reading that the ellipsis and multi-dominance analysis can also derive. It is assumed that when the sentence receives the reading, it has the structure in (84) at some point of derivation.

(84)



It is then assumed that CP_2 in (84) moves to the left periphery and $\sqcup$ attaches to the top node (85). As a result, $\sqcup$ outscopes $\sqcap$.

(85)



In (85), t_2 can be assumed to be a higher type trace; it denotes {g(2)} where *g* gets *2* mapped to a property. This set composes with a set of 50 dumplings by PFA, deriving a set of 50 propositions in (86a). Then, $\sqcap$ applies to CP_3, and CP_4 derives a singleton set of a proposition (86b). After the revised PPA applies to CP_4, CP_5 denotes (86c). Afterward, CP_5 composes with CP_2 which denotes the set of properties in (86d), and CP_6 denotes a doubleton set of propositions (86e).

(86) a. $[\![\text{CP}_3]\!] = \{g(2)(D_1), ..., g(2)(D_{50})\}$

b. $[\![\mathrm{CP}_4]\!] = \{\lambda w_s.\forall p \in \{g(2)(D_1), ..., g(2)(D_{50})\}\ p(w)=1\}$
c. $[\![\mathrm{CP}_5]\!] = \{\lambda f_{est}.\lambda w_s.\forall p \in \{f(D_1), ..., f(D_{50})\}\ p(w)=1\}$
d. $[\![\mathrm{CP}_2]\!] = \{$Abe-will-boil', Bert-will-fry'$\}$
e. $[\![\mathrm{CP}_6]\!] = \{\lambda w_s.\forall p \in \{\text{Abe-will-boil'}(D_1), ..., \text{Abe-will-boil'}(D_{50})\}\ p(w)=1,$
$\lambda w_s.\forall p \in \{\text{Bert-will-fry'}(D_1), ..., \text{Bert-will-fry'}(D_{50})\}\ p(w)=1\}$

Finally, $\sqcup$ applies to CP_6, and returns a singleton set of a proposition; the proposition asserts that at least one of the propositions in the set denoted by CP_6 is true. In this way, the structure in (85) can derive the $\sqcup>\sqcap$ reading.

To sum up, this section demonstrated that the movement parse can derive both the $\sqcap>\sqcup$ and $\sqcup>\sqcap$ readings of RNR with a disjunction under this paper's analyses of plurals and disjunctions. Importantly, the ellipsis and Grosz's multi-dominance parses seem to derive only the $\sqcup>\sqcap$ reading. Therefore, the availability of $\sqcap>\sqcup$ readings in RNR and the fact that the movement parse can derive them also suggest that the movement parse must be a possible parse.

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Word count: 15984 words