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# **Distribution of Distributivity in Syntax and Discourse**

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# Abstract

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In this thesis, I will explore the semantics of overt distributors and investigate how it interfaces with syntax and discourse. The main claims are as follows.

(1) a. **Syntax-semantics interface:**

Denotations of quantifiers over individuals are type-ambiguous with respect to their restrictor NP, while denotations of quantifiers over situations are constant across different syntactic positions.

b. **Semantics-discourse interface:**

Overt distributors are classified into two types: one partitions variable assignments and the other partitions situations.

As a case study, I discuss two overt distributors in Japanese, “sorezore” and “zutsu.” As for the first thesis, I will propose that quantifiers over individuals in Japanese has several type-variants which differ in (i) whether its restrictor NP occurs local to it or nonlocal to it, and (ii) whether its restrictor NP is predicative or argumental. Furthermore, I claim that idiosyncratic properties of quantifiers over individuals are also related with this variation with respect to the restrictor update. On the other hand, quantifiers over situations do not need a set of individuals for its restrictor and do not take a restrictor NP. Accordingly, they are not type-ambiguous and have the same denotation at the prenominal position and the floating position. Their interpretive difference comes from an independent difference between nominal predicates and verbal predicatess with respect to applicability of type-shifting principles and insertability of *situation pronouns*.

As for the second thesis, I claim that the semantic difference between “sorezore” and “zutsu” are best understood from the perspective of anaphoricity in dynamic semantics versus uniqueness requirement in situation semantics. “Sorezore” is anaphoric and partitions variable assignment, but “zutsu” involves uniqueness pre-supposition and partitions situations. Accordingly, this suggests that there are two types of overt distributors. The upshot is anaphoricity and uniqueness are two basic

strategies to pick up an individual from the context because they respectively rely on two types of information content stored in the context, namely the anaphoric content and the propositional content. Thus, the dichotomy in overt distributivity can be taken as a reflection of the bipartite structure of the discourse context.

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# Lay Summary

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The enterprise of formal semantics aims to uncover the logical inferential properties of expressions in natural languages. In this thesis, I explore the semantics of a class of expressions which I call *overt distributors*. An example of overt distributors in English is “each.” It induces an inference that a sentence “X each P.” entails that each member of X satisfies P. For example, “Ann and Belle each bought a house.” entails “Ann bought a house and Belle bought a house.” And vice versa. This kind of inference is called *distributivity inference* and this thesis explicates how this inference interacts with the grammatical properties and the discourse properties of natural language. I claim that both modes of interaction come with two different strategies. As for the interaction between meaning and grammar, I claim that an overt distributor can either induce a distributive inference based on a set of concrete individuals or based on a set of abstract situations. If an overt distributor requires a set of individuals, it requires a noun phrase which provides the relevant set of individuals. Accordingly, the grammatical behaviour of this type of overt distributors varies based on the grammatical properties of the noun phrase. On the other hand, if an overt distributor requires a set of situations, it does not need to be associated with a noun phrase. Thus, it does not show the grammatical variation which is observed with the other type of overt distributor. As for the interaction between meaning and discourse, I claim that an overt distributor can be context-dependent in two different ways. One is based on *anaphora*: an overt distributor looks for a set of referents which have already been mentioned in the discourse and induces a distributive inference with respect to it. The other is based on *uniqueness*: an overt distributor takes a set of situations each of which contains one and the only one entity that satisfies a certain property and induces a distributive inference with respect to it. These two types of context-dependency are also observed with the semantics of definite articles. Thus, this dichotomy of overt distributors can be regarded as a reflection of the structure of discourse, which also affects the semantics of definite articles.

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# Acknowledgements

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Although acknowledgement would be academically the least important part of a thesis, I love to read this section in someone's thesis because it often shows the life of the author which cannot be inferred from the academic content of the thesis. In this sense, I attempt to present this acknowledgement as a quite brief description of my life in Edinburgh and thank to those who appeared in this phase of my life. However, if I intend to express my gratitude for every single person in a detailed way, I would endlessly keep writing this section. Thus, I aim to keep it as simple as possible (to my eyes).

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# Chapter 1

## Introduction

---

Natural language has a class of expressions which force a *distributive reading* as exemplified in (1). I call this class of expressions *overt distributors*.

- (1) Ann and Belle **each** carried three suitcases.

In this thesis, I explore the semantics of overt distributors and investigate its interfaces with syntax and discourse. My main claim is two-fold.

- (2) a. **Syntax-semantics interface:**  
Denotations of quantifiers over individuals are type-ambiguous with respect to their restrictor NP, while denotations of quantifiers over situations are constant across different syntactic positions.
- b. **Semantics-discourse interface:**  
Overt distributors are classified into two types: one partitions variable assignments and the other partitions situations.

As a case study, I discuss two types of overt distributors in Japanese, i.e. “sorezore” and “zutsu.” I show that “sorezore” have various type-variants which differ in the way how their restrictor set is provided. Each variant of “sorezore” shows a different behaviour and this type-ambiguity is also found with other universal quantifiers over individuals in Japanese. I claim that this is tied with category-type mapping of Japanese common nouns. On the other hand, I claim that “zutsu” has the same denotation at the nominal domain and the verbal domain, i.e. the denotation of “zutsu” is not type-ambiguous, unlike “sorezore.” “Zutsu” induces different readings at different positions, but its behaviour suggests that “zutsu” is associated with situations and this interpretive difference comes from an independent difference between nominal predicates and verbal predicates.

Furthermore, I show that the interpretive differences between “sorezore” and “zutsu” are best understood from the perspective of anaphoricity in dynamic semantics with plurality of variable assignments versus uniqueness requirement in the possibilistic version of situation semantics. The upshot is that anaphoricity and uniqueness are the two basic strategies to pick up an individual from the context because these respectively rely on two different components of the context, namely the anaphoric content and the propositional content.

In this introductory chapter, I lay out the empirical background for the main discussion in this thesis and raise the main research questions I aim to answer. §1.1 is a brief introduction to the issue of distributivity and §1.2 is a brief introduction to Japanese grammar. In §1.3, I introduce the main empirical landscape and two research questions, namely *the distributional question* and *the key resolution question*. The two main claims in (2) respectively answer these two research questions. §1.4 concludes this chapter with an overview of the entire thesis.

## 1.1 Distributivity

In this section, I briefly review the development of theories of distributivity. Distributivity is a property of a predicate such that the same predicate also applies to sub-parts of an entity its argument denotes. For example, the leftside and the rightside of (3a) entail each other. I call this kind of mutual entailment *distributivity inference*. The predicates with an obligatory distributivity inference are called *distributive predicates*. On the other hand, the distributivity inference does not hold in (3b) and the rightside is even unacceptable.<sup>1</sup> The predicates which do not support a distributivity inference are called *collective predicates*.

- (3) a. Aki and Yukiko sneezed.  $\Leftrightarrow$  Aki sneezed and Yukiko sneezed.  
 b. Aki and Yukiko met.  $\Leftrightarrow$  \*Aki met and Yukiko met.

---

1. Unacceptable sentences are sometimes filtered out in syntax, but also in semantics. I use the term “unacceptable” as a cover term for sentences that native speakers of a language do not consider well-formed, regardless of contexts. I use ‘\*’ to signify it. When a sentence is syntactically well-formed, I use the term “grammatical.” A grammatical sentence can still be unacceptable for various non-syntactic reasons. On the other hand, some sentences are considered unacceptable under certain contexts, but acceptable under the other contexts. For them I use the term “infelicitous” and use ‘#’ to signify it.

Some predicates optionally have a distributive inference. I call such predicates *mixed predicates*. Due to this optionality, the mutual entailment does not generally hold in such cases. However, one can confirm that (4) has two readings with different truth conditions and a distributivity inference is observed with one of them, i.e. (4a). I call (4a) a *distributive reading* and (4b) a *collective reading*.

- (4) Aki and Yukiko bought a house.
- a. Aki bought a house and Yukiko bought a house. (distributive)
  - b. Aki and Yukiko together bought a house. (collective)

This pattern is observed with plural DPs other than conjoined DPs. Suppose there are three individuals, Adrian, Belle and Chris. Then, the leftside of (5a) entails that Adrian sneezed, Belle sneezed and Chris sneezed, whereas the leftside of (5b) does not entail that Adrian met, Belle met and Chris met. For the sake of brevity, I use a paraphrase with “each,” instead of a conjunction of multiple sentences.

- (5) a. Three people sneezed.  $\Leftrightarrow$  Three people **each** sneezed.  
 b. Three people met.  $\Leftrightarrow$  \*Three people **each** met. (Champollion, 2017)

In a similar manner, ambiguity in mixed predicates is also observed with plural DPs other than conjoined DPs. Again, if there are three individuals, Adrian, Belle and Chris, (6) has a reading which entails that Adrian bought a video game, Belle bought a video game and Chris bought a video game as in (6a).

- (6) Three students bought a video game.
- a. Three people **each** bought a video game. (distributive)
  - b. Three people **together** bought a video game. (collective)

The previous literature generally distinguishes two sources of a distributive inference: *lexical distributivity* and *syntactic distributivity*. Lexical distributivity is directly encoded in the lexical semantics of each predicate, whereas syntactic distributivity is encoded in an operator independent of a predicate. Note that such an operator cannot be encoded in the coordinator “and” or numerals because it wrongly predicts that such plural DPs always have a distributivity inference and cannot explain the cases where a distributivity inference is optional, e.g., (4) and (6), or absent, e.g., (3b) and (5b). In this thesis, I focus on the issue of syntactic distributivity. From this perspective, the question is which operator an overt distributor utilises. In the rest of this section, I review several versions of the distributivity operator.

### 1.1.1 Non-event based theories of distributivity

A classical approach is found in Link (1983). He proposes a mereological analysis of plurals. First, he takes plural DPs as denoting individual-sums of type  $e^2$  and the domain of individuals  $D_e$  is closed under a sum-formation ‘+’ and ordered by a part-of relation ‘ $\subseteq$ ’. As a result,  $D_e$  forms a *partially ordered join-semilattice*. I model ‘+’ with a union-formation and ‘ $\subseteq$ ’ with a subset relation. Individuals are either *atomic* or non-atomic. An individual is atomic if nothing other than itself is part of it. Otherwise, it is non-atomic.

$$(7) \text{ Atom}(x) \Leftrightarrow \forall y[y \subseteq x \rightarrow y = x]$$

For example, the conjoined DP “Aki and Yukiko” denotes the sum of Aki and Yukiko (8a) and both Aki and Yukiko are part of it (8b).

- (8) a.  $[[\text{Aki and Yukiko}]] = \text{Aki} + \text{Yukiko} = \{\text{Aki}, \text{Yukiko}\}$   
 b.  $\text{Aki} \subseteq \text{Aki} + \text{Yukiko}$  and  $\text{Yukiko} \subseteq \text{Aki} + \text{Yukiko}$

Now, the distributivity inference comes from a null  $\text{DIST}$ -operator. It takes a predicate  $P$  and an individual  $x$ . Then, it quantifies over atomic individuals that are parts of  $x$  and requires that each atomic individual satisfies  $P$ . Collective readings arise when the  $\text{DIST}$ -operator is not inserted.<sup>3</sup> Although I revise it as discussion proceeds, the  $\text{DIST}$ -operator is often taken as a covert version of “each.” To distinguish it from other versions of the  $\text{DIST}$ -operator, I call it  $\text{DIST}_{Ind}$  to indicate that this operator applies to a non-atomic individual.

$$(9) \text{ DIST}_{Ind} = \lambda P \lambda x \forall y [[y \subseteq x \& \text{Atom}(y)] \rightarrow P(y)]$$

On this point, I introduce two terms for the ease of discussion, namely *sorting key* and *distributive share*. A sorting key is an entity each of whose atomic parts satisfies the predicate that is its distributive share. In (3a), “Aki and Yukiko” provides the sorting key and “sneezed” provides the distributive share. Now, one can say that (9) take a predicate  $P$  as its distributive share and an individual  $x$  as its sorting key.

2. However, see Schein (1993) for an argument against it. I do not discuss it in this thesis.

3. More specifically, one often adopts a group-forming operator (Landman, 2000) and creates a group-atom out of a non-atomic individual. For my purpose, it makes no difference whether one adopts it or not in my analysis.

There is another kind of readings for plural DPs, which are neither distributive nor collective. I call it *cumulative readings*.<sup>4</sup> Imagine there are three boys, Alex, Dave and Greg, and five girls Belle, Chloe, Elin, Faye and Hazel. In this context, (10b) is true under the situation (10a).

- (10) a. Scenario: Alex invited Belle and Chloe. Dave invited Elin and Faye.  
Greg invited Hazel.
- b. Three boys invited five girls. ⇒ true

This is not a distributive reading because it does not have a distributive inference: none of Adrian, Danny and Greg alone invited five girls. However, this is yet different from a collective reading because Adrian, Danny and Greg do not share collective responsibility (Landman, 1996) of inviting. An extension of  $\text{DIST}_{Ind}$ -operator to a relation can describe cumulative readings (Beck, 2000; Beck & Sauerland, 2000; Sauerland, 1998). I call it  $**$ -operator, following the previous literature.<sup>5</sup>

$$(11) \quad ** = \lambda R \lambda x \lambda y \forall x' [[x' \subseteq x \& \text{Atom}(x')] \rightarrow \exists y'' [y'' \subseteq y \& R(x')(y'')]] \& \forall y' [[y' \subseteq y \& \text{Atom}(y')] \rightarrow \exists x'' [x'' \subseteq x \& R(x'')(y')]]$$

It universally quantifies over both arguments of a relation R and makes sure that atomic parts of each argument are related with at least one part of the other.

### 1.1.2 Event-based theories of distributivity

The mereological approach to plurals have been extended to non-individual entities such as Davidsonian events (Bach, 1986; Krifka, 1989). This leads to crystallisation of event-based analyses of distributivity. Since Schein (1993) and Lasnik (1995), event-based theories of distributivity gained more popularity (Champollion, 2017; Kratzer, 2007a; Landman, 1996, 2000). In event-based analyses, cumulative readings and distributive readings involve event plurality, whereas collective readings involve event singularity. Further difference between distributive readings and cumulative readings are that the former requires the  $\text{DIST}$  operator, whereas

4. This term comes from Scha (1981) and this term should not be confused with *cumulative reference* (Krifka, 1989), which is a higher-order property of a predicate. There is another term, *double distributive readings*, but I do not adopt it to avoid an implication for a particular analysis.

5. Another non-event-based account of cumulative readings is *plural projection*, a general mechanism which maintains cross-categorical plurality as composition proceeds (V. Schmitt, 2013, 2019). As this thesis does not aim to choose the best possible approach to cumulative readings, I do not discuss this option.

the latter only needs event plurality. Event plurality is attributed to the *cumulativity universal*, which states that lexical predicates are inherently plural when they are picked out from the lexicon (Cable, 2014a; Kratzer, 2007a; Krifka, 1992; Landman, 1996, 2000). I use the notation \*P to express the cumulative version of P.<sup>6</sup>

- (12) a. **Cumulativity universal:** Every lexical predicate satisfies *n*-ary cumulativity.  
 b. ***n*-ary cumulativity:** For any entities  $x_1, \dots, x_n, y_1, \dots, y_n$ , if  $P(x_1) \dots (x_n) = 1$  and  $P(y_1) \dots (y_n) = 1$ , then  $*P(x_1 + y_1) \dots (x_n + y_n) = 1$ .

The event-based  $\text{DIST}_{\text{Event}}$ -operator is defined in (13). I call it  $\text{DIST}_{\text{Event}}$ .

$$(13) \quad \text{DIST}_{\text{Event}} = \lambda V \lambda e \forall e' [[e' \subseteq e \ \& \ \text{Atom}(e')] \rightarrow V(e')]$$

An advantage of an event-based analysis coupled with the cumulativity universal is that collective readings and cumulative readings can be expressed with a single logical representation. Let's see how these reading of (10b) are expressed.  $[[\text{invite}]]$  denotes a set of triplets each of whose elements is a member of a set closed under +. Thus, if two triplet,  $\langle e_1, x_1, y_1 \rangle$  and  $\langle e_2, x_2, y_2 \rangle$  are members of  $[[\text{invite}]]$ , so as  $\langle e_1 + e_2, x_1 + x_2, y_1 + y_2 \rangle$  is. Thus, a cumulative verbal denotation can express two different readings: (14a) corresponds to collective reading scenarios and (14b) corresponds to cumulative reading scenarios. Crucially, three boys and five girls are associated with each other via just a single event in (14a), whereas each of the three boys is associated with at least one event and each of the five girls is associated with at least one event in (14b).<sup>7</sup>

- (14)  $\exists e \exists x \exists y [* \text{boy}(x) \ \& \ |x| = 3 \ \& \ * \text{girl}(y) \ \& \ |y| = 5 \ \& \ * \text{invite}(e)(x)(y)]$   
 a.  $[[\text{invite}]] = \{ \langle e, \text{Alex} + \text{Dave} + \text{Greg}, \text{Belle} + \text{Chloe} + \text{Elin} + \text{Faye} + \text{Hazel} \rangle \}$   
 b.  $[[\text{invite}]] = \{ \langle e_1, \text{Alex}, \text{Belle} \rangle, \langle e_2, \text{Alex}, \text{Chloe} \rangle, \langle e_3, \text{Dave}, \text{Elin} \rangle, \langle e_4, \text{Dave}, \text{Faye} \rangle, \langle e_5, \text{Greg}, \text{Hazel} \rangle, \dots, \langle e_1 + e_2 + e_3 + e_4 + e_5, \text{Alex} + \text{Dave} + \text{Greg}, \text{Belle} + \text{Chloe} + \text{Elin} + \text{Faye} + \text{Hazel} \rangle \}$

6. Alternatively, one may say that \*P is the *algebraic closure* of P with respect to the sum-formation (Link, 1983).

7. Throughout the thesis, I will just specify the relevant subset of a whole cumulative set. I use “...” to express omission of some members of a set. For example, when sums of individuals or events do not matter, I just write  $\{x, y, z, \dots\}$ . However, it just means that only these individuals are relevant and does not mean that this set is non-cumulative.

Such event-based analyses of distributivity are often coupled with *Neo-Davidsonian* event semantics, where thematic relations are severed from verbs and verbs denote a unary event predicate. This move is motivated by a certain kind of cumulative readings which involve a distributive quantifier at a non-subject position.

- (15) a. Three video games taught **every** quarterback two new plays.  
(Schein, 1993)
- b. Three copy editors caught **every** mistake in the manuscript.  
(Kratzer, 1996)

The relevant reading of (15a) is that none of the quarterbacks played all the three video games, but every quarterback played at least one of them to acquire two new plays. In the same way, in (15b), none of the three copy editors caught every mistake, but if you sum up the mistakes each of them caught, it covers all the mistakes in the manuscript. The problem here is that the distributive universal quantifier “every” is distributive in both cases and yet the subject plural DP is not within its scope. For example, the value of “quarterback” co-varies with the value of “two new plays,” but the value of “three video games” does not in (15a). This requires some complication of a scope mechanism if a verb denotes relations whether or not it has an event argument. However, Neo-Davidsonian event semantics can derive this reading as rather a default reading without any additional scope mechanism. The Neo-Davidsonian logical translation of (15b) is given in (16).<sup>8</sup>

- (16)  $\exists e \exists x [\text{three copy editor}(x) \ \& \ \text{agent}(e) = x \ \& \ \forall y [\text{mistake}(y) \rightarrow \exists e' [e' \subseteq e \ \& \ \text{theme}(e') = y \ \& \ \text{caught}(e')]]]$

Suppose there are three copy editors, Adrian, Bridgit and Chris, and five mistakes. (16) is true if Adrian found one mistake, Bridgit found two mistakes and Chris found two mistakes. The denotations of “caught” and the thematic relations are in (17). These are all inherently plural due to the cumulativity universal.

- (17) a.  $[[\text{caught}]] = \{e_1, e_2, e_3, e_4, e_5, \dots\}$
- b.  $[[\text{theme}]] = \{\langle e_1, \text{mistake}_1 \rangle, \langle e_2, \text{mistake}_2 \rangle, \langle e_3, \text{mistake}_3 \rangle, \langle e_4, \text{mistake}_4 \rangle, \langle e_5, \text{mistake}_5 \rangle, \dots\}$

8. Kratzer (1996) herself proposes that the theme-relation is part of denotations of lexical verbs. In this sense, her approach is at an intermediate position between the original Davidsonian approach and the full Neo-Davidsonian approach. This difference does not matter here.

- c.  $[[\text{agent}]] = \{\langle e_1, \text{Adrian} \rangle, \langle e_2, \text{Bridgit} \rangle, \langle e_3, \text{Bridgit} \rangle, \langle e_4, \text{Chris} \rangle, \langle e_5, \text{Chris} \rangle, \dots, \langle e_2 + e_3, \text{Bridgit} \rangle, \langle e_4 + e_5, \text{Chris} \rangle, \dots, \langle e_1 + e_2 + e_3 + e_4 + e_5, \text{Adrian+Bridgit+Chris} \rangle\}$

In this way, the Neo-Davidsonian approach allows “every” to scope over themes, but not over agents. The cumulative agent relation can later relate the sum of sub-events  $e'$  to the sum of Adrian, Bridgit and Chris.

### 1.1.3 Non-atomic distributivity

So far, I have discussed distribution over atomic parts. However, there are some cases of non-atomic distributivity, although these require some contextual support. For example, Schwarzschild (1996) shows an example which has distributivity over non-atomic individuals. (18a) is true under the scenario (18b).

- (18) a. The men wrote musicals.  
 b. Scenario: there are three men Rodgers, Hammerstein, and Hart. Rodgers and Hammerstein collaborated to write musicals and Rodgers and Hart also collaborated to write musicals.

$\text{DIST}_{Ind}$  cannot predict that (18a) is true under the scenario (18b) because it only derives a reading in which Rodgers wrote musicals, Hammerstein wrote musicals and Hart wrote musicals.

- (19)  $\forall y [[y \subseteq \text{Rodgers+Hammerstein+Hart} \ \& \ \text{Atom}(y)] \rightarrow \text{wrote musicals}(y)]$

To account for such non-atomic distributive readings, one needs to define another version of  $\text{DIST}$ , which quantifies over non-atomic parts. Schwarzschild (1996) proposes *cover* and *partition*.  $\text{Cov}(x)$  is a cover of an individual  $x$  if  $\text{Cov}(x)$  is a set of subparts of  $x$  such that the sum of its members is identical to  $x$ . Partition is a stronger version of covers.  $\text{Part}(x)$  is a partition of an individual  $x$  if  $\text{Part}(x)$  is a cover of  $x$  and no two members of  $\text{Part}(x)$  overlap. To define covers and partitions, let me first introduce the  $\iota$  operator as defined in (20).

- (20)  $\iota.P = x$  such that  $\forall y [P(y) \rightarrow y \subseteq x]$

Based on the  $\iota$  operator,  $\text{DIST}_{Cover}$  is defined as in (21).



- (21) a.  $\text{DIST}_{\text{Cover}} = \lambda P \lambda x \forall y [y \in \text{Cov}(x) \rightarrow P(y)]$   
 b.  $\text{Cov}(x)$  is a cover of  $x$  iff  $\text{Cov}(x) \subseteq \{y : y \subseteq x\}$  and  $\iota. \text{Cov}(x) = x$

The stronger version  $\text{DIST}_{\text{Part}}$  is defined as in (22).

- (22) a.  $\text{DIST}_{\text{Part}} = \lambda P \lambda x \forall y [y \in \text{Part}(x) \rightarrow P(y)]$   
 b.  $\text{Part}(x)$  is a partition of  $x$  iff  $\text{Part}(x) \subseteq \{y : y \subseteq x\}$  and  $\iota. \text{Part}(x) = x$  and  $\forall y, y' [[y \in \text{Part}(x) \& y' \in \text{Part}(x)] \rightarrow \neg \exists z [z \subseteq y \& z \subseteq y']]$

Covers and partitions are contextually supplied and thus non-atomic distributivity needs a context which supports them.

This issue of non-atomicity is more serious to event-based analyses. Defining atomic events is harder than defining atomic individuals. Especially, once an event becomes complex in the sense that it is linked with various participants, there are multiple ways to say that an event is atomic. For example, consider the example (23). Its distributive reading has the LF (23a) and the representation (23b).

- (23) Yang and Zoe carried two boxes.  
 a.  $[\text{Yang and Zoe}] \text{DIST}_{\text{Event}}$  carried two boxes.  
 b.  $\exists e \forall e' [* \text{agent}(e) = (\text{Yang} + \text{Zoe}) \& [e' \subseteq e \& \text{Atom}(e')] \rightarrow \exists y [* \text{theme}(e') = y \& * \text{box}(y) \& |y| = 2 \& * \text{carry}(e')]]]$

If the atomicity condition picks up events whose agent is an atomic individual, (23b) successfully expresses that Yang carried two boxes and Zoe carried two boxes. However, such atomicity would contradict to the intuition that an atomic carrying event just involve one thing which is carried. This suggests that the atomicity relevant to  $\text{DIST}_{\text{Event}}$  is not an atomicity of an event, but rather an atomicity of its participants.  $\text{DIST}_{\theta}$  achieves it. The restriction  $\{e : \text{Atom}(\theta(e))\}$  can be thought of as a version of partition, which is based on a thematic relation.

- (24)  $\text{DIST}_{\theta} = \lambda \theta \lambda V \lambda x \lambda e [\theta(e) = x \& \forall e' [e' \in \{e : \text{Atom}(\theta(e))\} \rightarrow V(e')]$

Now, the distributive reading of (23) has the denotation (25).

- (25)  $[\text{Yang and Zoe}] \text{AGENT } \text{DIST}_{\theta} [\text{carried two boxes}]$ .

The composition proceeds as follows.

- (26) a.  $[[\text{carried two boxes}]] =$   
 $\lambda e \exists y [*theme(e) = y \& *box(y) \& |y| = 2 \& *carry(e)]$   
 b.  $[[\text{agent}]] = \lambda x \lambda e [*agent(e) = x]$   
 c.  $\text{DIST}_\theta([[agent]]) ([[carries two boxes]]) =$   
 $\lambda x \lambda e [*agent(e) = x \& \forall e' [[e' \in \{e' : \text{Atom}(*agent(e'))\} \rightarrow$   
 $\exists y [*theme(e') = y \& *box(y) \& |y| = 2 \& *carry(e')]]]]]$

Note that use of  $\{e : \text{Atom}(\theta(e))\}$  is crucial to define  $\text{DIST}_\theta$ . Suppose another version of it with universal quantification over sub-events, which I call  $\text{DIST}_{\theta 2}$ .

- (27)  $\text{DIST}_{\theta 2} = \lambda \theta \lambda V \lambda x \lambda e [\theta(e) = x \& \forall e' [[e' \subseteq e \& \text{Atom}(\theta(e'))] \rightarrow V(e')]$

The distributive reading of (23) is true if the denotation of agent is (28).

- (28)  $[[agent]] = \{\langle e_1, \text{Yang} \rangle, \langle e_2, \text{Yang} \rangle, \langle e_3, \text{Zoe} \rangle, \langle e_4, \text{Zoe} \rangle, \langle e_1 + e_2, \text{Yang} \rangle, \langle e_3 + e_4, \text{Zoe} \rangle, \dots, \langle e_1 + e_2 + e_3 + e_4, \text{Yang+Zoe} \rangle\}$

If one uses  $\text{DIST}_{\theta 2}$ , all of  $e_1$ ,  $e_2$  and  $e_1 + e_2$  satisfy  $[e' \subseteq e \& \text{Atom}(\theta(e'))]$  because  $\langle e_1, \text{Yang} \rangle$ ,  $\langle e_2, \text{Yang} \rangle$  and  $\langle e_1 + e_2, \text{Yang} \rangle$  are members of  $[[agent]]$  in (28). As a result, the resulting truth condition becomes contradictory: the theme of  $e_1 + e_2$  is two boxes, while the theme of  $e_1$  is two boxes and the theme of  $e_2$  is two boxes. The use of partition can avoid this. In this case, two possible partitions are (i)  $\text{Part}(e) = \{e_1, e_2, e_3, e_4\}$  and (ii)  $\text{Part}(e) = \{e_1 + e_2, e_3 + e_4\}$ . Crucially,  $\text{Part}(e) = \{e_1, e_2, e_1 + e_2, e_3 + e_4\}$  is not legitimate because  $e_1$  and  $e_1 + e_2$  overlap, and  $e_2$  and  $e_1 + e_2$  overlap. This notion of partition will be crucial for my main proposal.

#### 1.1.4 Interim Summary

This section introduced the basic terminology and issues of distributivity, and I gave a brief overview of various versions of distributivity operators. Based on this background, I will show the range of the readings available for “sorezore” and “zutsu,” which raises two research questions concerning the semantics of distributivity operator suitable for these expressions. However, before introducing the core data, I will first clarify the basic grammatical characteristics of Japanese in the next section.

## 1.2 Basic characteristics of Japanese

In this section, I briefly discuss the relevant subsets of the basic characteristics of Japanese. This sets up the background for discussing the empirical phenomena central to this thesis. I start with general syntactic properties of Japanese nominals. First, Japanese generally allows bare arguments, which are underspecified with respect to definiteness and plurality as exemplified in (29).

- (29) Buin-ga booru-o katazuke-ta.  
 member-NOM ball-ACC put away-PAST  
 “({A / The}) club member(s) put away (a / the) ball(s).”

Some nouns in English require the definite article due to the common knowledge. Even those nouns can be a bare argument in Japanese.

- (30) Chikyuu-ga Taiyou-no mawari-o mawa-tte-iru.  
 earth-NOM sun-GEN around-ACC rotate-PROG-PRES  
 ‘The earth goes around the sun’

Second, Japanese does not attest  $\phi$ -feature agreement altogether. In (31), the subject express different combinations of person, number and gender, but the morphological shape of the verb remains the same.

- (31) {Boku(-ra) / Kimi(-ra) / Kare(-ra) / Kanojo(-ra)}-ga doa-o ake-ta.  
 {I(-PL) / you(-PL) / he(-PL) / she(-PL)}-NOM door-ACC open-PAST  
 “{I / we / you / he / she / they} opened (a / the) door(s).”

Plural pronouns involve a plural morpheme “-ra.”<sup>9</sup> As “kare-ra” is used to refer to a gender-neutral group of people, I use it as the default 3rd person plural pronoun.

From now on, I discuss expressions which occur in the nominal domain. Ordering among noun internal materials in Japanese is free.<sup>10</sup> Prenominal modifiers other than adjectives and nominal adjectives accompany the genitive particle “no.”<sup>11</sup> I do not show every possible combination, but the general pattern is exemplified in (32a) and (32b).

9. Another plural morpheme “-tachi” can be associated with the 1st person pronoun and the second person pronoun, but it cannot be combined with “kare” (he). I do not discuss it in this thesis, but see Nakanishi and Tomioka (2004) for discussion on the semantics of “-tachi.”

10. These include possessors, demonstratives, adjectives, nominal adjectives and nominal modifiers. The unmarked order seems to be Poss  $\geq$  Dem > Num > Mod > NomAdj > Adj > NP and other orders come with some informational emphasis.

11. Although its precise status is controversial, I gloss it as GEN for ease of discussion.

- (32) a. Demonstratives and adjectives:  
 (Aka-i) ko-no (akai-i) ringo-ga oisi-i.  
 (red-ADJ) this-GEN (red-ADJ) apple-NOM tasty-PRES  
 “These red apples are tasty.”
- b. Possessors and demonstratives:  
 (Ko-no) boku-no (ko-no) sakuhin-ga ninki-da.  
 (this-GEN) I-GEN (this-GEN) work-NOM popular-COP  
 “This work of mine is popular.”

Japanese demonstratives come in four subtypes, *a*-type, *ko*-type, *so*-type and *do*-type. (33) shows the deictic use of *a*-type, *ko*-type and *so*-type. *a*-type and *ko*-type each correspond to “that” and “this.” *So*-type is in-between “this” and “that” in its deictic use, but it also has an anaphoric use as shown in (34b). I gloss “sono” as “the” to assimilate it with the anaphoric definite.

- (33) {A-no / So-no / Ko-no}-hon-ga ure-te-iru.  
 {that-GEN / the-GEN / this-GEN}-book-NOM sell-PROG-PRES  
 “{That / That / This} book sells well.”
- (34) a. Takashi-ga saikin hito-ni a-tta.  
 Takashi-NOM recently person-DAT meet-PAST  
 “Takashi recently met someone.”
- b. {\*A-no / So-no / \*Ko-no}-hito-ga han'nin-da.  
 {that-GEN / the-GEN / this-GEN}-person-NOM culprit-COP  
 “{That / The / This} person is the culprit.”

*Do*-type demonstratives creates an *indeterminate pronoun*, which expresses varieties of quantifiers in combination with different particles as exemplified in (35).<sup>12</sup>

- (35) a. Do-no-hon-ga ure-te-iru no?  
 which-GEN-book-NOM sell-PROG-PRES Q  
 “Which book sells well?”
- b. Do-no-hon-mo ure-te-iru.  
 which-GEN-book-mo sell-PROG-PRES  
 Lit “Every book sells well.”

12. Indeterminate pronouns also functions as indefinites, a negative concord items and free choice indefinites, but I do not discuss these in this thesis.

Combination of a demonstrative with a sortal restrictor produces a deictic or pronominal element as shown in Table 1.1. Just like person pronouns, their plural counterparts accompany the optional plural morpheme “-ra.”<sup>13</sup>

	-re	-itsu
a-	are (that thing)	aitsu (that person)
ko-	kore (this thing)	koitsu (this person)
so-	sore (it)	soitsu (the person)
do-	dore (which)	doitsu (which person)

**Table 1.1:** Combination of a demonstrative and a sortal restrictor

Next, I discuss cardinals. Japanese is a *numeral classifier language*, in which numerals accompany a classifier in cases of cardinal modification. Japanese numerals have an allomorph of native Japanese origin and an allomorph of Sino-Japanese origin as exemplified in (36).

(36) Numerals:

- a. Native Japanese origin: *ichi* (1), *ni* (2), *san* (3), *shi* (4), *go* (5) ...
- b. Sino-Japanese origin: *hito-* (1), *huta-* (2), *mi-* (3), *yo-* (4), *itsu-* (5) ...

Classifiers come with various sortal restrictions. For example, some of them are individuals of different sorts, e.g., *-nin* and *-hiki*, some of them are measurement dimensions, e.g., *-rittoru*, and some of them are more complicated, e.g., *-hai* as a container and *-kumi* as a group. In a gross, I express a classifier with the combination of CL plus its sortal restriction as exemplified in (37).

(37) Classifiers: *-nin* (CL<sub>person</sub>), *-hiki* (CL<sub>small animal</sub>), *-rittoru* (CL<sub>litre</sub>), *-hai* (CL<sub>glass</sub>), *-kumi* (CL<sub>group</sub>), ...

Cardinal modifications are done via combinations of a numeral and a classifier. I call these units of a numeral and a classifier as *numeral quantifiers* in this thesis.

- (38) a. *san-nin*                                      b. *go-kumi*                                      c. *ni-rittoru*  
       3-CL<sub>person</sub>                                      5-CL<sub>group</sub>                                      2-CL<sub>litre</sub>  
       ‘three’    ‘five groups’                                    ‘two litres’

13. The plural version of “dore” is not attested. This is orthogonal to the main discussion.

Numeral quantifiers can occur in at least three positions in a clause as shown in (39). As a general term, I call a noun phrase associated with a quantifier its *host NP*. In (39), the host NP is “gakusei” (student). If a numeral quantifier precedes its host NP, it is prenominal. If it follows its host NP and precedes a case particle, it is postnominal. If it follows its host NP and a case particle, it is floating.

(39) a. Prenominal:

**San-nin**\*(-no) (\*kinoo) gakusei-ga hasi-tta.  
3-CL<sub>person</sub>(-GEN) (yesterday) student-NOM run-PAST

b. Postnominal:

Gakusei (\*kinoo) **san-nin**-(\*no)-ga hasi-tta.  
Student (yesterday) 3-CL<sub>person</sub>-(GEN)-NOM run-PAST

c. Floating:

Gakusei-ga (kinoo) **san-nin**(\*-no) hasi-tta.  
Student-NOM (yesterday) 3-CL<sub>person</sub>(-GEN) run-PAST  
“Three students ran (yesterday).”

The distribution of the temporal adverb “kinoo” (yesterday) and the genitive particle “no” disambiguates three positions. The prenominal position and the postnominal positions are within the nominal domain, as the intervention of the temporal adverb *kinoo* (yesterday) makes the sentences unacceptable.<sup>14</sup> On the contrary, the floating position is within the verbal domain, as the intervention of *kinoo* (yesterday) does not change the grammaticality of the sentence. The prenominal numeral quantifier must be followed by a genitive particle “no,” whereas the postnominal numeral quantifier and the floating numeral quantifier must not.<sup>15</sup>

This distributional pattern is also observed with quantifiers as shown in (40). Although they look similar at surface, recall that the postnominal position precedes the case particle, but the floating position follows the case particle.

(40) a. Prenominal:

{**Subete** / **Hotondo**}-no ringo-ga ochi-ta.  
{all / most}-GEN apple-NOM fall-PAST

14. Yasu Sudo (p.c.) pointed out that this is surely degraded, but not terribly bad. I suspect that Japanese has an option of left-branching extraction, but it requires a certain discourse condition.

15. Henceforth, I will omit the results of these diagnostics when I discuss other types of quantifiers. However, their results are the same across all quantifiers discussed in this thesis: prenominal quantifiers are followed by “no,” but neither postnominal nor floating quantifiers are, and floating quantifiers allow an adverb to intervene between them and their host NPs, but neither prenominal nor postnominal quantifiers do.

## b. Postnominal:

Ringo-**{subete / hotondo}**-ga ochi-ta.  
 apple-**{all / most}**-NOM fall-PAST

## c. Floating:

Ringo-ga **{subete / hotondo}** ochi-ta.  
 apple-NOM **{all / most}** fall-PAST  
 “{All / Most} apples fell.”

Crucially, the postnominal order is only allowed for cardinals and quantifiers: no other modifiers can occur postnominally as shown in (41).

- (41) Ringo-**{mi-ttu / subete / hotondo / \*kore-ra / \*boku-no / \*aka-i}**-ga  
 apple-**{(3-CL<sub>thing</sub> / all / most / this-PL-GEN / I-GEN / red-ADJ)}**-NOM  
 ure-ta.  
 sell-PAST  
 “{Three / all / most / these / my / red} apples were sold.”

Now, I have introduced the basic properties of Japanese grammar which are necessary to discuss the core data for my thesis. In the next section, I introduce the core empirical puzzles and research questions for this thesis.

## 1.3 Properties of overt distributors in Japanese

In this section, I discuss the syntactic distribution and the interpretations of two overt distributors “sorezore” and “zutsu” in Japanese based on the background I set up in the previous sections. The upshot is that (i) they allow different sets of readings, and (ii) which reading is available depends on where in a clause they occur. This raises two research questions, namely the *distributional question* and the *key resolution question*. The former concerns the syntax-semantics interface and the latter concerns the semantics-discourse interface.

### 1.3.1 Zutsu

In this section, I discuss the syntactic distribution of “zutsu” and the range of readings available in each position. First of all, (42) shows that “zutsu” has two different types of distributive readings at the floating position. Note that “zutsu” has to take a numeral quantifier on its left.

(42) Floating “zutsu”:

Karera-ga kaban-o \*(san-ko-)zutsu hakon-da.  
 they-NOM suitcase-ACC 3-CL<sub>thing</sub>-DIST carry-PAST

a. “They carried three suitcases each.”

b. “They carried three suitcases at each salient occasion.”

In (42a), “-zutsu” distributes over atomic individuals that are part of [[karera]]. I call it an *individual distributive reading*. On the other hand, in (42b), “-zutsu” distributes over contextually salient occasions. For example, (42) under the reading (42b) is true if they together brought three suitcases per once and repeated it until they finish carrying every suitcase. I call it an *occasion distributive reading*. This reading becomes easier to observe if one replaces “karera” (they) with a singular term.

(43) Floating “zutsu”:

Shun-ga kaban-o san-ko-zutsu hakon-da.  
 Shun-NOM suitcase-ACC 3-CL<sub>thing</sub>-DIST carry-PAST

“Shun carried three suitcases at each salient occasion.”

In (42b), the subject is a proper name and thus blocks individual distributive readings. Thus, (42b) only has an occasional reading. To be more precise, the denotation of the subject “Shun” is not the sorting key here. Rather, its sorting key is the set of relevant occasions, which is taken from the context.

On the other hand, the prenominal “zutsu” has another reading, which seemingly lacks a distributivity inference as shown in (44).

(44) Prenominal “zutsu”:

Daiki-ga ni-hon-zutsu-no ais-u-o tabe-ta.  
 Daiki-NOM 2-CL<sub>long object</sub>-DIST-GEN ice cream-ACC eat-PAST

“Daiki ate two-bar ice cream.”

↪ the kind of ice cream Daiki ate generally comes in two bars.

(44) means that each chunk of ice cream consists of two bars and Daiki ate an ice cream bar. Most importantly, it is not necessary that Daiki ate both of the two ice cream bars. In other words, (44) does not entail that Daiki ate two ice cream bars at different occasions and vice versa. However, it still evaluates distributivity: (44) requires that each of the instances of a kind of ice cream comes in two bars.<sup>16</sup>

16. For example, Papico and Chupet if you are familiar with Japanese ice cream.



Indeed, (44) is false if Daiki ate ice cream which does not come in two bars. For example, if Daiki ate a Häagen-Dazs ice cream bar, (44) is false because it does not come in two bars in general. This reading is not limited to the object position as shown in (45).

(45) Prenominal “zutsu”:

San-nin-**zutsu**-no keibiin-ga kono-biru-o junkai-site-iru.  
 3-CL<sub>person</sub>-DIST-GEN guard-NOM this-building-ACC patrol-PROG-PRES  
 “A three-member team of guards patrol this building.”

↪ the guards that patrol this building generally come in three members.

Imagine that you want to explain how secure this building is. This building has a different facility in each floor and thus different three-member teams of guards patrol these floors. As just one guard suffices to patrol one floor, only one member in each team patrols the building per day. In this scenario, (45) is true. However, this scenario does not involve an occasion in which three guards patrol the building. Thus, (45) should be false under an occasion distributive reading. Also, as “keibiin” (guard) denotes the distributive share and “kono-biru” (this building) is a singular term, individual distributive reading is not available. Thus, this reading is different from individual distributive readings and occasional distributive readings. Similarly to (44), (45) is false if those teams do not come with three members. I call it a *group distributive reading*. The most important feature which tells group distributive readings from the two other readings is that the unit Num-CL-zutsu is evaluated in a different situation than a situation in which the rest of the clause is evaluated.

Lastly, “zutsu” is unacceptable in the postnominal position.<sup>17</sup> Again, note that the postnominal position precedes the case particle.

(46) Postnominal “zutsu”:

- \* Karera-ga aisū-ni-hon-**zutsu**-o tabe-ta.  
 they-NOM ice cream-2-CL<sub>long object</sub>-DIST-ACC eat-PAST
- a. “They ate two bars of ice cream each.” (individual distributive)
  - b. “They ate two bars of ice cream each time.” (occasion distributive)
  - c. “They ate two-bar ice cream.” (group distributive)

17. Miyamoto (2009) accepts examples with the postnominal “zutsu.” Although some native speakers of Japanese, including me, do not accept it, they report that this is not completely unacceptable. The picture is further complicated because some of them told me that they sometimes re-analyse the postnominal order as the floating order by omitting the case particle. I keep assuming that the postnominal “-zutsu” is unavailable and leave this issue for future work.

I will claim that “-zutsu” in all the three types of distributive readings above takes a contextually salient situation as its sorting key. However, there is one crucial difference. Individual distributive readings and occasion distributive readings choose a situation in which the unit Num-CL-zutsu is evaluated with the rest of the clause where it appears. On the other hand, group distributive readings choose a situation in which the unit Num-CL-zutsu is evaluated, but the rest of the clause is not. Intuitively, situations that evaluate Num-CL-zutsu in group distributive readings concern characterisation of kinds and groups, whereas situations that evaluate the rest of the clause concerns an event denoted by a verb. For ease of discussion, I call the former *nominal situation*, whereas the latter *verbal situation*. The patterns observed so far is summarised in Table 1.2.

	Readings	Sorting key	Distributive share
<b>Floating</b>	Individual Occasion	Verbal situations	Verbal predicates
<b>Prenominal</b>	Group	Nominal situations	Nominal predicates
<b>Postnominal</b>	*	N/A	N/A

**Table 1.2:** Syntax of “-zutsu” and its interpretation

### 1.3.2 Sorezore

In this section, I shift my attention to “sorezore.” First of all, “sorezore” can occur at the floating position as shown in (47a). Unlike “zutsu,” “sorezore” does not have an occasion distributive reading as shown in (47b).<sup>18</sup>

(47) Floating “sorezore”:

- a. Karera-ga kaban-o    **sorezore** (san-ko)    hakon-da.  
they-NOM suitcase-ACC DIST    (3-CL<sub>things</sub>) carry-PAST  
‘‘They carried three suitcases each.’’
- b. \* Shun-ga kaban-o    **sorezore** (san-ko)    hakon-da.  
Shun-NOM suitcase-ACC DIST    (3-CL<sub>things</sub>) carry-PAST  
‘‘Shun carried three suitcases at each salient occasion.’’

The floating “sorezore” can also be associated with the object when it occurs at the post-object position, although it is a bit harder to diagnose.

18. A numeral quantifier is optional in (47a). Without a numeral quantifier, (47a) is ambiguous: “sorezore” can be linked to the subject or the object, although the reading in which “sorezore” is linked with the object is difficult to diagnose here. Such reading becomes more visible in (48).

(48) Floating “sorezore”:

Takayuki-ga mi-ttsu-no koori-o **sorezore** tokasi-ta.  
 Takayuki-NOM 3-CL<sub>thing</sub>-GEN ice-ACC DIST melt-PAST  
 Lit“Takayuki melted each three ice cubes.”

“Tokas-u” (melt) is a causative verb which existentially quantifies over a change-of-state event. In principle, one can imagine a situation in which Takayuki put three ice cubes on the same plate and heat it. In this scenario, there is just one event which cause three ice cubes to melt. However, (48) is false in this scenario. For (48) to be true, Takayuki has to melt three ice cubes one after another. If the proper noun “Takayuki” is replaced with a plural term, an ambiguity arises. (49a) has an individual distributive reading and even if someone melted three ice cubes just in one step, (49a) is still true. On the other hand, (49b) needs three ice cubes to be melt one by one, but an agent of melting event for one ice need not be atomic. Thus, the subject is cumulatively related with ice-cube-melting events.

(49) Floating “sorezore”:

Karera-ga mi-ttsu-no koori-o **sorezore** tokasi-ta.  
 They-NOM 3-CL<sub>thing</sub>-GEN ice-ACC DIST melt-PAST  
 a. “They each melted each three ice cubes.” (distributive)  
 b. Lit“They melted each three ice cubes.” (cumulative)

The reason why I call (49b) a cumulative reading is due to its striking similarity to the Schein/Krazter examples. For ease of discussion, I provide its possible logical translation in (50). Note that this does not reflect the final proposal in this thesis.

(50)  $[[49b]] = \exists e \exists x [ *agent(e) = they \& three \text{ ice cubes}(x) \& \\ \forall y \exists e' [[y \subseteq x \& Atom(y)] \rightarrow cause(e)(e') \& *theme(e') = y \& melt(e')]] ]$

Here, the point is that universal quantification over atomic ice cubes just scopes over the existential quantifier for ice melting subevents. It does not scope over the existential quantifier for the causer event performed by what “they” denotes. As a result, the agents are just cumulatively associated with the causer event and (50) does not require co-variation between the agents and the causer events. Imagine “they” denotes Ada and Yu. For example, (49b) is true with the denotations in (51).

(51) a. Causer events =  $\{e_1, e_2, e_3, \dots, e_1 + e_2 + e_3\}$   
 b.  $[[agent]] = \{\langle e_1, Ada \rangle, \langle e_2, Ada \rangle, \langle e_3, Yu \rangle, \dots, \langle e_1 + e_2 + e_3, Ada+Yu \rangle\}$

- c.  $[[\text{melt}]] = \{e'_1, e'_2, e'_3, \dots\}$
- d.  $[[\text{cause}]] = \{\langle e_1, e'_1 \rangle, \langle e_2, e'_2 \rangle, \langle e_3, e'_3 \rangle, \dots\}$
- e.  $[[\text{theme}]] = \{\langle e'_1, \text{ice cube}_1 \rangle, \langle e'_2, \text{ice cube}_2 \rangle, \langle e'_3, \text{ice cube}_3 \rangle, \dots\}$

In (51), agents are cumulatively related with causer events, but themes are distributively related with melting events. From now on, I use the term “cumulative reading” to label such readings that agents are cumulatively related with some events, whereas themes are distributively related with them.

“Sorezore” can also occur at the postnominal position, but it prefers a host NP with a numeral quantifier or a demonstrative as shown in (52). It has an individual distributive reading whose sorting key is its host NP.

(52) Postnominal “sorezore”:

??(Go-nin-no / kore-ra-no) koohosya-**sorezore**-ga seisaku-o teian-sita.  
 (5-CL<sub>person</sub>-GEN / DEM-PL-GEN) candidate-DIST-NOM policy-ACC propose-PAST  
 “Each of (the five / these) candidates proposed a policy.”

The postnominal “sorezore” at the object position induces a cumulative reading.

(53) Postnominal “sorezore”:

Huta-ri-no-kodomo-ga kore-ra-no kaban-**sorezore**-o hakon-da.  
 2-CL<sub>person</sub>-GEN-child-NOM DEM-PL-GEN suitcase-DIST-ACC carry-PAST  
 “Two children carried each of these suitcases.”

“Sorezore” can also occur at the prenominal position. It induces a distributive reading at the subject position and a cumulative reading at the object position as shown in (54a) and (54b).<sup>19</sup>

(54) Prenominal “sorezore”:

- a. **Sorezore**-no toosyu-ga kyuusyu-o huta-tsu oboe-ta.  
 DIST-GEN pitcher-NOM pitch type-ACC 2-CL<sub>thing</sub> acquire-PAST  
 “Each pitcher acquired two types of breaking balls.” (distributive)

19. (54b) has another reading that each of the five students carried her or his desk. This reading arises when “sorezore” is parsed as a possessive pronoun. This is an instance of “sorezore” without an overt host NP, which I discuss below. When a numeral quantifier intervenes between “sorezore” and its host NP, one can remove this parsing ambiguity.

- (1) Go-nin-no seito-ga **sorezore**-no mittu-no kadai-o oe-ta.  
 5-CL<sub>person</sub>-GEN student-NOM DIST-GEN 3-CL<sub>thing</sub>-GEN assignment-ACC finish-PAST  
 a. “Each of the five students finished his/her three assignments.” (possessive anaphoric)  
 b. \* “The five students finished each of the three assignments.” (cumulative)

- b. Go-nin-no seito-ga **sorezore**-no kadai-o oe-ta.  
 5-CL<sub>person</sub>-GEN student-NOM DIST-GEN assignment-ACC finish-PAST  
 “The five students finished each assignment.” (cumulative)

Crucially, the prenominal “sorezore” has an inter-sentential anaphoric use. (55) shows that “sorezore” can pick up the pitchers mentioned in (55a).

- (55) a. Kantoku-ga toosyu<sub>i</sub>-o nan-nin-ka shidoo-sita.  
 manager-NOM pitcher-ACC what-CL<sub>person</sub>-KA train-PAST  
 “The manager trains several pitchers.”
- b. Prenominal “sorezore”:  
**Sorezore**<sub>i</sub>-no toosyu-ga kyuusyu-o huta-tsu oboe-ta.  
 DIST-GEN pitcher-NOM pitch type-ACC 2-CL<sub>thing</sub> acquire-PAST  
 “Each pitcher acquired two types of breaking balls.”

The postnominal “sorezore” and the floating “sorezore” do not have this anaphoric use. Neither (56a-i) nor (56a-ii) can pick up the pitchers mentioned in (56a) and they can just mean that the pitchers in general acquired two new breaking balls.

- (56) a. Kantoku-ga toosyu<sub>i</sub>-o nan-nin-ka shidoo-sita.  
 manager-NOM pitcher-ACC what-CL<sub>person</sub>-KA train-PAST  
 “The manager trains several pitchers.”
- i. Postnominal “sorezore”:  
 \* Toosyu-**sorezore**<sub>i</sub>-ga kyuusyu-o huta-tsu oboe-ta.  
 pitcher-DIST-NOM pitch type-ACC 2-CL<sub>thing</sub> acquire-PAST  
 “Each of the pitchers acquired two types of breaking balls.”
- ii. Floating “sorezore”:  
 \* Toosyu-ga **sorezore**<sub>i</sub> kyuusyu-o huta-tsu oboe-ta.  
 pitcher-NOM DIST pitch type-ACC 2-CL<sub>thing</sub> acquire-PAST  
 “The pitchers each acquired two types of breaking balls.”

Lastly, “sorezore” can occur without an overt host NP. In such cases, “sorezore” behaves as a pronominal element which can have intra-sentential anaphora and inter-sentential anaphora. In (57), “sorezore” at the object position takes the subject as its antecedent and induces a reciprocal reading. In (58), “sorezore” takes “go-tai-no bosu” (five bosses) in the previous sentence as its antecedent.

- (57) San-nin-no [koohosya-tachi]<sub>i</sub>-ga **sorezore**<sub>i</sub>-o hihan-sita.  
 3-CL<sub>person</sub>-GEN candidate-PL-NOM DIST-ACC criticise-PAST  
 “The three candidates criticised each other.”

- (58) a. Kono dan'jon-ni-wa [go-tai-no bosu]<sub>i</sub>-ga toojoo-suru.  
 this dungeon-at-TOP 5-CL<sub>body</sub>-GEN boss-NOM appear-COP
- b. Sarani, **sorezore**<sub>i</sub>-ga chigau jakuten-o mo-tsu.  
 Moreover DIST-NOM different weak point-ACC have-PRES  
 “In this dungeon, there appears five bosses and, furthermore, each of them have a different weak point.”

Interpretations of “sorezore” at different positions are summarised in Table 1.3.

		Reading	Sorting key
Floating	Post-subject	Distributive	The subject
	Post-object	Distributive	The subject
		Cumulative	The object
Prenominal/Postnominal	Subject	Distributive	The subject
	Object	Cumulative	The object

**Table 1.3:** Syntax of “sorezore” and its interpretation

In addition to this, “sorezore” shows anaphoric behaviour when it occurs at the prenominal position and when it occurs without an overt host NP.

### 1.3.3 Two research questions

So far, I have discussed the syntactic distribution and the interpretive properties of “zutsu” and “sorezore.” The observed properties of these overt distributors raise two questions, namely the *distributional question* and the *key resolution question*.

First, “zutsu” and “sorezore” induce different readings at different syntactic positions. On one hand, “zutsu” induces an individual distributive reading and an occasion distributive reading at the floating position, but it induces a group distributive reading at the prenominal position. On the other hand, “sorezore” only allows an individual distributive reading, but its degree of anaphoricity changes across syntactic positions. This raises the *distributional question*.

(59) **Distributional question:**

What interface mechanism underlies the systematic interpretive difference of “zutsu” and “sorezore” across different syntactic positions?

This question is related with the syntactic distribution of overt distributors in other languages. (60) is an example of “each” in English.<sup>20</sup>

20. I put aside the binominal/adnominal “each” for now, but see Chapter 5 for discussion.

- (60) a. **Each** player drew two cards. (determiner)  
 b. **Each** of the players drew two cards. (partitive)  
 c. The players **each** drew two cards. (floating/adverbial)

There is a parallelism between “each” and “sorezore.” As shown in (60), definiteness and plurality marking on the NP which provides the sorting key of “each” differ across positions. It is singular at the determiner position and it is definite plural at the partitive position and the floating position. Although host NPs are sometimes not identical to the NPs which provide sorting keys, the constraint on their denotation in cases of “sorezore” is quite similar to that of “each.” (61) shows that the postnominal “sorezore” and the floating “sorezore” can have a plural full pronoun as its host NP, but the prenominal “sorezore” cannot.

- (61) a. Floating “sorezore”:  
 Kare-\*(ra)-ga **sorezore** atarasii puree-o huta-tsu syuutoku-sita.  
 he-(PL)-NOM DIST new play-ACC 2-CL<sub>thing</sub> acquire-PAST  
 b. Postnominal “sorezore”:  
 Kare-\*(ra)-**sorezore**-ga arasii puree-o huta-tsu syuutoku-sita.  
 he-(PL)-DIST-NOM new play-ACC 2-CL<sub>thing</sub> acquire-PAST  
 c. Prenominal “sorezore”:  
 \* **Sorezore**-no kare-(ra)-ga atarasii puree-o huta-tsu syuutoku-sita.  
 DIST-GEN he-(PL)-NOM new play-ACC 2-CL<sub>thing</sub> acquire-PAST  
 “Each of them acquired two new plays.”

This constraint on host NPs generally applies to other quantifiers as shown in (62).

- (62) a. Floating quantifier:  
 Kore-\*(ra)-ga {subete / hotondo} soro-tte-iru.  
 this-(PL)-NOM {all / most} get gathered-PROG-PAST  
 b. Postnominal quantifier:  
 Kore-\*(ra) {subete / hotondo}-ga soro-tte-iru.  
 this-(PL) {all / most}-NOM get gathered-PROG-PRES  
 c. Prenominal quantifier:  
 \* {Subete / Hotondo}-no kore-\*(ra)-ga soro-tte-iru.  
 {all / most}-GEN this-(PL)-NOM get gathered-PROG-PRES  
 Lit“{All / most} of these are here.”

This suggests that there is a common mechanism which deals with different variants of a quantifier and this is closely related with the way how the interpretations of “sorezore” differ across syntactic positions.

On the other hand, “zutsu” cannot occur at the postnominal position. One can find the same distributional pattern in the adverbial universal quantifier “itsumo” (always) as shown in (63). This suggests that the distributional pattern of “zutsu” is closer to adverbial quantifiers.

- (63) a. Floating “itsumo”:  
         Ryo-wa **itsumo** jaketto-o ki-tei-ru.  
         Ryo-TOP always jacket-ACC wear-PROG-PRES  
         “Ryo always wears a jacket.”
- b. Prenominal “itsumo”:  
         Ryo-wa **itsumo-no** jaketto-o ki-tei-ru.  
         Ryo-TOP always-GEN jacket-ACC wear-PROG-PRES  
         “Ryo wears the jacket he always wears.”
- c. Postnominal “itsumo”:  
         \* Ryo-ga jaketto-**itsumo**-o ki-te-iru.  
         Ryo-NOM jacket-always-ACC wear-PROG-PRES  
         i. “Ryo always wears a jacket.”  
         ii. “Ryo wears the jacket he always wears.”

Second, “sorezore” and “zutsu” choose their sorting key in different ways. “Zutsu” can induce an individual distributive reading or an occasion distributive reading at the floating position and it induces a group distributive reading at the prenominal position. It suggests that “zutsu” takes some situations as its sorting key, even though these are not overtly expressed. In contrast, “sorezore” can only induce an individual distributive reading and it requires an overt sorting key. However, “sorezore” shows some anaphoric properties, i.e. it can non-locally be associated with its sorting key at the prenominal position and it has an anaphoric reading when it occurs at the prenominal position or occurs without an overt host NP. This raises the *key resolution question*.

(64) **Key resolution question:**

What mechanism underlies the semantics of “zutsu” and “sorezore” so that “zutsu” takes a covert situation as its sorting key, whereas “sorezore” takes an overt individual as its sorting key?

Intuitively, the contrast between “zutsu” and “sorezore” is reminiscent of the uniqueness / anaphoricity contrast in the semantics of definiteness.



## (65) Uniqueness scenario:

I attended a wedding last week. **The bride** / **#She** looked happy.

In this scenario, the bride of the wedding is not overtly mentioned. Using the pronoun “she” to refer to the bride is not possible in this situation, whereas the definite description “the bride” can take its referent from the context. Thus, this definite description does not require an overt antecedent. On the other hand, another use of definite DPs is in line with pronouns.

## (66) Anaphoric scenario:

A girl entered the chat. **The girl** / **She** disagreed with my opinion.

In this scenario, the definite description “the girl” picks up a referent introduced by the indefinite “a girl” in the previous utterance. Recently, Jenks (2015); Schwarz (2009, 2013) show that these two types of definiteness are morpho-syntactically distinguished in a number of languages. Actually, Japanese is one of such languages as shown in (67). Bare arguments are used in a uniqueness scenario and NPs with “sono” are used in an anaphoric scenario.

- (67) a. Sensyuu, tonari machi-ni asobi ni i-tta. Suruto, (#sono) shichoo-ga  
 last week, neighbour town-to visit-PAST. Then, (the) mayor-NOM  
 syuunin enzetsu-o si-te-ita.  
 inaugural speech-ACC do-PROG-PAST  
 “(I) visited a neighbouring town. Then, the mayor was making an inaugural speech.” (uniqueness)
- b. Sensyuu, sugoude-no doramaa-ni a-tta. Kyoo, yatto ??(sono)  
 last week, talented-GEN drummer-with meet-PAST. today, finally (the)  
 doramaa-ga yuumeijin-dearu koto-o shi-tta.  
 drummer-NOM celebrity-COP that-ACC know-PAST  
 “Last week, I met a talented drummer. Today, I finally got to know that the drummer was a celebrity.” (anaphora)

This morpho-syntactic dichotomy of definiteness in Japanese serves as a guiding intuition: I suggest that “zutsu” and “sorezore” are overt realisations of two distinct strategies to obtain overt distributivity, just like bare nouns and *so*-type demonstratives which are overt realisation of the uniqueness strategy and the anaphora strategy of definiteness.

## 1.4 Outline

In the rest of this thesis, I tackle the distributional question and the key resolution question. My main proposal is summarised in (68) as answers to these questions.

(68) a. **My answer to the distributional question:**

the denotations of quantifiers over individuals are type-ambiguous with respect to their restrictor update, whereas the denotations of quantifiers over situations are constant across different syntactic positions.

b. **My answer to the key resolution question:**

there are two types of overt distributivity, one of which partitions variable assignments and the other partitions situations. “Sorezore” and “zutsu” respectively represent these two types of overt distributivity.

As for (68a), I will propose that quantifiers over individuals in Japanese has several type-variants which differ in (i) whether its restrictor NP occurs local to it or non-local to it, and (ii) whether its restrictor NP is predicative or argumental. Furthermore, I claim that idiosyncratic properties of quantifiers over individuals are also related with this variation with respect to the restrictor update. On the other hand, quantifiers over situations do not need a set of individuals for its restrictor and do not take a restrictor NP. Accordingly, they are not type-ambiguous and have the same denotation at the prenominal position and the floating position. The interpretive difference between these positions comes from an independent difference between nominal predicate and verbal predicates with respect to applicability of type-shifting principles and insertability of *situation pronouns*.

As for (68b), I will propose an analysis of “sorezore” in a dynamic system with pluralities of variable assignments (Brasoveanu, 2008; Nouwen, 2007; van den Berg, 1996, a.o) and propose an analysis of “zutsu” in the possibilistic version of situation semantics (Elbourne, 2005; Kratzer, 1989; Schwarz, 2009, a.o.). After showing that these two theories are well suited for “sorezore” and “zutsu,” I define a dynamic system with pluralities of variable assignments and possible situations, which treat “sorezore” and “zutsu” in a unified framework.

As a rough roadmap, I will discuss “sorezore” and “zutsu” one by one and offer fine-grained compositional analyses to these expressions. Each of these analyses provide half of my answer to the two research questions.

The rest of this thesis is structured as follows. In Chapter 2, I motivate a particular dynamic approach to “sorezore.” I claim that the anaphoric behaviour of “sorezore” requires a dynamic semantic theory with pluralities of variable assignments.

In Chapter 3, I introduce a version of dynamic system I adopt. Specifically, I adopt *Plural Compositional Discourse Representation Theory* (Brasoveanu, 2008), which comes with pluralities of variable assignment and full sub-clausal compositionality.

From Chapter 4, I start to lay out my main proposal. In Chapter 4, I discuss mapping from syntax to semantics with Japanese universal quantifiers and the analysis proposed in this chapter serves as a prerequisite to answer the distributional question concerning “sorezore.” More specifically, I define the type-variants of quantifiers over individuals based on a decompositional approach to dynamic selective generalised quantification (Brasoveanu, 2010).

Chapter 5 proposes a PCDRT analysis of “sorezore” and discusses its anaphoric behaviour. I first propose that the reciprocal readings of “sorezore” suggests that its reciprocity comes from the distributive evaluation of binding condition B. This analysis of “sorezore” suggests that reciprocity is decomposed into three separate components, namely the distributivity component, the anaphoric component and the disjointness component. This three-way decomposition further provides a potential typology of reciprocal strategies. Then, I define type-variants of “sorezore” based on the analysis in Chapter 4 and discuss their interpretive difference. I further discuss an economy principle on restrictor properties and a constraint on inter-sentential dependencies.

Chapter 6 proposes a situation-based analysis of “zutsu.” I show that the distributivity of “zutsu” is evaluated in a situation other than the one in which the rest of the clause is evaluated. I call this the *shifted evaluation effect*. This motivates a situation semantic account in which “zutsu” utilises a *situation pronoun* and partition of a situation. The shifted evaluation effect is observed when “zutsu” partitions the value of a situation pronoun. I further show that the shifted evaluation effect is only observed at the prenominal position. I propose that this interpretive difference comes from an independent difference between the nominal predicates and the verbal predicates. Accordingly, the same denotation of “zutsu” derives different interpretations at different syntactic positions. This means that type-ambiguity of “zutsu” is not motivated. I show that the same analysis is applicable to the adverbial universal quantifier “itsumo” (always) as well.

Lastly, Chapter 7 unifies the PCDRT analysis of “sorezore” and the situation-based analysis of “zutsu.” I show that “zutsu” is ‘intermediately’ dynamic: “zutsu” is not fully static, but not as dynamic as “sorezore.” I propose an intermediately dynamic entry of “zutsu” under a version of PCDRT with situations, in which contexts are taken as pairs of a set of situations and a set of variable assignments. In this final analysis, partition of a situation corresponds to distributivity with respect to the first coordinate of the context and partition of a variable assignment corresponds to distributivity with respect to the second coordinate of the context. As a result, the dichotomy of distributivity is regarded as a natural consequence of the bipartite architecture of the context.

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## Chapter 2

# Dynamics in “sorezore”

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### 2.1 First approximation to “sorezore”

In this chapter, I claim that the anaphoricity of “sorezore” requires some kind of dynamic system and show that the classical singular dynamic system does not suffice. The main point of chapter is (1).

- (1) The semantics of “sorezore” motivates the idea that the meaning of a sentence is an update on *plural variable assignments*.

In this chapter, I focus on clausal meanings. An implementation with full sub-clausal compositionality will be discussed in Chapter 3.

First of all, one can start with a static theory of anaphora and assimilate “sorezore” to plural anaphora, which requires its antecedent to be plural. (2b) repeats the example with inter-sentential anaphora with “sorezore.”

- (2) a. Kantoku-ga toosyu<sub>i</sub>-o nan-nin-ka shidoo-sita.  
manager-NOM pitcher-ACC what-CL<sub>person</sub>-KA train-PAST  
“The manager trains several pitchers.”  
b. **Sorezore**<sub>i</sub>-no toosyu-ga kyuusyu-o huta-tsu oboe-ta.  
DIST-GEN pitcher-NOM pitch type-ACC 2-CL<sub>thing</sub> acquire-PAST  
“Each pitcher acquired two types of breaking balls.”

As long as this datum concerns, just a static account of anaphora seems to work.

- (3) Hypothesis 1: Static anaphoric system  
a. Interpretation of formula is relative to a model  $M$  and an assignment  $g$ .  
b. The sorting key of “sorezore” is a variable.

Anaphoricity of “sorezore” is modelled in the denotation function  $\llbracket \cdot \rrbracket^{M,g}$ . An assignment  $g$  can be thought of as a set of variable-individual pairs.

$$(4) \quad g = \{\langle x_1, \text{Ann} \rangle, \langle x_2, \text{Belle} \rangle, \langle x_3, \text{Claire} \rangle, \dots\}$$

The interpretation of a formula is relative to the content of a variable assignment.

- (5) Scenario: Ann bought a car, but Belle didn't.
- a. She<sub>1</sub> bought a car.  $\Rightarrow$  **true** relative to  $g$
  - b. She<sub>2</sub> bought a car.  $\Rightarrow$  **false** relative to  $g$

The toy static entry of “sorezore” is defined in (6).<sup>1</sup> I follow the convention to put a superscript on the denotation of an anaphoric item to express its antecedent.

$$(6) \quad \llbracket \text{sorezore}^n \phi \rrbracket^g \Leftrightarrow \forall y [\llbracket y \subseteq g(x_n) \& \text{ATOM}(y) \rrbracket \rightarrow \phi]$$

However, this hypothesis runs into several problems. Firstly, “sorezore” cannot pick up its antecedent which is under the scope of negation as shown in (7b).

- (7) a. Kono dan'jon-ni-wa bosu<sub>i</sub>-ga toojoo-si-nai.  
       this  dungeon-at-TOP boss-NOM appear-PRES-NEG  
       “In this dungeon, no boss appears.”
- b. Daga, [sorezore-no-bosu]<sub>\*i,j</sub>-ga saigo-no dan'jon-de toojoo-suru.  
       but  DIST-GEN-BOSS-NOM          last-gen  dungeon-at appear-PRES  
       “However, each boss appears in the last dungeon.”

(7b) only has a reading that all the bosses in this game appear in the last dungeon, but does not have a reading that the bosses which did not appear in this dungeon appear in the last dungeon or such a reading is simply unimaginable.<sup>2</sup>

Secondly, “sorezore” can pick up its antecedent within a conditional only if “sorezore” is also within the conditional as in (8).

- (8) a. [If ... XP<sub>i</sub> ..., then ... sorezore<sub>i</sub> ... ].  
       b. \*[If ... XP<sub>i</sub> ..., then ...]. [... sorezore<sub>i</sub> ... ].

1. In this chapter, I only provide a syncategorematic entry of “sorezore” and the compositional implementation is discussed in Chapter 5.

2. One can obtain a specific indefinite reading by adding more descriptive content. In that case, it is more reasonable to assume that the indefinite scopes over negation. Thus, for the purpose here, it is crucial to control an indefinite so that it does not give rise to a specific reading.

“Sorezore” within the consequent of a conditional can find its antecedent in the antecedent of the conditional as shown in (9).

- (9) Kantoku-ga [atarasii toosyu]<sub>i</sub>-o nan-nin-ka yato-tta-ra, kare-wa  
 manager-NOM new pitcher-ACC what-CL<sub>Person</sub>-KA hire-PAST-if he-TOP  
 [sorezore-no toosyu]<sub>i</sub>-o jikkuri sodate-ru.  
 DIST-GEN pitcher-ACC carefully train-PRES  
 “If the manager hires several new pitchers, he carefully trains each pitcher.”

However, if “sorezore” occurs outside of a conditional, it cannot felicitously take an antecedent within the antecedent of the conditional as shown in (10b).<sup>3</sup>

- (10) a. Kantoku-ga [atarasii toosyu]<sub>i</sub>-o san-nin-ijoo yato-tta-ra, kare-wa  
 manager-NOM new pitcher-ACC 3-CL<sub>Person</sub>-more hire-PAST-if he-NOM  
 oo-yorokobi darou.  
 big-pleasure would  
 “If the manager hires more than three pitchers, he would exult.”  
 b. Kare-wa [sorezore-no toosyu]<sub>??i/j</sub>-o jikkuri sodate-ru.  
 he-TOP DIST-GEN pitcher-ACC carefully train  
 “He carefully trains each pitcher.”

In (10b), “sorezore” can only quantify over pitchers in general and it cannot pick up the three students mentioned in the antecedent of the conditional in (10a).

Lastly, when “sorezore” is in the second disjunct, it cannot find its antecedent within the first disjunct as shown in (11).

- (11) Kantoku-ga [atarasii toosyu]<sub>i</sub>-o san-nin-ijoo yato-tta ka, sukauto-ga  
 manager-NOM new pitcher-ACC 3-CL<sub>Person</sub>-more hire-PAST or scout-NOM  
 [sorezore-no toosyu]<sub>\*i/j</sub>-to koosho-sita ka-da.  
 DIST-GEN pitcher-with negotiate-PAST or-COP  
 “Either the manager hired more than three new pitchers or the scout negotiated with each pitcher.”

Again, “sorezore” can only quantify over pitchers in general and it cannot pick up the three pitchers mentioned in the first disjunct in (11).

As long as inter-sentential anaphora is possible for “sorezore,” these three observations are puzzling. The heart of the matter is that the antecedent of “sorezore” has to be ‘accessible’ for anaphoric dependency.

3. It is crucial not to add modal expressions such as “darou” (would) and “ni-chigai-nai” (must) because these license *modal subordination*. Availability of modal subordination is another indirect support for dynamic status of the sorting key of “sorezore.”

## 2.2 Dynamic system for “sorezore”

The three problems in the previous section suggest that “sorezore” requires an antecedent which is introduced to the discourse at some point and remains accessible thereafter. This is one of the classical motivations for *dynamic semantics* (Groenendijk & Stokhof, 1991; Heim, 1983a; Kamp, 1981, a.o.). To introduce dynamic semantics, let me first discuss inter-sentential anaphora with an indefinite antecedent. Take (12) as an example.

(12) Mary has a car<sub>*i*</sub>. It<sub>*i*</sub> is orange.

(13a) is a faithful logical translation based on the syntax of (12). However, it is ill-formed: *x* in the second clause is not within the scope of the existential quantifier and thus left free. (13b) derives a correct truth-condition for (12). However, it requires extension of the scope of an existential quantifier beyond the sentence boundary, which breaks the compositional mapping from syntax to semantics.

- (13) a.  $\exists x[\text{car}(x) \& \text{buy}(\text{Mary})(x)] \& \text{orange}(x)$   
 b.  $\exists x[\text{car}(x) \& \text{buy}(\text{Mary})(x) \& \text{orange}(x)]$

Even if one stipulates that existential quantifiers can take their scope beyond sentence boundaries, it still faces problems. An indefinite in some environments cannot antecedent a pronoun which occurs outside (Kamp, 1981; Karttunen, 1969).

- (14) a. Mary **does not** have a car<sub>*i*</sub>. # It<sub>*i*</sub> is orange.  
 b. [If Mary has a car<sub>*i*</sub>, she likes it<sub>*i*</sub> very much.]  
 c. i. [If Mary has a car<sub>*i*</sub>, she will take us for driving.]  
 ii. # She likes it<sub>*i*</sub> very much.  
 d. # Either Mary has a car **or** it is broken.

This is where dynamic semantics enters in. In dynamic semantics, the meaning of a sentence is an update on the context (*context change potentials*) and a formula denotes a relation between variable assignments. Thus, the meaning of a sentence directly contributes to incremental update of the context. Indefinites are not mere existential quantifiers, but they introduce a new referent to the contexts. However, negations, conditionals and disjunction talk about *hypothetical contexts*



and referents introduced there cannot survive beyond them. Thus, pronouns that are external to negations, conditionals and disjunction cannot pick up the referents introduced there. I introduce a revised hypothesis for “sorezore” with a classical dynamic semantics system.

(15) Hypothesis 2: Dynamic system

- a. The meaning of a sentence is a relation between an input variable assignment and an output variable assignments.
- b. An indefinite introduces a new variable and expands the existing assignments to assign it a random value.
- c. Some formulae do not pass on the values of variables introduced there to the output variable assignments.
- d. “Sorezore” has to bear the same index as its antecedent.

From now on, I call the variables in the domain of variable assignments *discourse referents* (dref). I use letters  $u_1, u_2, u_3 \dots$  as variables for discourse referents and  $x, y, z$  as variables for individuals. A discourse referent  $u$  is mapped to an individual  $x$  under a variable assignment  $g$ , i.e.  $g(u) = x$ .

In this section, I adopt a notation in the style of *Dynamic Predicate Logic (DPL)* (Groenendijk & Stokhof, 1991).<sup>4</sup> The interpretation function  $\llbracket \cdot \rrbracket$  maps a formula to a relation between variable assignments. If  $g$  is an input assignment and  $h$  is an output assignment for  $\phi$ , I notate it as  $g \llbracket \phi \rrbracket h$ .<sup>5</sup> (16) is the DPL definition of truth.

- (16) Truth:  $\phi$  is true with respect to an input assignment  $g$  iff there is an output assignment  $h$  such that  $g \llbracket \phi \rrbracket h$ .

Discourse referent introduction is expressed as random (re)assignment of the value of a dref.<sup>6</sup> I notate it as  $g[u_n]h$ . This is defined in (17):  $g$  and  $h$  minimally differ with respect to the newly introduced dref  $u_n$ .

$$(17) \quad g[u_n]h = \forall u [u \neq u_n \rightarrow g(u) = h(u)]$$

4. This is because DPL has expressive power of object language quantification over variable assignments. This helps me to smoothly enrich this dynamic system with plurality of variable assignments. With other frameworks, e.g., *Discourse Representation Theory* (Kamp, 1981), this transition is not as straightforward as in DPL, although not impossible.

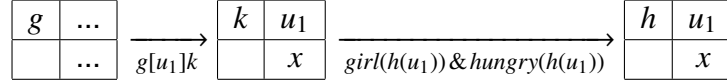
5. In the original notation of Groenendijk and Stokhof (1991), it is written as  $\langle g, h \rangle \in \llbracket \phi \rrbracket$ .

6. Although I do not discuss differences between total assignments and partial assignments in this chapter, I adopt the combination of total assignments and the dummy individual  $\star$ , which emulates partial assignments (van den Berg, 1996). See Chapter 3 for the details.

Let’s see how it works. For example, (18) is true iff there is an output assignment  $h$  with respect to the input assignment  $g$  in which  $h(u_1)$  is a hungry girl.<sup>7</sup>

(18) A girl<sup>1</sup> is hungry.

This is visualised in Table 2.1: the indefinite assigns a random value  $x$  to dref  $u_1$  and it is checked if  $x$  is a hungry girl in the possible output assignments. If an assignment  $h$  meets these conditions, (18) is true.



**Table 2.1:** Update with an indefinite

Some formulae check if output variable assignments satisfy some conditions and discard those which do not meet the condition. Such formulae are called *tests*. Negation, conditional, disjunct and universal quantifier are defined as tests and they do not pass on the value of drefs introduced under their scope to the output variable assignments. The definitions of logical connectives in DPL (Groenendijk & Stokhof, 1991) are given in (19).

- (19) a.  $g[[\phi \text{ and } \psi]]h \Leftrightarrow \exists k[g[[\phi]]k \& k[[\psi]]h]$   
 b.  $g[[\exists u \phi]]h \Leftrightarrow \exists k[g[u]k \& k[[\phi]]h]$   
 c.  $g[[\text{not } \phi]]h \Leftrightarrow [g = h \& \neg \exists k[h[[\phi]]k]]$   
 d.  $g[[\text{if } \phi \text{ then } \psi]]h \Leftrightarrow [g = h \& \forall i[h[[\phi]]i \rightarrow \exists j[i[[\psi]]j]]]$   
 e.  $g[[\phi \text{ or } \psi]]h \Leftrightarrow [g = h \& \exists k[h[[\phi]]k \vee h[[\psi]]k]]$   
 f.  $g[[\forall u \phi]]h \Leftrightarrow [g = h \& \forall i[h[u]i \rightarrow \exists j[i[[\phi]]j]]]$

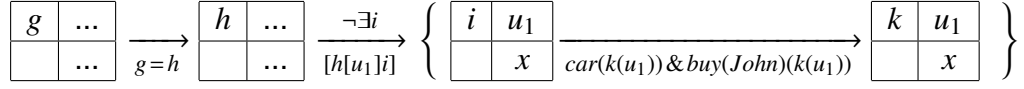
Let me illustrate updates with tests one by one.

First,  $[[\text{not } \phi]]$  negates existence of output assignments that make  $\phi$  true. For example, (20) is true iff the input assignment does not have an output assignment  $k$  such that  $k(u_1)$  is a car and John bought  $k(u_1)$ .

(20) John **didn’t** buy a car<sup>1</sup>.

This is visualised in Table 2.2. I express quantification over variable assignment above an arrow and its scope is indicated by a large curly bracket.

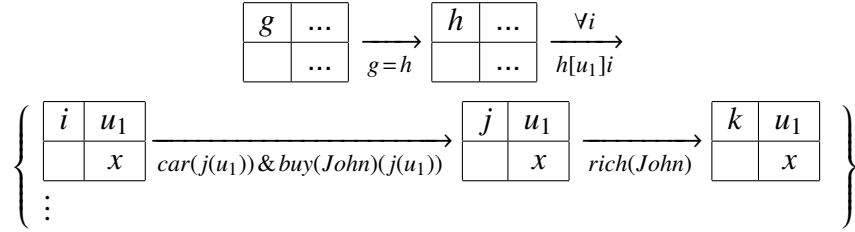
7. I follow the convention to use a numerical superscript for dref introduction.

**Table 2.2:** Update with negation

In Table 2.2, the value of  $u_1$  is introduced under the scope of negation. As default introduction in  $k$  is not reflected in  $h$ , the value of  $u_1$  is not yet introduced in  $h$ .<sup>8</sup>

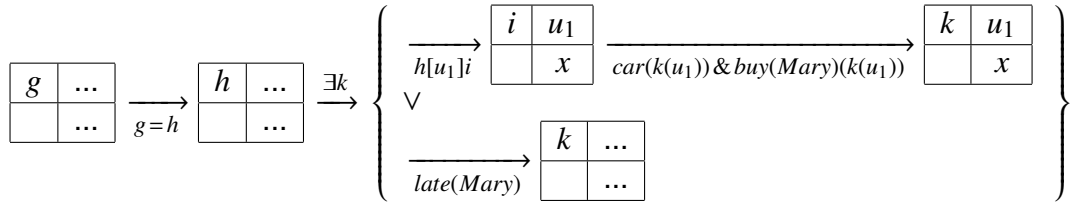
Second,  $[[\text{if } \phi, \text{ then } \psi]]$  universally quantifies over variable assignments so that any assignment which makes  $\phi$  true is updated to another assignment which makes  $\psi$  true. For example, (21) is true iff for any assignment  $i$  in which  $i(u_1)$  is a car and John buys  $i(u_1)$ , there is another assignment  $j$  in which John is rich. This is visualised in Table 2.3, in which  $u_1$  is introduced in  $i$ , but not yet introduced in  $h$ .

(21) If John buys a car<sup>1</sup>, he is rich.

**Table 2.3:** Update with conditionals

Lastly,  $[[\phi \text{ or } \psi]]$  is disjunctive updates so that there is an assignment in which  $\phi$  or  $\psi$  is true. For example, (22) is true iff there is an assignment  $k$  in which  $k(u_1)$  is a car and Mary has  $k(u_1)$  or Mary is late as visualised in Table 2.4. Again, the value of  $u_1$  is not yet introduced in  $h$  because  $i$  does not pass on its value to  $h$ .

(22) Either Mary has a car<sup>1</sup> or she is late.

**Table 2.4:** Update with disjunction

8. Since I do not specify partiality of assignments in this chapter, I use the phrase “the value of  $u_1$  is not yet introduced” to make it theory-neutral. If assignments are total,  $h(u_1)$  stores the default value which has not been updated from  $g$ . If assignments are partial,  $h(u_1)$  is undefined.

Now, let me define a possible entry of “sorezore” in this system. First of all, pronouns can be treated as a free occurrence of a discourse referent as in (23), which gets its value relative to a variable assignment.<sup>9</sup>

$$(23) \quad \llbracket it_{u_n} \rrbracket = u_n$$

Based on (23), the toy dynamic semantic entry of “sorezore” is defined in (24).

$$(24) \quad g[\llbracket \text{sorezore}_{u_n} \phi \rrbracket] h \Leftrightarrow [g = h \ \& \ \forall i [\llbracket h[u_m] i \rrbracket \& \text{ATOM}(i(u_m)) \& i(u_m) \subseteq i(u_n)] \rightarrow \exists j [\llbracket i[\phi] j \rrbracket]]$$

“Sorezore” is defined as an anaphoric universal quantifier.<sup>10</sup> (24) introduces a new dref  $u_m$  and is anaphoric to its antecedent  $u_n$  at the same time. Then, it quantifies over assignments in which the value of  $u_m$  is an atomic part of the value of its antecedent  $u_n$ .  $\llbracket \text{sorezore} \phi \rrbracket$  is a test and it takes  $i(u_n)$  as its sorting key.

Let’s see how (24) works. From now on, when I introduce an example, I use  $u_n$  superscript to indicate that an item introduces dref  $u_n$  and  $u_n$  subscript to indicate that an item is anaphoric to dref  $u_n$ . One has to be careful to not confuse it with superscripts on a denotation, which indicates its antecedent. First, consider intersentential anaphora with “sorezore” in (25b).

- (25) a. Kono dan’jon-ni-wa go-tai-no bosu<sup>u<sub>1</sub></sup>-ga toojoo-suru.  
           this dungeon-at-TOP 5-CL<sub>body</sub>-GEN boss-NOM appear-PRES-NEG  
           “In this dungeon, there appear five bosses.”
- b. Sarani, [**sorezore**-no-bosu]<sub>u<sub>1</sub></sub><sup>u<sub>2</sub></sup>-ga hijooni tegowa-i.  
           moreover DIST-GEN-BOSS-NOM very tough-PRES  
           “Moreover, each boss is really tough.”

(25a) and (25b) each denote (26a) and (26b). I omit the irrelevant details such as locative modification, adverbs and numerals for now.

$$(26) \quad \text{a. } g[\llbracket (25a) \rrbracket] k \Leftrightarrow \exists i [g[u_1] i \& i[\text{boss}(k(u_1))] k \& i[\text{appear}(k(u_1))] k]$$

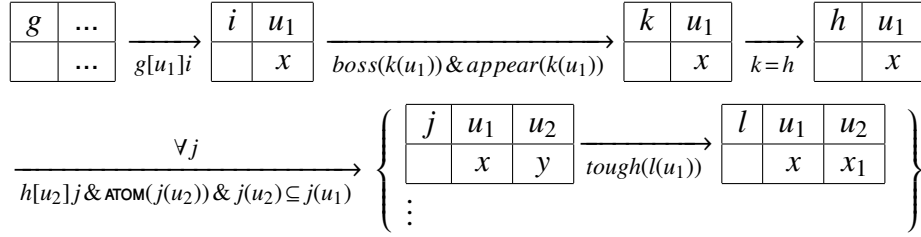
9. However, I will adopt an entry of pronouns which introduces a discourse referent which assigns the same individual as its antecedent in Chapter 3. This assumption will be crucial when I discuss reciprocal readings of “sorezore.”

(1)  $g[\llbracket it_{u_n} \rrbracket] h \Leftrightarrow g[u_m] h \& h(u_m) = h(u_n)$

10. As I define “sorezore” only syncategorematically in this chapter, I write it as  $\llbracket \text{sorezore}_{u_n} \phi \rrbracket$ , instead of  $\llbracket \text{sorezore}_{u_n} \rrbracket$ . See Chapter 5 for a compositional entry of “sorezore” based on Plural Compositional DRT, which will be introduced in Chapter 3.

$$\begin{aligned} \text{b. } k[[ (25b) ]] h &\Leftrightarrow [k = h \& \forall j [[h[u_2]j \& \text{ATOM}(j(u_2)) \& j(u_2) \subseteq j(u_1)] \\ &\rightarrow \exists l [j[\text{tough}(l(u_2))]l]]] \end{aligned}$$

In (26b), “sorezore” looks for its antecedent in an assignment  $j$  and the value of dref  $u_1$  is introduced in  $j$  as shown in Table 2.5. This update is successful and correctly predicts (25b) to be felicitous.



**Table 2.5:** Intersentential anaphora with “sorezore”

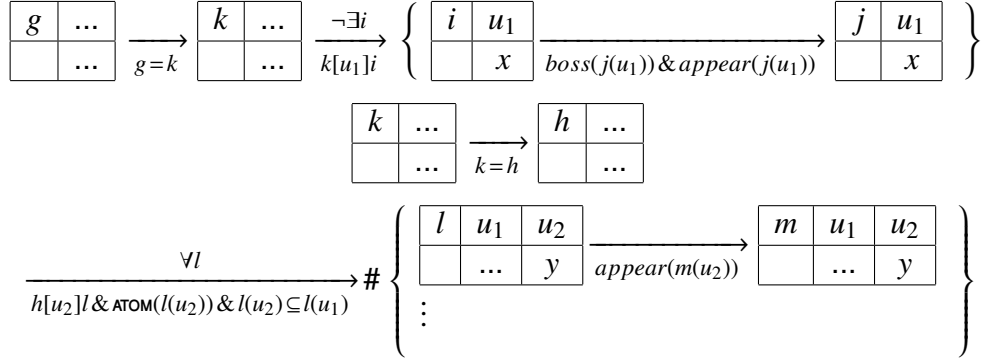
On the other hand, if “sorezore” takes an antecedent whose value is introduced under a test, it results in infelicity. Negation is a test and “sorezore” cannot pick up its antecedent within the scope of negation. Consider (27b).

- (27) a. Kono dan'jon-ni-wa bosu<sup>u1</sup>-ga toojoo-si-nai.  
           this  dungeon-at-TOP boss-NOM appear-PRES-NEG  
           “In this dungeon, no boss appears.”
- b. # Sikasi, [sorezore-no-bosu]<sup>u1</sup>-ga saigo-no dan'jon-de toojoo-suru.  
           but     DIST-GEN-BOSS-NOM      last-gen  dungeon-at appear-PRES  
           “However, each boss appears in the last dungeon.”

(27a) and (27b) each denote (28a) and (28b).

- (28) a.  $g[[ (27a) ]] k \Leftrightarrow$   
            $[g = k \& \neg \exists j [i[k[u_1]i] \& i[\text{boss}(j(u_1))]j \& i[\text{appear}(j(u_1))]j]]$
- b.  $k[[ (27b) ]] h \Leftrightarrow [k = h \& \forall l [[h[u_2]l \& \text{ATOM}(l(u_2)) \& l(u_2) \subseteq l(u_1)]$   
            $\rightarrow \exists m [l[\text{appear}(m(u_2))]m]]]$

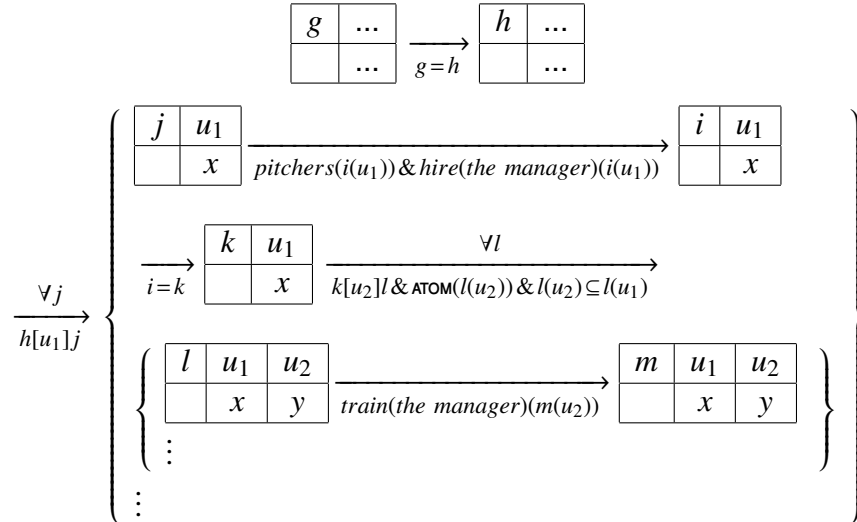
In (28b), “sorezore” cannot find any antecedent in an assignment  $l$ . The value of dref  $u_1$  is introduced in an assignment  $j$ , which is under the scope of negation and not passed on to  $k$ . This is visualised in Table 2.6. I use # to indicate failure of an update. In this case, the update from  $h$  to  $l$  fails because the value of  $l(u_1)$  is not yet introduced there. Thus, it correctly predicts (27b) to be infelicitous.

**Table 2.6:** Indefinite under negation with “sorezore”

Conditional is also a test. “sorezore” can pick up its antecedent within the antecedent of a conditional if it is within its consequent. (29a) denotes (29b).

- (29) a. Kantoku-ga toosyu<sup>u<sub>1</sub></sup>-o nan-nin-ka yato-tta-ra, kare-wa  
 manager-NOM pitcher-ACC what-CL<sub>Person</sub>-KA hire-PAST-if he-NOM  
 [sorezore<sup>u<sub>2</sub></sup>-no toosyu]<sub>i</sub>-o jikkuri sodate-ru.  
 DIST-GEN pitcher-ACC carefully train-PRES  
 “If the manager hires several pitchers, he carefully trains each pitcher.”
- b.  $g[(29a)]h \Leftrightarrow [g = h \& \forall i [\exists j [h[u_1]j \& j[\text{pitchers}(i(u_1))]i \& j[\text{hire}(\text{the manager})(i(u_1))]i] \rightarrow [\exists k [i = k \& \forall l [[k[u_2]l \& \text{ATOM}(l(u_2)) \& l(u_2) \subseteq l(u_1)] \rightarrow \exists m [l[\text{train}(\text{the manager})(m(u_2))]m]]]]]$

In (29b), “sorezore” looks for an antecedent in an assignment  $l$  and the value of  $u_1$  is introduced in  $l$  as visualised in Table 2.7.

**Table 2.7:** “sorezore” internal to a conditional

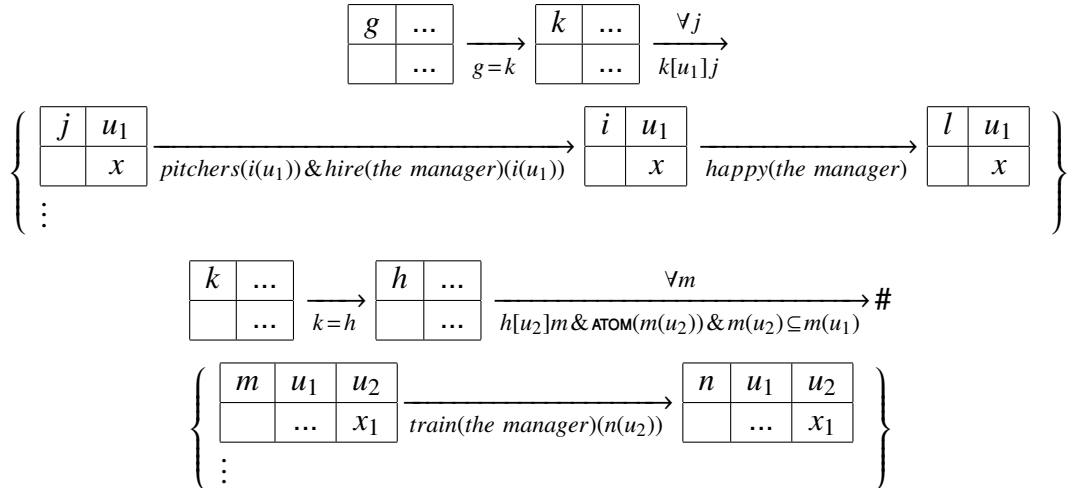
This update is successful and correctly predicts (29a) to be felicitous. Importantly, the values of drefs introduced under a test are passed on to another assignment under the test. Thus, “sorezore” makes reference to the value of  $u_1$  as long as “sorezore” itself also occurs within the test.

On the other hand, (30a) and (30b) each denote (31a) and (31b).

- (30) a. Kantoku-ga toosyu <sup>$u_1$</sup> -o san-nin-ijoo yato-tta-ra, kare-wa oo yorokobi  
 manager-NOM pitcher-ACC 3-CL<sub>Person</sub>-more hire-PAST-if he-TOP big pleasure  
 darou.  
 would  
 “If the manager hires more than three pitchers, he would be glad.”
- b. # Kare-wa [sorezore-no toosyu] <sup>$u_1$</sup> -o jikkuri sodate-ru.  
 he-TOP DIST-GEN pitcher-ACC carefully train  
 “He carefully trains each pitcher.”

- (31) a.  $g[[ (30a) ]]k \Leftrightarrow [g = k \& \forall i [\exists j [k[u_1]j \& j[\text{pitchers}(i(u_1))]]i$   
 $\& j[\text{hire}(\text{the manager})(i(u_1))]]i \rightarrow \exists l [i[\text{happy}(\text{the manager})]l]]$
- b.  $k[[ (30b) ]]k \Leftrightarrow [k = h \& \forall m [[h[u_2]m \& \text{ATOM}(m(u_2)) \& m(u_2) \subseteq m(u_1)]$   
 $\rightarrow \exists n [m[\text{train}(\text{the manager})(n(u_2))]n]]]$

In (31b), “sorezore” cannot find any antecedent in an assignment  $m$ . The value of the  $u_1$  is introduced in an assignment  $j$ , which is within a conditional and not passed on to  $k$ . As a result, the update from  $k$  to  $m$  fails because  $(m(u_1))$  is not yet introduced. This is visualised in Table 2.8.



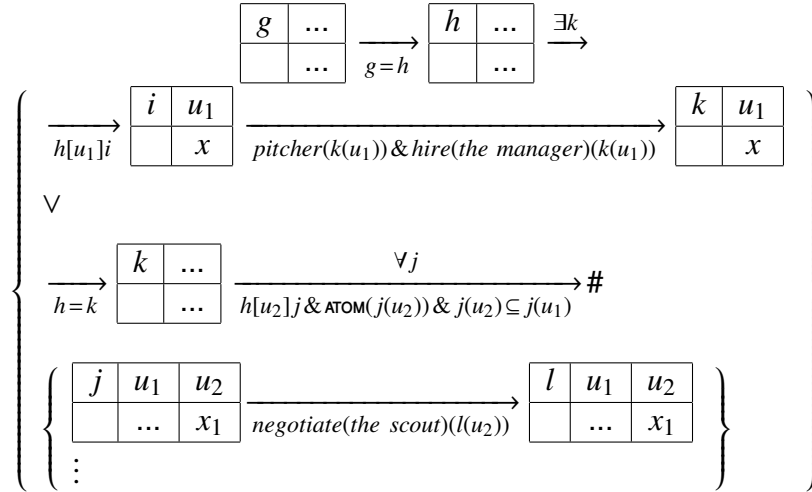
**Table 2.8:** “sorezore” external to a conditional

Lastly, “sorezore” cannot pick up its antecedent within a disjunction as shown in (32). The denotation of (32) is given in (33).

- (32) # Kantoku-ga toosyu<sup>u<sub>1</sub></sup>-o nan-nin-ka yato-tta ka, sukauto-ga  
 manager-NOM pitcher-ACC what-CL<sub>Person</sub>-KA hire-PAST or scout-NOM  
 [sorezore-no toosyu]<sup>u<sub>2</sub></sup><sub>u<sub>1</sub></sub>-to koosho-sita ka-da.  
 DIST-GEN pitcher-with negotiate-PAST or-COP  
 “Either the manager hired several pitchers or the scout negotiated with each pitcher.

- (33)  $g[[ (32) ]]h \Leftrightarrow [g = h \& \exists k [\exists i [h[u_1]i \& i[pitchers(k(u_1))]]k \& i[hire(the\ manager)(k(u_1))]]k] \vee [h = k \& \forall j [[k[u_2]j \& \text{ATOM}(j(u_2)) \& j(u_2) \subseteq j(u_1)] \rightarrow \exists l [j[negotiate(the\ scout)(l(u_2))]]l]]]$

This is visualised in Table 2.9. This update fails for the same reason: “sorezore” requires the value of  $j(u_1)$ , which is not yet introduced when “sorezore” is evaluated.



**Table 2.9:** “sorezore” within a disjunction

In this way, this dynamic system correctly accounts for the distribution of the antecedent of “sorezore.”



## 2.3 Problems with the classical dynamic analysis

So far, I have shown that anaphoricity of “sorezore” requires a dynamic approach to anaphora. In this section, I show that a classical dynamic system is still not sufficient and motivate dynamic semantics with plurality of variable assignments.

The problem is that “sorezore” allows anaphoric reference to the drefs which are introduced under its scope as shown in (34b).

- (34) Context: A new cake shop held a cake tasting to advertise their products. In the event, participants can choose two cakes and taste them. They are overall satisfied with their choice.
- a. Sankasya<sup>u1</sup>-ga sorezore<sup>u2</sup> keeki<sup>u3</sup>-o huta-tu eran-da.  
 participant-NOM DIST cake-ACC 2-CL<sub>thing</sub> choose-PAST  
 “(The) participants each chose two cakes.”
  - b. Karera<sub>u1</sub>-wa sorezore [sono-huta-tu-no keeki]<sub>u3</sub>-ni manzoku-site-ita.  
 they-TOP DIST the-2-CL<sub>thing</sub>-GEN cake-DAT satisfied-PERF-PAST  
 “They were each satisfied with the two cakes.”

This exemplifies the phenomenon of *dependent anaphora* (Krifka, 1996; Nouwen, 2007; van den Berg, 1996, *et seq.*).<sup>11</sup> The crucial observation here is that “sono-huta-tu-no keeki” (the two cake) can pick up its antecedent from the scope of “sorezore,” expressing covariation between the participants and the cakes. I use an example with the floating “sorezore” for ease of exposition, but the same result is obtained with the prenominal “sorezore” and the postnominal “sorezore.”<sup>12</sup>

- (35) a. i. **Sorezore**-no sankasya<sup>u2</sup>-ga keeki<sup>u3</sup>-o huta-tu eran-da.  
 DIST-GEN participant-NOM cake-ACC 2-CL<sub>thing</sub> choose-PAST  
 “Each participant chose two cakes.”
- ii. Kore-ra-no sankasya<sup>u1</sup>-**sorezore**<sup>u2</sup>-ga keeki<sup>u3</sup>-o huta-tu eran-da.  
 this-PL-GEN participant-DIST-NOM cake-ACC 2-CL<sub>thing</sub> choose-PAST  
 “Each of these participants chose two cakes.”
- b. Karera<sub>u1</sub>-wa sorezore [sono-huta-tu-no keeki]<sub>u3</sub>-ni manzoku-site-ita.  
 they-TOP DIST the-2-CL<sub>thing</sub>-GEN cake-DAT satisfied-PERF-PAST  
 “They were each satisfied with the two cakes.”

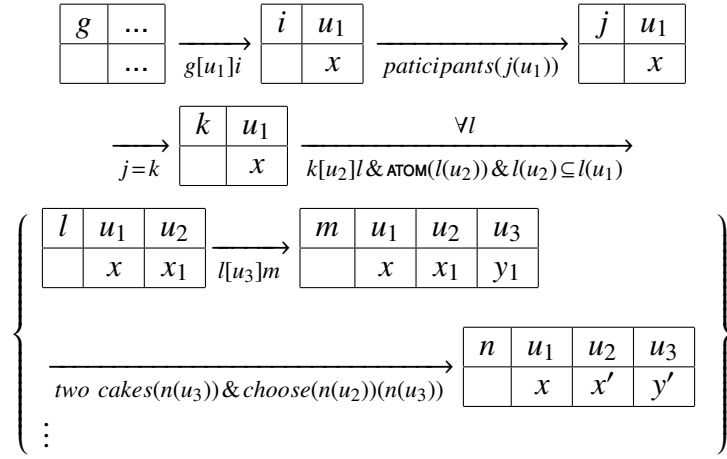
11. Or *quantificational subordination* (Karttunen, 1969, *et seq.*).

12. See Chapter 5 for their denotations.

It is unexpected that “sorezore” allows pronouns under its scope to pick up an antecedent outside its scope. This is because universal quantifiers are defined as tests in DPL. To see why this is problematic, let me show how a classic dynamic system works for this example. The denotation of (34a) is given in (36).

$$(36) \quad g[[ (34a) ]]k \Leftrightarrow \exists j[\exists i[g[u_1]i \& i[\text{participants}(j(u_1))]]j] \& j = k \& \\ \forall l[k[u_2]l \& \text{ATOM}(l(u_2)) \& l(u_2) \subseteq l(u_1)] \rightarrow \exists m \exists n[l[u_3]m \& \\ m[\text{two cakes}(n(u_3))]n \& m[\text{choose}(n(u_1))(n(u_3))]n]]$$

The update with (36) is visualised in Table 2.10. This is parallel with the semantics of conditionals: the value of  $\text{dref } u_2$  is introduced in the assignment  $l$ . However, this value is not passed on to the output assignment  $k$ .

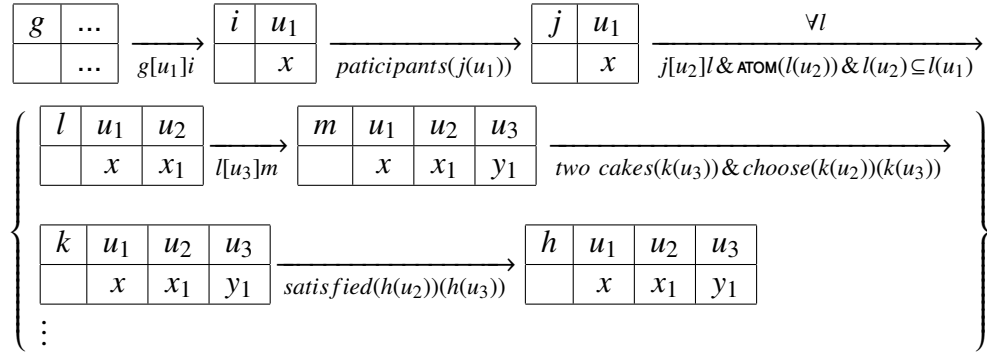


$$(38) \quad g[[\text{sorezore}_{u_n} \phi]]h \Leftrightarrow \forall k [[g[u_m]k \& \text{ATOM}(k(u_m)) \& k(u_m) \subseteq k(u_n)] \rightarrow k[[\phi]]h]$$

This modification makes drefs introduced under the scope of a universal quantifier accessible. With this entry, (34a) denotes (39).

$$(39) \quad g[[ (34a) ]]k \Leftrightarrow \exists j [\exists i [g[u_1]i \& i[\text{participants}(j(u_1))j] \& \forall l [j[u_2]l \& \text{ATOM}(l(u_2)) \& l(u_2) \subseteq l(u_1)] \rightarrow \exists m [l[u_3]m \& m[\text{two cakes}(n(u_3))]k \& m[\text{choose}(k(u_1))(k(u_3))]k]]]$$

This is visualised in Table 2.12.



**Table 2.12:** Universal quantification with extended scope

However, it wrongly predicts (40b) to be felicitous.

- (40) a. Sankasya<sup>u1</sup>-ga sorezore<sup>u2</sup> keeki<sup>u3</sup>-o huta-tu eran-da.  
 participant-NOM DIST cake-ACC 2-CL<sub>thing</sub> choose-PAST  
 “Participants each chose two cakes.”
- b. # Soitu<sup>u1</sup>-wa (\*sorezore) [sono-huta-tu-no keeki]<sup>u3</sup>-ni  
 the person-TOP DIST the-2-CL<sub>thing</sub>-GEN cake-DAT  
 manzoku-site-ita.  
 satisfied-PERF-PAST  
 (Lit) “The person was each satisfied with the two cakes.”

As the scope of universal quantifier is extended, (39) wrongly predicts that the singular pronoun “soitu” (he/she) can have a bound variable reading. This suggests that the scope of a universal quantifier must not extend beyond a sentential boundary.

The second option is to use Skolem functions. Compare the standard translation and Skolemised translation of (34a).

- (41) a.  $\forall x[\text{participant}(x) \rightarrow \exists y[\text{two cakes}(y) \& \text{choose}(x)(y)]]$   
 b.  $\exists f \forall x[\text{participant}(x) \rightarrow [\text{two cakes}(f(x)) \& \text{choose}(x)(f(x))]]$

The idea is that the seemingly narrow scope reading of an indefinite actually comes from a Skolem function of type  $\langle e, e \rangle$  and the existential quantifier which binds this function takes scope over the universal quantifier. This idea has been applied to the interaction between *wh*-expressions and quantifiers (Chierchia, 1993; Engdahl, 1986, a.o.) and exceptional wide scope of indefinites (Kratzer, 1998; Reinhart, 1997; Winter, 1997, a.o.).<sup>13</sup> For the ease of exposition, I demonstrate how to implement this idea in a static setting. Note that this does not affect the main body of the discussion. One can implement a dynamic semantic system with Skolem functions by using discourse referents for functions.

Let's see how Skolem functions derive the dependent singular anaphora observed in (34b). First of all, I assume cumulativity for functions.

- (42)  $f$  is cumulative iff  $\forall x, y[[f(x) = x' \& f(y) = y'] \rightarrow f(x+y) = x' + y']$

Now, the observed readings of (34b) comes for free. The indefinite “huta-tu-no keeki” (two cakes) introduces a function  $f$  from participants to cakes and “sono-huta-tu-no keeki” (the two cakes) is anaphoric to this function.

- (43) a.  $\exists f \forall x[\text{participant}(x) \rightarrow [\text{two cakes}(f(x)) \& \text{choose}(x)(f(x))]]$   
 b.  $[\text{satisfied}(\text{participants})(f(\text{participants}))]$

Imagine the content of  $f$  is as in (44).

- (44)  $f = \{\langle \text{participant}_1, \text{cake}_1 + \text{cake}_2 \rangle, \langle \text{participant}_2, \text{cake}_3 + \text{cake}_4 \rangle, \dots, \langle \text{participant}_n, \text{cake}_n + \text{cake}_m \rangle, \dots, \langle \text{participant}_1 + \dots + \text{participant}_n, \text{cake}_1 + \text{cake}_2 + \dots + \text{cake}_n + \text{cake}_m \rangle\}$

13. The definition of an  $n$ -ary General Skolem function is as follows Chierchia (2001); Schlenker (2006); Winter (2002, 2004). Choice functions are special cases of this general Skolem function when it is 0-ary.

(1)  $F$  is an  $n$ -ary general Skolem function for restricted quantification if for any  $n$ -tuple  $\langle d_1, \dots, d_n \rangle$  of objects and any set  $E$ ,  $F(d_1, \dots, d_n, E) \in E$  if  $E \neq \emptyset$ , and  $F(d_1, \dots, d_n, \emptyset) = \#$  if  $E = \emptyset$ .

The function  $f$  stores dependency between participants and cakes:  $f$  is a set of pairs whose first coordinate is a participant and the second coordinate is two cakes which the participant chose. Thus, if the pronoun “karera” (they) refers to the plural individual  $\text{participant}_1 + \dots + \text{participant}_n$ ,  $f(\text{they}) = \text{cake}_1 + \text{cake}_2 + \dots + \text{cake}_n + \text{cake}_m$ . In this way, the intended reading is derived without putting an indefinite under the scope of “sorezore” and (34b) does not pose a problem for the classic dynamic semantics any more.

Although this second option derives the dependent singular anaphora without extending the scope of universal quantification, it still does not explain why (40b) is infelicitous. In order to make (40b) infelicitous, one has to stipulate that the relevant Skolem function has to be strictly plural: the domain of Skolem functions do not contain any atomic individual.

$$(45) \quad f \text{ is strictly plural iff } \forall x [\text{ATOM}(x) \rightarrow x \notin \text{Dom}(f)]$$

If  $f$  is strictly plural, it explains why (40b) is infelicitous: “soitu” (the person) refers to an atomic individual and thus  $f$  is undefined with respect to it. However, this pluralisation of a Skolem function must not apply in (40a). “Sorezore” quantifies over a set of atomic participants and  $f$  maps an atomic participant to the corresponding set of two cakes in (43a). Thus, if  $f$  has to be strictly plural in (40a),  $f(x)$  is not defined because atomic individuals are not within the domain of the strictly pluralised denotation of  $f$ . As a result, (40a) is wrongly predicted to be infelicitous. There is a similar problem with respect to drefs under the scope of “sorezore.” Dependent singular anaphora is observed without having a pronoun which is co-referential with the sorting key of “sorezore.”

- (46) a. Eigyoobuchoo-tachi<sup>u1</sup>-ga sorezore<sup>u2</sup><sub>u1</sub> ichiban-shinyoodekiru buka<sup>u3</sup>-ni  
 sales manager-PL-NOM DIST most-trustworthy subordinate-DAT  
 juuyoona-anken<sup>u4</sup>-o takushi-ta.  
 important-case leave-PAST  
 “The managers of the sales department left an important case to a subordinate who they trust the most.”
- b. Karera<sup>u3</sup>-wa sorezore **sono-anken**<sub>u4</sub>-o migotoni konashi-ta.  
 they-TOP DIST the-case-ACC well complete-PAST  
 “They completed the case very well.”

In parallel with (34b), (46b) poses a problem for the classical dynamic semantics because drefs under the scope of “sorezore” antecedent pronouns outside the scope of “sorezore.” However, unlike (34b), no variable occurs in (46b) whose value is co-referential with the antecedent of “sorezore.” Thus, if the relevant functions choose managers as its domain, these are undefined as in (47b). In other words, it is left unexplained where the value of “managers” comes from.

- (47) a.  $\exists f \exists g \forall x [\text{manager}(x) \rightarrow [\text{subordinate}(f(x)) \& \text{case}(g(x)) \& \text{leave}(x)(f(x))(g(x))]]$   
 b.  $*[\text{complete}(f(\text{managers}))(g(\text{managers}))]$

One possible modification is to make the value of “anken” (case) dependent on the value of “buka” (subordinate). When the value of “buka” (subordinate) is dependent on the value of “eigyoobuchoo” (sales manager), “anken” (case) is transitively dependent on “eigyoobuchoo” (sales manager). In other words, this modification enables a Skolem function to take one of its co-argument as its domain. With this modification, the intended reading of (46b) is obtained as in (48b).

- (48) a.  $\exists f \exists g \forall x [\text{manager}(x) \rightarrow [\text{subordinate}(f(x)) \& \text{case}(g(f(x))) \& \text{leave}(x)(f(x))(g(f(x)))]]$   
 b.  $[\text{complete}(\text{subordinates})(g(\text{subordinates}))]$

Although (48b) can express covariation between subordinates and cases, it does not explain where the value of “subordinates” comes from. If “karera” (they) takes its value not via the function  $f$ , there has to be an antecedent which refers to plural subordinates. However, (48a) does not involve such plural subordinates.

This raises a dilemma: if “karera” (they) picks up a Skolem function  $f$ , it is undefined because its domain is undefined in (46b). If “karera” (they) picks up the value of plural subordinates, it is undefined because plurality of subordinates is not given in the prior discourse.

That being said, the observations so far motivate some kind of functional dependency among the antecedent of “sorezore” and indefinites under the scope of “sorezore.” This functional dependency is described in (49).

- (49) a.  $F = \{\langle a_1, a_2, a_3, \dots \rangle, \langle b_1, b_2, b_3, \dots \rangle, \langle c_1, c_2, c_3, \dots \rangle\}$   
 b. For any  $n$ -th coordinate  $x$  and  $n + m$ -th coordinate  $y$  of  $F$ , there is a function  $f$  such that  $f(x) = y$ .

$F$  is quite similar to the notion of case (Lewis, 1975). (49) is amount to saying that one can construct an arbitrary function from a coordinates to another coordinate of a case. The challenge is how to implement such functional dependency in a way that this is sensitive to plurality of pronouns.

Summing up, dependent singular anaphora poses a challenge to the classical dynamic semantics. In the classical dynamic system, universal quantifiers are tests and thus supposed to not pass on the value of drefs introduced in its scope to the output assignments. The alternatives with extended scope of universal quantification and Skolem functions do not work. The main problem with these alternatives is that the contrast between (34b) and (40b) remains puzzling. In other words, these do not explain the role of plurality in dependent singular anaphora. In addition to this, there is a case in which a dref under the scope of “sorezore” antecedes a plural pronoun in absence of a term which refers to the antecedent of “sorezore.” Neither anaphoric reference to a Skolem function nor anaphoric reference to a plural individual can derive the intended reading.

## 2.4 Pluralities of variable assignments

The problem of dependent anaphora poses a challenge to Hypothesis 2 in (15). It suggests that the scope of universal quantifier is not always inaccessible. This is a motivation for dynamic semantics with plurality of variable assignments (Brasoveanu, 2007, 2008; Nouwen, 2003; van den Berg, 1996, a.o.). In parallel with conditionals, a universal quantifier passes on the value of drefs introduced in its restrictor to its scope as shown in (50a), but it does not beyond it as shown in (50b-i) and (50b-ii). This is on a par with the prediction of the classical dynamic system. However, plural pronouns can take the value of those supposedly inaccessible drefs as shown in (50b-iii) and (50b-iv).

- (50) a. Every student <sup>$u_1$</sup>  who wrote a manuscript <sup>$u_2$</sup>  submitted it <sub>$u_2$</sub>  to a journal.  
 b. Every student <sup>$u_1$</sup>  wrote a manuscript <sup>$u_2$</sup> .  
     i. # She <sub>$u_1$</sub>  submitted it <sub>$u_2$</sub>  to a journal.  
     ii. # It <sub>$u_2$</sub>  discusses a novel issue.  
     iii. They <sub>$u_1$</sub>  submitted these <sub>$u_2$</sub>  to a journal.  
     iv. These <sub>$u_2$</sub>  discuss a novel issue.

This challenges to the idea in the classical dynamic system that universal quantifiers are tests. At the same time, one wants to keep the system disallowing singular pronouns to access to the drefs introduced within universal quantification. One intuitive idea is that universal quantifiers also pass on the value of drefs to the next formulae, but they only assign a plural value. However, the notion of plurality in this context differs from the classic notion of plurality of individuals (Brasoveanu, 2008; Kanazawa, 2001; Krifka, 1996).

- (51) a. Farmers round up the donkeys at night.  
 b. \*A farmer rounds up a donkey at night.  
 c. \*Every farmer<sup>*u*<sub>1</sub></sup> who owns a donkey<sup>*u*<sub>2</sub></sup> rounds it<sub>*u*<sub>2</sub></sub> up at night.

The contrast between (51a) and (51b) shows that the collective predicate “round up” requires its direct object to denote a plural individual. If universal quantification introduces plural value to a dref, it should be the case that a morphologically singular term “a donkey” licenses the collective predicate under the scope of universal quantifier. However, (51c) shows that this is not the case. Thus, here is a dilemma: on one hand, drefs introduced under universal quantifier are accessible to morphologically plural pronouns, but on the other hand, these pronouns are not plural in the classical sense.

In addition to it, a singular pronoun under the scope of another quantifier behaves in parallel with a plural pronoun as in (52b).

- (52) a. Every student<sup>*u*<sub>1</sub></sup> wrote a manuscript<sup>*u*<sub>2</sub></sup>.  
 b. Each of the student<sub>*u*<sub>1</sub></sub> submitted it<sub>*u*<sub>2</sub></sub> to a journal.

This is a case of dependent singular anaphora, which poses another challenge to the classical dynamic notion of universal quantification.

Thus, the challenge is to allow plural pronouns and singular pronouns under the scope of another quantifier to pick up the value of drefs introduced under the scope of quantifiers, while disallowing plain singular pronouns to do so. On this point, one can consider that universal quantification introduces *pluralities of variable assignments* (Brasoveanu, 2007, 2008; Nouwen, 2003; van den Berg, 1996, a.o.). A plural assignment is a set of assignments as shown in (53).



- (53) Plural assignment  $G$  is a set of variable assignments such that  
 $G = \{g_1, g_2, \dots, g_n\}$ ,  $g_1(u_n) = x_1$ ,  $g_2(u_n) = x_2$ , ...,  $g_n(u_n) = x_n$  and  
 $G(u_n) = \{g_1(u_n), g_2(u_n), \dots, g_n(u_n)\} = \{x_1, x_2, \dots, x_n\}$

The idea is that distributive universal quantification introduces plurality of variable assignments and evaluates its scope with respect to subsets of a plural variable assignment. Accordingly, universal quantifiers are not defined as tests, but a pronoun has to be plural to pick up the plural value of the dref. I introduce the final version of the hypothesis for “sorezore” based on this plural dynamic system.

- (54) Hypothesis 3: Plural dynamic system
- The meaning of a sentence is a relation between an input **set of** variable assignments and output **sets of** variable assignments.
  - An indefinite introduces a new variable and expands the set of existing assignments to assign it a random value.
  - Some formulae do not pass on the values of variables introduced there to the output sets of variable assignments.
  - “Sorezore” has to bear the same index as its antecedent.

Discourse referent introduction is generalised so that it introduces new values to plural variable assignments as defined in (55). Note that I use (55) for an expository purpose in this Chapter and I will revise it in Chapter 3.<sup>14</sup>

$$(55) \quad G[u]H \Leftrightarrow \forall g[g \in G \rightarrow \exists h[h \in H \& g[u]h]] \& \forall h[h \in H \rightarrow \exists g[g \in G \& g[u]h]]$$

The logical connectives in this plural dynamic system are defined in the same way as in the classical dynamic system.

- (56) a.  $G[[\phi \text{ and } \psi]]H \Leftrightarrow \exists K[G[[\phi]]K \& K[[\psi]]H]$   
 b.  $G[[\exists u \phi]]H \Leftrightarrow \exists K[G[u]K \& K[[\phi]]H]$   
 c.  $G[[\text{not } \phi]]H \Leftrightarrow [G = H \& \neg \exists K[H[[\phi]]K]]$   
 d.  $G[[\text{if } \phi \text{ then } \psi]]H \Leftrightarrow [G = H \& \forall K[H[[\phi]]K \rightarrow \exists J[K[[\psi]]J]]]$   
 e.  $G[[\phi \text{ or } \psi]]H \Leftrightarrow [G = H \& \exists K[H[[\phi]]K \vee H[[\psi]]K]]$

14. The definition I adopt in Chapter 3 is given in (1), which is another prominent definition of dref introduction to plural variable assignment. See Chapter 3 for discussion.

(1)  $G[u]H \Leftrightarrow \exists D[H = \{h | \exists g \exists d[g[u]h \& h(u) = d \& g \& d \in D]\}]$

The plural dynamic system and the classical dynamic system differ in how universal quantification is defined. In the classical dynamic system, a universal quantifier unselectively quantifies over variable assignments and the output assignment forgets about these assignments. In the plural dynamic system, a universal quantifier selectively quantifies over variable assignments and the output assignment is the sum of those assignments. To define selective quantification over variable assignments, one needs the dynamic distributivity operator  $\delta$  (van den Berg, 1996, *et seq*). Formulae under the scope of the  $\delta$ -operator are evaluated with respect to subsets of a plural variable assignment. (57a) is a way to choose a subset of  $G$  with respect to  $\text{dref } u_n$  and (57b) is the definition of the  $\delta$  operator.<sup>15</sup>

- (57) a.  $G_{u_n=d} = \{g : g \in G \ \& \ g(u_n) = d\}$   
 b.  $G[\delta_{u_n}(\phi)]H \Leftrightarrow [G(u_n) = H(u_n) \ \& \ \forall d [d \in G(u_n) \rightarrow G_{u_n=d}[[\phi]]H_{u_n=d}]]$

(57b) partitions a plural variable assignment with respect to  $u_n$ , i.e. it partitions  $G$  into  $G_{u_n=d}$  for each value of  $u_1$  stored in  $G$ . Then, it distributively evaluates a formula  $\phi$  with respect to those subsets of the input plural variable assignment  $G$  and the corresponding subsets of an output plural variable assignment  $H$ .

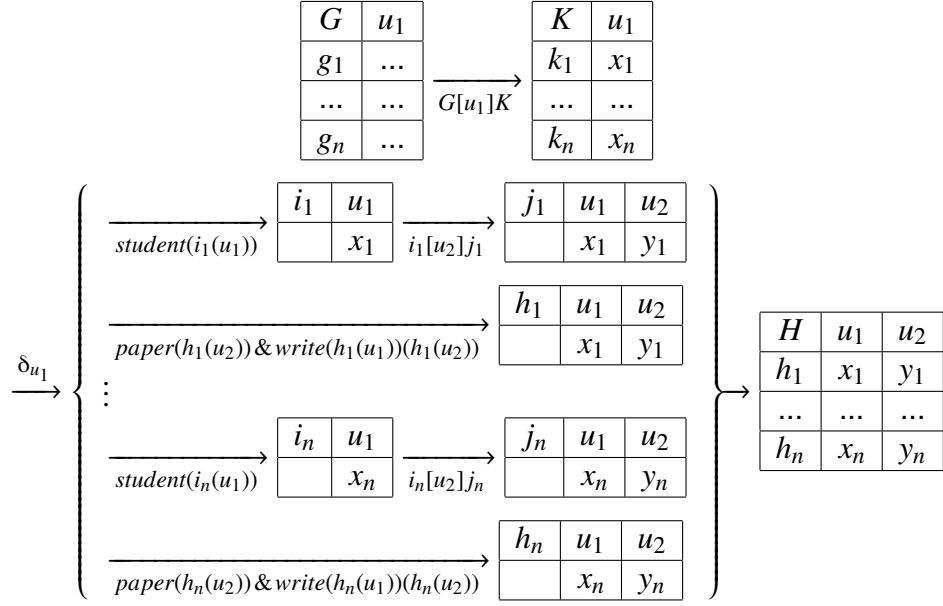
To see how it works, consider the pair of sentences in (58).

- (58) a. Every student <sup>$u_1$</sup>  wrote a paper <sup>$u_2$</sup> .  
 b. They <sub>$u_1$</sub>  submitted these <sub>$u_2$</sub>  to a journal.

Table 2.13 visualises how (58a) updates an input assignment. I keep using a large curly bracket to indicate the scope of an operator. I do not reflect it in tables, but the output assignment sums

15. Brasoveanu (2008) also defines an unselective version  $\delta$ -operator.

(1)  $G[\delta(\phi)]H \Leftrightarrow \exists f [G = \text{Dom}(f) \ \& \ H = \cup \text{Ran}(f) \ \& \ \forall g [g \in \text{Dom}(f) \rightarrow g[[\phi]]f(g)]]$

**Table 2.13:** Universal quantification with plural variable assignments

In Table 2.13, “every” introduces some values to  $u_1$  and evaluates its restrictor and scope with the  $\delta$  operator.<sup>16</sup> It requires that for each subset of  $K$  in which  $u_1$  has a particular value, if  $u_1$  is a student, then  $u_2$  is a paper such that  $u_1$  wrote  $u_2$ . On this point, it is crucial that the values of  $u_1$  and  $u_2$  are singular under each subset of assignments, but their values are plural under the largest sum of assignments, e.g.,  $h_1(u_2) = y_1$ ,  $h_n(u_2) = y_n$  and  $H(u_2) = y_1 + \dots + y_n$ . This explicates the role of plurality in distributive quantification: singular terms can store a plural value when it is evaluated under the scope of  $\delta$ . For example, “paper” is singular and it requires an atomic individual. However, it is evaluated under the scope of  $\delta$  in Table 2.13 and thus it only requires the value of  $u_2$  to be singular in each subset of assignments, i.e.  $h_1, \dots, h_n$ .

Now, the output plural variable assignment  $H$  in Table 2.13 stores a plural value of students in  $u_1$  and a plural value of papers in  $u_2$ . The plural pronouns “they” and “these” can retrieve these plural values when they are respectively co-indexed with  $u_1$  and  $u_2$ . In this case,  $[[\text{they}]] = u_1$  and  $[[\text{they}]] = u_2$ . Table 2.14 shows that “they” and “these” each pick up the plural values of students and papers.

16. See Chapter 4 for the more precise definition of generalised quantifiers.

$H$	$u_1$	$u_2$		$L$	$u_1$	$u_2$
$h_1$	$x_1$	$y_1$	$\xrightarrow{\text{submit to a journal}(l(u_1))(l(u_2))}$	$l_1$	$x_1$	$y_1$
...	...	...		...	...	...
$h_n$	$x_n$	$y_n$		$l_n$	$x_n$	$y_n$

**Table 2.14:** Anaphoric dependency across the scope of universal quantifier

Since the  $\delta$  operator is not a test, it is expected that pronouns can retrieve the values of drefs introduced under the scope of  $\delta$ . Furthermore, the drefs introduced under the  $\delta$  operator stores a plural value. Thus, a pronoun has to be plural to pick up the value of  $u_1$  and  $u_2$  in Table 2.14. If a pronoun is singular, it conflicts with the plural value of  $u_1$  and  $u_2$  under assignment  $H$  because singular pronouns can only take an atomic value. This explains the infelicity of (59b).

- (59) a. Every student <sup>$u_1$</sup>  wrote a manuscript <sup>$u_2$</sup> .  
 b. # She <sub>$u_1$</sub>  submitted it <sub>$u_2$</sub>  to a journal.

However, if a singular pronoun is evaluated under the scope of  $\delta$ , its singularity condition is evaluated with respect to each subset of a plural variable assignment. Thus, this approach offers a natural account for dependent singular anaphora, which is exemplified in (60b).

- (60) a. Every student <sup>$u_1$</sup>  wrote a paper <sup>$u_2$</sup> .  
 b. Each of the students <sub>$u_1$</sub>  submitted it <sub>$u_2$</sub>  to a journal.

In (60b), “each” introduces the  $\delta$  operator and it distributively evaluates its scope with respect to the value of  $u_1$ . Crucially, the singular pronoun is evaluated under the scope of  $\delta$  and its singularity condition is evaluated with respect to those subsets of assignments. As a result, “it” can pick up a singular value when it is co-indexed with  $u_2$  because the value of  $u_2$  is singular in the subsets of assignments, e.g.,  $l_1, \dots, l_n$  as illustrated in Table 2.15.

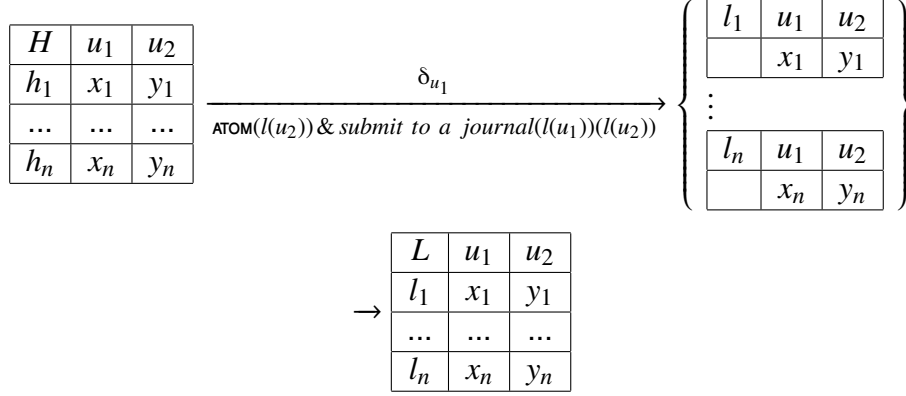


Table 2.15: Dependent anaphora

Notice that (60b) has to mean that the students submitted the paper which she/he wrote to a journal, i.e. the student-paper pairs introduced in (60a) are retrieved in (60b). Another advantage of adopting plurality of variable assignments lies here: plural variable assignments store not only the value of drefs, but also dependency among them. Specifically, the columns show the values of a dref across assignments and the rows show dependency among drefs in each assignment. This is exactly the type of functional dependency discussed in §3. Thus, plural variable assignments can easily deal with the storage and retrieval of dependencies.

In this way, this plural dynamic system offers a principled account for the contrast between a singular pronoun and a plural pronoun. Now, the toy plural dynamic semantic entry of “sorezore” is defined in (61).

$$(61) \quad G[\text{sorezore}_{u_n} \phi]H \Leftrightarrow [G(u_n) = H(u_n) \& \forall d [[d \in G(u_n) \& \text{ATOM}(d)] \rightarrow G_{u_n=d}[\phi]H_{u_n=d}]]$$

Essentially, “sorezore” can be thought of as an overt realisation of  $\delta$ -operator.<sup>17</sup>

Let’s see how this semantics solves the problems raised in §3. The pair of examples of dependent singular anaphora are repeated in (62)

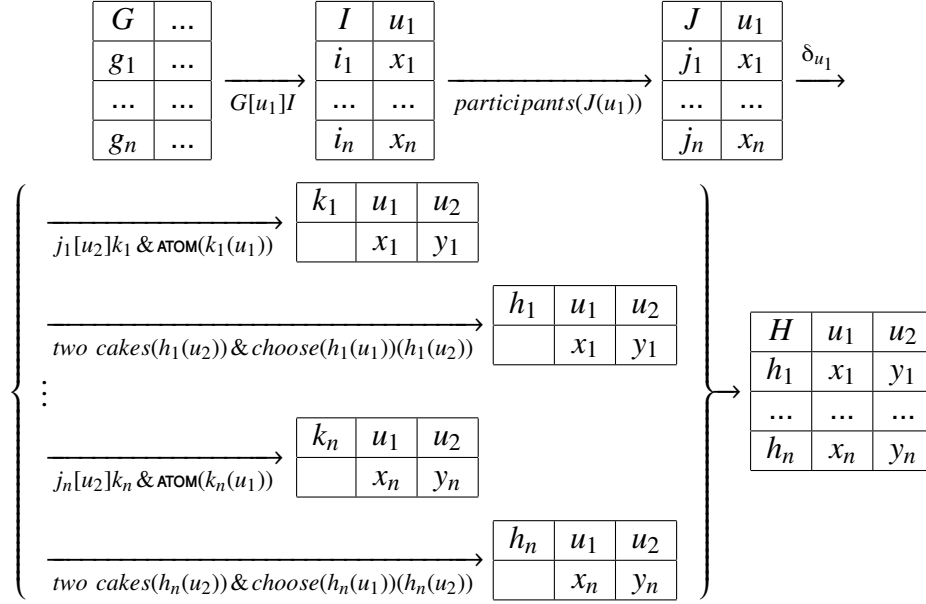
- (62) a. Sankasya<sup>u1</sup>-ga sorezore<sub>u1</sub> keeki<sup>u2</sup>-o huta-tu eran-da.  
 participant-NOM DIST cake-ACC 2-CL<sub>thing</sub> choose-PAST  
 “(The) participants each chose two cakes.”
- b. Karera<sub>u1</sub>-wa sorezore [sono-huta-tu-no keeki]<sub>u3</sub>-ni manzoku-site-ita.  
 they-TOP EACH the-2-CL<sub>thing</sub>-GEN keeki-DAT satisfied-PERF-PAST  
 “They were each satisfied with the two cakes.”

17. Again, this is only a toy semantics in the sense that “sorezore” is defined syncategorematically.

The denotation of (62a) is given in (63).

$$(63) \quad G[(62a)]H \Leftrightarrow \exists J[\exists I[G[u_1]I \& I[\text{participants}(J(u_1))]]J] \& \\ [J(u_1) = H(u_1) \& \forall d[[d \in J(u_1) \& \text{ATOM}(d)] \rightarrow \exists K[J_{u_1=d}[u_2]K_{u_1=d} \& \\ K_{u_1=d}[\text{two cakes}(H_{u_1=d}(u_2))]H_{u_1=d} \& \\ K_{u_1=d}[\text{choose}(H_{u_1=d}(u_1))(H_{u_1=d}(u_2))]H_{u_1=d}]]]$$

The update with (63) is visualised in Table 2.16.



**Table 2.16:** Update with plural dynamic “sorezore”

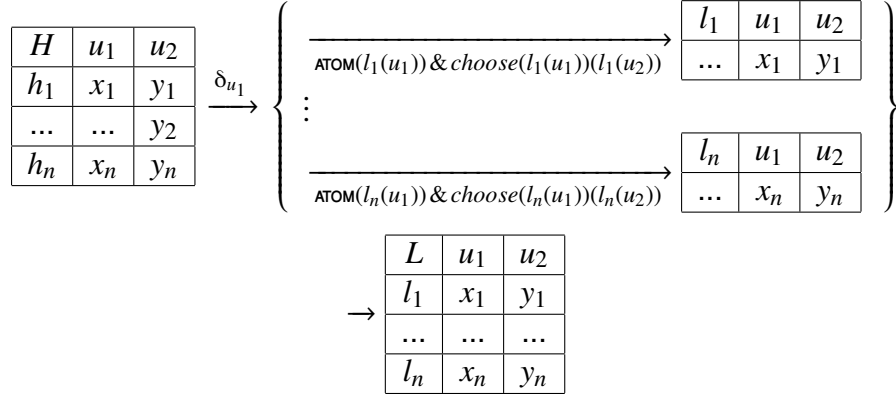
“Sorezore” is co-indexed with  $u_1$  and evaluates its scope with respect to the subset  $J_{u_1=d}$  of a plural variable assignment  $J$ . Importantly, the value of  $u_2$  is introduced in each of those subsets and the cardinality requirement is also checked with respect to those subsets. Accordingly,  $u_2$  stores a set of two cakes for each participants stored in  $u_1$ .

The denotation of (62b) is given in (64). Here, the anaphoric expression “sono-huta-tu-no keeki” (the two cakes) is evaluated under the scope of  $\delta$  and thus looks for its antecedent in the subsets  $L_{u_n=d}$ .<sup>18</sup>

$$(64) \quad H[(62b)]L \Leftrightarrow [H(u_1) = L(u_1) \& \forall d[[d \in H(u_1) \& \text{ATOM}(d)] \rightarrow \\ H_{u_1=d}[\text{choose}(L_{u_1=d}(u_1))(L_{u_1=d}(u_2))]L_{u_1=d}]]]$$

18. The subject pronoun “karera” is not under the scope of the floating “sorezore” in (62b). See Chapter 5 for the compositional detail.

This is visualised in Table 2.17. The  $\delta$  operator in (37) chooses the subset of assignment in the same way as “sorezore” in (64). As a result, “sono-huta-tu-no keeki” (the two cakes) can correctly pick up the appropriate value in each of those subsets, i.e.  $l_1(u_2), \dots, l_n(u_2)$ .



**Table 2.17:** Dependent singular anaphora with “sorezore”

This approach can be extended to the dependent singular anaphora among drefs under the scope of “sorezore.”

- (65) a. Eigyoobuchoo-tachi <sup>$u_1$</sup> -ga sorezore <sub>$u_1$</sub>  ichiban-shinyoodekiru buka <sup>$u_2$</sup> -ni  
 sales manager-PL-NOM DIST most-trustworthy subordinate-DAT  
 juuyoona-anken <sup>$u_3$</sup> -o takushi-ta.  
 important-case leave-PAST  
 “The managers of the sales department left an important case to a subordinate who they trust the most.”
- b. Karera <sub>$u_2$</sub> -wa sorezore **sono-anken** <sub>$u_3$</sub> -o migotoni konashi-ta.  
 they-TOP EACH the-case-ACC well do-PAST  
 “They did the case very well.”

The denotation of (65a) is given in (66).<sup>19</sup>

$$(66) \quad G[(65a)]H \Leftrightarrow \exists J [\exists I [G[u_1]I \& I[\text{manager}(J(u_1))]]J] \& [J(u_1) = H(u_1) \& \forall d [[d \in G(u_1) \& \text{ATOM}(d)] \rightarrow \exists K [G_{u_1=d}[u_2, u_3]K_{u_1=d} \& K_{u_1=d}[\text{subordinate}(H_{u_1=d}(u_2))]H_{u_1=d} \& K_{u_1=d}[\text{case}(H_{u_1=d}(u_3))]H_{u_1=d} \& K_{u_1=d}[\text{leave}(H_{u_1=d}(u_1))(H_{u_1=d}(u_2))(H_{u_1=d}(u_3))]H_{u_1=d}]]]$$

This is visualised in Table 2.18.

19. As in §2, I omit the irrelevant details in these denotations.

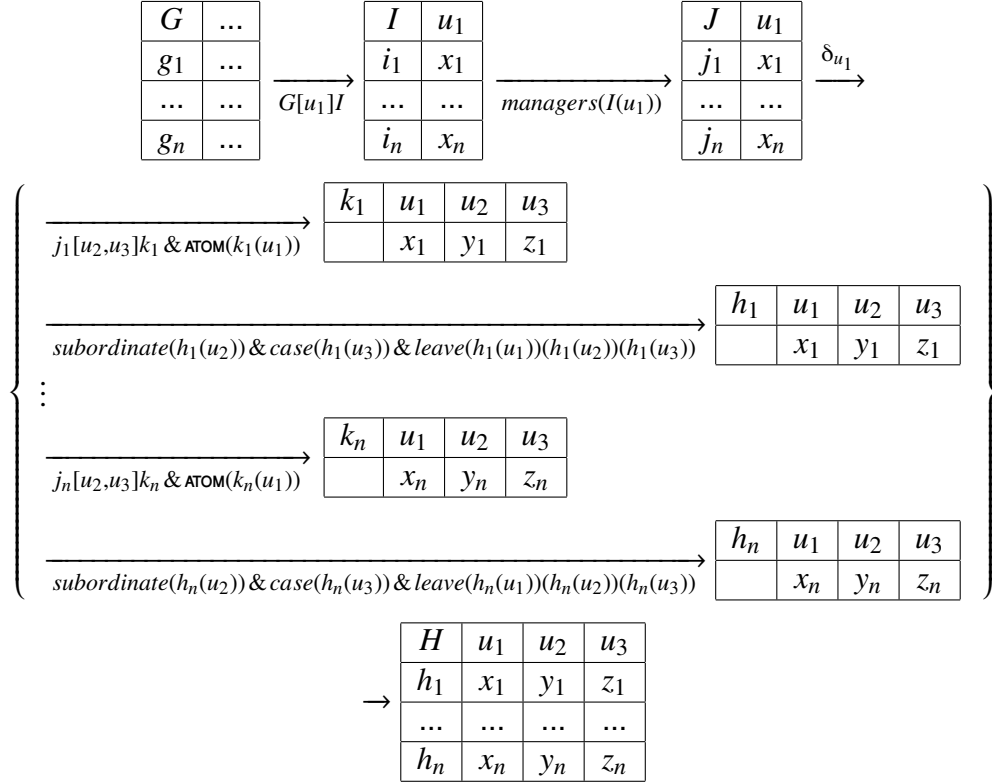


Table 2.18: Distributive reading of “sorezore”

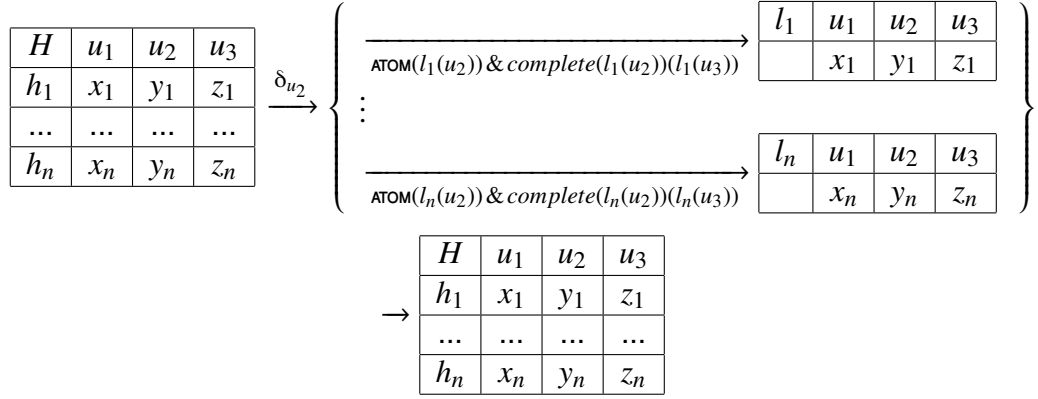
Since “sorezore” distributively evaluates its scope with respect to the value of its antecedent, any dref introduced under the scope of “sorezore” and the antecedent of “sorezore” are functionally related. Here, the dependency among managers, subordinates and cases in (65a) is stored in the plural variable assignment  $H$  as shown in Table 2.18.

Next, (65b) denotes (67). Unlike the previous example, “sorezore” in (67) is associated with  $u_2$ . As long as the value of  $u_2$  with respect to each sub-assignment  $h$  is atomic, this  $\delta$  operator specifies the same subsets as the one that “sorezore” in (66) specifies. As a result, “sono-anken” (the case) can correctly pick up the appropriate value in each of those subsets of assignments.

$$(67) \quad H[[ (65b) ]] L[H(u_2) = L(u_2) \& \forall d[[d \in L(u_2) \& \text{ATOM}(d)] \rightarrow H_{u_2=d}[[\text{do}(L_{u_2=d}(u_2))(L_{u_2=d}(u_3))]] L_{u_2=d}]]]$$

This visualised in Table 2.19.



**Table 2.19:** Dependent singular anaphora under the scope of “sorezore”

Since the dependency among managers, subordinates and cases is stored in the context, dependent singular anaphora with the  $\delta$  operator can retrieve any part of this dependency. Thus, the availability of dependent singular anaphora in (65b) follows naturally in this approach.

Summing up, the notion of pluralities of variable assignments offers a solution to the issues of dependent anaphora and one can assume that “sorezore” is defined as an overt realisation of the  $\delta$  operator. This account for the contrast between plural pronouns and singular pronouns discussed in §3. Also, the functional dependency among drefs is guaranteed by plurality of variable assignments.

## 2.5 Conclusion

In this chapter, I motivated an approach to “sorezore” under the dynamic semantics with plurality of variable assignments. I started with a static theory of anaphora, but this approach runs into a problem of tests: negation, conditional and disjunction disallow “sorezore” to pick up its antecedent there. This motivates a dynamic approach, in which the meaning of a sentence is an update on variable assignments. Although the distribution of the antecedent of “sorezore” follows in this approach, it faces a problem of dependent anaphora. This motivates a dynamic approach with pluralities of variable assignments. In this approach, distributive universal quantifiers plurality of variable assignments and it can deal with dependent anaphora in a way that acknowledges the contribution of the plural marking on pronouns.

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## Chapter 3

# Plural Compositional Discourse Representation Theory with events

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### 3.1 Necessity for sub-clausal compositionality

In this chapter, I introduce a dynamic semantic system which comes with pluralities of variable assignments and full sub-clausal compositionality. As a general theoretical concern, a compositional system is called for to clarify how syntactic structures are translated into logical semantic representations. In addition, the syntactic and semantic properties of “sorezore” suggest that its interpretation crucially depends on where in a clause it occurs. Thus, a compositional dynamic semantics is vital for my purpose. In this thesis, I adopt *Plural Compositional Discourse Representation Theory*, (PCDRT) (Brasoveanu, 2007, 2008), which is based on *Compositional Discourse Representation Theory*, (CDRT) (Muskens, 1996). (P)CDRT allows us to define standard techniques in Montague-style type-driven semantics under a dynamic setting and thus sub-clausal compositionality follows in a straightforward way. As another important feature of PCDRT, it is easy to compare with other static Montague-style compositional semantic theories. I adopt a version of PCDRT with four features: (i) its sub-clausal composition is Neo-Davidsonian with events and eventive discourse referents, (ii) anaphoric expressions introduce their own discourse referents and anaphoric dependency is modelled with the co-reference condition, (iii) the default option of discourse referent introduction does not introduce a new dependency, and (vi) it acknowledges both domain pluralities and discourse pluralities.

## 3.2 Compositional dynamic semantics

In this section, I introduce a compositional implementation of dynamic semantics which serves as the baseline for the theory I adopt in this thesis. I first review the *Compositional Discourse Representation Theory* (CDRT) (Muskens, 1996) and then review the *Plural Compositional Discourse Representation Theory* (PCDRT) (Brasoveanu, 2007, 2008), which is a CDRT with pluralities of variable assignments.

Muskens (1996) emulates *Discourse Representation Theory* (DRT) with a simple ordinal many-sorted type logic.<sup>1</sup> He assumes four basic types in Table 3.1.<sup>2</sup>

Types	Names	Variables	Constants
$t$	truth value		1, 0
$e$	entities	$x, y, z, \dots$	Ann, Belle, Chris, ...
$s$	states	$g, h, i, \dots$	
$\pi$	registers	$v, v', v'', \dots$	$u_n$

**Table 3.1:** The basic types in CDRT

Registers of type  $\pi$  can be thought of as a small chunk of space to store one object and used to model discourse referents (drefs). Intuitively speaking, whenever one encounters an indefinite, a new referent is stored in a register and whenever one encounters a pronoun, it retrieves the content of the register associated with its antecedent. Drefs  $u$  are names of registers and thus constants of type  $\pi$ . Muskens (1996) distinguishes *variable registers* and *constant registers*. The content of the former changes when an indefinite introduces a new value to it, where as the content of the latter is fixed. These each corresponds to individual variables and constants in a static system. He calls drefs which name variable registers *unspecific discourse referents* and those which name constant registers *specific discourse referents*. He assumes that proper names denote specific drefs, i.e.  $\text{John}_u$  such that  $v(\text{John}_u)(g) = \text{John}$ . However, I treat proper names with unspecific drefs, i.e.  $[u|u = \text{John}]$ , following Brasoveanu (2007).

States of type  $s$  can be thought of as lists of the current inhabitants of all registers and used to model variable assignments as Table 3.2 demonstrates.

1. In this Chapter, I adopt DRT-style discourse representations in a type logical object language. Nevertheless, the result is quite similar to the DPL-style notation I adopted in Chapter 2.

2. The type  $\pi$  is not used in Brasoveanu (2008). Instead, he defines a discourse referent as a function from a state to an individual, i.g.  $\langle se \rangle$ . In this thesis, I follow the original version proposed in Muskens (1996). Note that Dotlačil (2013) also adopts type  $\pi$  in his version of PCDRT.

	$u_1$	$u_2$	$u_3$	...
$g_1$	Angelika	Danny	Greg	...

	$u_1$	$u_2$	$u_3$	...
$g_2$	Barbara	Elin	Hannah	...

	$u_1$	$u_2$	$u_3$	...
$g_3$	Craige	Fred	Irene	...

**Table 3.2:** Registers and states

Following Brasoveanu (2010); van den Berg (1996), I adopt a dummy individual  $\star$ . This is a universal falsifier and if a relation takes  $\star$  as its argument, it is false, e.g.,  $\text{dog}(\star)$  is false.<sup>3</sup> Introduction of a new value to a dref is now understood as replacement of a dummy individual with a non-dummy individual as exemplified in Table 3.3.

	$u_1$	$u_2$	$u_3$	...
$g$	$\star$	$\star$	$\star$	...

 $\rightarrow$ 

	$u_1$	$u_2$	$u_3$	...
$k$	$x$	$\star$	$\star$	...

 $\rightarrow$ 

	$u_1$	$u_2$	$u_3$	...
$h$	$x$	$y$	$\star$	...

**Table 3.3:** Dummy individuals

Lastly, Muskens (1996) defines a non-logical constant  $v$  of type  $\langle \pi, \langle se \rangle \rangle$ . This tells the occupant of a register  $u_n$  under a state  $g$ , e.g.,  $v(u_3)(g_1) = \text{Greg}$  in Table 3.2. Note that variable assignments are modelled as a primitive entity in CDRT.<sup>4</sup>

Building on this type system, Muskens (1996) sets up four axioms to emulate DRT. Let  $\text{VAR}$  be a set of variable registers.

- (1) a. Axiom 1:  $\forall g \forall v \forall x [\text{VAR}(v) \rightarrow \exists h [g[v]h \ \& \ v(v)(h) = x]]$
- b. Axiom 2:  $\text{VAR}(u)$ , if  $u$  is an unspecific discourse referent.
- c. Axiom 3: For any different unspecific discourse referents  $u_n$  and  $u_m$ , they refer to different registers.
- d. Axiom 4:  $\forall g [v(a)(g) = a]$  if  $a$  is a specific discourse referent.

3. van den Berg (1996) assumes that  $\star$  makes a relation undefined.

4. A state  $g$  corresponds to a function  $\lambda v [v(v)(g)]$ , which preserves the original intuition that a variable assignment is a function from a dref to an individual variable. Brasoveanu (2008) notes that this is to ‘type-lift’ an assignment  $g$ , instead of a variable  $x$ .

The first axiom says that for every state, register and individual, there is another state which is minimally different from the original one with respect to the occupant of the given register. The second axiom says that an unspecific dref refers to a variable register. The third axiom says that different unspecific drefs refer to different variable registers. This is necessary to avoid a situation in which  $u_n$  and  $u_m$  happen to be the names for the same register and an update on one affects the other.<sup>5</sup> The fourth axiom says that the value of a specific dref is invariant across different states.

Now, dynamic semantic representations are treated as abbreviations of expressions in this type logical object language, which Muskens (1996) calls *the Logic of Change*. Let's see how it works with a simple example given in (2).

(2) A dog smiled.

In the classical DRT, the meaning of a sentence is represented as a *discourse representation structure* (DRS). The DRS of (2) is notated as a box as shown in (3a) or as a bracket with conditions as shown in (3b).

$x$
$\text{dog}(x)$ $\text{smiled}(x)$

b.  $[x | \text{dog}(x), \text{smiled}(x)]$

Here, I adopt the latter notation. The main point of Muskens (1996) is that this kind of representations can be regarded as abbreviations of logical forms in the Logic of Change. He proposes four abbreviations.

(4) Abbreviation 1 (Conditions):

- a.  $R\{u_1, u_2, \dots, u_n\} \Leftrightarrow \lambda g [R(v(u_1)(g))(v(u_2)(g)) \dots (v(u_n)(g))]$
- b.  $u_1 = u_2 \Leftrightarrow \lambda g [v(u_1)(g) = v(u_2)(g)]$

(5) Abbreviation 2 (Negation, disjunction and material implication):

- a.  $\text{not } K = \lambda g \neg \exists k [K(g)(k)]$
- b.  $K \text{ or } K' = \lambda g \exists k [K(g)(k) \vee K'(g)(k)]$
- c.  $K \Rightarrow K' = \lambda g \forall i [K(g)(i) \rightarrow \exists j [K'(i)(j)]]$

5. This should not be confused with co-reference: when two drefs are co-referential, they store the same value of type  $e$ , but they each refer to different registers of type  $\pi$ .

$$(6) \text{ Abbreviation 3 (DRS): } [u_1, \dots, u_n, | C_1, C_2, \dots, C_n] \\ = \lambda g \lambda h [g[u_1, \dots, u_n]h \& C_1(h) \& C_2(h) \& \dots \& C_n(h)]$$

$$(7) \text{ Abbreviation 4 (Sequencing): } K; K' = \lambda g \lambda h \exists k [K(g)(k) \& K'(k)(h)]$$

Abbreviation 1 states that an  $n$ -ary condition on drefs is an abbreviation of a condition on a state so that the occupants of registers under the state satisfies the relation  $R$ . Also,  $u_1 = u_2$  states that they store the same value under the same state.<sup>6</sup> Abbreviation 2 defines negation, disjunction and material implication. Note that these are essentially the same as their definitions in DPL. Abbreviation 3 states that a DRS is an abbreviation of a relation between two states so that (i) these minimally differ in newly introduced drefs and (ii) conditions check if an input state satisfies these. Again, these are essentially the same as the definition of formula in DPL. Lastly, Abbreviation 4 states that more than one DRS can be sequenced with the sequencing operator “;”. This is also an abbreviation. This is identical to the definition of conjunction in DPL.

With these abbreviations, for example, (2) is represented as (8a), which is an abbreviation of (8b).

$$(8) \text{ a. } [u_1 | \text{dog}\{u_1\}, \text{smiled}\{u_1\}] \\ \text{b. } = \lambda g \lambda h [g[u_1]h \& \text{dog}(v(u_1)(h)) \& \text{smiled}(v(u_1)(h))]$$

(Abbreviation 1 & 3)

As a result, a DRS representation is reduced to a logical form of the Logic of Change, which one can compute with lambda calculus. Now, the common semantic apparatus used in the classical Montagovian compositional semantics can be defined in CDRT. One can define “meta-type” (Brasoveanu, 2008), which makes types in CDRT and types in Montague grammar homomorphic. I use the capital letter  $T$  for  $\langle s, \langle st \rangle \rangle$  and  $E$  for  $\pi$ . For example, one place predicates of  $\langle et \rangle$  correspond to type  $\langle ET \rangle$  and generalised quantifiers of type  $\langle et, \langle et, t \rangle \rangle$  correspond to  $\langle ET, \langle ET, T \rangle \rangle$ . Consider the meaning of (2). The denotation of each terminal node is as in (9).

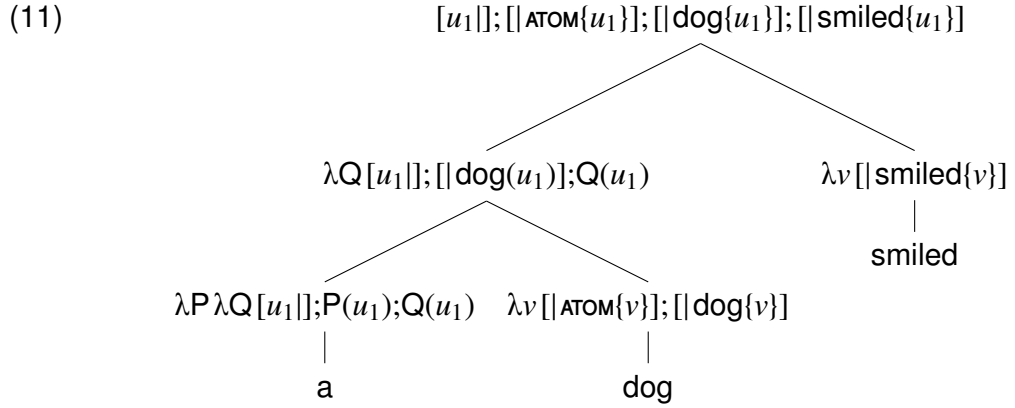
6. In Muskens (1996), it is the meaning for “is.” As I discuss later, I assume that an anaphoric expression introduces its own dref which is co-referential with its antecedent. Accordingly, I essentially take this abbreviation as the co-reference condition instead of the meanin of “is.” This does not suggest that I assume any relationship between the semantics of “is” and co-reference, which I do not discuss.

- (9) a.  $\llbracket a \rrbracket = \lambda P_{\langle ET \rangle} \lambda Q_{\langle ET \rangle} [u_n]; P(u_n); Q(u_n)$   
 b.  $\llbracket \text{dog} \rrbracket = \lambda v_E [\text{ATOM}\{v\}]; [\text{dog}\{v\}]$   
 c.  $\llbracket \text{smiled} \rrbracket = \lambda v_E [\text{smiled}\{v\}]$

(10) is obtained as the denotation of (2).

- (10)  $[u_1]; [\text{ATOM}\{u_1\}]; [\text{dog}\{u_1\}]; [\text{smiled}\{u_1\}]$

These are combined in a compositional way as shown in (11).



A sequence of DRSs can be simplified with *Merging Lemma*.

- (12) **Merging Lemma** (Muskens, 1996): If  $u'_1, \dots, u'_n$  do not occur in any of  $C_1, \dots, C_n$ , then the following two DRSs are equivalent.
- a.  $[u_1, \dots, u_n | C_1, \dots, C_n]; [u'_1, \dots, u'_n | C'_1, \dots, C'_n]$   
 b.  $[u_1, \dots, u_n, u'_1, \dots, u'_n | C_1, \dots, C_n, C'_1, \dots, C'_n]$

With this lemma, (10) is equivalent to (13a), which is an abbreviation of (13b).

- (13) a.  $[u_1 | \text{ATOM}\{u_1\} \& \text{dog}\{u_1\} \& \text{smiled}\{u_1\}]$   
 b.  $\lambda g \lambda h [g[u_1]h \& \text{ATOM}(u_1(h)) \& \text{dog}(v(u_1)(h)) \& \text{smiled}(v(u_1)(h))]$

Thus, the Logic of Change allows one to interpret DRT-style discourse representations as abbreviations of logical forms written in an ordinary many sorted type logic. As a result, one can compute the denotation of a clause from its parts with lambda calculus, just like in the classical Montagovian compositional semantic systems.

Now, I introduce PCDRT, which is a plural version of CDRT. In PCDRT, the values of drefs are stored with a set of states, which Brasoveanu (2008) calls *plural information states*. Plural information states correspond to plural variable assignments introduced in Chapter 2. As a result, each dref stores the values across different states and each singular state stores dependencies among drefs as shown in Table 3.4. I use capital letters  $G, H, I, \dots$  for variables of plural information states.

$G$	$u_1$	$u_2$	$u_3$	...
$g_1$	Angelika	Danny	Greg	...
$g_2$	Barbara	Elin	Hannah	...
$g_3$	Craige	Fred	Irene	...
...	...	...	...	...

**Table 3.4:** Plural states and registers

Evaluation of conditions is collective in PCDRT: a condition applies to a plural information state as a whole as shown in (14).<sup>7</sup> Note that  $v(u_n)(G)$  is an abbreviation of  $\{v(u_n)(g) : g \in G\}$ .

$$(14) \quad R\{u_1, \dots, u_n\} = \lambda G [R(v(u_1)(G)), \dots, (v(u_n)(G))]$$

(15) shows the atomicity condition and the cardinality condition in PCDRT .

$$(15) \quad \begin{aligned} \text{a. } \llbracket \text{ATOM} \rrbracket &= \lambda P_{\langle ET \rangle} \lambda v_E [\llbracket \text{ATOM} \{v\} \rrbracket] \\ \text{b. } \llbracket \text{three} \rrbracket &= \lambda P_{\langle ET \rangle} \lambda v_E [\llbracket 3 \text{ ATOM} \{v\} \rrbracket] \end{aligned}$$

The dynamic distributivity operator  $\delta$  is defined in (77b).

$$(16) \quad \begin{aligned} \text{a. } G_{u_n=d} &= \{g : g \in G \ \& \ v(u_n)(g) = d\} \\ \text{b. } \delta_{u_n}(D) &= \lambda G \lambda H [v(u_n)(G) = v(u_n)(H) \ \& \ \forall d \in v(u_n)(G) [D(G_{u_n=d})(H_{u_n=d})]] \end{aligned}$$

To see how the cardinality conditions and the  $\delta$  operator interact, consider the distributive reading of (17a) as an example.<sup>8</sup> In (17a), the  $\delta$  operator is co-indexed with dref  $u_1$  introduced with “three girls” and take “eat cakes” within its scope.

$$(17) \quad \begin{aligned} \text{a. } &\text{Three girls}^{u_1} \text{ eat two cakes}^{u_2}. \\ \text{b. } &[u_1]; [\llbracket 3 \text{ ATOM} \{u_1\} \rrbracket; [\llbracket \text{girl(s)} \{u_1\} \rrbracket; \\ &\delta_{u_1}([u_2]; [\llbracket 2 \text{ ATOM} \{u_2\} \rrbracket; [\llbracket \text{cake(s)} \{u_2\} \rrbracket; [\llbracket \text{eat} \{u_1\} \{u_2\} \rrbracket]]]] \end{aligned}$$

This is visualised in Table 3.5.

7. However, see §3.3.3 for discussion.

8. See §3.3.3 for collective readings and cumulative readings.



$G$	$u_1$	$\xrightarrow{\delta_{u_1}}$	$H$	$u_1$	$u_2$	$\rightarrow$	$H$	$u_1$	$u_2$
$g_1$	girl <sub>1</sub>		$h_1$	girl <sub>1</sub>	cake <sub>1</sub>		$h_1$	girl <sub>1</sub>	cake <sub>1</sub>
$g_2$	girl <sub>2</sub>		$h_2$	girl <sub>1</sub>	cake <sub>2</sub>		$h_2$	girl <sub>1</sub>	cake <sub>2</sub>
$g_3$	girl <sub>3</sub>		$h_3$	girl <sub>2</sub>	cake <sub>3</sub>		$h_3$	girl <sub>2</sub>	cake <sub>3</sub>
			$h_4$	girl <sub>2</sub>	cake <sub>4</sub>		$h_4$	girl <sub>2</sub>	cake <sub>4</sub>
			$h_5$	girl <sub>3</sub>	cake <sub>5</sub>		$h_5$	girl <sub>3</sub>	cake <sub>5</sub>
			$h_6$	girl <sub>3</sub>	cake <sub>6</sub>		$h_6$	girl <sub>3</sub>	cake <sub>6</sub>

Table 3.5: Update with  $\delta$ -operator

In the input plural information state  $G$ ,  $g_1$  stores the value girl<sub>1</sub>,  $g_2$  stores the value girl<sub>2</sub> and  $g_3$  stores the value girl<sub>3</sub>.  $\delta_{u_1}$  evaluates its scope with respect to these subsets of assignments. As a result, two cakes are stored as values of  $u_2$  for each subset of assignments as shown in Table 3.5.

Summing up, CDRT achieves the classical Montagovian sub-clausal compositionality by treating DRT-style discourse representations as abbreviations of logical forms in an ordinary many sorted type logic. PCDRT enriches this system of CDRT with the notion of plural information states. As a result, PCDRT achieves an explicit treatment of quantificational dependencies in the discourse.

### 3.3 PCDRT with events

In this section, I introduce a particular version of PCDRT I adopt in Chapter 4 and 5. Specifically, I make four assumptions: (i) sub-clausal composition achieves Neo-Davidsonian semantic composition, (ii) anaphoric expressions introduce their own drefs, (iii) the default definition of dref introduction does not introduce a new dependency, and (iv) the system acknowledges both domain pluralities and discourse pluralities. I later enrich this system in Chapter 7, but it is a straightforward extension of this version of PCDRT and all of the four assumptions stay the same.

#### 3.3.1 Event variables and Neo-Davidsonian composition

First of all, I add events and eventive drefs to PCDRT. I keep assuming a single type for registers, but I sort them into individual type registers and event type registers. I use  $v$  to name individual type registers and  $\epsilon$  to name event level registers.

Types	Names	Variables	Constants
$t$	truth value		1, 0
$e$	entities	$x, y, z, \dots$	Ann, Belle, Chris
$v$	entities	$e, e', e'', \dots$	
$s$	states	$g, h, i, \dots$	
$\pi$	registers	$v, v', v'', \dots, \epsilon, \epsilon', \epsilon'', \dots$	$u_n, \epsilon_n$

**Table 3.6:** The basic types in PCDRT with events

I revise the meta-type convention: I use meta-type  $E$  for type  $\pi$  entities which are sorted for individual drefs and meta-type  $V$  for type  $\pi$  entities which are sorted for eventive drefs. With eventive drefs, I adopt Neo-Davidsonian composition. Consider the meaning of (2), which is repeated in (18), again to see how it works.

(18) A dog smiled.

The denotation of each terminal node is given in (19). The verbal denotation is now decomposed into a unary eventive predicate and thematic relations. An eventive dref is introduced with the existential closure operator EC.<sup>9</sup>

- (19) a.  $\llbracket a \rrbracket = \lambda P_{\langle ET \rangle} \lambda Q_{\langle E, \langle VT \rangle \rangle} \lambda \epsilon_V [u_n]; P(u_n); Q(\epsilon)(u_n)$   
 b.  $\llbracket \text{dog} \rrbracket = \lambda v_E [\llbracket \text{ATOM}\{v\} \rrbracket]; [\llbracket \text{dog}\{v\} \rrbracket]$   
 c.  $\llbracket \text{smiled} \rrbracket = \lambda \epsilon_V [\llbracket \text{smiled}\{\epsilon\} \rrbracket]$   
 d.  $\llbracket \text{agent} \rrbracket = \lambda V_{\langle VT \rangle} \lambda v \lambda \epsilon_V [\llbracket \text{agent}\{\epsilon\}\{v\} \rrbracket]; V(\epsilon)$   
 e.  $\llbracket \text{EC} \rrbracket = \lambda V_{\langle VT \rangle} [\epsilon_n]; V(\epsilon)$

(20) is obtained as the denotation of (2).

(20)  $[\epsilon_1]; [u_1]; [\llbracket \text{ATOM}\{u_1\} \rrbracket]; [\llbracket \text{dog}\{u_1\} \rrbracket]; [\llbracket \text{agent}\{\epsilon_1\}\{u_1\} \rrbracket]; [\llbracket \text{smiled}\{\epsilon_1\} \rrbracket]$

9. Alternatively, one can assume that a lexical verb introduces a sub-event dref as defined in (1).

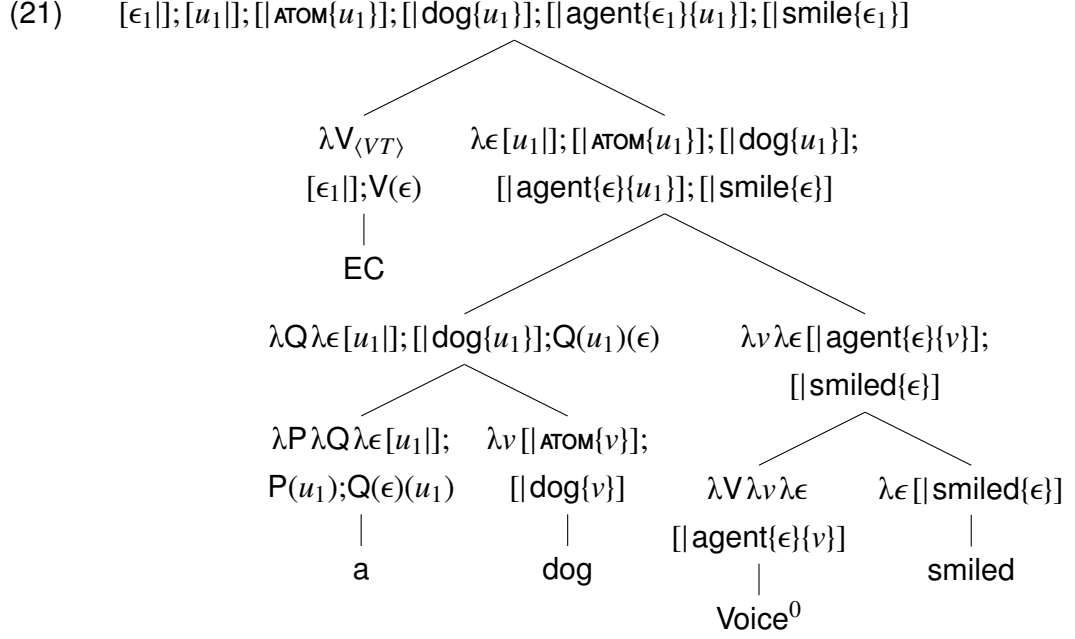
(1)  $\llbracket \text{Verb} \rrbracket = \lambda \epsilon_V [\epsilon']; [\epsilon' \subseteq \epsilon]; [\llbracket V\{\epsilon\} \rrbracket]$

This ensures that one can pick up the value of sub-events under the scope of distributive quantifiers. For example, the pronoun “it” picks up the largest sum of events in (2a), while it picks up different events relative to different girls in (2b).

(2) a. Every organ student sustained a note on the Wurlitzer for sixteen measures. **It** was unharmonious.  
 b. Every girl<sup>*u*<sub>1</sub> sang in her<sub>*u*<sub>1</sub></sub> room. They<sub>*u*<sub>1</sub></sub> each enjoyed **it**.</sup>

By allowing a verb itself to introduce an eventive dref, one can capture both of these options: “it” is co-indexed with the event that the EC operator introduces in (2a) and it is co-indexed with the event that the verb itself introduces in (2b). As the anaphoric potential of events is not the main focus of this thesis, I do not discuss it further and I adopt the simpler alternative in (19).

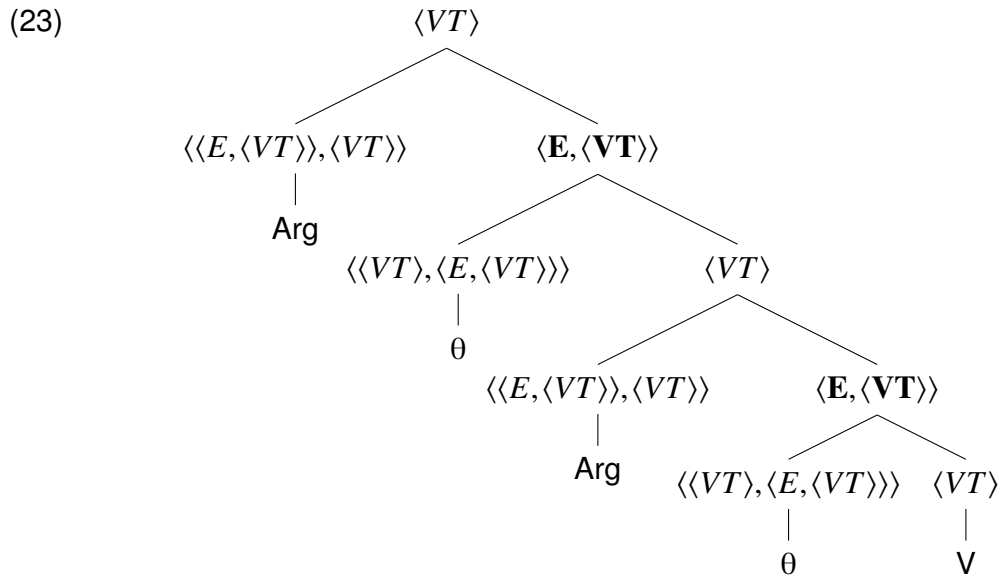
These are combined in a compositional way as shown in (21).



With Merging lemma, (20) is equivalent to (22a), which abbreviates (22b).

- (22) a.  $[u_1, \epsilon_1 | \text{ATOM}\{u_1\} \& \text{dog}\{u_1\} \& \text{agent}\{\epsilon_1\}\{u_1\} \& \text{smiled}\{\epsilon_1\}]$   
 b.  $\lambda g \lambda h [g[u_1, \epsilon_1] h \& \text{ATOM}(u_1(h)) \& \text{dog}(\nu(u_1)(h)) \& \text{agent}(\nu(\epsilon_1)(h))(\nu(u_1)(h)) \& \text{smiled}(\nu(\epsilon_1)(h))]$

With this Neo-Davidsonian event semantic ingredient, the denotation of an unsaturated verbal predicate is always of type  $\langle E, \langle VT \rangle \rangle$ .



It allows us to apply event modifiers to any node within the clausal spine without type-shifting nor quantifier movement.

### 3.3.2 Anaphora and discourse referent

Second, I assume that pronouns introduce their own drefs as shown in (24a), instead of assuming that they are free occurrences of drefs as shown in (24b).

- (24) a.  $[[it_{u_n}]] = \lambda V_{\langle E, VT \rangle} [n_m]; [u_m = u_n]; V(u_n)$   
 b.  $[[it_{u_n}]] = \lambda V_{\langle E, VT \rangle} V(u_n)$

This assumption will be vital to analyse reciprocal readings in PCDRT. Following Dotlačil (2013), I assume that a reciprocal pronoun is collectively co-referential, but distributively disjoint with its antecedent as exemplified in Table 3.7.

$H$	...	$u_n$	...	$u_m$	...
$h_1$	...	$x$	...	$y$	...
$h_2$	...	$y$	...	$x$	...

**Table 3.7:** Collective co-reference and distributive disjointness

In Table 3.7,  $u_n$  and  $u_m$  are collectively co-referential, i.e.  $v(u_n)(H) = v(u_m)(H) = \{x, y\}$ , but they are distributively disjoint, i.e.  $v(u_n)(h_1) \cap v(u_m)(h_1) = \emptyset$  and  $v(u_n)(h_2) \cap v(u_m)(h_2) = \emptyset$ . If a pronoun is a free occurrence of a dref, plural information states such as Table 3.7 cannot be obtained. In Chapter 5, I show that “sorezore” has a reciprocal reading in some, but not all of the environments. To capture the non-inherent reciprocity of “sorezore,” one has to assume that “sorezore” introduces its own dref. This is the motivation behind the assumption. I generalise it over anaphoric expressions and assume that they all introduce their own drefs.<sup>10</sup>

Now that anaphoric expressions also introduce a new dref, a newly added dref can have the same value(s) as an old dref. Since indefinites usually do not have this option, one has to make sure that non-anaphoric expressions never introduce a dref whose value is the same as the value of an old dref. For this, I adopt the novelty condition (Heim, 1982). I define it as shown in (25)

- (25)  $\text{nov}(u) = \lambda G \lambda H [G = H \ \& \ \forall v [v(v)(H) \neq \star \rightarrow [v(u)(H) \cap v(v)(H) = \emptyset]]]$

10. One may assume that some of the anaphoric expressions are free occurrences of drefs and the others introduce their own drefs. However, see §3.3.3 for the discussion of an entry of English plural pronoun which introduces its own dref.

The novelty condition in (25) requires that the value of a newly introduced dref  $u$  is disjoint with any of the values of drefs which are already introduced to the discourse. I assume that the semantics of the indefinite article involves the novelty condition as shown in (26).

$$(26) \quad [[a]] = \lambda P_{\langle ET \rangle} \lambda Q_{\langle E, \langle VT \rangle \rangle} \lambda \epsilon_V [u_n]; [| \text{nov}\{u_n\} |]; P(u_n); Q(\epsilon)(u_n)$$

(26) introduces a new dref  $u_n$  and the novelty condition  $\text{nov}\{u_n\}$  ensures that  $u_n$  was not used in the previous discourse. Thus, the novelty condition avoids over-generation even though a dref may, in principle, store the same value as a dref which has already been introduced to the discourse.

### 3.3.3 Cumulation and dependency

In this section, I discuss two choice points concerning dependency and plurality. Plural dynamic systems differ in (i) if dref introduction introduces dependency and (ii) if a system admit domain plurals in addition to discourse plurals. In this thesis, I adopt a system in which dref introduction does not introduce a new dependency and individuals can be plural at the domain level or at the discourse level.

Firstly, families of plural dynamic systems differ in if addition of a new value also introduces a new dependency. I adopt the standard definition of dependency (van den Berg, 1996, *et seq*) as defined in (27).

$$(27) \quad \text{In a state } G, u_m \text{ is dependent on } u_n \text{ iff} \\ \exists d, e \in v(u_n)(G) [v(u_m)(G_{u_n=d}) \neq v(u_m)(G_{u_n=e})]$$

To see how it works, consider the context in Table 3.8.

$H$	$u_1$	$u_2$	$u_3$	$u_4$
$h_1$	$a$	$x_2$	$x_3$	$x_4$
$h_2$	$b$	$y_2$	$x_3$	$x_4$
$h_3$	$c$	$z_2$	$z_3$	$x_4$

**Table 3.8:** Dependency and co-variation

In this context, the values of  $u_2$  shows total co-variation, the values of  $u_3$  shows partial co-variation and the value of  $u_4$  shows no co-variation with respect to  $u_1$ . Based on the definition (27),  $u_2$  and  $u_3$  are dependent on  $u_1$ , but  $u_4$  is not.

The varieties of plural dynamic systems agree that the  $\delta$  operator introduce dependency among variables, but they differ in if introduction of new values can also introduce a new dependency. Dref introduction in DeVries (2016); Law (2020); Nouwen (2003); van den Berg (1996) makes a newly added variable independent from the old values in the context as shown in (28).

$$(28) \quad G[u]H \Leftrightarrow \exists D [H = \{h \mid \exists g \exists d [g[u]h \& v(u)(h) = d \& g \& d \in D]]$$

Accordingly, evaluation of lexical relations is always collective as shown in (29).

$$(29) \quad R\{u_1, \dots, u_n\} = \lambda G [R(v(u_1)(G)), \dots, (v(u_n)(G))]$$

On the other hand, dref introduction in Brasoveanu (2008, 2010); Henderson (2014); Kuhn (2015) allows a newly added value to be dependent to the old values as shown in (30).

$$(30) \quad G[u]H \Leftrightarrow \forall g [g \in G \rightarrow \exists h [h \in H \& g[u]h]] \& \forall h [h \in H \rightarrow \exists g [g \in G \& g[u]h]]$$

Evaluation of lexical relations can be collective or distributive as shown in (31).  $\cup u$  indicates the sum of the values of  $u$  in all the members of a plural information state.

$$(31) \quad \begin{aligned} \text{a. } R\{\cup u_1, \dots, \cup u_n\} &= \lambda G [R(v(u_1)(G)), \dots, (v(u_n)(G))] && \text{(Collective)} \\ \text{b. } R\{u_1, \dots, u_n\} &= \lambda G [G \neq \emptyset \& \forall g [g \in G \rightarrow R(v(u_1)(g), \dots, v(u_n)(g))]] && \text{(Distributive)} \end{aligned}$$

Now, compare (30) and (28). Imagine that an input state  $G$  with two values and new value are added to  $u_2$  as shown in Table 3.9 and Table 3.10.

$G$	$u_1$			
$g_1$	$x_1$			
$g_2$	$x_2$			

 $\xrightarrow{G[u_2]H}$ 

$H$	$u_1$	$u_2$
$h_1$	$x_1$	$y_1$
$h_2$	$x_2$	$y_2$

**Table 3.9:** Dependent

$G$	$u_1$			
$g_1$	$x_1$			
$g_2$	$x_2$			

 $\xrightarrow{G[u_2]H}$ 

$H$	$u_1$	$u_2$
$h_1$	$x_1$	$y_1$
$h_2$	$x_1$	$y_2$
$h_3$	$x_2$	$y_1$
$h_4$	$x_2$	$y_2$

**Table 3.10:** Independent

(30) randomly assigns dependency among the values which have already been introduced and those which are newly added. The point-wise definition of addition of a new value in (30) is satisfied both in Table 3.9 and in Table 3.10. On the other hand, (28) does not introduce a new dependency. Crucially, (28) allows Table 3.10, but disallows Table 3.9: (28) requires that each value of  $v(H)(u_2)$  is added to each sub-assignment, but this is not the case in Table 3.9.

Both definitions do not have a problem in dealing with collective readings and distributive readings. However, cumulative readings pose a problem for dependence-free dref introduction. Consider (32) as an example.

(32) Three <sup>$u_1$</sup>  students recited seven poems <sup>$u_2$</sup>  in this class.

For example, if two students recited two poems each and one student recited three, (32) is true under its cumulative reading. In this sense, (32) involves an underspecified dependency among the three students and the seven poems. (28) cannot describe this underspecified dependency: it forces the students and the poems to be independent of each other as shown in Table 3.11. However, (30) allows a newly added dref to bear random dependencies to other drefs as shown in Table 3.12. Thus, only (30) can express the cumulative dependency of (32).

$H$	$u_1$	$u_2$
$h_1$	student <sub>1</sub>	poem <sub>1</sub>
$\vdots$	$\vdots$	$\vdots$
$h_2$	student <sub>1</sub>	poem <sub>7</sub>
$h_3$	student <sub>2</sub>	poem <sub>1</sub>
$\vdots$	$\vdots$	$\vdots$
$h_4$	student <sub>2</sub>	poem <sub>7</sub>
$\vdots$	$\vdots$	$\vdots$
$h_5$	student <sub>3</sub>	poem <sub>1</sub>
$\vdots$	$\vdots$	$\vdots$
$h_6$	student <sub>3</sub>	poem <sub>7</sub>

**Table 3.11:** Lack of dependency

$H$	$u_1$	$u_2$
$h_1$	student <sub>1</sub>	poem <sub>1</sub>
$h_2$	student <sub>1</sub>	poem <sub>2</sub>
$h_3$	student <sub>2</sub>	poem <sub>3</sub>
$h_4$	student <sub>2</sub>	poem <sub>4</sub>
$h_5$	student <sub>2</sub>	poem <sub>5</sub>
$h_6$	student <sub>3</sub>	poem <sub>6</sub>
$h_7$	student <sub>3</sub>	poem <sub>7</sub>

**Table 3.12:** Random dependency

However, I claim that this way of deriving a cumulative reading makes a too strong prediction. To show this, I discuss cases of dependent and independent anaphora. One of the main motivation for plurality of variable assignments comes from the phenomena of dependent anaphora such as (33b).

- (33) a. Every student<sup>*u*<sub>1</sub></sup> recited a poem<sup>*u*<sub>2</sub></sup>.  
b. Each of them<sup>*u*<sub>1</sub><sup>3</sup></sup> liked it<sup>*u*<sub>2</sub><sup>4</sup></sup>.

(33a) stores the student-poem correspondence and (33b) retrieves it so that the pronoun “it” picks up the poem which each student recited. This type of dependent readings is available for plural pronouns, too. Note that plural pronouns are ambiguous between a dependent reading and an independent reading.<sup>11</sup>



random dependency is too strong. At least, it is too strong to assume that dependent anaphora is readily possible with cumulative readings. This problem does not arise for dependency-free dref introduction because the  $\delta$  operator is necessary to introduce dependency. However, it cannot derive a cumulative reading.<sup>14</sup>

This is the suitable timing to discuss another choice point in plural dynamic systems. Plural dynamic systems in Kuhn (2015); Nouwen (2003); van den Berg (1996) only acknowledge discourse plurals, whereas those in Brasoveanu (2008); Henderson (2014); Law (2020) acknowledge both. More specifically, the value of an assignment function (or  $\nu$  function in my framework) only contains atomic individuals in the former varieties, but it also contains plural individuals in the latter varieties. In this thesis, I follow the latter group of researchers to solve this issue with cumulativity: having domain plurals allows a way to derive a cumulative reading without resorting to dependency.

Let me spell out how to derive a cumulative reading without introducing a dependency (Henderson, 2014; Law, 2020). (35a) has the denotation (36).

$$(36) \quad \llbracket 35a \rrbracket = [\epsilon_1]; [u_1]; [\exists 3 \text{ ATOMS}\{u_1\}]; [\text{student}\{u_1\}]; [\text{agent}\{\epsilon_1\}\{u_1\}] \\ [u_2]; [\exists 7 \text{ ATOMS}\{u_2\}]; [\text{poem}\{u_2\}]; [\text{theme}\{\epsilon_1\}\{u_2\}]; [\text{recite}\{\epsilon_1\}]$$

As a plural individual can occupy a position in a state, Table 3.13 is a legitimate output context of (36). Compare it with Table 3.12.

$H$	$u_1$	$u_2$
	student <sub>1</sub> +student <sub>2</sub> +student <sub>3</sub>	poem <sub>1</sub> +...+poem <sub>7</sub>

**Table 3.13:** Domain-level plurality

14. There is another advantage of (30) which is discussed in Brasoveanu (2007). He shows that (28) makes a wrong prediction that books and credit cards are independent, i.e., every book is bought with the same credit card or every credit card is used to buy the same book in (1).

- (1) Every <sup>$u_1$</sup>  person who buys a <sup>$u_2$</sup>  book on amazon.com and has a <sup>$u_3$</sup>  credit card uses it <sub>$u_3$</sub>  to pay for it <sub>$u_2$</sub> . (Brasoveanu, 2007)

However, this problem does not occur if the  $\delta$  operator applies to the restrictor update as in (2).

- (2)  $\text{MAX}^{u_1}(\delta_{u_1}([\text{person}\{u_1\}]; [u_2]; [\text{ATOM}\{u_2\}]; [\text{buy}\{u_1\}\{u_2\}]; [u_3]; [\text{ATOM}\{u_3\}]; [\text{credit card}\{u_3\}]); \text{MAX}^{u_4 \in u_1}(\delta_{u_4}([\text{use}\{u_4\}\{u_3\}]; [\text{pay for}\{u_4\}\{u_2\}]))$

As a book and a credit card are introduced for each assignment in which  $u_1$  stores one person, it correctly capture person-book-credit card correspondence. Indeed, Brasoveanu (2008, 2010) adopt the definition of dynamic selective generalised quantification which has the  $\delta$  operator for the restrictor update. Thus, I conclude that (1) does not pose a serious argument against (28). However, see Brasoveanu (2007) for two theoretical reasons to prefer (30).

To check if (36) expresses a cumulative reading, let me unpack this abbreviation. First, (36) is equivalent to (37) with Merging Lemma.

$$(37) \quad [\epsilon_1 u_1, u_2] 3 \text{ ATOMS}\{u_1\} \& \text{student}\{u_1\} \& \text{agent}\{\epsilon_1\}\{u_1\} \& 7 \text{ ATOMS}\{u_2\} \& \text{poem}\{u_2\} \& \text{theme}\{\epsilon_1\}\{u_2\} \& \text{recite}\{\epsilon_1\}]$$

Second, (37) is unpacked as (38).

$$(38) \quad \lambda G \lambda H [G[\epsilon_1, u_1, u_2] H \& 3 \text{ ATOMS}(v(u_1)(H)) \& \text{student}(v(u_1)(H)) \& \text{agent}(v(\epsilon_1)(H))v(u_1)(H) \& 7 \text{ ATOMS}(v(u_2)(H)) \& \text{poem}(v(u_2)(H)) \& \text{theme}(v(\epsilon_1)(H))v(u_2)(H) \& \text{recite}(v(\epsilon_1)(H))]$$

Lastly, providing entities of type  $e$  and  $v$  via  $v$  function, it expresses an underspecified cumulative relation as shown in (39).

$$(39) \quad \begin{aligned} \text{a. } \llbracket \text{recite} \rrbracket &= \{e_1, e_2, \dots, e_1 + e_2, \dots, e_1 + \dots + e_7\} \\ \text{b. } \llbracket \text{theme} \rrbracket &= \{\langle e_1, \text{poem}_1 \rangle, \langle e_2, \text{poem}_2 \rangle, \dots, \langle e_1 + e_2, \text{poem}_1 + \text{poem}_2 \rangle, \dots, \\ &\quad \langle e_1 + \dots + e_7, \text{poem}_1 + \dots + \text{poem}_7 \rangle\} \\ \text{c. } \llbracket \text{agent} \rrbracket &= \{\langle e_1, \text{student}_1 \rangle, \langle e_2, \text{student}_1 \rangle, \langle e_1 + e_2, \text{student}_1 \rangle, \dots, \\ &\quad \langle e_1 + \dots + e_7, \text{student}_1 + \text{student}_2 + \text{student}_3 \rangle\} \end{aligned}$$

(39) derives a cumulative reading via cumulativity of thematic relations. In this way, a cumulative reading is expressed at the level of domain plurals without introducing discourse-level dependency. Note that one does not need to postulate a pair of operations which let a formula go back and forth between a dynamic representation and a static representation because DRSs in PCDRT are abbreviations of expressions in an ordinary many-sorted type logical object language.

In this way, one can derive a cumulative reading without assuming introduction of random dependencies if one assumes cumulative predication with domain pluralities. That being said, I admit that there are several expressions which motivate introduction of random dependencies. Especially, I claim in Chapter 5 that the distribution of reciprocal readings of “sorezore” strongly motivates an analysis with the dref introduction with random dependencies. Accordingly, I adopt a version of PCDRT which utilises the dependency free dref introduction as the default method, but utilises the dref introduction with random dependencies as a non-default method. The distribution of the  $\eta$  operator is limited to a certain class of expressions. I use

the notation  $G[u]H$  for the default dref introduction. This method does not come with a random dependency as repeated in (40a). On the other hand, I define an operator  $\eta$  for the non-default method of dref introduction. This method comes with a random dependency as shown in (40b).

- (40) a.  $G[u]H \Leftrightarrow \exists D [H = \{h \mid \exists g \exists d [g[u]h \& v(u)(h) = d \& g \& d \in D]]$   
 b.  $G[\eta(u)]H \Leftrightarrow \forall g [g \in G \rightarrow \exists h [h \in H \& g[u]h]] \& \forall h [h \in H \rightarrow \exists g [g \in G \& g[u]h]]$

Now, let me come back to the issue of dependent anaphora and show how to derive the observed readings with the version of PCDRT I adopt in this thesis. I assume that plural pronouns in English utilise the default method of dref introduction, but optionally accompany the  $\delta$  operator as shown in (41).

- (41) a.  $[[\text{they}_{u_n}]] = \lambda V_{\langle E, VT \rangle} \lambda \epsilon [u_m]; [[u_n = u_m]]; [|\text{NON-ATOM}\{u_m\}|]; V(\epsilon)(u_m)$   
 b.  $[[\text{they}_{u_n}]] = \lambda V_{\langle E, VT \rangle} \lambda \epsilon \delta_{u_n}([u_m]; [[u_n = u_m]]; [|\text{NON-ATOM}\{u_m\}|]; V(\epsilon)(u_m))$

This optionality of the  $\delta$  operator allows pronouns to be dependent or independent to its antecedent. Importantly, this is all-or-nothing: it does not allow an intermediately co-varying dependency unlike the  $\eta$  operator. I start with an independent reading of a plural pronoun. Let the output context of (35a) be  $K$ . Table 3.14 shows how (35b) updates the context. For the sake of notational brevity, I abbreviate domain plurals as  $P_{1,\dots,n}$ .

$K$	$u_1$	$u_2$	$\rightarrow$	
	students <sub>1,2,3</sub>	poems <sub>1,2,3,4,5,6,7</sub>		

$H$	$u_1$	$u_2$	$u_3$	$u_4$
$h_1$	students <sub>1,2,3</sub>	poems <sub>1,2,3,4,5,6,7</sub>	student <sub>1</sub>	poems <sub>1,2,3,4,5,6,7</sub>
$h_2$	students <sub>1,2,3</sub>	poems <sub>1,2,3,4,5,6,7</sub>	student <sub>2</sub>	poems <sub>1,2,3,4,5,6,7</sub>
$h_3$	students <sub>1,2,3</sub>	poems <sub>1,2,3,4,5,6,7</sub>	student <sub>3</sub>	poems <sub>1,2,3,4,5,6,7</sub>

$H'$	$u_1$	$u_2$	$u_3$	$u_4$
	students <sub>1,2,3</sub>	poems <sub>1,2,3,4,5,6,7</sub>	students <sub>1,2,3</sub>	poems <sub>1,2,3,4,5,6,7</sub>

**Table 3.14:** Non-dependent pronoun

$H$  is the output context in which “they” does not involve  $\delta$ . In this case, “they” introduce  $u_3$  which is collectively co-referential with  $u_1$ , but not dependent on it. In each of the states  $h_1$ ,  $h_2$  and  $h_3$ , the value of  $u_2$  is poems<sub>1,2,3,4,5,6,7</sub>. Thus, this is the only accessible antecedent for the plural definite “the poem” and the plural

pronoun “them.” As a result, (35b) only supports an independent reading. On the other hand,  $H'$  is the output context in which “they” involves  $\delta$ .  $u_1$  only stores a single value and thus distributivity is trivially satisfied.<sup>15</sup> In this case, too, only an independent reading is possible.

Next, I show that this system predicts that both a dependent reading and a non-dependent reading are possible if the previous discourse stores quantificational dependency. In this case, the optionality of the  $\delta$  operator plays a crucial role. Let me start with the dependent reading. Table 3.15 shows the output context of (34b) when “them” involves  $\delta$ . Here,  $u_3$  is distributively co-referential with  $u_1$ :  $u_3$  is introduced by “them” and it involves its own  $\delta$  operator above the co-reference condition.

$K$	$u_1$	$u_2$		
$k_1$	students <sub>1</sub>	poems <sub>1,2</sub>		
$k_2$	students <sub>2</sub>	poems <sub>3,4,5</sub>		
$k_3$	students <sub>3</sub>	poems <sub>6,7</sub>		

→

$H$	$u_1$	$u_2$	$u_3$	$u_4$
$h_1$	students <sub>1</sub>	poems <sub>1,2</sub>	students <sub>1</sub>	poems <sub>1,2</sub>
$h_2$	students <sub>2</sub>	poems <sub>3,4,5</sub>	students <sub>2</sub>	poems <sub>3,4,5</sub>
$h_3$	students <sub>3</sub>	poems <sub>6,7</sub>	students <sub>3</sub>	poems <sub>6,7</sub>

**Table 3.15:** Dependent reading with “each”

This structure of dependencies allows retrieval of quantificational dependency stored between  $u_1$  and  $u_2$ , i.e.  $H_{u_3=d} = \{h_1 h_2, h_3\}$ . In each subset, the value of  $u_4$  is identical to the value of  $u_2$ .

On the other hand, the independent reading is derived when “then” does not involve  $\delta$ . Table 3.16 shows the output context of (34b) under the independent reading. This complex structure of dependencies can be unpacked as follows. First, the subject pronoun “they” does not accompany the  $\delta$  operator and thus it introduces independent values which are collectively co-referential with  $u_1$  under  $H$ . Accordingly,  $u_3$  is independent of  $u_1$  and  $u_3$ , e.g., student<sub>1</sub> is related with student<sub>1</sub> and poems<sub>1,2</sub> under  $h_1$ , student<sub>2</sub> and poems<sub>3,4,5</sub> under  $h_2$ , and student<sub>3</sub> and poems<sub>6,7</sub> under  $h_3$ . Second, the object pronoun “them” is under the scope of the  $\delta$  operator

15. One can avoid this possibility by prohibiting trivial satisfaction of distributivity.

of “each.” Accordingly, it picks up the value of  $u_2$  under subsets of assignments  $H_{u_3=d}$  such that  $d \in \{\text{student}_1, \text{student}_2, \text{student}_3\}$ . Those subsets are specified as  $\{h_1, h_4, h_7\}, \{h_2, h_5, h_8\}, \{h_3, h_6, h_9\}$ . Crucially, the value of  $u_4$  is the seven poems in each subset because  $u_3$  are independent of  $u_2$ . This is an independent reading.

$K$	$u_1$	$u_2$		
$k_1$	students <sub>1</sub>	poems <sub>1,2</sub>	→	
$k_2$	students <sub>2</sub>	poems <sub>3,4,5</sub>		
$k_3$	students <sub>3</sub>	poems <sub>6,7</sub>		

$H$	$u_1$	$u_2$	$u_3$	$u_4$
$h_1$	students <sub>1</sub>	poems <sub>1,2</sub>	students <sub>1</sub>	poems <sub>1,2</sub>
$h_2$	students <sub>1</sub>	poems <sub>1,2</sub>	students <sub>2</sub>	poems <sub>1,2</sub>
$h_3$	students <sub>1</sub>	poems <sub>1,2</sub>	students <sub>3</sub>	poems <sub>1,2</sub>
$h_4$	students <sub>2</sub>	poems <sub>3,4,5</sub>	students <sub>1</sub>	poems <sub>3,4,5</sub>
$h_5$	students <sub>2</sub>	poems <sub>3,4,5</sub>	students <sub>2</sub>	poems <sub>3,4,5</sub>
$h_6$	students <sub>2</sub>	poems <sub>3,4,5</sub>	students <sub>3</sub>	poems <sub>3,4,5</sub>
$h_7$	students <sub>3</sub>	poems <sub>6,7</sub>	students <sub>1</sub>	poems <sub>6,7</sub>
$h_8$	students <sub>3</sub>	poems <sub>6,7</sub>	students <sub>2</sub>	poems <sub>6,7</sub>
$h_9$	students <sub>3</sub>	poems <sub>6,7</sub>	students <sub>3</sub>	poems <sub>6,7</sub>

**Table 3.16:** Independent reading with “each”

In this way, the availability of dependent readings of plural pronouns is fully predicted with the combination of the dependency-free dref introduction and two types of plurality.<sup>16</sup>

Summing up, this section aimed to defend my decision in two choice points: I adopt a plural dynamic system with the dependency-free dref introduction and two types of plurality. The main empirical reason for this choice comes from cumulative readings. If dref introduction makes a new value independent of the previous values, a cumulative reading is not predicted, but if dref introduction adds a random dependency, it wrongly predicts that cumulative readings feed dependent plural pronouns in the later discourse. To solve this dilemma, I derive cumulative readings via cumulativity at the domain level, following Henderson (2014) and Law (2020).

16. I do not aim to compare the proposed account with the previous analysis of dependent pronouns, but it would be useful to compare it with Nouwen (2007). Nouwen (2007) makes both a dependent value and an independent value available at a given context by concatenating an input plural assignment (or *stack* in his framework) to each subset of assignments. Thus, the semantics of pronouns is uniform, but the context is enriched so that it makes both readings possible. On the other hand, my analysis does not enrich the context and makes pronouns optionally distributive. Thus, the context stays the same, but the semantics of pronouns has to be flexible. I leave the comparison of these two approaches to future work.

In this approach, cumulative readings do not establish quantificational dependency which is retrievable in the later discourse. And yet, the option of dref introduction with random dependencies is crucial in my analysis of “sorezore” in Chapter 5. Thus, I adopt the dependency-free dref introduction as the default method, while adopt the dref introduction with random dependencies as the non-default option which is allowed for a certain class of expressions. The official definitions of the two methods of dref introduction and lexical relations are repeated in (42).

- (42) a.  $R\{u_1, \dots, u_n\} = \lambda G [R(v(u_1)(G)), \dots, (v(u_n)(G))]$   
 b.  $G[u]H \Leftrightarrow \exists D [H = \{h \mid \exists g \exists d [g[u]h \& v(u)(h) = d \& g \& d \in D]]]$   
 c.  $G[\eta(u)]H \Leftrightarrow \forall g [g \in G \rightarrow \exists h [h \in H \& g[u]h]] \& \forall h [h \in H \rightarrow \exists g [g \in G \& g[u]h]]]$

### 3.4 Conclusion

In this chapter, I introduced a compositional implementation of dynamic semantics with plurality of variable assignments. Specifically, I introduced Plural Compositional DRT (Brasoveanu, 2007, 2008) which is equipped with the notion of plural information states and the Montagovian sub-clausal compositionality. Based on the general architecture of PCDRT, I introduce a version of it which I adopt in Chapter 4 and 5. The essential features of it are (i) sub-clausal composition proceeds in Neo-Davidsonian way, (ii) pronouns introduce their own drefs, (iii) the default dref introduction does not assign a random dependency, and (iv) it acknowledges both the domain plurality and the discourse plurality. Each of these features will be crucial in later chapters.

### List of definitions and notations

I provide the definitions and notations I discussed in this chapter.

- (43) Negation, disjunction and material implication:  
 a.  $\text{not } D = \lambda G \neg \exists K [D(G)(K)]$   
 b.  $D \text{ or } D' = \lambda G \exists K [D(G)(K) \vee D'(G)(K)]$   
 c.  $D \Rightarrow D' = \lambda G \forall I [D(G)(I) \rightarrow \exists J [D'(I)(J)]]$

- (44) DRS:  $[u_1, \dots, u_n, | C_1, C_2, \dots, C_n]$   
 $= \lambda G \lambda H [G[u_1, \dots, u_n]H \& C_1(H) \& C_2(H) \& \dots \& C_n(H)]$
- (45) Sequencing:  $D; D' = \lambda G \lambda H \exists K [D(G)(K) \& D'(K)(H)]$
- (46) Lexical relations:  $R\{u_1, \dots, u_n\} = \lambda G [R(v(u_1)(G)), \dots, (v(u_n)(G))]$
- (47) Dref introduction
- a. Default (dependency free):  
 $G[u]H \Leftrightarrow \exists D [H = \{h | \exists g \exists d [g[u]h \& v(u)(h) = d \& g \& d \in D]]]$
  - b. Non-default (random dependency):  
 $G[\eta(u)]H \Leftrightarrow \forall g [g \in G \rightarrow \exists h [h \in H \& g[u]h]] \& \forall h [h \in H \rightarrow \exists g [g \in G \& g[u]h]]$
- (48) Dynamic distriutivity operator  $\delta$ :
- a.  $G_{u_n=d} = \{g : g \in G \& v(u_n)(g) = d\}$
  - b.  $\delta_{u_n}(D) = \lambda G \lambda H [v(u_n)(G) = v(u_n)(H) \& \forall d \in v(u_n)(G) [D(G_{u_n=d})(H_{u_n=d})]]$

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## Chapter 4

# Decomposition of generalised quantification in Japanese

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### 4.1 Introduction

So far, I have introduced the main puzzles and the theoretical framework I adopt. From this chapter, I begin to illustrate my main proposal. In this chapter, I propose an analysis of mapping from syntax to semantics of Japanese universal quantifiers other than “sorezore.” This analysis serves as a prerequisite to answer the distributional question concerning “sorezore.” More specifically, I propose that decomposition of generalised quantification offers a way to derive the three variants of quantifiers in Japanese. Selective dynamic generalised quantification in PCDRT consists of three separate updates, namely (i) the restrictor update with the maximal set of individuals, (ii) the scope update with the maximal subset of the restrictor set and (iii) the static generalised quantification over the restrictor set and the scope set. I propose that the way how (i) is performed varies across quantifiers in Japanese with respect to two factors. The first factor is whether a quantifier takes an independent restrictor NP or not. The second factor is whether a quantifier introduces a new discourse referent or relies on the discourse referent introduced by its host NP to provide a restrictor set. Since the second factor is relevant only when a quantifier takes a restrictor NP, these two binary choices predict three types of quantifiers, which correspond to the three variants of quantifiers. On the one hand, a prenominal quantifier and a postnominal quantifier both take a restrictor NP, whereas a floating quantifier does not. On the other hand, a prenominal quantifier introduces a new discourse referent for its restrictor NP, whereas a postnominal quantifier does not and relies on the dref that its argumental restrictor NP introduces. Thus, the syntactic variation within the class of quantifiers in Japanese comes from different ways to perform the restrictor update.



## 4.2 Generalised quantification in Japanese

In this section, I aim to derive the three variants of Japanese quantifiers from a compositional analysis of generalised quantification. The key ingredient is the way in which selective generalised quantification is achieved in PCDRT. The gist is that generalised quantifiers in Japanese all have the static generalised quantification and the scope update in common, but they show variation in regard to the restrictor update. This variation is based on two independent factors. Firstly, quantifiers either have an argument slot for a restrictor NP or not. Secondly, if quantifiers take a restrictor NP as one of its arguments, then they either take a predicative restrictor NP or an argumental restrictor NP. As a result, these two binary choices predict three types of quantifiers, which are exactly the ones which are observed in Japanese.

### 4.2.1 Decomposing generalised quantification

In this section, I claim that the semantic decomposition of generalised quantification in PCDRT paves the way to pin down the point of divergence among three syntactic variants of quantificational expressions in Japanese. Brasoveanu (2013) decomposed generalised quantification into at least two components.

- (1) a. A *static* generalized quantifier component
- b. One or more components operating over matrices that regulate the *dynamics* of dependencies (Brasoveanu, 2013)

This motivates him to define a general template of selective dynamic quantificational determiners in PCDRT, which comes with three separate updates. To define it, I introduce two techniques, namely the dynamic maximality operator  $\text{max}$  and the structural inclusion relation  $\subseteq$ . First, the  $\text{max}$  operator is defined in (2). It provides a maximal sum of individuals which satisfy  $D$ .

$$(2) \quad \text{max}^{u_n}(D) = \lambda G \lambda H [G[[u_n]]; D]H \ \& \ \forall K [G[[u_n]]; D]K \rightarrow v(u_n)(K) \subseteq v(u_n)(H)]$$

It compares the possible output plural information states and pick the one with the largest union of individuals in  $u_n$ . Second, the  $\subseteq$  relation is defined in (3). This is a structure-reserving subset relation between two discourse referents.

$$(3) \quad u \subseteq u' \Leftrightarrow \lambda G \forall g \in G [v(u)(g) = v(u')(g) \vee v(u) = \star]$$

It requires that for each member  $g$  of a plural information state  $G$ , if the value of  $u'$  is defined in  $g$ , then either it is the same as the value of  $u$  in  $g$  or it only stored a dummy individual. Consider Table 4.1 to see that it necessarily preserves the structure of a plural information state. First, a normal subset relation  $\subseteq$  does not require structure-preservation. Thus,  $u_2$  is a subset of  $u_1$  even though they have distinct values under each assignment. On the other hand, the structural inclusion  $\in$  is structure-preserving. For example,  $u_3 \in u_1$  holds because  $u_1$  and  $u_3$  store exactly the same value in each of assignment.  $u_4$  does not have a value in some of the assignments, but when it stores some value, it is identical to the value of  $u_1$ , i.e. there is no assignment in which  $u_4$  stores a non-dummy individual that is different from the value of  $u_1$ . Thus,  $u_4 \in u_1$ . However,  $u_2 \notin u_1$  because there are assignments in which  $u_1$  and  $u_2$  store different non-dummy individuals.

$G$	$u_1$	$u_2 \subseteq u_1$ ( $u_2 \notin u_1$ )	$u_3 \in u_1$	$u_4 \in u_1$
$g_1$	$a$	$b$	$a$	$a$
$g_2$	$b$	$c$	$b$	★
$g_3$	$c$	$d$	$c$	$c$
$g_4$	$d$	$e$	$d$	$d$
$g_5$	$e$	$e$	$e$	★

Table 4.1: Structural inclusion

Brasoveanu (2010) defines the general template of quantificational determiners in PCDRT as shown in (4).

$$(4) \quad \llbracket \text{det} \rrbracket = \lambda P_{\langle ET \rangle} \lambda Q_{\langle ET \rangle} \text{MAX}^u(\delta_u(P(u))); \text{MAX}^{u'} \in u(\delta_{u'}(Q(u'))); \text{DET}\{u\}\{u'\}$$

(4) first takes a maximal set of individuals which distributively satisfy the restrictor property and then check if a structured subset of it distributively satisfies a nuclear scope in the way that the two sets stand in the relation denoted by the static quantificational determiner. These three steps of updates in the PCDRT generalised quantification are summarised in (5).

- (5) a. The static semantics of quantificational determiners  $\text{DET}$
- b. Introduction of the maximal set of individuals which satisfy the restrictor property
- c. Introduction of the maximal subset of the restrictor set which satisfy the scope property

This decomposition of generalised quantification fits well with the syntactic variation among quantifiers in Japanese. I propose that they vary with respect to how they perform the restrictor update. First, the three variants differ with respect to the locality between a quantifier and its host NP. A prenominal quantifier or a postnominal quantifier occurs in the same nominal extended projection as its host NP, whereas a floating quantifier does not. As (6) shows, a temporal adverb can intervene between a quantifier and its host NP when the quantifier occurs at the floating position, whereas it cannot when the quantifier occurs in the prenominal position or in the postnominal positions.

- (6) a. Subete-no (\*kinoo) zairyoo-ga soro-tta.  
all-GEN (yesterday) ingredient-NOM gather-PAST  
b. Zairyoo (\*kinoo) subete-ga soro-tta.  
ingredient (yesterday) all-NOM gather-PAST  
c. Zairyoo-ga (kinoo) subete soro-tta.  
ingredient-NOM (yesterday) all gather-PAST  
“All ingredients have been gathered (yesterday).”

Note that floating quantifiers other than “sorezore” are not anaphoric and combines with the most local argument in a compositional way. “subete” (all) and “hotondo” (most) cannot be associated with the subject when they occur at the post-object floating position as shown in (7b) and (8b).

- (7) a. Kore-ra-no ginkoo<sup>u1</sup>-ga **subete**<sub>u1</sub> ayasii kooza<sup>u2</sup>-o toketu-sita.  
this-PL-GEN bank-NOM all dubious account-ACC freeze-PAST  
“These banks all froze a dubious account.”  
b. Kore-ra-no ginkoo<sup>u1</sup>-ga ayasii kooza<sup>u2</sup>-o **subete**<sub>\*u1/u2</sub> toketu-sita.  
this-PL-GEN bank-NOM dubious account-ACC all freeze-PAST  
i. \*“(These banks all froze a dubious account.”  
ii. “These banks froze all the dubious accounts.”
- (8) a. Kore-ra-no ginkoo<sup>u1</sup>-ga **hotondo**<sub>u1</sub> hurui kooza<sup>u2</sup>-o toketu-sita.  
this-PL-GEN bank-NOM most old account-ACC freeze-PAST  
“Most of these banks froze an old account.”  
b. Kore-ra-no ginkoo<sup>u1</sup>-ga hurui kooza<sup>u2</sup>-o **hotondo**<sub>\*u1/u2</sub> toketu-sita.  
this-PL-GEN bank-NOM old account-ACC most freeze-PAST  
i. \*“(Most of these banks froze an old account.”  
ii. “These banks froze most of the old accounts.”

Second, the three variants differ with respect to the semantic type of its host NP. The host NP of a prenominal quantifier is predicative, whereas the host NP of a postnominal quantifier and a floating quantifier is argumental. As (9) shows, a postnominal quantifier and a floating quantifier can take a pronoun as its host NP, whereas a prenominal quantifier cannot.

- (9) a. \* Subete-no kore-(ra)-ga soro-tte-iru.  
           all-GEN    this-(PL)-NOM gathered-PROG-PRES  
       b. Kore-\*(ra) subete-ga soro-tte-iru.  
           this-(PL)   all-NOM   gathered-PROG-PRES  
       c. Kore-\*(ra)-ga subete soro-tte-iru.  
           this-(PL)-NOM all       gathered-PROG-PAST  
           Lit‘All of these are here.’

These two factors classify the three variants as summarised in Table 4.2.

Prenominal	Postnominal	Floating
Local host NP		Non-local host NP
Predicative host NP	Argumental host NP	

**Table 4.2:** Classification of the three variants of quantifiers in Japanese

In the rest of this section, I propose the denotations of the three variants of quantifiers and show how they are combined with the rest of the clause.

### 4.2.2 Semantics of Japanese quantifiers

In this section, I discuss the semantics of quantifiers in Japanese. First of all, I assume the standard semantics of generalised quantifier as shown in (10).<sup>1</sup>

- (10) Static generalised quantifier component  $\text{DET}$
- a.  $\llbracket \text{all} \rrbracket(P)(Q) = \llbracket P \rrbracket \subset \llbracket Q \rrbracket$
  - b.  $\llbracket \text{most} \rrbracket(P)(Q) = \llbracket P \rrbracket \cap \llbracket Q \rrbracket > \llbracket P \rrbracket - \llbracket Q \rrbracket$
  - c.  $\llbracket \text{many} \rrbracket(P)(Q) = \llbracket P \rrbracket \cap \llbracket Q \rrbracket > c$

The general template of selective dynamic generalised quantification under PCDRT with events is given in (11): it consists of the restrictor update, the scope update and the static generalised quantifier component.

1. I do not assume a static entry *SOME* and treat “some” as a plain indefinite, putting aside the issue of semantic difference between an indefinite article and “some.”

$$(11) \quad \underbrace{\text{MAX}^u(\delta_u(P(u)))}_{\text{Restrictor update}}; \underbrace{\text{MAX}^{u' \in u}(\delta_{u'}(Q(u')(\epsilon)))}_{\text{scope condition}}; \underbrace{\text{DET}\{u\}\{u'\}}_{\text{GQ component}}$$

I propose that the scope update with the structural inclusion condition  $u' \in u$  is common to all the generalised quantifiers in Japanese. I omit the static GQ component in the denotations of some universal quantifiers, but this choice is orthogonal to the main point of the discussion.<sup>2</sup> The difference among the three variants of Japanese quantifiers comes from variation in the restrictor update.

The first strategy is to perform the restrictor update in the same way as quantificational determiners do. In this strategy, the restrictor update requires a property of type  $\langle ET \rangle$  and one can obtain the denotation of quantificational determiner in PCDRT with events as shown in (12).<sup>3</sup>

$$(12) \quad \llbracket \text{det} \rrbracket = \lambda P_{\langle ET \rangle} \lambda Q_{\langle E, VT \rangle} \lambda \epsilon \text{MAX}^u(\delta_u(P(u))) ; \text{MAX}^{u' \in u}(\delta_{u'}(Q(u')(\epsilon))) ; \text{DET}\{u\}\{u'\}$$

I propose that the prenominal quantifiers in Japanese employs this strategy and has the same denotation as English quantificational determiners as shown in (13). One can see that (13) takes its restrictor set with a predicative NP of type  $\langle ET \rangle$ .

$$(13) \quad \llbracket \text{Prenominal quantifier} \rrbracket = \lambda P_{\langle ET \rangle} \lambda V_{\langle E, VT \rangle} \lambda \epsilon \text{MAX}^{u_n}(\delta_{u_n}(P(u_n))) ; \text{MAX}^{u_m \in u_n}(V(\epsilon)(u_m)) ; \text{DET}\{u_n\}\{u_m\}$$

The second strategy does not let quantifiers themselves to introduce a restrictor set as shown in (14). It does not involve the  $\text{MAX}$  operator for its restrictor, but it still requires the restrictor set  $u$ .

$$(14) \quad \underbrace{\text{MAX}^{u' \in u}(\delta_{u'}(Q(u')(\epsilon)))}_{\text{Scope update}}; \underbrace{\text{DET}\{u\}\{u'\}}_{\text{GQ component}}$$

I propose that the postnominal quantifiers and the floating quantifiers in Japanese use this strategy. The denotation of postnominal quantifiers in Japanese is shown in (15). It takes an argumental NP of type  $\langle \langle E, VT \rangle, VT \rangle$ , which provides the restrictor set for postnominal quantifiers.

2. More specifically, I do not assume a static component  $\text{EVERY}$  and treat “every” as a generalised quantifier which distributively evaluate its scope property.

3. I assume that the novelty condition is absent in the restrictor update of quantificational determiners in English and the prenominal quantifiers in Japanese to allow the restrictor set to include some of the values which are already introduced to the discourse.

$$(15) \quad \llbracket \text{Postnominal quantifier} \rrbracket = \lambda R_{\langle \langle E, VT \rangle, \langle VT \rangle \rangle} \lambda V_{\langle E, VT \rangle} \\ R(\lambda v \lambda \epsilon [\text{MAX}^{u_m \in v}(V(\epsilon)(u_m)); \text{DET}\{v\}\{u_m\}])$$

On the other hand, the denotation of floating quantifiers in Japanese is shown in (16). It has a modifier type for verbal predicates and its restrictor set is provided when the  $v$ -term is saturated with an argument nominal.

$$(16) \quad \llbracket \text{Floating quantifier} \rrbracket = \lambda V_{\langle E, VT \rangle} \lambda v_E \lambda \epsilon_V [\text{MAX}^{u_m \in v}(V(\epsilon)(u_m)); \text{DET}\{v\}\{u_m\}]$$

The proposed denotations of the three variants of Japanese quantifiers are summarised in (17).

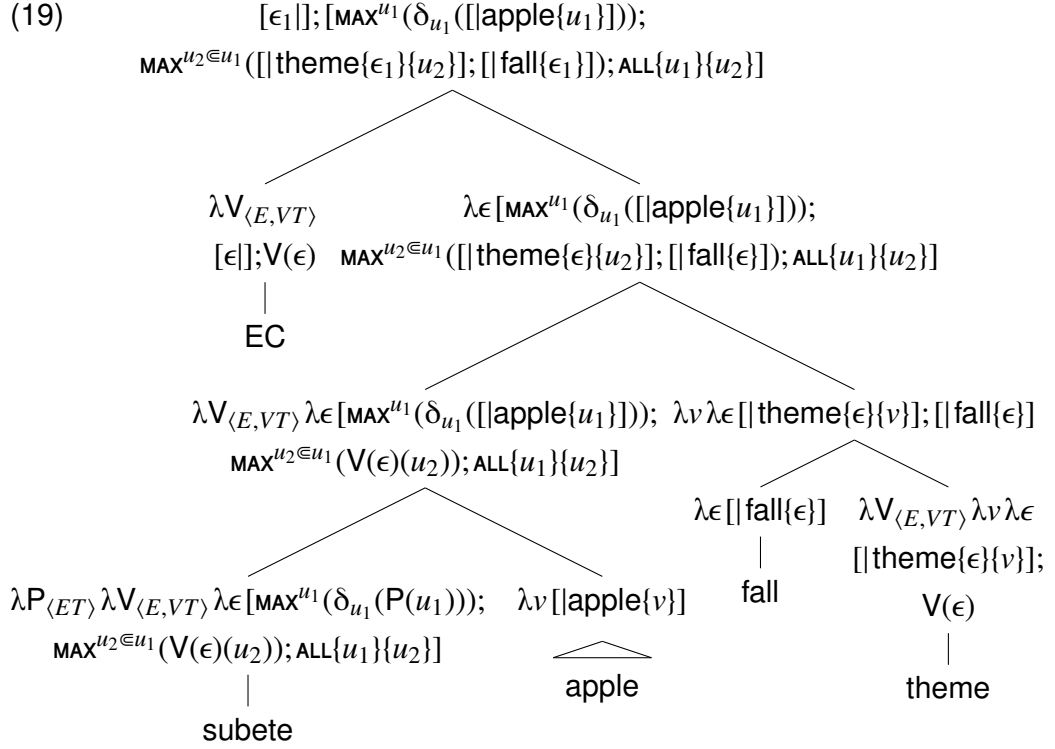
$$(17) \quad \begin{aligned} \text{a. } \llbracket \text{Prenominal quantifier} \rrbracket &= \lambda P_{\langle ET \rangle} \lambda V_{\langle E, VT \rangle} \lambda \epsilon [\text{MAX}^{u_n}(\delta_{u_n}(P(u_n))); \\ &\quad \text{MAX}^{u_m \in u_n}(V(\epsilon)(u_m)); \text{DET}\{u_n\}\{u_m\}] \\ \text{b. } \llbracket \text{Postnominal quantifier} \rrbracket &= \\ &\quad \lambda R_{\langle \langle E, VT \rangle, \langle VT \rangle \rangle} \lambda V_{\langle E, VT \rangle} R(\lambda v \lambda \epsilon [\text{MAX}^{u_m \in v}(V(\epsilon)(u_m)); \text{DET}\{v\}\{u_m\}]) \\ \text{c. } \llbracket \text{Floating quantifier} \rrbracket &= \lambda V_{\langle E, VT \rangle} \lambda v_E \lambda \epsilon_V [\text{MAX}^{u_m \in v}(V(\epsilon)(u_m)); \\ &\quad \text{DET}\{v\}\{u_m\}] \end{aligned}$$

In terms of its semantic type, the postnominal quantifier and the floating quantifier do not have the quantifier type. Rather, their semantic types are modificational. In this sense, one cannot distinguish generalised quantifiers from other types of expressions if one adopts (17). Still, one can see that all the three variants share the scope update and the structural inclusion between the restrictor set and the scope set. Thus, I propose that generalised quantifiers are those which involve the scope update with structural inclusion between two drefs.

Let me show how clausal denotations are compositionally derived with the three variants defined in (17). I will discuss syntax of Japanese quantifiers again in §4.5, but the structures proposed there will achieve the same compositional process. To exemplify the semantic composition, I use “subete” (all) because it allows all the three variants. I start with prenominal quantifiers. I use (18) as an example with a prenominal quantifier.

$$(18) \quad \text{Subete-no ringo-ga ochi-ta.} \\ \text{all-GEN apple-NOM fall-PAST} \\ \text{“All apples fell.”}$$

The denotation of (18) is derived as shown in (19).



The clausal denotation in (19) successfully updates the input context iff there is an output context in which (i) there is a maximal set of individuals each of whose atomic member is an apple (the restrictor update), (ii) there is a (plural) falling event whose theme is the maximal subset of the restrictor set (the scope update), and (iii) these two set stand in ALL relation, i.e., the scope set is a proper subset of the restrictor set (static generalised quantification). This captures the appropriate truth condition for (18).

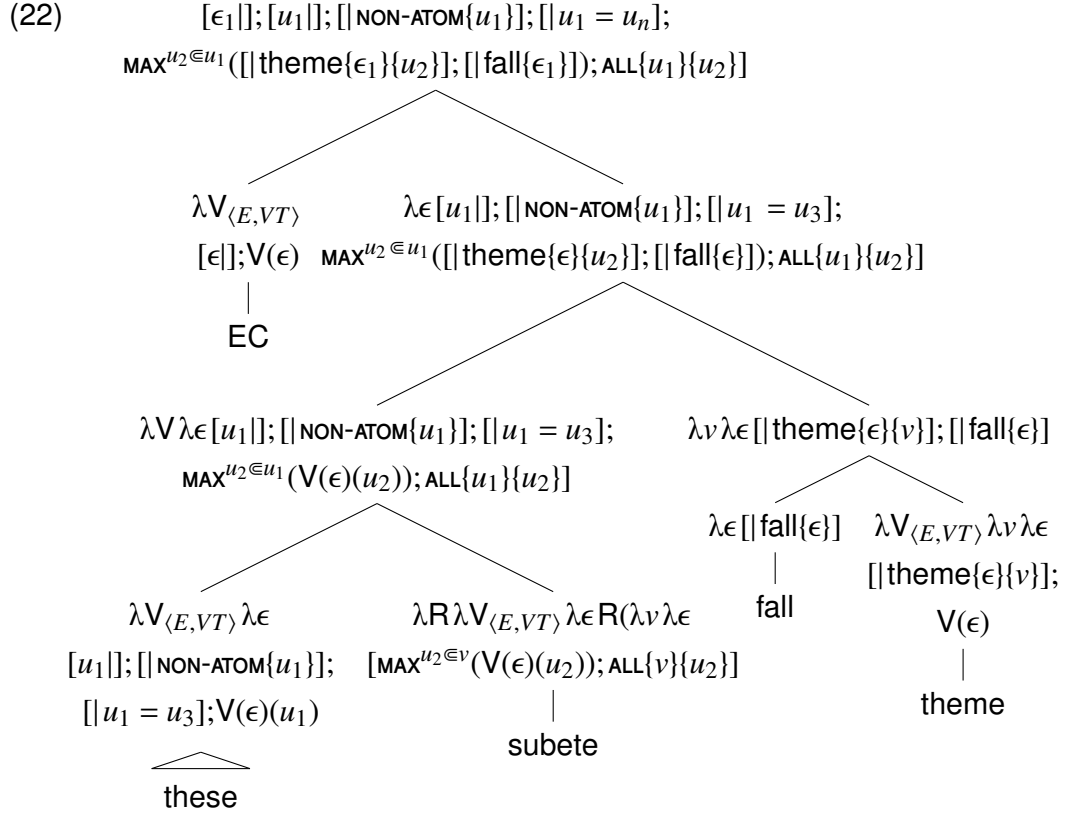
Second, I use (20) as an example with a postnominal quantifier. To illustrate how the postnominal quantifier is combined with an argumental host NP, I use an example with the full pronoun “sorera” (these).

- (20) Sorera-**subete**-ga ochi-ta.  
 it-PL-all-NOM fall-PAST  
 “All of these fell.”

The denotation of “sorera” (these) is given in (21).

- (21)  $[[\text{Sorera}_{u_n}]] = \lambda_{\langle E, VT \rangle} \lambda \epsilon_V [u_n]; [\text{NON-ATOM}\{u_n\}]; [u_n = u_n']; V(u_n)$

As the anaphoric potential of “sorera” (these) is irrelevant here, I do not specify its antecedent here. The denotation of (20) is derived as shown in (22).



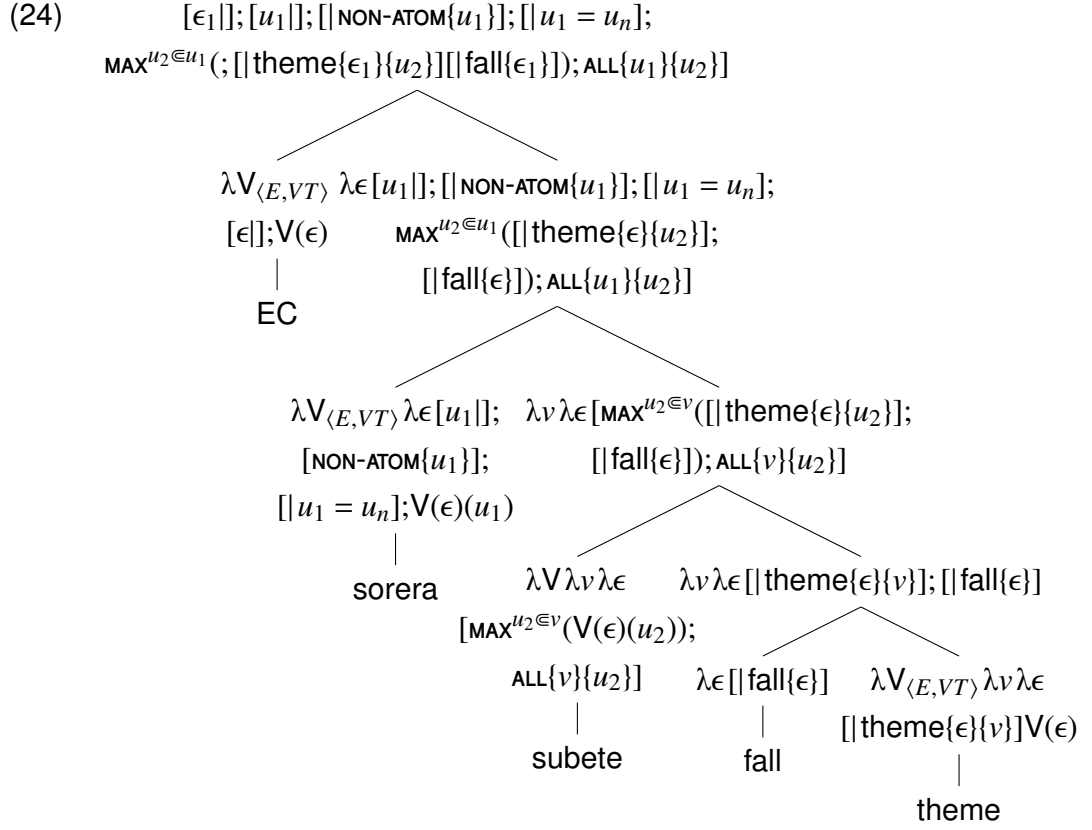
The clausal denotation in (22) is different from (19) the restrictor update: “subete” (all) in (22) does not introduce a dref for the restrictor set and relies on an argumental host NP, i.e. “sorera” (these) in this case. Despite this difference, this update requires that (i) there is a (plural) falling event whose theme is the maximal subset of the restrictor set (the scope update), and (ii) these two set stand in **ALL** relation, i.e., the scope set is a proper subset of the restrictor set (static generalised quantification). In this sense, the essential part of generalised quantification is also observed in (22).

Lastly, I use (23) as an example with a floating quantifier. Again, I use an example with the full pronoun to illustrate how the floating quantifier is combined with an argumental host NP.

- (23) Sorera-ga **subete** ochi-ta.  
 these-NOM all fall-PAST  
 “These all fell.”

The denotation of (23) is derived as shown in (24).





The scope update and the static generalised quantification in (24) are identical to those in (22). The difference again lies in the restrictor update. In (24), “subete” (all) modifies a VP and does not introduce a dref for the restrictor set. Instead, the restrictor set is provided with the subject, which is an argumental NP and introduces a dref by itself.

These ways, the proposed entries of generalised quantifiers in Japanese derive appropriate dynamic truth-conditions for clauses with a generalised quantifier. The difference among quantifiers with respect to the restrictor update is captured in a fully compositional way under the proposed account.

### 4.2.3 Predicative/Argumental NPs and type shifting principles

In this section, I show that the predicative/argumental distinction of restrictor NPs in Japanese correlates with the category-type mapping in Japanese common nouns. I repeat the denotations of the prenominal quantifier and the postnominal quantifier in (25).

- (25) a.  $[[\text{Prenominal quantifier}]] = \lambda P_{\langle ET \rangle} \lambda V_{\langle E, VT \rangle} \lambda \epsilon [\text{MAX}^{u_n}(\delta_{u_n}(P(u_n))); \text{MAX}^{u_m \in u_n}(V(\epsilon)(u_m)); \text{DET}\{u_n\}\{u_m\}]$
- b.  $[[\text{Postnominal quantifier}]] = \lambda R_{\langle \langle E, VT \rangle, \langle VT \rangle \rangle} \lambda V_{\langle E, VT \rangle} R(\lambda v \lambda \epsilon [\text{MAX}^{u_m \in v}(V(\epsilon)(u_m)); \text{DET}\{v\}\{u_m\}])$

Recall that the prenominal quantifiers in Japanese have essentially the same denotation as English quantificational determiners. I claim that this difference correlates with whether an NP itself introduces a dref without projecting a DP. The proposed account liaise with the semantic variation in the semantics of common nouns on this point. Chierchia (1998) proposes that if a language has an overt determiner, it blocks an application of a type-shifting rule which has the same semantics as the the determiner. He calls it the *Blocking Principle*.

- (26) **Blocking Principle** (Chierchia, 1998): For any type shifting operation  $\tau$  and any  $X: {}^* \tau(X)$ , if there is a determiner  $D$  such that for any set  $X$  in its domain,  $D(X) = \tau(X)$

He shows that languages like Mandarin and Russian lack overt articles and allow general use of bare arguments which can be indefinite or definite in different contexts. Japanese is one of those languages. As I discussed in Chapter 1, Japanese lacks an overt article and allows bare arguments in various environments. First, Japanese does not attest  $\phi$ -feature agreement as shown in (27).

- (27) {Boku(-ra) / Kimi(-ra) / Kare(-ra) / Kanojo(-ra)}-ga doa-o ake-ta.  
 {I(-PL) / you(-PL) / he(-PL) / she(-PL)}-NOM door-ACC open-PAST  
 “{I / we / you / he / she/ they} opened ({a / the}) door(s).”

Second, Japanese allows bare arguments as shown in (28).

- (28) Buin-ga booru-o katazuke-ta.  
 member-NOM ball-ACC put away-PAST  
 “({A / The}) club member(s) put away ({a / the}) ball(s).”

Thus, Japanese bare nouns can be an argument without recourse to overt nor syntactically active determiners. In other words, Japanese can flexibly shift the semantic type of common noun denotations between the predicative type and the argumental type.<sup>4</sup> The relevant type shifters are covert counterparts of the indefinite article and the definite article. I define the denotations of articles in the version of PCDRT I adopt in this thesis as shown in (29).

- (29) a.  $[[\text{the}_{UQ}]] = \lambda P_{\langle ET \rangle} \lambda V_{\langle E, VT \rangle} \lambda \epsilon_V \text{MAX}^{u_n}(P(u_n)); [[\text{NOV}\{u_n\}]]; Q(\epsilon)(u_n)$   
 b.  $[[a]] = \lambda P_{\langle ET \rangle} \lambda V_{\langle E, VT \rangle} \lambda \epsilon_V [u_n]; [[\text{NOV}\{u_n\}]]; [[\text{ATOM}\{u_n\}]]; P(u_n); V(\epsilon)(u_n)$

The argument type in PCDRT is  $\langle \langle E, VT \rangle, VT \rangle$  and both articles have the same semantic type. They differ in maximality:  $[[\text{the}_{UQ}]]$  introduces a maximal dref, whereas  $[[a]]$  introduces a non-maximal dref.<sup>5</sup> Note that I distinguish the uniqueness/maximality definite and the anaphoric definite following Brasoveanu (2008). I assume that the uniqueness/maximality definite article  $[[\text{the}_{UQ}]]$  introduces a novel dref. In contrast, I assume that the anaphoric definite article is co-referential with its antecedent as defined in (30).

- (30)  $[[\text{the}_{u_n'}]] = \lambda P_{\langle ET \rangle} \lambda V_{\langle E, VT \rangle} \text{MAX}^{u_n}(P(u_n)); [[u_n = u_n']]; Q(\epsilon)(u_n)$

Now, the type shifting principles which are responsible for Japanese bare arguments are defined based on (29). Japanese allows two type shifting principles, namely the  $\iota$ -shift and the  $\exists$ -shift, which turn a predicate to an argument. The definition of these type shifters under PCDRT with event is given in (31).

- (31) Type shifting principles under PCDRT with events  
 a.  $\iota(P) = \lambda V_{\langle E, VT \rangle} \lambda \epsilon_V \text{MAX}^{u_n}(P(u_n)); [[\text{NOV}\{u_n\}]] V(\epsilon)(u_n)$   
 b.  $\exists(P) = \lambda V_{\langle E, VT \rangle} \lambda \epsilon_V [u_n]; [[\text{NOV}\{u_n\}]]; P(u_n); V(\epsilon)(u_n)$

4. As another important contribution, Chierchia (1998) suggests that bare common nouns in languages like Mandarin and Japanese are kind-denoting terms as default. Although it is an elegant and interesting typological generalisation, I assume that the default semantic type of Japanese is  $\langle ET \rangle$  in this thesis. The reason is purely expository and one can aim to reconstruct my analysis with the assumption that common nouns in Japanese are kind-terms and one applies the predicativising operator  $^U$ -shift to obtain a predicative NP. Also, see Chapter 6 for discussion on kinds.

5. However, see Brasoveanu (2008) for an entry of  $[[a]]$  which introduce an individual which is maximal relative to both P and V. This option is orthogonal to the main point of this thesis.

The  $\iota_{TA}$  shift is the covert counterpart of  $[[the_{UQ}]]$  and the  $\exists$  shift is the covert counterpart of  $[[a]]$ , which is neutral with respect to atomicity.<sup>6</sup> Since English has both an overt definite article and an overt indefinite article, the Blocking Principle blocks application of the  $\iota_{TA}$  shift and the  $\exists$  shift in English<sup>7</sup>.

Note that the  $\iota_{TA}$  shift is the uniqueness/maximality definite article and it does not function as an anaphoric definite. In Japanese, *so*-type demonstratives correspond to the anaphoric definite. I assume that the demonstrative “sono” (the) has the same denotation as the anaphoric definite in English.

$$(32) \quad [[sono_{u_n'}]] = \lambda P_{\langle ET \rangle} \lambda V_{\langle E, VT \rangle} \text{MAX}^{u_n}(P(u_n)); [[u_n = u_n']]; Q(\epsilon)(u_n)$$

Summing up, the type flexibility of Japanese quantifiers correlates with the type flexibility of Japanese common nouns: various quantificational expressions in Japanese can take an argumental restrictor NP because Japanese common nouns does not need an overt article to be an argument.

### 4.3 Defining quantifiers without relying on types

So far, I defined three type-variants of generalised quantifiers in Japanese. Among the three variants, only the prenominal quantifier has the semantic type as a quantifier in the traditional sense. Moreover, I assume that non-quantificational arguments and quantificational arguments have the same semantic type in my analysis. In this section, I claim that this is not a problem. More specifically, I show that the PCDRT definition of generalised quantifiers can correctly predict the constraints on host NPs of postnominal quantifiers.

6. Dotlačil (2013) assumes that plural indefinites in English obtain a *dref* via the existential closure, which is essentially identical to the  $\exists$  shift defined in (31b).

7. English allows bare plurals and Chierchia (1998) claims that the blocking does not take place with plural indefinites, which explains why bare plurals can either be kind-denoting or existential.

### 4.3.1 Stacking multiple quantifiers

In this section, I discuss the constraint that a postnominal quantifier cannot take a quantificational argument as its host NP and show that the PCDRT definition of generalised quantifiers derives this constraint. First of all, argument NPs all have type  $\langle\langle E, VT \rangle, VT \rangle$  in PCDRT with events. On this point, the denotation of a prenominal quantifier plus its host NP has the type  $\langle\langle E, VT \rangle, \langle VT \rangle\rangle$ . Thus, one may expect this unit to be able to occur as a host NP of a postnominal quantifier. However, this is not the case as shown in (33).

- (33) \* [subete-no gakusei] hotondo  
           all-GEN student most  
           ‘most of all the students’

The constituent [subete-no gakusei] has type  $\langle\langle E, VT \rangle, \langle VT \rangle\rangle$  and the postnominal quantifier “hotondo” (most) look for a host NP with this exact type. Thus, the unacceptability of (33) is unexpected in terms of semantic type.

On this point, one may take it as an indication that non-quantificational arguments and quantificational argument have to be distinguished in terms of semantic type.<sup>8</sup> However, which semantic type is assigned to which expression is, in principle, a theory-internal matter and one can always define type-variants of those expressions. In this sense, it is not explanatory to employ type-crash to prevent quantificational arguments from being the restrictor of a postnominal quantifier. Instead, I claim that the unacceptability of (33) directly comes from the core component of generalised quantification in PCDRT. To see this, consider the denotations of “subete-no gakusei” (all students) and “hotondo” (most) as shown in (34).

- (34) a.  $[[\text{subete-no gakusei}]] = \lambda V_{\langle E, VT \rangle} \lambda \epsilon_V [\text{MAX}^{u_1}(\delta_{u_1}([[\text{student}\{u_1\}]]);$   
            $\text{MAX}^{u_2 \in u_1}(V(\epsilon)(u_2)); \text{ALL}\{u_1\}\{u_2\})]$   
       b.  $[[\text{hotondo}]] = \lambda R_{\langle\langle E, VT \rangle, \langle VT \rangle\rangle} \lambda V_{\langle E, VT \rangle} R(\lambda v \lambda \epsilon [ \text{MAX}^{u_3 \in v}(V(\epsilon)(u_3));$   
            $\text{MOST}\{v\}\{u_m\}])]$

8. For example, one can define the postnominal quantifiers in Japanese as shown in (1).

(1)  $[[\text{Postnominal quantifier}]] = \lambda v_E \lambda V_{\langle E, VT \rangle} \lambda \epsilon \text{MAX}^{u_m \in v}(V(\epsilon)(u_m); \text{DET}\{v\}\{u_m\})]$

This entry takes a restrictor of type  $E$ . This is a straightforward dynamic implementation of generalised quantification over entities of type  $e$  (Matthewson, 2001). It explains why quantificational nominal plus NPs cannot be the restrictor of a postnominal quantifier for type reasons. However, it requires an analytical device which performs dref introduction with an expression of type  $E$  under a dynamic system which takes variable assignments as primitives. Although I believe it is not impossible, I leave this for future research.

With these, the denotation of (33) is given in (35).

$$(35) \quad \llbracket (33) \rrbracket = \lambda V_{\langle E, VT \rangle} \lambda \epsilon_V [\text{MAX}^{u_1}(\delta_{u_1}(\llbracket \text{student}\{u_1\} \rrbracket)); \\ \text{MAX}^{u_2 \in u_1}(\text{MAX}^{u_3 \in u_2}(V(\epsilon)(u_3)); \text{MOST}\{u_2\}\{u_3\}); \text{ALL}\{u_1\}\{u_2\}]$$

One can see that maximisation is nested in (35):  $\text{MAX}^{u_3 \in u_2}$  is evaluated under the scope of  $\text{MAX}^{u_2 \in u_1}$ . This nesting makes (35) undefined.  $\text{MAX}^{u_2 \in u_1}$  introduces a new dref such that it stores the maximal individual which satisfies its restriction, i.e.  $[\text{MAX}^{u_3 \in u_2}(V(\epsilon)(u_3)); \text{MOST}\{u_2\}\{u_3\}]$  in this case. However, this restriction includes the condition  $u_3 \in u_2$  since  $\text{MAX}^{u' \in u}(D)$  is defined as  $\text{MAX}^{u'}([\llbracket u' \in u \rrbracket; D])$ . This means that one has to know the value of  $u_2$  to introduce  $u_2$ , which is impossible. Technically speaking,  $u_3 \in u_2$  is evaluated before  $\text{MAX}^{u_2 \in u_1}$ . This means that  $u_2$  only stores dummy individuals  $\star$  when  $u_3 \in u_2$  is evaluated. Thus,  $u_3 \in u_2$  is undefined.

Note that this is not limited to (33): whenever a quantifier plus an NP occurs as the restrictor of a postnominal quantifier, this nesting occurs and this makes the inner maximisation undefined. (36) shows the general logical skeleton of [quantifier-no NP] quantifier.

$$(36) \quad \lambda V_{\langle E, VT \rangle} \lambda \epsilon_V [\text{MAX}^{u_n}(\delta_{u_n}(\llbracket \text{NP}\{u_n\} \rrbracket)); \\ \text{MAX}^{u_{n+1} \in u_n}(\text{MAX}^{u_{n+2} \in u_{n+1}}(V(\epsilon)(u_{n+2})); \text{DET}\{u_{n+1}\}\{u_{n+2}\}); \text{DET}\{u_n\}\{u_{n+1}\}]$$

One can see that nesting of maximisation is independent of quantificational force and lexical choice of NP. Whenever  $\text{MAX}^{u_{n+2} \in u_{n+1}}$  is embedded under the scope of  $\text{MAX}^{u_{n+1} \in u_n}$ , reference to the value of  $u_{n+1}$  is necessary before its value is introduced. Thus, this accounts for the reason why the configuration [[quantifier-no NP] quantifier] is disallowed. This issue does not arise when a postnominal quantifier takes a definite NP as shown in (37).

$$(37) \quad \begin{aligned} \text{a. } \text{iota}[\llbracket \text{gakusei} \rrbracket] &= \lambda V_{\langle E, VT \rangle} \lambda \epsilon_V [\text{MAX}^{u_1}(\llbracket \text{student}\{u_1\} \rrbracket; V(\epsilon)(u_1))] \\ \text{b. } \llbracket \text{hotondo} \rrbracket &= \lambda R_{\langle \langle E, VT \rangle, \langle VT \rangle \rangle} \lambda V_{\langle E, VT \rangle} R(\lambda v \lambda \epsilon [\text{MAX}^{u_2 \in v}(V(\epsilon)(u_2)); \\ &\quad \text{MOST}\{v\}\{u_2\}]) \\ \text{c. } \llbracket \text{gakusei hotondo} \rrbracket &= \lambda V_{\langle E, VT \rangle} [\text{MAX}^{u_1}(\llbracket \text{student}\{u_1\} \rrbracket; \\ &\quad \text{MAX}^{u_2 \in u_1}(V(\epsilon)(u_2)); \text{MOST}\{u_1\}\{u_2\})] \end{aligned}$$

The crucial difference between a definite NP and quantificational argument is that the latter involves maximisation on its scope, while the former does not. This maximisation on the scope property leads to the nesting of maximisation operator. Note that this analysis relies on the assumption that the scope set of a quantifier is the

However, one can also claim that (2) involves the *iota*-shift. As an analysis based on the *iota*-shift can also explain (2), this does not necessarily suggest that a strategy with a specific indefinite is also available in Japanese postnominal quantifier construction.

While some authors claim that this constraint comes from the semantics of “of” (Barker, 1998; Ladusaw, 1982), Matthewson (2001); Shin (2016) claims that it comes from the semantics of quantifiers. Their motivations and implementations differ, but they agree that some quantifiers take an individual of type  $e$  and this makes an indefinite unavailable as the inner DP of a partitive construction. However, this story is not applicable to PCDRT: indefinites and (maximal/non-anaphoric) definites both introduce a new dref and have the same semantic type.

On this point, I adopt an idea discussed in Matthewson (2000). She points out that an indefinite inner DP makes partitive quantification vacuous.<sup>10</sup>

- (40) a. all of some women = some women  
 b. most of some women = some women (Matthewson, 2000)

If one randomly picks up a non-maximal set of women and take all the members of it, the resulting set is still a non-maximal set of women. In this sense, quantification with “all” is vacuous. Similarly, if one randomly picks up a non-maximal set of women and take most of them, the resulting set is still a non-maximal set of women. To see this is the case, consider the PCDRT denotations of them. I assume that quantifier in partitive constructions have the same semantics as the postnominal quantifiers in Japanese. This can be regarded as an implementation of partitive quantification in Matthewson (2001); Shin (2016) under PCDRT.

- (41) a.  $[[\text{some women}]] = \lambda V_{\langle E, VT \rangle} \lambda e_V [u_1]; [[\text{woman}\{u_1\}]; [[\text{NON-ATOM}\{u_1\}]; V(u_1)(e)]$   
 b.  $[[\text{all of some women}]] = \lambda V_{\langle E, VT \rangle} \lambda e_V [u_1]; [[\text{woman}\{u_1\}]; [[\text{NON-ATOM}\{u_1\}]; \text{MAX}^{u_2 \in u_1}(V(u_2)(e)); \text{ALL}\{u_1\}\{u_2\}]]$   
 c.  $[[\text{most of some women}]] = \lambda V_{\langle E, VT \rangle} \lambda e_V [u_1]; [[\text{woman}\{u_1\}]; [[\text{NON-ATOM}\{u_1\}]; \text{MAX}^{u_2 \in u_1}(V(u_2)(e)); \text{MOST}\{u_1\}\{u_2\}]]$

Now, consider the context (42).

- (42) Context: there are seven women and three of them danced.  
 a. Some women danced.  
 b. All of some women danced.  
 c. Most of some women danced.

10. See Matthewson (2000) for cases with other quantifiers.



Suppose three women  $woman_1$ ,  $woman_2$  and  $woman_3$  danced. (42a) is true if  $u_1$  stores at least two of these three women. The same thing applies to (42b). For example, if  $u_1$  and  $u_2$  both store  $woman_1$  and  $woman_2$ , (42b) is true. How about (42c)? It is slightly more complex, but the same thing applies. For example, if  $u_1$  stores  $woman_1$ ,  $woman_2$  and a woman who did not dance, while  $u_2$  both store  $woman_1$  and  $woman_2$ , (42c) is true. Essentially, as the value of  $u_1$  is randomly assigned, (42c) does not preserve the proportional meaning.

Thus, partitive quantification with an indefinite inner DP ends up being vacuous as Matthewson (2000) points out. She suggests that the partitive constraint is pragmatic in nature and infelicity comes from vacuity of partitive quantification. If this is on the right track, the infelicity of (38) follows even though the type of indefinites and (maximal/non-anaphoric) definites are the same in PCDRT.

Although I do not discuss an implementation it here, one can derive this pragmatic version of the partitive constraint from a general economy principle. Crucially, (42b) and (42c) are just as informative as (42a) despite that (42b) and (42c) are more complex than (42a). Thus, this is an instance of the cases in which  $\phi$  has an alternative  $\psi$  such that (i)  $\psi$  is (structurally) simpler than  $\phi$  and (ii)  $\phi$  is at most as informative as  $\psi$ . For example, *Efficiency* (Meyer, 2014) generally blocks those cases. Note that whatever principle one employs to prohibit (42b) and (42c) have to be defined in terms of entailment and not in terms of denotations. The three expressions in (41) still update the context in different ways. Thus, they do not have the same denotation in terms of anaphoric content.

Summing up, constraints on the host NP of postnominal quantifiers can be explained in terms of economy and thus this does not pose a problem for PCDRT in which definites and indefinites have the same semantic type.

## 4.4 Type-ambiguity of universal quantifiers

In this section, I discuss the variation within the class of universal quantifiers in Japanese. I first show that some of the quantifiers in Japanese can occur at an argument position without having a host NP. I call this *the unary use*. Adding this variant, there are four type-variants of universal quantifiers in Japanese. I suggest that idiosyncratic properties of universal quantifiers in Japanese are found in the

way how they introduce their restrictor set and evaluate their scope. Based on this, I revise the template of type-variants of generalised quantifiers in Japanese and show that this derives four type-variants of universal quantifiers while predicting that some quantifiers lack the unary use or the prenominal use.

#### 4.4.1 Unary universal quantifiers

So far, I have suggested that the three variants of generalised quantifiers in Japanese can be classified based on how they perform the restrictor update. In this section, I show that Japanese has universal quantifiers which sometimes do not take a host NP. I call them *unary* variant of generalised quantifiers. Two non-distributive universal quantifiers “zen’in” and “minna” can occur as an argument without a host NP as shown in (43).

- (43) {**Zen’in** / **Min’na**}-ga heya-o sooji-sita.  
 {all / all}-NOM room-ACC clean-PAST  
 “Everyone cleaned up a room.”

Difference between these expressions and “subete” is clearer in possessive constructions. Since Kamio (1983), it has been noticed that omission of an NP with a stranded “-no” allows a property reading, i.e. a book is a three-volume one, but disallows a cardinal reading, i.e. books are three, as shown in (44b).<sup>11</sup>

- (44) a. Hon’ya-ni hon-ga naran-de-i-ru.  
 book store-at book-NOM line up-PROD-PRES  
 “Books line up at the book store.”  
 b. Ken-wa **ni-satsu**-no-o ka-tta.  
 Ken-TOP 2-CL<sub>volume</sub>-GEN-ACC buy-PAST  
 i. “Ken bought a two-volume one.” (property reading)  
 ii. \*“(Ken bought two.” (cardinal reading)

“Subete,” (all) does not have a property reading and is unacceptable in this environment.

- (45) a. Hon’ya-ni hon-ga naran-de-i-ru.  
 book store-at book-NOM line up-PROD-PRES  
 “Books line up at the book store.”

11. I take a neutral position between NP ellipsis analyses and pro-form analyses.

- b. \* Ken-wa {subete / hotondo}-no-o ka-tta.  
 Ken-TOP {all / most}-GEN-ACC buy-PAST  
 “Ken bought a {all/ most} one.”

However, if possessor individuals are made salient, “zen’in” and “minna” can have a possessive reading, while “subete” remains unacceptable as shown in (46).

- (46) a. Hon’ya-ni ironna chosya-no hon-ga naran-de-i-ru.  
 book store-at various author-GEN book-NOM line up-PROD-PRES  
 “Various authors’ books line up at the book store.”  
 b. Ken-wa { \*subete / zen’in / minna / ?sorezore }-no-o ka-tta.  
 Ken-TOP {all / all / all / DIST}-GEN-ACC buy-PAST  
 “Ken bought {everyone / each one}’s.”

With “zen’in” and “minna,” (46b) can be acceptable and true if Ken bought every author’s books. Note that “sorezore” is also acceptable in this context.

At the first sight, they seem to behave like a pronoun as shown in (47).<sup>12</sup>

- (47) Kantoku-ga toosyu<sup>u1</sup>-o nan-nin-ka yato-tta-ra, kare-wa {sorezore /  
 manager-NOM pitcher-ACC what-CL<sub>Person</sub>-KA hire-PAST-if he-NOM {DIST /  
**zen’in** / ?**min’na**}<sup>u2</sup><sub>u1</sub>-o jikkuri sodate-ru.  
 all / all}-ACC carefully train-PRES  
 “If the manager hires several pitchers, he carefully trains {each / everyone}.”

However, they differ from “sorezore” under the scope of negation as shown in (48). In (48a), dref  $u_1$  is introduced under negation. Thus, it is expected that “sorezore” is degraded in (48b) because  $u_1$  is not accessible for “sorezore.” However, “zen’in” and “min’na” sound fine in this context.

- (48) a. Uchi<sup>u1</sup>-wa sokkyuu uwan toosyu<sup>u2</sup>-o dare-mo to-re-naka-tta.  
 we-TOP fastball righthand pitcher-ACC who-also get-can-NEG-PAST  
 “We could not get any right-hand fastball pitcher.”  
 b. Nazenara, hoka-no chiimu-ga { \*sorezore / **zen’in** / ?**min’na** }<sup>u3</sup><sub>u2</sub>-o  
 because, other-GEN team-NOM {DIST / all / all}-ACC  
 kakutoku-sita kara-da.  
 get-PAST because-COP  
 “Because other teams get {each / everyone}.”

12. Kenta Mizutani and Ryoichiro Kobayashi (p.c.) accepted (48b) with “zen’in” and “min’na,” but they prefer to omit the case particle “o.” I leave this preference for future research. This preference is observed in (48), too.

This is puzzling if “zen’in” and “min’na” are anaphoric just like “sorezore.” Instead, I propose that the restrictor of “zen’in” and “min’na” pick up the maximal individual from a contextually salient set of individuals. In (48b), those individuals are the pitchers in this year’s rookie draft.

The unary “zen’in” and “min’na” cannot pick up the contextually salient individuals if they are inanimate as shown in (49).<sup>13</sup>

- (49) Akira-wa baiku<sup>u<sub>1</sub></sup>-o nan-dai-ka mo-tte-iru ga, kare-wa {sorezore  
 Akira-TOP bike-ACC what-CL<sub>Vehicle</sub>-KA OWN-PROG-PRES but, he-TOP {DIST  
 / \*zen’in / \*min’na}<sup>u<sub>2</sub></sup>-o chanto tuka-tte-iru.  
 / all / all}-ACC properly USE-PROG-PRES  
 “Akira owns several bikes, but he use {each/ everyone} properly.”

The denotation of “zen’in” and “min’na” is given in (50).  $C$  is a set of salient individuals in a given context.

- (50)  $[[zen'in/min'na]] = \lambda V_{\langle E, VT \rangle} \lambda \epsilon \text{MAX}^{u_n}([ \cup u_n = C ]); \text{MAX}^{u_m \in u_n}([ \text{ANIMATE}\{u_m\} ];$   
 $V(\epsilon)(u_m)); \text{ALL}\{u_n\}\{u_m\}]$

In the next section, I discuss other variants of “zen’in” and “min’na” with host NPs and show how they differ from another universal quantifier “subete.”

#### 4.4.2 Variation in universal quantifiers

In this section, I discuss other aspects of “zen’in” and “min’na” which make them different from “subete.” Firstly, “zen’in” and “min’na” cannot occur at the prenominal position as shown in (51).

- (51) a. \* {Zen’in / Min’na}-no sutahhu-ga heya-o sooji-sita.  
 {all / all}-GEN employee-NOM room-ACC clean-PAST  
 b. (Kore-ra-no) sutahhu- {zen’in / min’na}-ga heya-o sooji-sita.  
 (this-PL-GEN) employee- {all / all}-NOM room-ACC clean-PAST  
 “All (of these) employees cleaned up a room.”  
 c. Sutahhu-ga {zen’in / min’na} heya-o sooji-sita.  
 employee-NOM {all / all} room-ACC clean-PAST  
 “The employees all cleaned up a room.”

13. “Zen’in” prefers human individuals, but it can pick up non-human animate individuals in a proper context. This preference is weaker for “min’na.” As the difference between human individuals and non-human animate individuals is orthogonal to the main point of this chapter, I do not discuss it further.

Floating variants of “zen’in” and “min’na” are also not anaphoric. When they occur at the post-object position, they cannot be associated with the subject as shown in (52b).<sup>14</sup>

- (52) a. Kore-ra-no sutahhu<sup>u1</sup>-ga {zen’in / min’na}<sub>u1</sub> heya<sup>u2</sup>-o sooji-sita.  
 this-PL-GEN employee-NOM {all / all} room-ACC clean-PAST  
 b. \*Kore-ra-no sutahhu<sup>u1</sup>-ga heya<sup>u2</sup>-o {zen’in / min’na}<sub>u1</sub> sooji-sita.  
 this-PL-GEN employee-NOM room-ACC {all / all} clean-PAST  
 “Five employees all cleaned up rooms.”

Second, “zen’in” and “min’na” have to take an animate host NP, whereas “subete” is not sensitive to animacy as shown in (53).

- (53) a. (Notional) mass nouns:  
**Mizu**-{subete / \*min’na / \*zen’in}-ga kobore-ta.  
 water-{all / all / all}-NOM spill-PAST  
 “All of the water spilled.”  
 b. Inanimate (notional) count nouns:  
**Hon**-{subete / \*min’na / \*zen’in}-ga katadui-ta.  
 book-{all / all / all}-NOM cleaned up-PAST  
 “All (the) books are put in order.”  
 c. Person-denoting nouns:  
**Stahhu**-{??subete / min’na / zen’in}-ga heya-o sooji-sita.  
 staff-{all / all / all}-NOM room-ACC clean-PAST  
 “All (the) staffs cleaned up a room.”

First, “min’na” and “zen’in” are infelicitous if their host NP is mass as shown in (53a). Second, only “zen’in” is infelicitous if its host NP is an inanimate count noun as shown in (53b). Lastly, both “min’na” and “zen’in” are felicitous with a person-denoting nouns, but “subete” is degraded in this case as shown in (53c).<sup>15</sup>

14. In principle, “zen’in” and “min’na” at the post-object position can be associated with the object. In such cases, (52b) has a reading in which five employees cleaned up all the rooms. However, as I will show in Footnote 15, the floating variant of “zen’in” requires a human-denoting host NP, but the floating variant of “min’na” does not. Thus, the floating “min’na” allows this reading, while the floating “zen’in” does not.

15. This animacy restriction is also observed with the floating “zen’in,” but the floating “min’na” is not sensitive to animacy and it is not even sensitive to atomicity as shown in (1).

- (1) a. (Notional) mass nouns:  
**Mizu**-ga {subete / ?min’na / \*zen’in} kobore-ta.  
 water-NOM {all / all / all} spill-PAST  
 “All of the water spilled.”

“Subete” is also degraded in the postnominal position, but not in the prenominal position as shown in (54). It suggests that “subete” is degraded only when it occurs where “zen’in” can also occur.

- (54) a. Subete-no sutahhu-ga heya-o sooji-sita.  
 all-GEN staff-NOM room-ACC clean-PAST  
 “All (the) staffs cleaned up a room.”
- b. ?? (Kore-ra-no) sutahhu-ga subete heya-o sooji-sita.  
 (this-PL-GEN) staff-NOM all room-ACC clean-PAST  
 “These staffs all cleaned up a room.”

Considering that “subete” can felicitously occur at any of the three positions when its host NP is inanimate, I assume that this is an anti-animacy effect due to pragmatic competition between “subete” versus “zen’in” and “min’na.”

Now, one can see that the class of universal quantifiers in Japanese involve at least three distributional patterns as shown in Table 4.3.

	Unary	Prenominal	Postnominal	Floating
sorezore	ok	ok	ok	ok
subete	*	ok	ok	ok
zen’in, min’na	ok	*	ok	ok

**Table 4.3:** Distributional pattern of universal quantifiers in Japanese

I claim this variation is tied with the idiosyncratic properties of each type of universal quantifiers and it provides a window into the interaction between those idiosyncratic properties and the type-ambiguity of quantifiers in Japanese. In the next section, I suggest a way to explain why there are gaps in this table.

- b. Inanimate (notional) count nouns:  
**Hon**-ga {subete / min’na / \*zen’in} katadui-ta.  
 book-NOM {all / all / all} cleaned up-PAST  
 “All (the) books are put in order.”
- c. Person-denoting nouns:  
**Stahhu**-ga {??subete / min’na / zen’in} heya-o sooji-sita.  
 employee-NOM {all / all / all} room-ACC clean-PAST  
 “All (the) employees cleaned up a room.”

I leave this puzzle for the future research.

### 4.4.3 Parametrisation of quantifier denotations

I have suggested that variation within the same quantifier is found in the way how the restrictor update is performed as repeated in (55).

$$(55) \quad \underbrace{\text{MAX}^u(\delta_u(P(u)))}_{\text{Restrictor update}}; \underbrace{\text{MAX}^{u'} \in^u(\delta_{u'}(Q(u')(\epsilon)))}_{\text{Scope update}}; \underbrace{\text{DET}\{u\}\{u'\}}_{\text{GQ component}}$$

In this section, I suggest that variation across different types of universal quantifiers is found in the way how idiosyncratic properties of each quantifier are encoded in the restrictor update and the scope update. More specifically, I propose that the universal quantifiers I discussed above differ in the way (i) how they introduce the restrictor set and (ii) what condition they impose in their scope update. I call idiosyncratic properties in the restrictor update *restrictor conditions* and the idiosyncratic properties in the scope update *scope conditions*. Different types of the restrictor conditions and the scope conditions are shown in (56) and (57).<sup>16</sup>

(56) Restrictor conditions

- |   |                |
|---|----------------|
| a. Unmarked: $\text{MAX}^{u_n}(P(u_n))$                     | subete         |
| b. Contextual: $\text{MAX}^{u_n}([ \cup u_n = C ]; P(u_n))$ | zen'in, min'na |
| c. Anaphoric: $\eta(u_n); P(u_n)$                           | sorezore       |

(57) Scope conditions

- |  |                |
|--|----------------|
| a. Unmarked: $\lambda V_{\langle E, VT \rangle} \lambda \epsilon \lambda v [V(\epsilon)(v)]$                         | subete         |
| b. Sorted: $\lambda V_{\langle E, VT \rangle} \lambda \epsilon \lambda v [\text{SORT}(v); V(\epsilon)(v)]$           | zen'in, min'na |
| c. Anaphoric distributive: $\lambda V_{\langle E, VT \rangle} \lambda \epsilon \lambda v [\delta_u(V(\epsilon)(v))]$ | sorezore       |

Based on (56) and (57), I propose (58) as a general template of type-ambiguity of universal quantifiers in Japanese.<sup>17</sup> **RESTRICTOR** is a place holder for a specific restrictor condition and **SCOPE** is a place holder for a specific scope condition.

16. See Chapter 5 for the detailed discussion on “sorezore.”

17. In this thesis, I do not analyse universal quantification use of indeterminate pronouns, which is exemplified in (1).

(1) **Dono-gakusei-mo** kisei-sita.  
 which-student-also go home-PAST  
 “Every student went back to their home town.”

However, I sometimes use “dono-NP-mo” (every NP) in examples. It behaves as a distributive universal quantifier: it is incompatible with a collective predicate as shown in (2).

- (58) a.  $[[\text{Unary quantifier}]] = \lambda V_{\langle E, VT \rangle} \lambda \epsilon [\text{RESTRICTOR}^{u_n}; \text{MAX}^{u_m \in u_n}(\text{SCOPE}(V)(\epsilon)(u_n); \text{DET}\{u_n\}\{u_m\})]$
- b.  $[[\text{Prenominal quantifier}]] = \lambda P_{\langle ET \rangle} \lambda V_{\langle E, VT \rangle} \lambda \epsilon [\text{RESTRICTOR}^{u_n}(\delta_{u_n}(P(u_n)); \text{MAX}^{u_m \in u_n}(\text{SCOPE}(V)(\epsilon)(u_m)); \text{DET}\{u_n\}\{u_m\})]$
- c.  $[[\text{Postnominal quantifier}]] = \lambda R_{\langle \langle E, VT \rangle, \langle VT \rangle \rangle} \lambda V_{\langle E, VT \rangle} R(\lambda v \lambda \epsilon [\text{MAX}^{u_m \in v}(\text{SCOPE}(V)(\epsilon)(u_m)); \text{DET}\{v\}\{u_m\}])]$
- d.  $[[\text{Floating quantifier}]] = \lambda V_{\langle E, VT \rangle} \lambda v_E \lambda \epsilon_V [\text{MAX}^{u_m \in v}(\text{SCOPE}(V)(\epsilon)(u_m)); \text{DET}\{v\}\{u_m\}]$

Note that a quantifier involves its idiosyncratic restrictor condition only in its unary variant and in its prenominal variant. Restrictor conditions are not encoded in postnominal variants and floating variants because they rely on an argumental host NP, which introduce a dref by itself. Accordingly, the properties associated with the restrictor condition disappear at the postnominal position and at the floating position. To confirm this point, let me take “zen’in/min’na” as an example. The three variants of “zen’in” and “min’na” are defined in (59).

- (59) a.  $[[\text{zen’in/min’na}]] = \lambda V_{\langle E, VT \rangle} \lambda \epsilon \text{MAX}^{u_n}([| \cup u_n = C |]); \text{MAX}^{u_m \in u_n}([| \text{ANIMATE}\{u_n\}; V(\epsilon)(u_n) |]; \text{ALL}\{u_n\}\{u_m\})$  (Unary)
- b.  $[[\text{zen’in/min’na}]] = \lambda R_{\langle \langle E, VT \rangle, \langle VT \rangle \rangle} \lambda V_{\langle E, VT \rangle} R(\lambda v \lambda \epsilon [\text{MAX}^{u_m \in v}([| \text{ANIMATE}\{u_m\}; V(\epsilon)(u_m) |]; \text{ALL}\{v\}\{u_m\}])$  (Postnominal)
- c.  $[[\text{zen’in/min’na}]] = \lambda V_{\langle E, VT \rangle} \lambda v_E \lambda \epsilon_V [\text{MAX}^{u_m \in v}([| \text{ANIMATE}\{u_m\} |]; V(\epsilon)(u_m)); \text{ALL}\{v\}\{u_m\}]$  (Floating)

“Zen’in/Min’na” introduces a contextually salient restrictor set and evaluates its scope with the animacy condition. This predicts that the postnominal “zen’in” and “min’na” cannot pick up the contextually salient individuals from the context via the  $C$  variable. This prediction is borne out as show in (60). Neither (60a) nor (60b) have the same reading as (47): the consequent of (60a) and (60b) can mean that the director carefully train all the pitchers in the team, but cannot mean the director carefully train all of the pitchers that he newly hired.

- (2) \* **Dono**-sutahhu-**mo** atuma-tta.  
which-staff-also gather-PAST  
“Every staff gathered.”

Leaving the precise compositional implementation aside, I define its denotation as follows.

- (3)  $[[\text{dono NP mo}]] = \lambda P_{\langle ET \rangle} \lambda V_{\langle E, VT \rangle} \lambda \epsilon [\text{MAX}^{u_n}(\delta_{u_n}(P(u_n)); \text{MAX}^{u_n \in u_m}(\delta_{u_n}(V(\epsilon)(u_m)); \text{ALL}\{u_n\}\{u_m\})]$



- (60) a. ?? Kantoku-ga toosyu<sup>u1</sup>-o nan-nin-ka yato-tta-ra, kare-wa toosyu-  
 manager-NOM pitcher-ACC what-CL<sub>Person</sub>-KA hire-PAST-if he-NOM pitcher-  
 $\{\text{zen'in} / \text{min'na}\}_C^{u2}$ -o jikkuri sodate-ru.  
 $\{\text{all} / \text{all}\}$ -ACC carefully train-PRES
- b. ?? Kantoku-ga toosyu<sup>u1</sup>-o nan-nin-ka yato-tta-ra, kare-wa toosyu-  
 manager-NOM pitcher-ACC what-CL<sub>Person</sub>-KA hire-PAST-if he-NOM pitcher-  
 o  $\{\text{zen'in} / \text{min'na}\}_C^{u2}$  jikkuri sodate-ru.  
 ACC  $\{\text{all} / \text{all}\}$  carefully train-PRES  
 “If the manager hires several pitchers, he carefully trains all the pitch-  
 ers.”

This suggests that the contextual restrictor condition is limited to the unary variant, which is expected from (58).

Now, I claim that (58) also explains why “zen'in/min'na” does not have a prenominal variant. Let me consider the hypothetical denotation of the prenominal “zen'in” and “min'na” in (61), which is predicted by (58).

$$(61) \quad \llbracket \text{zen'in/min'na} \rrbracket = \lambda P_{\langle ET \rangle} \lambda V_{\langle E, VT \rangle} \lambda \epsilon \text{MAX}^{u_n}([\cup u_n = C]; P(u_n)); \\ \text{MAX}^{u_m} \in u_n([\text{ANIMATE}\{u_n\}]; V(\epsilon)(u_m)); \text{ALL}\{u_n\}\{u_m\}] \quad (\text{Prenominal})$$

Here, the restriction with P becomes redundant because the C variable already fully specifies the members of the restrictor set. I adopt the extended version of the principle of *Minimize restrictors!* (Schlenker, 2005a) as an economy condition which blocks (61).<sup>18</sup> Its PCDRT version is defined in (62). A is referentially irrelevant if the set of pairs of assignments  $\langle G, H \rangle$  in which  $\llbracket \alpha(A)(B) \rrbracket$  is identical with the set of pairs of assignments  $\langle G, H \rangle$  in which  $\llbracket \alpha(B) \rrbracket$  is true.

- (62) **Minimize Restrictors! (PCDRT version):** An expression  $\alpha(A)(B)$  is deviant if A is redundant, i.e.
- if  $\lambda G \lambda H \llbracket \alpha(A)(B) \rrbracket = \lambda G \lambda H \llbracket \alpha(B) \rrbracket$  (= *Referential Irrelevance*), and
  - A does not serve another purpose (= *Pragmatic Irrelevance*).

Since “zen'in/min'na” introduces the restrictor set with the C variable, addition of a predicative host NP is redundant. On the other hand, this does not apply to their postnominal variant and floating variant because these variant do not perform the contextual restrictor condition. Thus, (62) does not block these entries.

18. This principle plays a crucial role in my analysis of the prenominal “sorezore” in Chapter 5 and my analysis of the prenominal “zutsu” in Chapter 6.

Next, I define the three variants of “subete” as shown in (63). The restrictor condition and the scope condition are both unmarked ones with “subete.”

- (63) a.  $[[\text{subete}]] = \lambda P_{\langle ET \rangle} \lambda V_{\langle E, VT \rangle} \lambda \epsilon \text{MAX}^{u_n}(\delta_{u_n}(P(u_n))); \text{MAX}^{u_m \in u_n}(V(\epsilon)(u_m));$   
 $\text{ALL}\{u_n\}\{u_m\}$  (Prenominal)
- b.  $[[\text{subete}]] = \lambda R_{\langle \langle E, VT \rangle, \langle VT \rangle \rangle} \lambda V_{\langle E, VT \rangle} R(\lambda \nu \lambda \epsilon [\text{MAX}^{u_m \in \nu}(V(\epsilon)(u_m));$   
 $\text{ALL}\{\nu\}\{u_m\}]$  (Postnominal)
- c.  $[[\text{subete}]] = \lambda V_{\langle E, VT \rangle} \lambda \nu_E \lambda \epsilon_V [\text{MAX}^{u_m \in \nu}(V(\epsilon)(u_m)); \text{ALL}\{\nu\}\{u_m\}]$  (Floating)

This is the same as the entries defined in §4.2.2. Now, consider the hypothetical entry of the unary “subete.” (58) predicts that the unary “subete” results in vacuous maximisation as shown in (64).

- (64)  $[[\text{subete}]] = \lambda V_{\langle E, VT \rangle} \lambda \epsilon \text{MAX}^{u_n}(); \text{MAX}^{u_m \in u_n}(V(\epsilon)(u_n)); \text{ALL}\{u_n\}\{u_m\}]$  (Unary)

This results in a plain saturation failure because no argument is fed to  $\text{MAX}^{u_n}$ . Thus, the unary variant of “subete” is undefinable according to (58) and it correctly predicts the lack of the unary variant of “subete.”

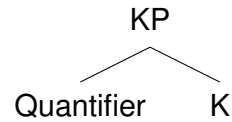
One may suggest that the four variants are derived from the common base denotation with general type-shifting principles. However, the observed idiosyncrasies of the restrictor condition and the scope condition make it a non-straightforward task. For example, one may take the floating quantifier denotation as the base and let a type-shifting operation introduce the restrictor set so that one can derive the unary quantifier denotation and the prenominal quantifier denotation from the floating quantifier denotation.<sup>19</sup> However, this cannot predict which quantifier introduce its restrictor set in which way. For example, “subete” does not introduce its restrictor with the  $C$  variable nor the co-reference condition, but if the restrictor condition is performed as an operation independent of the lexical semantics of quantifiers, this connection is lost. Thus, I assume that the four type-variants defined in (58) are inter-related, but lexically ambiguous.

19. Alternatively, one may define an operation to ‘cancel’ the restrictor condition. For this, one has to postulate an operation of abstraction over constants of type  $\pi$  which have already been introduced to the discourse. Such an operation makes a dynamic system too powerful because it allows overwriting of the information stored in the discourse. Although one may find a good reason to take this option, I leave examination of it for future research.

## 4.5 Syntax of Japanese quantifiers and type-ambiguity

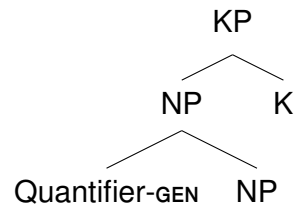
In this section, I discuss syntax of Japanese quantifiers and clarify how it is related with the proposed type-ambiguity of generalised quantifiers in Japanese. First of all, I assume that case particles in Japanese is a realisation of a nominal functional head  $K^0$ . I propose that unary quantifiers occur as the complement of  $K^0$  as an argument as shown in (65).

(65) The unary quantifier:



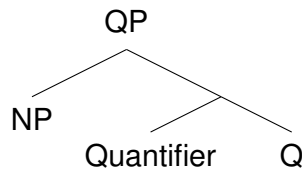
Next, I propose that the prenominal quantifiers occur as an NP adjunct as shown in (66). I assume that the genitive case “no” is inserted in the morphological component (Kitagawa & Ross, 1982; Watanabe, 2006).

(66) The prenominal quantifier:



Third, I adopt a functional head  $Q^0$ , which introduces a host NP in its maximal projection. I assume that  $Q^0$  takes a quantifier in its complement position and an NP in its specifier position as shown in (67).

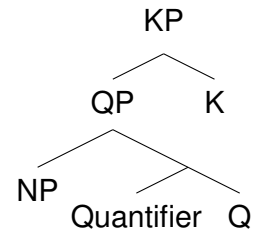
(67)



Postnominal quantifiers are derived with  $Q^0$  as shown in (68).<sup>20</sup>

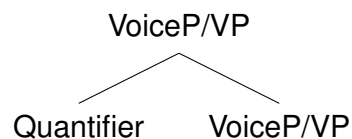
20. Watanabe (2006) derives the postnominal order of numeral quantifiers with an NP raising to the specifier position of  $\text{Case}^0$  and Huang and Ochi (2014) proposes similar NP raising to derive the postnominal order. As far as I know, NP raising seems to be the standard way to derive the post-nominal order of Japanese numeral quantifiers in the recent literature. One can easily reconstruct my analysis with NP raising if one (i) rewrites the denotation of the postnominal quantifier so that it takes type  $E$  restrictor, (ii) assumes that NP raising generally moves a type  $\langle\langle E, VT \rangle, VT\rangle$  expression, leaving a type  $E$  trace, and (iii) define a trace abstraction rule to convert  $T$  to  $\langle\langle E, VT \rangle, VT\rangle$ . I do not pursue this alternative here because presence of NP raising is orthogonal to the main point of this chapter. Note that the prenominal quantifiers and postnominal quantifiers should have different denotations even if one adopts NP raising.

(68) The postnominal quantifier:



Lastly, I propose that floating quantifiers adjoin to a verbal extended projection as shown in (69).

(69) The floating quantifier:



The proposed syntax of Japanese quantifiers explains the fact that the postnominal order is only allowed for quantifiers. Recall that Japanese allows flexible ordering among noun internal modifiers as exemplified in (70).

- (70) a. (Aka-i) ko-no (akai-i) ringo-ga oisi-i.  
 (red-ADJ) this-GEN (red-ADJ) apple-NOM tasty-PRES  
 "These red apples are tasty."  
 b. (Ko-no) boku-no (ko-no) sakuhin-ga ninki-da.  
 (this-GEN) I-GEN (this-GEN) work-NOM popular-COP  
 "This work of mine is popular."

However, only quantifiers can appear post-nominally as shown in (71).

- (71) Ringo-{subete / hotondo / ???kore-ra / \*boku-no / \*aka-i}-ga ochi-ta.  
 apple-{all / most / this-PL / I-GEN / red-ADJ}-NOM fall-PAST  
 "(All / most / these / my / red) apples fell."

This difference between quantifiers and other modifiers follows from the proposed syntax: the postnominal order is due to the presence of a QP layer with an intransitive  $Q^0$ . Thus, it follows that only an item which can occur at the complement of  $Q^0$  can have the postnominal order.

On this point, note that the four variants of quantifiers are in one-to-one correspondence with their syntactic position as summarised in (72).<sup>21,22</sup>

- (72) a. The unary variant  $\leftrightarrow [ \_ K ]$   
 b. The prenominal variant  $\leftrightarrow [ \_ NP ]$   
 c. The postnominal variant  $\leftrightarrow [ \_ Q ]$   
 d. The floating variant  $\leftrightarrow [ \_ VP/VoiceP ]$

I assume that  $Q^0$  and  $K^0$  do not have semantic contribution and just denote an identity function as defined in (73). The sister of unary quantifiers is  $K^0$  and the sister of postnominal quantifiers is  $Q^0$ , both of which denote an identity function.

- (73) a.  $[[Q^0]] = \lambda G_{\langle\langle E, VT \rangle, VT \rangle, \langle\langle E, VT \rangle, VT \rangle} \lambda R_{\langle\langle E, VT \rangle, VT \rangle} G(\lambda V \lambda \epsilon [R(V)(\epsilon)])$   
 b.  $[[K^0]] = \lambda R_{\langle\langle E, VT \rangle, \langle VT \rangle \rangle} \lambda V_{\langle E, VT \rangle} R(\lambda v \lambda \epsilon [V(\epsilon)(v)])$

Accordingly, each syntactic position in (72) corresponds a unique variant of quantifier as shown in Table 4.4.

	type	sister's type
Unary	$\langle\langle E, VT \rangle, VT \rangle$	$\langle\langle\langle E, VT \rangle, VT \rangle, \langle\langle E, VT \rangle, VT \rangle \rangle$
Prenominal	$\langle ET, \langle\langle E, VT \rangle, VT \rangle \rangle$	$\langle ET \rangle$
Postnominal	$\langle\langle\langle E, VT \rangle, VT \rangle, \langle\langle E, VT \rangle, VT \rangle \rangle$	$\langle\langle\langle\langle E, VT \rangle, VT \rangle, \langle\langle E, VT \rangle, VT \rangle \rangle, \langle\langle\langle E, VT \rangle, VT \rangle, \langle\langle E, VT \rangle, VT \rangle \rangle \rangle$
Floating	$\langle\langle E, VT \rangle, \langle E, VT \rangle \rangle$	$\langle E, VT \rangle$

**Table 4.4:** Types of the four-variants and types of their sister

In this way, the four type-variants of universal quantifiers in Japanese are related with their syntactic positions in one-to-one correspondence.

21. One may take this as an instance of *contextual allosemy* (Marantz, 2013; Wood, 2015; Wood & Marantz, 2017, a.o.), which is hinted at the morphological notion of *contextual allomorphy*. In short, one morpheme is mapped to multiple meanings, i.e. allosemies, and this mapping is conditioned by the local environment in which the morpheme is embedded. I leave examination of this option for future research.

22. Instead of making a generalised quantifier type-ambiguous, one may assume various types of  $Q^0$  and define a set of type-shifting principle so that one can maintain a single denotation for generalised quantifiers. As this investigation goes beyond the scope of this thesis, I leave examination of this alternative for future research.

## 4.6 Conclusion

In this chapter, I proposed that the PCDRT decomposition of generalised quantification sheds light on type-ambiguity among variants of generalised quantifiers in Japanese. The general template of generalised quantification in PCDRT (Brasoveanu, 2010) decomposes generalised quantification into (i) the restrictor update, (ii) the scope update and (iii) the static generalised quantification over the restrictor set and the scope set. I proposed that type-variants of a quantifier in Japanese differ with respect to the restrictor update: they vary in the locality between a quantifier and its host NP, and the semantic type of its host NP. More specifically, (i) the prenominal variant and the postnominal variant of a quantifier take their host NP within the same nominal extended projection, while its floating variant does not, and (ii) the prenominal variant of a quantifier takes a predicative host NP, while its postnominal variant and its floating variant take an argumental host NP.

I further claimed that the PCDRT decomposition of generalised quantification sheds light on the idiosyncratic difference among quantifiers in Japanese, too. I proposed that the idiosyncratic properties of a quantifier is encoded in (i) how it introduces its restrictor set  $\text{RESTRICTOR}$  and (ii) what condition it imposes for its scope update  $\text{SCOPE}$ . Crucially, the restrictor condition is only realised when a quantifier introduces a dref for its restrictor set by itself. As a result, the restrictor condition is not observed with the postnominal variant and the floating variant of a quantifier. As a case study, I discussed two universal quantifiers, “subete” and “zen’in/min’na,” and showed that the proposed account derives their distributional patterns. The general template of type-variants of Japanese quantifiers is repeated in (74)

- (74) a.  $[[\text{Unary quantifier}]] =$   
 $\lambda V_{\langle E, VT \rangle} \lambda \epsilon [\text{RESTRICTOR}^{u_n}; \text{MAX}^{u_m \in u_n}(\text{SCOPE}(V)(\epsilon)(u_n); \text{DET}\{u_n\}\{u_m\})]$
- b.  $[[\text{Prenominal quantifier}]] = \lambda P_{\langle ET \rangle} \lambda V_{\langle E, VT \rangle} \lambda \epsilon [\text{RESTRICTOR}^{u_n}(\delta_{u_n}(P(u_n));$   
 $\text{MAX}^{u_m \in u_n}(\text{SCOPE}(V)(\epsilon)(u_m)); \text{DET}\{u_n\}\{u_m\})]$
- c.  $[[\text{Postnominal quantifier}]] =$   
 $\lambda R_{\langle \langle E, VT \rangle, \langle VT \rangle \rangle} \lambda V_{\langle E, VT \rangle} R(\lambda v \lambda \epsilon [\text{MAX}^{u_m \in v}(\text{SCOPE}(V)(\epsilon)(u_m)); \text{DET}\{v\}\{u_m\})]$
- d.  $[[\text{Floating quantifier}]] = \lambda V_{\langle E, VT \rangle} \lambda v_E \lambda \epsilon_V [\text{MAX}^{u_m \in v}(\text{SCOPE}(V)(\epsilon)(u_m));$   
 $\text{DET}\{v\}\{u_m\}]$

In Chapter 5, I utilise this template to derive the four variants of “sorezore.” Importantly, I will claim that “sorezore” introduces an anaphoric restrictor only when it occurs at the prenominal position or it occurs without an overt host NP. This distribution of anaphoric restrictors follows from (74). On the other hand, I will propose that the semantics of “zutsu” stays the same whether it occurs at the prenominal position or at the floating position. Crucially, I will propose that “zutsu” partitions a situation and it does not involve generalised quantification. The main proposal for the semantics of “zutsu” will be made in Chapter 6 and Chapter 7.

## List of definitions and notations

I provide the reminder of the definitions and notations of the operators I discussed in Chapter 3-4 before entering Chapter 5.

(75) Lexical relations:  $R\{u_1, \dots, u_n\} = \lambda G [R(v(u_1)(G)), \dots, (v(u_n)(G))]$

(76) Dref introduction

a. Default (dependency free):

$$G[u]H \Leftrightarrow \exists D [H = \{h \mid \exists g \exists d [g[u]h \& v(u)(h) = d \& g \& d \in D]]]$$

b. Non-default (random dependency):

$$G[\eta(u)]H \Leftrightarrow \forall g [g \in G \rightarrow \exists h [h \in H \& g[u]h]] \& \forall h [h \in H \rightarrow \exists g [g \in G \& g[u]h]]$$

(77) Dynamic distriutivity operator  $\delta$ :

a.  $G_{u_n=d} = \{g : g \in G \& v(u_n)(g) = d\}$

b.  $\delta_{u_n}(D) = \lambda G \lambda H [v(u_n)(G) = v(u_n)(H) \& \forall d \in v(u_n)(G) [D(G_{u_n=d})(H_{u_n=d})]]]$

(78) Dynamic selective maximisation operator:

$$\text{MAX}^{u_n}(D) = \lambda G \lambda H [G[[u_n]]; D]H \& \forall K [G[[u_n]]; D]K \rightarrow v(u_n)(K) \subseteq v(u_n)(H)]]$$

(79) Structural inclusion (structure-preserving subset relation):

$$u \subseteq u' \Leftrightarrow \lambda G \forall g \in G [v(u)(g) = v(u')(g) \vee v(u) = \star]$$

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## Chapter 5

# Dynamic properties of “sorezore” and a potential typology of distributive anaphora

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### 5.1 Introduction

In this chapter, I discuss the dynamic properties of “sorezore” and propose that “sorezore” encodes two independent components. One is the distributivity component with the  $\delta$  operator. The other is the anaphoricity component with the  $\eta$  operator and the co-reference condition. These two components are shown in (1).

- (1) The two components of “sorezore”
- a. The anaphoric component:  $\eta(u_m); [|u_n = u_m|]$
  - b. The distributivity component:  $\delta_{u_n'}$

These two components both look for their antecedent in different ways: the anaphoric component looks for an antecedent  $u_n$  which is co-referential with  $u_m$ , the restrictor set of “sorezore,” and the distributive component looks for an antecedent  $u_{n'}$  which is co-indexed with the  $\delta$  operator. I further claim that these two components obey different locality constraints. The anaphoric component is subject to Condition B, whereas the distributive component operator is subject to a locality constraint based on the notion of the *minimal sequence of evaluation*.

I discuss two empirical puzzles to argue for this analysis of “sorezore.” First, I show that “sorezore” behaves as a pronominal element when “sorezore” occurs without an overt host NP. I call this variant *bare anaphoric* “sorezore.” If the bare anaphoric “sorezore” and its antecedent are co-arguments, it strongly prefers a reciprocal reading, but if they are not, it has a weak truth condition which subsumes three



readings: a reciprocal reading, a reflexive reading and a mixed reading. To account for this non-inherent reciprocity of “sorezore,” I decompose reciprocity into three independent components, namely the distributivity component, the anaphoricity component and the disjointness component. Importantly, “sorezore” only encodes the anaphoricity component and the distributivity component as shown in (1). Thus the disjointness effect has to come from somewhere else. I propose that the disjointness effect comes from distributive evaluation of Condition B: when a lexical relation is evaluated under the scope of  $\delta$ , its co-arguments have to be disjoint with respect to each subset of a plural information state, but it still allows them to be co-referential with respect to a plural information state itself. In other words, evaluation of Condition B under the scope of  $\delta$  allows “sorezore” and its antecedent to be collectively co-referential, but distributively disjoint. This explains the fact that “sorezore” induces a reciprocal reading only when it is a co-argument of its antecedent. I further discuss other reciprocal strategies in Japanese and several other languages. One can find other reciprocal strategies which involve distributive evaluation of Condition B to induce the disjointness effect. The upshot is that the proposed three way decomposition of reciprocity can derive varieties of reciprocal strategies available across languages.

Second, the three quantificational variants of “sorezore” show different degrees of anaphoricity. On the one hand, the host NP of the prenominal “sorezore” behaves as an anaphoric expression, whereas the postnominal “sorezore” and the floating “sorezore” cannot. On the other hand, the floating “sorezore” can non-locally choose its sorting key, whereas the prenominal “sorezore” and the postnominal “sorezore” cannot. This suggests that “sorezore” is anaphoric with respect to its restrictor set and its sorting key. I claim that the decomposition of “sorezore” in (1) plays a crucial role to solve this puzzle, too. Recall that I proposed that the idiosyncratic properties of a quantifier is realised in its restrictor condition and its scope condition. I claim that the anaphoric component is encoded as the restrictor update of “sorezore” and the distributivity component is encoded as the scope condition of “sorezore.” Accordingly, it predicts that the distributive component is common among all the variants of “sorezore” and the anaphoric component is limited to the cases in which “sorezore” introduces its own dref, i.e. the bare anaphoric “sorezore” and the prenominal “sorezore.” This makes further prediction: the prenominal “sorezore” and the bare anaphoric “sorezore” should minimally differ in terms of presence of a restrictor property. This prediction is borne out: I show that the prenominal “sorezore” allows intra-sentential anaphora only when the restrictor

property plays a role to disambiguate its antecedent. This effect follows from the principle of *Minimise Restrictors!*. Thus, the bare anaphoric “sorezore” and the prenominal “sorezore” both involve the same anaphoric restrictor set and their difference comes from a general economy principle. At the end, I briefly discuss “each” in English and analyse “sorezore” and “each” in a parallel way.

## 5.2 “sorezore” and decomposition of reciprocity

In this section, I discuss the properties of “sorezore” when it occurs in its bare form. I show that it sometimes induces a reciprocal reading, but not always. The main point of the discussion is that reciprocity is not inherent to “sorezore” and thus it is not desirable to assign the semantics of reciprocal pronouns to it. Rather, the distribution of reciprocal readings suggests that the disjointness condition comes from constraint on co-reference, i.e., the binding condition B. I propose that distributive evaluation of Condition B offers the disjointness effect only when it is necessary. In this approach, “sorezore” collectively evaluates the co-reference condition, but distributively evaluates lexical relations. It suggests that reciprocity consists of three independent components, namely the distributivity component, the anaphoricity component and the disjointness component. I provide further support for this claim with two other reciprocal strategies in Japanese, i.e. “otagai” and “-au” and reciprocal strategies in other languages.

### 5.2.1 The bare anaphoric use, reflexivity and reciprocity

As I have shown in Chapter 1, “sorezore” can occur in its bare form, i.e. without an overt host NP. I call it a *bare anaphoric* use. When the bare anaphoric “sorezore” takes a clause-internal antecedent, it induces a reciprocal reading as shown in (2).<sup>1</sup>

- (2) San-nin-no      koohosya<sup>u1</sup>-ga **sorezore**<sub>u1</sub>-o hihan-sita.  
      3-CL<sub>Person</sub>-GEN candidate-NOM DIST-ACC      criticise-PAST  
      “The three candidates criticised each other.”

In (2), “sorezore” only has a reciprocal reading. (2) is true under the reciprocal scenario shown in (3a), but false under the reflexive scenario shown in (3a) or the mixed scenario shown in (3c).

1. Some native speakers of Japanese found the reciprocal reading is not obligatory in (2), but they agreed that the reciprocal reading is strongly preferred.

- (3) Context: Ann, Belle and Chris are nominated as candidates of the president of a student union. They participate a pre-election debate.
- a. **Reciprocal:** Ann criticised Belle and/or Chris, Belle criticised Ann and/or Chris, and Chris criticised Ann and/or Belle.  $\Rightarrow$  (2) is **true**
  - b. **Reflexive:** They are not keen for the election. Ann criticised herself, Belle criticised herself, and Chris criticised himself.  $\Rightarrow$  (2) is **false**
  - c. **Mixed:** While Ann and Belle are keen for the election, Chris is not. Ann criticised Belle and Belle criticised Ann. Chris only criticised himself.  $\Rightarrow$  (2) is **false**

However, “sorezore” does not always induce a reciprocal reading. “Sorezore” can also occur as a possessive pronoun as shown in (4).

- (4) Dezainaa-tachi<sup>u1</sup>-ga **sorezore**<sub>u1</sub>-no huta-tu-no an’-o hihan-sita.  
 designer-PL-NOM DIST-GEN 2-CL-GEN plan-ACC criticise-PAST  
 “The designers criticised their two plans.”

In (4), “sorezore” is not only compatible with a reciprocal scenario, but it is also compatible with a reflexive scenario and a mixed scenario. (5) shows that (4) can be true under the reciprocal scenario shown in (5b), the reflexive scenario shown in (5a) or a mixed scenario shown in (5c).

- (5) Context: Ann, Belle and Chris are designers and they each proposed two plans for the design of their new product. They examine those plans to decide which plan is the best.
- a. **Reciprocal:** Ann criticised Belle’s and/or Chris’, Belle criticised Ann’s and/or Chris’ and Chris criticised Ann’s and/or Belle’s.  $\Rightarrow$  (4) is **true**
  - b. **Reflexive:** They each criticised their own plans.  $\Rightarrow$  (4) is **true**
  - c. **Mixed:** Ann criticised Belle’s and Belle criticised Ann’s. Chris only criticised his own plans.  $\Rightarrow$  (4) is **true**

This contrast between the truth condition of (2) and the truth condition of (4) suggests that reciprocity is not inherent to “sorezore”: it has a weak truth condition which subsumes a reflexive reading, a reciprocal reading and a mixed reading when it occurs as a possessive pronoun.

Note that a cardinal modifier following “sorezore” is necessary to disambiguate the bare anaphoric “sorezore” from the prenominal “sorezore.” Compare (6a) and (6b): (6a) has both a non-anaphoric distributive reading and an anaphoric reading, whereas (6b) only has an anaphoric reading. Thus, (6a) is structurally ambiguous between one with the prenominal “sorezore” and the other with the possessive bare anaphoric “sorezore,” while (6b) only allows the parse with the latter.

- (6) a. Kare-ra<sup>u1</sup>-ga **sorezore**<sub>u1</sub>-no kadai-o oe-ta.  
           he-PL-NOM   DIST-GEN       assignment-ACC finish-PAST  
           i. “They finished each assignment.” (non-anaphoric)  
           ii. “Each of them finished his/her assignment(s).” (anaphoric)
- b. Kare-ra<sup>u1</sup>-ga **sorezore**<sub>u1</sub>-no mittu-no kadai-o oe-ta.  
           he-PL-NOM   DIST-GEN       3-CL<sub>thing</sub>-GEN assignment-ACC finish-PAST  
           i. \*“(They finished each of the three assignments.” (non-anaphoric)  
           ii. “Each of them finished his/her three assignments.” (anaphoric)

“Sorezore” also has a weak truth condition when it occurs as an argument and takes a clause-external antecedent. In (7), “sorezore” occurs as the object of the embedded clause and takes the matrix subject as its antecedent.

- (7) Gakusya-tachi<sup>u1</sup>-wa [guuguru<sup>u2</sup>-ga **sorezore**<sub>u1</sub>-o manei-ta to] it-ta.  
       scholar-PL-TOP       [google-NOM DIST-ACC   invite-PAST that] say-PAST  
       Lit “The scholars said that Google invited them.”

(7) can be true under any of the three scenarios in (8).

- (8) Context: David, Elin and Fran were invited to a workshop on artificial intelligence. In a banquet, they are talking about who invited them.
- a. **Reciprocal**: David said that Google invited Elin and/or Fran, Elin said that Google invited David and/or Fran and Fran said that Google invited David and/or Elin. ⇒ (7) is **true**
- b. **Reflexive**: David said that Google invited him (i.e. David), Elin said that Google invited her (i.e. Elin) and Fran said that Google invited her (i.e. Fran). ⇒ (7) is **true**
- c. **Mixed**: David said that Google invited Elin, Elin said that Google invited David and Fran said that Google invited her (i.e. Fran). ⇒ (7) is **true**

In (9), “sorezore” occurs as a possessor of the embedded object and takes the matrix subject as its antecedent.

- (9) Gakusya-tachi<sup>u1</sup>-wa [guuguru<sup>u2</sup>-ga **sorezore**<sub>u1</sub>-no huta-tu-no ronbun-o in'yoo-sita  
 scholar-PL-TOP [google-NOM DIST-GEN 2-CL-GEN paper-ACC cite-PAST  
 to] it-ta.  
 that] say-PAST  
 Lit “The scholars said that Google cited their two papers.”

Again, (9) can be true under any of the three scenarios in (10).

- (10) Context: David, Elin and Fran have two recent publications this year. They are talking about who cited these papers.
- Reciprocal:** David said that Google cited Elin’s and/or Fran’s, Elin said that Google cited David’s and/or Fran’s and Fran said that Google cited David’s and/or Elin’s.  $\Rightarrow$  (9) is **true**
  - Reflexive:** David said that Google cited his (i.e. David’s), Elin said that Google cited hers (i.e. Elin’s) and Fran said that Google cited hers (i.e. Fran’s).  $\Rightarrow$  (9) is **true**
  - Mixed:** David said that Google cited Elin’s, Elin said that Google cited David’s and Fran said that Google cited hers (i.e. Fran’s).  $\Rightarrow$  (9) is **true**

The pattern observed so far is summarised in Table 5.1.

Antecedent	Position	Reflexive	Reciprocal	Mixed
Clause-internal	Argument	*	ok	*
	Possessor	ok	ok	ok
Clause-external	Argument	ok	ok	ok
	Possessor	ok	ok	ok

**Table 5.1:** Availability of reflexive readings and reciprocal readings

This suggest that reciprocal readings arise only when “sorezore” is a co-argument of its antecedent. It is reminiscent of the disjointness condition on pronouns: pronouns cannot be co-referential to a clause-mate antecedent.

- (11) a. \* Anna<sup>u1</sup> praised her<sup>u2</sup><sub>u1</sub>.  
 b. Anna<sup>u1</sup> praised [her<sup>u2</sup><sub>u1</sub> student<sup>u3</sup>].  
 c. Anna<sup>u1</sup> believes that [she<sup>u2</sup><sub>u1</sub> is smart].  
 d. Anna<sup>u1</sup> believes that [her<sup>u2</sup><sub>u1</sub> student<sup>u3</sup> is smart].

I propose that the reciprocal reading of “sorezore” comes from distributive evaluation of Condition B.

### 5.2.2 Reciprocity and distributive evaluation of Condition B

In this section, I propose that “sorezore” is not inherently reciprocal, but its reciprocal reading comes from distributive evaluation of Condition B.

First of all, I review the previous PCDRT analyses on reciprocals. Dotlačil (2013) proposes a PCDRT analysis of the English reciprocal pronoun “each other” as shown in (12). Note that this entry is a revised version in the framework I adopt. Dotlačil (2013) adopts dref introduction with random dependency, which corresponds to the method with the  $\eta$  operator in my analysis.

$$(12) \quad \llbracket \text{each other}_{u_n} \rrbracket = \lambda V_{\langle E, VT \rangle} \lambda \epsilon_V \eta(u_m); [\llbracket u_m = u_n \rrbracket; \delta_{u_n}([\llbracket u_m \cap u_n = \emptyset \rrbracket]; V(\epsilon)(u_m))$$

Crucially, reciprocals just distribute over itself and nothing else, i.e. the  $\delta$  operator only scope over the disjointness condition. However, the anaphoric component, i.e.  $[\llbracket u_m = u_n \rrbracket]$ , is not under the scope of the  $\delta$  operator. These two indices achieve the collective co-reference and the distributive disjoint referent. As shown in Table 5.2 and Table 5.3, the values of two drefs can differ under  $h_1$ ,  $h_2$  and  $h_3$  even though they are co-referential under  $H$ .<sup>2</sup>

$H$	$u_1$	$u_2$
$h_1$	$x$	$x$
$h_2$	$y$	$y$
$h_3$	$z$	$z$

**Table 5.2:** Reflexive dependency

$H$	$u_1$	$u_2$
$h_1$	$x$	$y$
$h_2$	$y$	$z$
$h_3$	$z$	$x$

**Table 5.3:** Reciprocal dependency

Both in Table 5.2 and in Table 5.3,  $u_1$  and  $u_2$  store the same value under  $H$ , i.e.  $v(u_1)(H) = v(u_2)(H)$ . However, these tables differ with respect to sub-assignments. In Table 5.2,  $u_1$  and  $u_2$  are distributively co-referential, too, i.e.  $\forall h \in H [v(u_1)(h) = v(u_2)(h)]$ . On the other hand, in Table 5.3,  $u_1$  and  $u_2$  are distributively disjoint, i.e.  $\forall h \in H [v(u_1)(h) \cap v(u_2)(h) = \emptyset]$ . Table 5.3 expresses a reciprocal reading and (12) requires such output context by putting the co-reference condition above the  $\delta$  operator and putting the disjointness condition under the scope of  $\delta$  operator. On this point, it is important that  $\llbracket \text{each other}_{u_n} \rrbracket$  introduces its own dref with random

2. I put aside the cases such as “Plates are stacked with each other.”

dependencies via the  $\eta$  operator. Otherwise,  $u_2$  is always independent of  $u_1$  and it does not derive a reciprocal reading. Even if one puts  $\delta$  above the dref introduction, it makes  $u_1$  distributively co-referential with  $u_2$ , which contradicts with the disjointness condition.

However, this analysis cannot be directly applied to “sorezore.” As we have seen, the bare anaphoric “sorezore” does not always behave as a reciprocal pronoun. If the distributive disjointness condition is lexically encoded to denotation of “sorezore,” it loses an account for non-reciprocal readings of the bare anaphoric “sorezore.” Thus, the question is how to obtain the distributive disjointness effect without lexically encoding it to the denotation of “sorezore.” The distribution of reciprocal readings of the bare anaphoric “sorezore” suggests that reciprocal readings arise only when “sorezore” and its antecedent are co-arguments, i.e. when the configuration between “sorezore” and its antecedent violates Condition B. I adopt the predicate-based Condition B in Reinhart and Reuland (1993), refining it based on Neo-Davidsonian event semantics as shown in (13).

(13) **Condition B:** If a predicate  $V$  is reflexive, it is reflexive-marked.

- a.  $x$  and  $y$  are *co-participants* of an event  $e$  iff  $x$  and  $y$  are related with  $e$  via different thematic functions.
- b. A predicate  $V$  is *reflexive-marked* iff for any event  $e$  and individual  $x$  such that  $V(e)(x)$ , either (i) there are thematic relations  $\theta$  and  $\theta'$  such that  $\theta(e) = \theta'(e)$  (lexical reflexivity) or (ii) one of the participants of  $e$  is introduced with a SELF anaphor.

(13) states that unless a predicate is reflexive-marked with lexical reflexivity or a reflexive anaphor, its co-participants have to be disjoint. Imagine a pronoun is co-indexed with  $u_1$  and introduces  $u_2$ , where  $u_1$  and  $u_2$  are co-arguments. If  $\delta$  is absent, it results in contradiction as in (14). However, if  $u_2$  is under the scope of  $\delta$ , it is consistent as in (15).

(14) a. Co-reference:  $u_1 = u_2$

b. Condition B:  $u_1 \cap u_2 = \emptyset$

**contradiction**

(15) a. Co-reference:  $u_1 = u_2$

b. Condition B:  $\forall d [d \in v(u_1)(H) \rightarrow v(u_1)(h) \cap v(u_2)(h) = \emptyset]$

**consistent**

The combination of collective co-reference and distributive evaluation of Condition B shown in (15) achieves a reciprocal dependency as shown in Table 5.4. Again, this option presupposes that  $u_2$  is introduced via the  $\eta$  operator.

$G$	$u_1$		$H$	$u_1$	$u_2$
$g_1$	$x$	→	$h_1$	$x$	$y$
$g_2$	$y$		$h_2$	$y$	$z$
$g_3$	$z$		$h_3$	$z$	$x$

**Table 5.4:** Collective co-reference and distributive disjointness

On this point, note that Condition B in (13) is defined for static event predication and it interacts with pluralities of information states so that two drefs in a single information state may not store the same value if they are co-participants. This may require a dynamic system to be *representational* in the sense that application of Condition B needs a layer other than the discourse and the dynamic denotation of a clause.<sup>3</sup> In the case above, the static event predication serves as the additional layer in which Condition B operates on. I do not examine if this is an inevitable conclusion when one implements Condition B in a dynamic system with plural information states. However, if one defines Condition B as a constraint on the values of co-arguments or the patterns of indexation on drefs, it requires an additional semantic representation at which Condition B applies.<sup>4</sup>

Based on the discussion so far, I propose the denotation of “sorezore” in (16).<sup>5</sup>

$$(16) \quad \llbracket \text{sorezore}_{u_n} \rrbracket = \lambda V_{\langle E, VT \rangle} \lambda \epsilon_V \eta(u_m); [\llbracket u_m = u_n \rrbracket]; \delta_{u_m}(V(\epsilon)(u_m))$$

3. This conclusion may depend on how one judges if a semantic theory is representational. For example, Muskens (1996) states that a semantic theory is non-representational if it accounts for semantic phenomena in terms of semantic values only. He discusses the notion of *proper* DRSs and argues that his system is representational in the sense that a proper DRS and a DRS which is not proper may have the same semantic values. From this perspective, it is not obvious if a dynamic theory with (13) is representational because one can check if Condition B is obeyed or violated by looking at the value of an event and the values of its participants. However, one must still make reference to event structure in order to check Condition B and it is not clear how one can access such information without presupposing that the information about the mappings from an event to its participants is always available. Although this issue leads to an interesting broad question about how binding conditions are implemented in the grammar, I leave it for the future research.

4. One may implement Condition B in different ways which may not require an appeal to a semantic representation, e.g., the formulation of Condition B in a variable-free approach (Jacobson, 2007). I thank to Jeremy Kuhn (p.c.) for bringing this option to my attention.

5. In 5.3.2, I revise this entry with the  $\text{max}$  operator and the structural inclusion  $\in$  to take it as a unary variant of “sorezore.” However, I omit this in this section as these details are irrelevant here and addition of them does not affect the proposal in this section.



Just like “each other” in (12), “sorezore” defined in (16) introduces its own dref via the  $\eta$  operator and encodes the co-reference condition above the  $\delta$  operator. However, unlike “each other,” “sorezore” does not encode the disjointness condition. Instead, it distributively evaluates a relation of type  $\langle E, VT \rangle$ . Thus, whether the disjointness effect arises or not hinges on if the configuration between “sorezore” and its antecedent violates Condition B.

To demonstrate how this works, I use the example (17).

- (17) San-nin-no      koohosya<sup>*u*<sub>1</sub></sup>-ga **sorezore**<sup>*u*<sub>2</sub></sup>-o hihan-sita.  
       3-CL<sub>Person</sub>-GEN candidate-NOM DIST-ACC      criticise-PAST  
       “The three candidates criticised each other.”

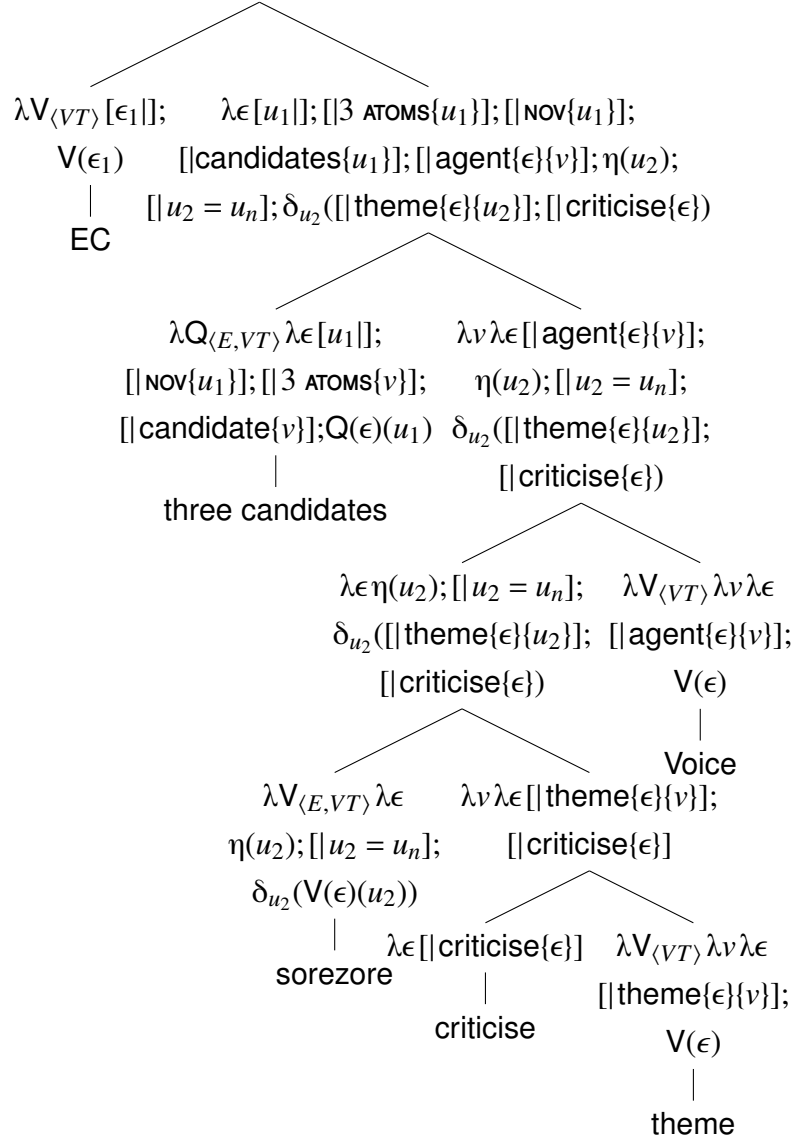
Its denotation is given in (18).

- (18)  $\llbracket (17) \rrbracket = [\epsilon_1]; [u_1]; [\llbracket \text{NOV}\{u_1\} \rrbracket]; [\llbracket 3 \text{ ATOMS}\{u_1\} \rrbracket]; [\llbracket \text{candidates}\{u_1\} \rrbracket];$   
 $[\llbracket \text{agent}\{\epsilon_1\}\{u_1\} \rrbracket]; \eta(u_2); [u_2 = u_1]; \delta_{u_2}([\llbracket \text{theme}\{\epsilon_1\}\{u_2\} \rrbracket]; [\llbracket \text{criticise}\{\epsilon_1\} \rrbracket])$

In this denotation, the co-reference condition  $[u_2 = u_1]$  is collectively evaluated, i.e. this is evaluated with respect to a set of assignments  $H$ . So, it requires the sum of the values of  $u_1$  across states to be identical to the sum of the values of  $u_2$  across states. However, the theme relation and the event predicate are distributively evaluated. Thus, for each assignment  $h$  such that  $h \in H_{u_2=d}$ , Condition B requires the value of  $u_1$  to be disjoint from the value of  $u_2$  because they are co-participants of  $\epsilon_1$ . As a result, (18) is dynamically true iff three candidate criticised each other.

The sub-clausal composition of (18) is given in (19). Note that the anaphoric component of “sorezore” is left unresolved in (19). A reciprocal reading is derived when  $u_n$  is co-indexed with  $u_1$  as shown in (18).

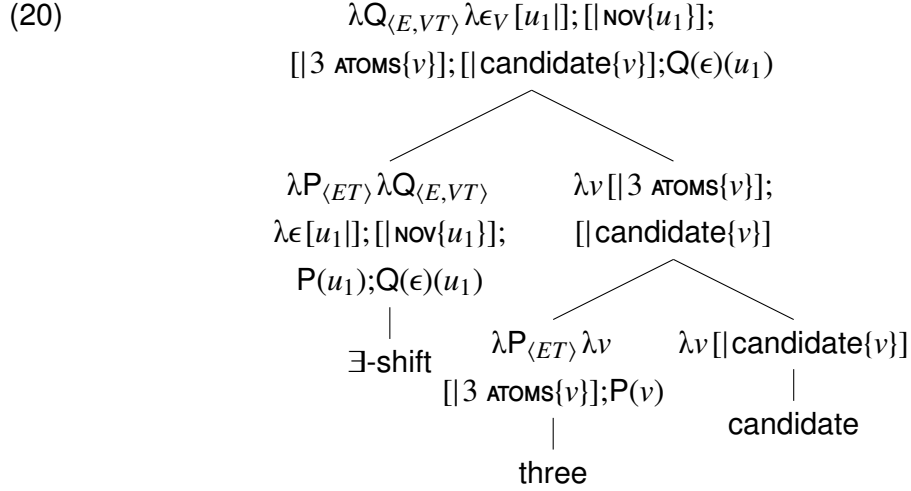
- (19)  $[\epsilon_1]; [u_1]; [\text{NOV}\{u_1\}]; [\exists \text{ ATOMS}\{u_1\}]; [\text{candidates}\{u_1\}]; [\text{agent}\{\epsilon_1\}\{v\}];$   
 $\eta(u_2); [u_2 = u_n]; \delta_{u_2}([\text{theme}\{\epsilon_1\}\{u_2\}]; [\text{criticise}\{\epsilon_1\}])$



Recall that I assume that Japanese allows free application of type-shifting between the argument type and the predicative type due to absence of overt articles (Chierchia, 1998). The denotation of the subject “san-nin-no koohosya” (three candidates) is shifted from a predicate into an argument via  $\exists$ -shift or the  $\text{iota}$ -shift. (20) shows the composition of the subject when  $\exists$ -shift applies.<sup>6</sup>

6. The result of applying the  $\text{iota}$ -shift is given below.

(1)  $\lambda Q_{\langle E, VT \rangle} \lambda \epsilon \text{MAX}^{u_1}([\exists \text{ ATOMS}\{v\}]; [\text{candidate}\{v\}]); [\text{NOV}\{u_1\}]; Q(\epsilon)(u_1)$



On the other hand, when the configuration between “sorezore” and its antecedent does not violate Condition B, reciprocity does not arise and the sentence has an underspecified reading. Take (21) as an example.

- (21) Sutahhu-tachi<sup>u<sub>1</sub></sup>-ga **sorezore**<sup>u<sub>2</sub></sup>-no huta-tu-no an<sup>u<sub>3</sub></sup>-o hihan-sita.  
 employee-PL-NOM DIST-GEN 2-CL<sub>Object</sub>-GEN plan-ACC criticise-PAST  
 a. “The employees criticised their two plans.” (reflexive)  
 b. “The employees criticised each other’s two plans.” (reciprocal)

Its denotation is given in (22).

- (22)  $[[ (21) ]] = [\epsilon_1]; [u_1]; [[\text{NOV}\{u_1\}]; [\text{NON-ATOM}\{u_1\}]; [\text{employees}\{u_1\}];$   
 $[[\text{agent}\{\epsilon_1\}\{u_1\}]; [\epsilon_2]; \eta(u_2); [u_2 = u_1]; \delta_{u_2}([u_3]; [[\text{NOV}\{u_3\}]; [2 \text{ ATOMS}\{u_3\}];$   
 $[[\text{plans}\{u_3\}]; [\text{POSS}\{\epsilon_2\}\{u_2\}\{u_3\}]; [\text{theme}\{\epsilon_1\}\{u_2\}]; [\text{criticise}\{\epsilon_1\}]]$

Just like in (18), the co-reference condition is evaluated above the  $\delta$  operator in (22). However, the  $\delta$  operator does not scope over thematic relations nor an eventive predicates in this case. Instead, the  $\delta$  operator scopes over the possession relation in (22). Thus, Condition B does not induce the disjointness effect: “sorezore” introduces  $u_2$  and takes  $u_1$  as its antecedent. However,  $u_1$  and  $u_2$  are not co-participants: the agent of  $\epsilon_1$  is  $u_1$ , the theme of  $\epsilon_1$  is  $u_3$  and nothing else is a participant of  $\epsilon_1$ . As a result, it only requires that  $u_1$  and  $u_2$  are collectively co-referential, i.e.  $v(u_1)(H) = v(u_2)(H)$ , and does not specify dependency between their distributive values. This explains why the possessive “sorezore” has weak truth condition which allows a mixed reading.

I do not commit to any particular analysis of possessive NPs in Japanese. For expository sake, I assume that covert operator P-shift makes a non-relational noun relational as shown in (23).

$$(23) \quad \text{P-shift}(P) = \lambda R_{\langle\langle E, VT \rangle, \langle VT \rangle\rangle} \lambda v_E [\epsilon_n]; R(\lambda v'_E \lambda \epsilon'_V [[\text{POSS}\{\epsilon'\}\{v'\}\{v\}]; P(v))(\epsilon_n)$$

(23) is a version of (24) such that the type of its first argument is lifted.

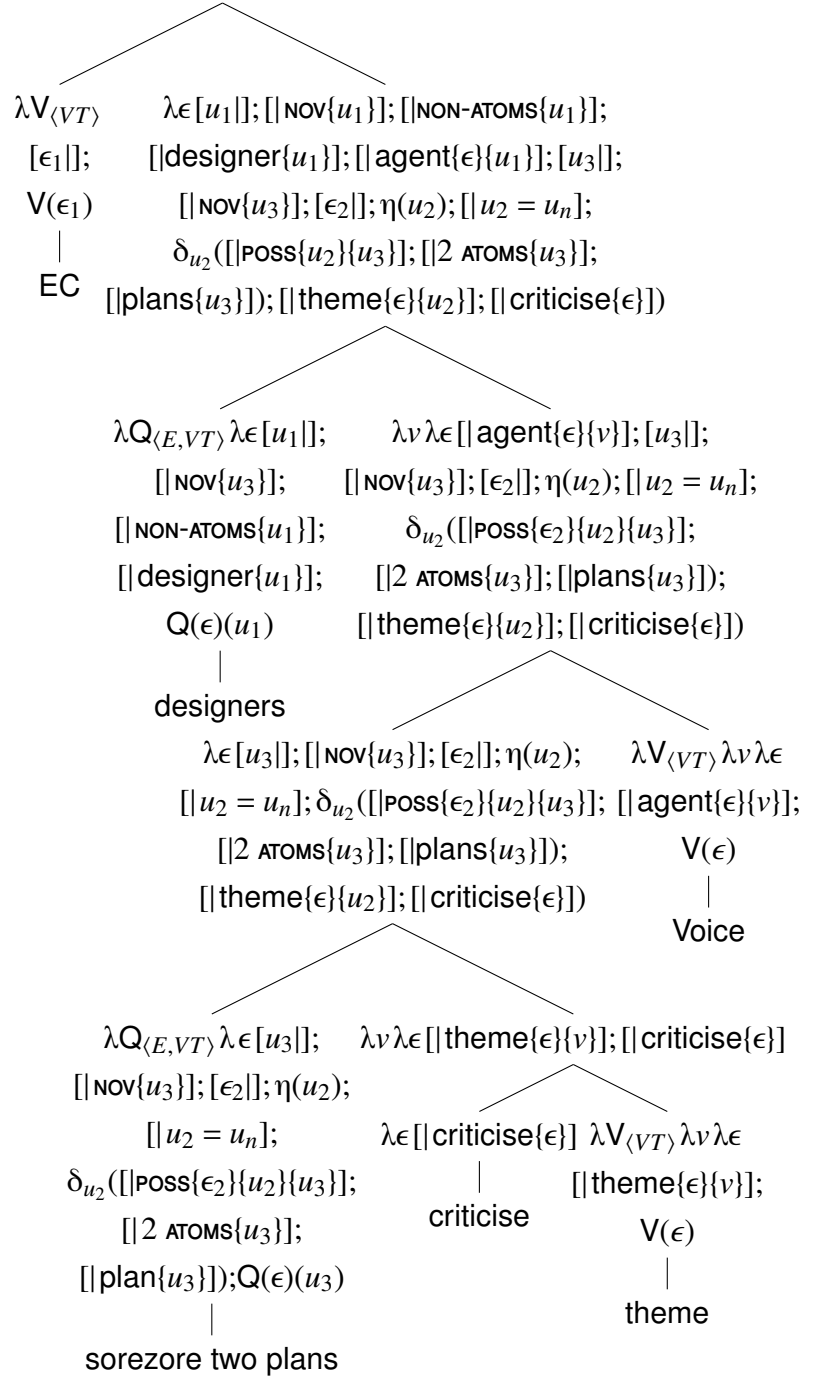
$$(24) \quad \text{P-shift}(P) = \lambda v'_E \lambda v_E [\epsilon_n] [[\text{POSS}\{\epsilon\}\{v'\}\{v\}]; P(v)]$$

(25) shows how “sorezore” is combined with an NP when it occurs as a possessive pronoun.

$$(25) \quad \begin{array}{c} \lambda Q_{\langle E, VT \rangle} \lambda \epsilon [u_3]; [[\text{NOV}\{u_3\}]; [\epsilon_2]; \eta(u_2); [u_2 = u_n]; \\ \delta_{u_2}([\text{POSS}\{\epsilon_2\}\{u_2\}\{u_3\}]; [2 \text{ ATOMS}\{u_3\}]; [\text{plan}\{u_3\}]); Q(\epsilon)(u_3) \\ \swarrow \quad \searrow \\ \begin{array}{cc} \lambda P_{\langle ET \rangle} \lambda Q_{\langle E, VT \rangle} & \lambda v [\epsilon_2]; \eta(u_2); [u_2 = u_n]; \\ \lambda \epsilon [u_3]; [[\text{NOV}\{u_3\}]; & \delta_{u_2}([\text{POSS}\{\epsilon_2\}\{u_2\}\{v\}]; \\ P(u_3); Q(\epsilon)(u_3) & [2 \text{ ATOMS}\{v\}]; [\text{plan}\{v\}]) \end{array} \\ \downarrow \text{ } \exists\text{-shift} \\ \begin{array}{cc} \lambda V_{\langle E, VT \rangle} \lambda \epsilon \eta(u_2); & \lambda R_{\langle\langle E, VT \rangle, \langle VT \rangle\rangle} \lambda v [\epsilon_2]; \\ [u_2 = u_n]; & R(\lambda v' \lambda \epsilon' [[\text{POSS}\{\epsilon'\}\{v'\}\{v\}]; \\ \delta_{u_2}(V(\epsilon)(u_2)) & [2 \text{ ATOMS}\{v\}]; [\text{plan}\{v\}])(\epsilon_1) \end{array} \\ \downarrow \text{ } \text{sorezore} \\ \begin{array}{cc} \lambda P_{\langle ET \rangle} \lambda R_{\langle\langle E, VT \rangle, \langle VT \rangle\rangle} & \lambda v [2 \text{ ATOMS}\{v\}]; \\ \lambda v [\epsilon_2]; R(\lambda v' \lambda \epsilon' & [[\text{plan}\{v\}]] \\ [[\text{POSS}\{\epsilon'\}\{v'\}\{v\}]; & \\ P(v))(\epsilon_2) & \lambda P_{\langle ET \rangle} \lambda v \lambda v [[\text{plan}\{v\}]] \\ \downarrow \text{ } \text{P-shift} & [2 \text{ ATOMS}\{v\}]; \downarrow \text{ } \text{plan} \\ P(v) & \downarrow \text{ } \text{two} \end{array} \end{array}$$

(26) shows the composition of the full clausal denotation. Again, I left the index  $u_n$  of “sorezore” unresolved in (26). (22) shows a case in which  $u_n$  is resolved with  $u_1$ .

- (26)  $\lambda\epsilon[u_1]; [\text{NOV}\{u_1\}]; [\text{NON-ATOMS}\{u_1\}]; [\text{designer}\{u_1\}]; [\text{agent}\{\epsilon\}\{u_1\}];$   
 $[u_3]; [\text{NOV}\{u_3\}]; [\epsilon_2]; \eta(u_2); [u_2 = u_n]; \delta_{u_2}([\text{POSS}\{u_2\}\{u_3\}];$   
 $[2 \text{ ATOMS}\{u_3\}]; [\text{plans}\{u_3\}]); [\text{theme}\{\epsilon\}\{u_2\}]; [\text{criticise}\{\epsilon\}]$



Summing up, the proposed entry of “sorezore” collectively evaluates the co-reference condition and distributively evaluates a lexical relation. Accordingly, when “sorezore” and its antecedent are co-arguments, Condition B is distributively evaluated. This correctly predicts the distribution of reciprocal readings of “sorezore.”

### 5.2.3 Comparison with English pronominal expressions

In this section, I compare “sorezore” with various pronominal expressions in English. First, I show that the proposed account correctly predicts that English pronouns cannot resort to the same strategy as “sorezore.” Second, I show that “sorezore” takes a scope over a verbal predicate, whereas “each other” does not. The result of each comparison highlights two important aspects of the semantics of “sorezore” in terms of the scope of the  $\delta$  operator and random dependencies with the  $\eta$  operator.

I start with comparison between “sorezore” and English pronouns. One may wonder why pronouns and reflexives in English do not induce a reciprocal reading. These expressions differ from “sorezore” in terms of the position of the  $\delta$  operator. First, singular reflexives are accepted under the scope of a distributive quantifier. However, they only induce a distributive reflexive reading and cannot induce a reciprocal reading as shown in (27).

- (27) Every <sup>$u_1$</sup>  candidate criticised {himself / herself} <sup>$u_2$</sup>  <sub>$u_1$</sub> .  
 $\neq$  The candidates criticised each other.

The difference between “sorezore” and reflexive pronouns in English is that the former has its own  $\delta$  operator, whereas the latter does not. In (27), the co-reference condition is evaluated under the scope of the  $\delta$  operator. Thus, the values of  $u_1$  and  $u_2$  have to be identical in each subset of assignments. As a result, it cannot achieve collective co-reference and distributive disjointness at the same time.

On the other hand, plural reflexives are not acceptable under the scope of a distributive quantifier as shown in (28).

- (28) \* Every <sup>$u_1$</sup>  candidate criticised themselves <sup>$u_2$</sup>  <sub>$u_1$</sub> .

In (28), the plural reflexive is evaluated under  $\delta_{u_1}$ . As a result, the non-atomicity condition of “themselves” is not satisfied. Thus, the proposed account does not predict that reflexives in English gives rise to a reciprocal reading under the scope of a distributive quantifier.

Second, a singular pronoun also lacks a reciprocal reading when it occurs under the scope of a distributive quantifier as shown in (29). (29) cannot mean that every candidate criticised other candidates.

- (29) \* Every <sup>$u_1$</sup>  candidate criticised {him / her} <sup>$u_2$</sup>  <sub>$u_1$</sub> .

In this case, Condition B requires the value of  $u_1$  and  $u_2$  to be disjoint in each subset of assignments. This precludes a reflexive reading. If there is no other antecedent available for the singular pronoun in this context, (29) is infelicitous.

Plural pronouns in English also lack a reciprocal reading when it occurs under the scope of a distributive quantifier as shown in (30).

- (30) \* Every <sup>$u_1$</sup>  candidate criticised them <sup>$u_2$</sup>  <sub>$u_1$</sub> .

While “sorezore” encodes the  $\delta$  operator below the co-reference condition, English plural pronouns can only have an optional  $\delta$  operator above the co-reference condition. As a result, whenever pronouns are under the scope of the  $\delta$  operator, its co-reference condition is distributively evaluated. This results in contradiction between the co-reference condition and Condition B as shown in (14).

However, plural pronouns can also involve independent anaphora as discussed in Chapter 3. If it suggests that the co-reference condition of plural pronouns can sometimes be evaluated above the  $\delta$  operator, the proposed analysis wrongly predicts that a plural pronoun can induce a reciprocal reading in such cases.

- (31) a. Every student <sup>$u_1$</sup>  chose a book <sup>$u_2$</sup> .  
 b. They <sup>$u_3$</sup>  <sub>$u_1$</sub>  each wrote an essay <sup>$u_4$</sup>  about them <sup>$u_5$</sup>  <sub>$u_2$</sub> . (Nouwen, 2007)

On this point, it is crucial that the current proposal adopts the dependency-free dref introduction as the default method. In Chapter 3, I showed that independent anaphora is derived from the default dependency-free dref introduction and dependent anaphora requires an optional  $\delta$  operator. In this approach, one does not need to evaluate the co-reference condition above the  $\delta$  operator.<sup>7</sup> Thus, whether a plural pronoun is dependent or independent, its co-reference condition is evaluated under the  $\delta$  operator in (30), violating Condition B.

Lastly, a plural pronoun cannot induce a reciprocal reading when it is associated with one of its co-participants as shown in (32).

- (32) \* Three <sup>$u_1$</sup>  candidates criticised them <sup>$u_2$</sup>  <sub>$u_1$</sub> .

7. For example, Brasoveanu (2011) briefly suggests that plural pronouns can undergo quantifier raising and scope over a quantifier at the subject position. This approach wrongly predicts that (30) can have a reciprocal reading. In contrast, Nouwen (2007) leaves the position of a plural pronoun constant and lets dependent antecedent and independent antecedent both accessible in the context. This approach correctly predicts that (30) lacks a reciprocal reading.

Again, dependency-free dref introduction is crucial. This blocks output contexts with reciprocal dependencies as exemplified in Table 5.5.

$H$	$u_1$	$u_2$
$h_1$	candidate <sub>1</sub>	candidate <sub>2</sub>
$h_2$	candidate <sub>2</sub>	candidate <sub>3</sub>
$h_3$	candidate <sub>3</sub>	candidate <sub>1</sub>

**Table 5.5:** Reciprocal dependency with random assignment of dependencies

As pronouns do not introduce a random dependency, it cannot distributively satisfy Condition B. Thus, the plural pronoun “them” in (32) is infelicitous due to Condition B violation at the plural information state  $H$ . Conversely speaking, the availability of reciprocal readings with “sorezore” hinges on its use of the  $\eta$  operator.

Now, I compare “sorezore” and “each other.” One difference I discussed is that “each other” encodes the disjointness condition, whereas “sorezore” does not. However, there is another difference: “sorezore” takes its scope over a verbal predicate, whereas “each other” only takes its scope over the disjointness condition. This predicts that they show different scopal behaviour.<sup>8</sup> First, “each other” does not scope over anything other than the disjointness condition. In (33), co-variation between “a Christmas present” and “the two children” is strongly dispreferred.

(33) The two children <sup>$u_1$</sup>  gave each other <sup>$u_2$</sup>  <sub>$u_1$</sub>  a Christmas present <sup>$u_3$</sup> .

(Moltmann, 1992)

If “each other” takes its scope over a verbal predicate at this position, the direct object “a Christmas present” is under the scope of the  $\delta$  operator. (33) shows that this is not the case.

On the other hand, (16) predicts the opposite: “sorezore” should allow co-variation between children and presents in this case. This prediction is borne out: (34) allows co-variation between children and presents as default even though a numeral quantifier “hito-tsu” (one-CL<sub>Object</sub>) modifies the object.

(34) Huta-ri-no kodomo <sup>$u_1$</sup> -ga **sorezore** <sup>$u_2$</sup>  <sub>$u_1$</sub> -ni kurisumasu presento <sup>$u_3$</sup> -o **hito-tsu**  
 2-CL<sub>Person</sub>-GEN child-NOM DIST-DAT Christmas present-ACC one-CL<sub>Object</sub>  
 oku-tta.  
 give-PAST  
 “The two children gave each other one Christmas present.”

8. I thank Jeremy Kuhn for bringing this issue to my attention.



The difference between (33) and (34) is expected. Since the disjointness comes from Condition B, “sorezore” always takes scope over a verbal predicate, whereas it is not the case with “each other” because it lexically encodes the disjointness condition. This is another consequence of the difference in how the disjointness is realised in cases of “each other” and in cases of “sorezore.”

Summing up, I highlighted two important aspects of the semantics of “sorezore.” One is that “sorezore” introduces a random dependency with the  $\eta$  operator and the other is that the  $\delta$  operator scopes over the eventive predicate, but not over the co-reference condition. These two feature distinguishes “sorezore” from pronouns, reflexives and “each other” in English.

### 5.2.4 Decomposition and variation among reciprocal items

In this section, I propose that the semantics of reciprocity is decomposed into three separate components, namely (i) the distributivity component, (ii) the anaphoric component and (iii) the disjointness component. To support this three-way decomposition, I discuss reciprocal strategies other than “sorezore” in Japanese and in a few other languages. Examination of these strategies suggests that reciprocal interpretation requires three different ingredients, but these ingredients are not always realised as a single item or morpheme. Looking ahead the conclusion, I propose a decomposition of various reciprocal strategies as shown in Table 5.6.

	Distributivity	Anaphoricity	Disjointness
Japanese	“sorezore”		underspecified
	“otagai <sub>1</sub> ”		
	“otagai <sub>2</sub> ”		underspecified
	“-au”	<i>pro</i>	underspecified
English	“each other”		
Brazilian Portuguese	“um”		“o outro”
Cuzco Quechua	“-na”	“-ku”	underspecified
German, French, Spanish, Portuguese, Italian	underspecified	reflexives	underspecified

**Table 5.6:** Variations in the reciprocal strategies

I first discuss reciprocal strategies in Japanese. Second, I discuss cases of long-distance reciprocals and explain its relevance to the three-way decomposition approach. Lastly, I discuss reciprocal strategies in languages other than English and Japanese and show that the three-way decomposition approach is also applicable to the reciprocal strategies in those languages.

### Reciprocal strategies in Japanese

In this section, I discuss two other reciprocal strategies than “sorezore” in Japanese. Japanese has a so-called reciprocal pronoun “otagai” and a so-called reciprocal verbal suffix “-au” as shown in (35).

- (35) a. San-nin-no koohosya-tachi-ga **otagai**-o hihansi-ta.  
           3-CL-GEN candidate-PL-NOM other-ACC criticise-PAST  
       b. San-nin-no koohosya-tachi-ga hihansi-**at**-ta.  
           3-CL-GEN candidate-PL-NOM criticise-RECP-PAST  
           “The three candidates criticised each other.”

Although it has been claimed that “otagai” is a reciprocal pronoun, it allows various readings at the possessor position as shown in (36).

- (36) [Mary-to-Bill]<sup>u1</sup>-ga **otagai**<sub>u1</sub><sup>u2</sup>-no kodomo<sup>u3</sup>-o yuuenchi-ni ture-te-it-ta.  
       [Mary-and-Bill]-NOM each other-GEN child-ACC park-LOC take-and-go-PAST  
       “Mary and Bill took {their / each other’s} children to the park.”

(Imani & Peters, 1996)

This weak truth condition at the possessor position is reminiscent of the pattern of “sorezore.” This suggests that “otagai” is not always reciprocal.

However, the empirical picture concerning “otagai” is not fully clear. Specifically, there are at least two patterns of acceptability judgements on the readings of “otagai.” Instead of resolving this discrepancy, I aim to show that both options lead to a different formulation of “otagai.”

First, Hoji (2006) claims that “otagai” allows a non-reciprocal reading in any possible positions. He claims that (37) allows a reflexive reading, i.e. John promoted himself and Bill promoted himself.

- (37) [John-to-Bill]<sup>u1</sup>-ga hissi ni natte **otagai**<sub>u1</sub>-o urikon-de-ita.  
       John-and-Bill-NOM very hard otagai-ACC promote-PROG-PAST  
       “John and Bill was promoting themselves with utmost enthusiasm.”

(Hoji, 2006)

Hoji (2006) also claims that “otagai” allows a non-reciprocal reading when it takes a clause-external antecedent as shown in (38).

- (38) [John-to-Bill]<sup>u<sub>1</sub></sup>-ga [Mary<sub>u<sub>2</sub></sub>-ga **otagai**-ni hore-te-iru to]  
 John-and-Bill-NOM [Mary-NOM otagai-DAT in love-PROG-PRES that]  
 omoi konde-ita.  
 think-PAST  
 Lit “John and Bill thought that Mary is in love with {them / the other}.”

(Hoji, 2006)

This pattern of acceptability judgements reported in Hoji (2006) suggests that “otagai” always induces a weak truth condition. I propose that “otagai” is a long-distance reflexive with the  $\eta$  operator as shown in (39). I use the condition  $[\text{SELF}\{v\}]$  to mark that  $v$  is a self-anaphor so that it obviates Condition B violation.

- (39)  $[[\text{otagai}_{u_n}]] = \lambda V_{\langle E, VT \rangle} \lambda \epsilon \eta(u_m); \text{SELF}(u_m); |u_m = u_n|; \delta_{u_m}(V(\epsilon)(u_m))$

Essentially, the entry of “otagai” in (39) can be called a “distributive reflexive,” i.e. a reflexive pronoun which distributively evaluates a lexical relation. An apparent reciprocal reading is just a sub-case of weak truth condition due to plurality of variable assignments and a random dependency. Although more work is necessary to uncover the nature of long-distance reflexive in the current framework, the upshot is that the pattern of judgement reported in Hoji (2006) suggests that “otagai” does not lexically encode the disjointness condition.

Second, Nakao (2003) claims that “otagai” induces an obligatory reciprocal reading when it takes a clause-internal antecedent. However, she agrees with Nishigauchi (1992) that there is a subject-object asymmetry when it takes a clause-external antecedent. When “otagai” occurs as the embedded object, it cannot take the matrix subject as its antecedent as shown in (40a), but when “otagai” occurs as the embedded subject, it can take a clause-external antecedent as shown in (40b).

- (40) a. \* [John-to-Mary]<sup>u<sub>1</sub></sup>-ga [Bill<sub>u<sub>2</sub></sub>-ga **otagai**-o seme-ta to] omo-tta.  
 John-and-Mary-NOM [Bill-NOM otagai-ACC accuse-PAST that] think-PAST  
 Lit “John and Mary thought Bill accused {them / each other}.”  
 b. [John-to-Mary]<sup>u<sub>1</sub></sup>-ga [**otagai**-ga Bill<sub>u<sub>2</sub></sub>-o seme-ta to] omo-tta.  
 John-and-Mary-NOM [otagai-NOM Bill-ACC accuse-PAST that] think-PAST  
 Lit “John and Mary thought {they / each other} accused Bill.”

(Nakao, 2003; Nishigauchi, 1992)

Lastly, Nakao (2003) reports that “otagai” can take a clause-external antecedent when it occurs at the possessor position of the embedded object as shown in (41), although it is slightly degraded.

- (41) ? [John-to-Mary]<sup>u1</sup>-ga [Bill<sub>u2</sub>-ga **otagai**-no kodomo-o seme-ta to]  
 John-and-Mary-NOM [Bill-NOM otagai-GEN child-ACC accuse-PAST that]  
 omo-tta.  
 think-PAST  
 Lit “John and Mary thought Bill accused their children.” (Nakao, 2003)

Nakao (2003) proposes that instances of “otagai” at the embedded subject position and the possessor position are logophoric. In this thesis, I neither argue for nor against this ambiguity view, but notice that the reciprocal “otagai” in her sense employs the semantics of “each other” in English and the logophoric “otagai” in her sense employs the entry defined in (39). Note that these two entries of “otagai” correspond to “otagai<sub>1</sub>” and “otagai<sub>2</sub>” in Table 5.6. In this sense, both patterns of the reciprocal readings with “otagai” suggest that there are some cases in which “otagai” does not encode the disjointness condition. Thus, it provides an additional piece of evidence for decomposition of the disjointness component from the other components.

“-au” is also not inherently reciprocal. “-au” allows non-reciprocal pluractional readings as shown in (42) (Nakao, 2003; Nishigauchi, 1992; Yamada, 2010).

- (42) Kodomo-tachi-ga odori-**at**-ta.  
 child-PL-NOM dance-RECP-PAST  
 “The children danced competing with each other/one after another/etc.”  
 (Yamada, 2010)

As Yamada (2010) proposes, “-au” should be analysed as a pluractional verbal suffix. Indeed, “-au” is incompatible with collective predicates as shown in (44).

- (43) \* Karera-ga koodoo-ni atsumari-**at**-ta.  
 they-NOM lecture hall-at gather-RCPL-PAST  
 “They gathered at the lecture hall competing with each other/one after another/etc.”

However, distributivity of “-au” is slightly different from that of “sorezore”: it does not have a distributive reading in which the internal argument of a verb takes its scope under the distributivity operator. (44) shows that “-au” does not support co-variation between atomic parts of “karera” (they) and a set of two books.

- (44) Karera-ga ni-satu-no hon-o yomi-at-ta.  
 they-NOM 2-CL-GEN book-ACC read-RCPL-PAST  
 a. “They read two books competing with each other/one after another/etc.”  
 b. \* “They read two books each.”

I propose that “-au” is a subject-oriented suffixal distributor as defined in (45). It modifies a unary event predicate so that it is distributively evaluated with respect to the subject. The restriction that  $u_n$  has to be the subject is given as presupposition, which I notate with an underline.

$$(45) \quad \llbracket \text{au}_{u_n} \rrbracket = \lambda V_{\langle E, VT \rangle} \lambda v_E \lambda \epsilon_V \delta_{u_n}(V(\epsilon)(v)); \llbracket \text{agent}\{\epsilon\}\{u_n\} \rrbracket$$

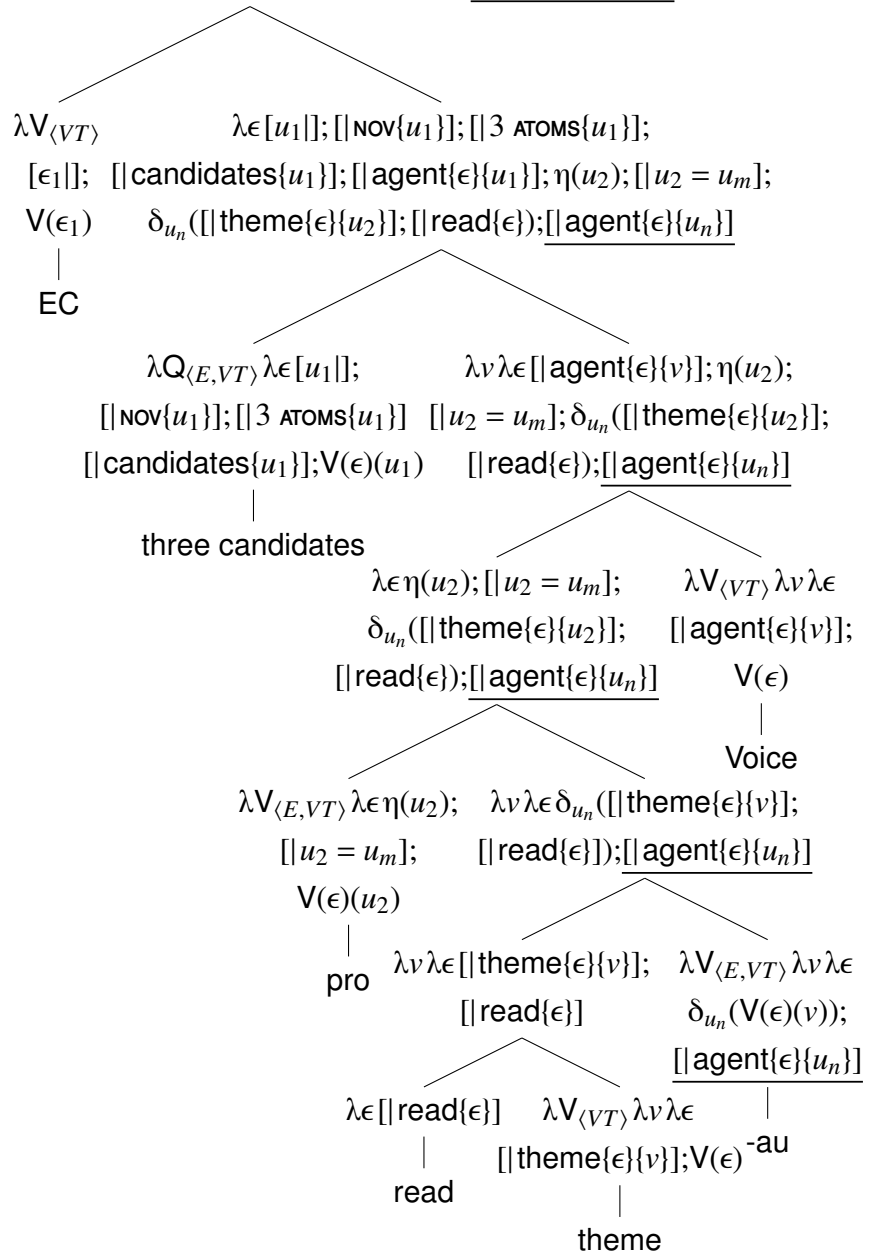
Crucial part of this denotation is that the  $\delta$  operator encoded in “-au” only scopes over an eventive predicate and never scopes over verbal arguments. This is the key property of “-au,” which is observed in (44). (46) shows how the internal argument is combined with V-au in (44).

$$(46) \quad \begin{array}{c} \lambda \epsilon[u_2]; \llbracket \text{NOV}\{u_2\} \rrbracket; \llbracket 2 \text{ ATOMS}\{u_2\} \rrbracket; \llbracket \text{books}\{u_2\} \rrbracket; \\ \delta_{u_n}(\llbracket \text{theme}\{\epsilon\}\{u_2\} \rrbracket; \llbracket \text{read}\{\epsilon\} \rrbracket; \llbracket \text{agent}\{\epsilon\}\{u_n\} \rrbracket) \\ \swarrow \quad \searrow \\ \begin{array}{c} \lambda V_{\langle E, VT \rangle} \lambda \epsilon[u_2]; \llbracket \text{NOV}\{u_2\} \rrbracket; \\ \llbracket 2 \text{ ATOMS}\{u_2\} \rrbracket; \llbracket \text{books}\{u_2\} \rrbracket; V(\epsilon)(u_2) \end{array} \quad \begin{array}{c} \lambda v \lambda \epsilon \delta_{u_n}(\llbracket \text{theme}\{\epsilon\}\{v\} \rrbracket; \\ \llbracket \text{read}\{\epsilon\} \rrbracket; \llbracket \text{agent}\{\epsilon\}\{u_n\} \rrbracket) \end{array} \\ \mid \quad \swarrow \quad \searrow \\ \text{two books} \quad \begin{array}{c} \lambda v \lambda \epsilon \llbracket \text{theme}\{\epsilon\}\{v\} \rrbracket; \llbracket \text{read}\{\epsilon\} \rrbracket \quad \lambda V_{\langle E, VT \rangle} \lambda v \lambda \epsilon \\ \delta_{u_n}(V(\epsilon)(v)); \\ \llbracket \text{agent}\{\epsilon\}\{u_n\} \rrbracket \end{array} \\ \swarrow \quad \searrow \quad \mid \\ \lambda \epsilon_V \llbracket \text{read}\{\epsilon\} \rrbracket \quad \lambda V_{\langle VT \rangle} \lambda v \lambda \epsilon \quad \llbracket \text{agent}\{\epsilon\}\{u_n\} \rrbracket \\ \mid \quad \mid \quad \mid \\ \text{read} \quad \llbracket \text{theme}\{\epsilon\}\{v\} \rrbracket; V(\epsilon) \quad \text{-au} \\ \mid \\ \text{theme} \end{array}$$

Now, this entry of “-au” provides a yet another way to derive a reciprocal reading. I assume that Japanese has a null pronoun *pro* (Hoji, 1985; Kuroda, 1965; M. Nakamura, 1987; Ohso, 1976; Saito, 1985, a.o.) and propose that (35b) has *pro* at the object position. I propose that *pro* has the denotation in (47).

$$(47) \quad \llbracket \text{pro}_{u_n} \rrbracket = \lambda V_{\langle E, VT \rangle} \lambda \epsilon \eta(u_m); \llbracket u_m = u_n \rrbracket; V(\epsilon)$$

(48)  $[\epsilon_1]; [u_1]; [\text{Nov}\{u_1\}]; [3 \text{ ATOMS}\{u_1\}]; [\text{candidates}\{u_1\}]; [\text{agent}\{\epsilon_1\}\{u_1\}];$   
 $\eta(u_2); [u_2 = u_m]; \delta_{u_n}([\text{theme}\{\epsilon_1\}\{u_2\}]; [\text{read}\{\epsilon_1\}]; [\text{agent}\{\epsilon_1\}\{u_n\}])$



The presupposition of “-au” forces  $u_n$  to be co-indexed with  $u_1$ . If *pro* is co-referential with the subject, (35b) denotes (49). In this denotation, the combination of a null pronoun and the suffixal distributivity gives rise to the same configuration as that of the bare anaphoric “sorezore”: the co-reference condition between  $u_1$  and  $u_1$  and  $u_2$  is evaluated above the  $\delta$  operator and the theme relation is evaluated under the scope of the  $\delta$  operator. Since  $u_1$  and  $u_2$  are co-participants, this results in collective co-reference and distributive disjointness.

$$(49) \quad \begin{aligned} \llbracket (35b) \rrbracket = & [\epsilon_1]; [u_1]; [\text{NOV}\{u_1\}]; [\text{3 ATOMS}\{u_1\}][\text{candidates}\{u_1\}]; \\ & [\text{agent}\{\epsilon_1\}\{u_1\}]; \eta(u_2); [u_2 = u_1]; \delta_{u_1}([\text{theme}\{\epsilon_1\}\{u_2\}]; [\text{read}\{\epsilon_1\}]) \end{aligned}$$

This provides further support for the three-way compositional approach: “-au” only encodes the distributivity component and anaphoricity and disjointness respectively come from *pro* and distributive evaluation of Condition B.

Now, one issue arises. If *pro* encodes the  $\eta$  operator, it predicts that *pro* alone can induce a reciprocal reading. Actually, this prediction is borne out. Tatsumi (2017) claims that Japanese has a null reciprocal, whereas it lacks a null reflexive. He shows the contrast between (50) and (51).

- (50) John-ga tatai-ta.  
 John-NOM hit-PAST  
 a. “John hit someone.” (non-reflexive)  
 b. \* “John hit himself.” (reflexive)  
 (Tatsumi, 2017)
- (51) John-to-Mary-ga tatai-ta.  
 John-and-Mary-NOM hit-PAST  
 a. “John and Mary hit someone.” (non-reciprocal/non-reflexive)  
 b. ? “John and Mary hit each other.” (reciprocal)  
 (Tatsumi, 2017)

Although it is not as good as a pronominal interpretation, a reciprocal reading is not unacceptable in (51), while a reflexive reading is not available in (50). He further shows that a reciprocal reading becomes more salient with the adverb “koogo ni” (alternately) as shown in (52). Importantly, a reflexive reading of a null element remains unavailable here.

- (52) John-to-Mary-ga    **koogo ni**    tatai-ta.  
 John-and-Mary-NOM alternately hit-PAST
- a. “John and Mary hit someone alternately.”    (non-reflexive/reciprococal)
- b. “John and Mary hit each other alternately.”    (reciprocal)
- c. \* “John hit himself and Mary hit herself alternately.”    (reflexive)
- (Tatsumi, 2017)

These observations in Tatsumi (2017) suggest that the covert pronoun *pro* in Japanese encodes the  $\eta$  operator. Thus, these cases of null reciprocals come from the random dependency provided via the  $\eta$  operator. Note that one does not need to postulate a null reciprocal in addition to *pro* because both a pronominal use and a reciprocal use are derived from the underspecified dependency introduced by the  $\eta$  operator.<sup>9</sup> Also, note that the proposed analysis correctly predicts that the unavailability of a null reflexive reading because it violates Condition B.

Summing up, I discussed two other reciprocal strategies and show that “otagai” and “-au” are both not always reciprocal. “Otagai” sometimes induces a weak truth condition and thus provides further support for decomposition of disjointness. “-au” only encodes distributivity and the other two components come from *pro* and Condition B. Thus, these two reciprocal strategies provide further support for the decomposition of reciprocity into three separate components. The result of the discussion in this section is summarised in Table 5.7.

	Distributivity	Anaphoricity	Disjointness
Japanese	“sorezore”		underspecified
	“otagai <sub>1</sub> ”		
	“otagai <sub>2</sub> ”		underspecified
	“-au”	<i>pro</i>	underspecified

**Table 5.7:** Variations in the reciprocal strategies in Japanese

9. Tatsumi (2017) reports that a null element does not induce a reciprocal reading when it occurs at a non-argument position. This argument versus non-argument distinction does not follow from the proposed analysis. Although I leave this issue for future work, I suspect that this is due to a general constraint for covert pronouns at non-argument positions. When *pro* occurs at a non-argument position, there is no strong cue for the hearer to construe *pro*, whereas when *pro* occurs at an argument position, the hearer can notice that one argument is missing and thus can easily construe *pro*. If this line of thoughts is on the right track, it predicts that (i) *pro* should also be slightly degraded at the positions where a null reciprocal interpretation is unavailable, and (ii) when a non-argument *pro* is signalled in some pragmatic contexts, a null reciprocal interpretation should also be more acceptable.



**Long-distance reciprocals**

So far, I have mainly been concerned with reciprocal antecedents within the same clause. However, instances of long-distance reciprocals have been a topic of extensive discussion (Heim, Lasnik, & May, 1991b; Higginbotham et al., 1981; Williams, 1986). For example, (53) has two interpretation. In (68a), “each other” seems to take a narrow scope and be associated with “they” in the embedded clause. On the other hand, “each other” seems to take a wide scope and be associated with “John and Mary” in the matrix clause in (53b).

- (53) [John and Mary]<sup>u<sub>1</sub></sup> think that they<sub>u<sub>1</sub></sub> like each other.
- a. John and Mary think they, i.e. John and Mary, like each other.
  - b. John thinks that he likes Mary and Mary thinks that she likes John.

(Heim et al., 1991b)

The seemingly long-distance association between the matrix subject and “each other” in (53b) is not always possible. Once the embedded subject is replaced with a non-pronominal singular element, this ambiguity disappears as shown in (54). If “each other” can take a clause-external antecedent, (54) could have meant that each of John and Mary thinks that I like the other.

- (54) \*[John and Mary]<sup>u<sub>1</sub></sup> think that I<sup>u<sub>2</sub></sup> like each other. (Heim et al., 1991b)

Thus, the challenge is that one has to account for the long-distance construal in (53b) while disallowing (54).

Heim et al. (1991b) propose that “each” undergoes LF movement while “other” is an anaphor which is subject to Condition A. In this sense, the antecedent of “other” is constant across the two readings in (53), but “each” has two possible ways to take scope as shown in (55a) and in (55b).

- (55) a. [John and Mary]<sup>u<sub>1</sub></sup> think that they<sub>u<sub>1</sub></sub> **each** like other<sub>u<sub>1</sub></sub>.  
       ⇒ John and Mary think they, i.e. John and Mary, like each other.
- b. [John and Mary]<sup>u<sub>1</sub></sup> **each** think that they<sub>u<sub>1</sub></sub> like other<sub>u<sub>1</sub></sub>.  
       ⇒ John thinks that he likes Mary and Mary thinks that she likes John.

This nicely account for the ambiguity in (53) while disallowing (54): (53) has two readings each of which correspond to a different landing site of the LF-movement of “each,” but (54) is unacceptable because “other” cannot be locally bound.

However, this LF movement analysis of “each” wrongly predicts that “each” takes scope over its c-commanding domain as discussed in §5.2.2. To solve this problem, I claim that long-distance construals do not arise due to the scope of “each,” but these readings are due to dependent readings of a plural pronoun at the embedded subject position, following Dimitriadis (1999). In my account, dependent anaphora arises when the co-reference condition of a plural pronoun is evaluated under the  $\delta$  operator as I suggested in Chapter 3. Thus, the ambiguity in (53) is tied with the optionality of the  $\delta$  operator for the embedded subject “they” as shown in (56). Here, I put the superscript  $\delta_{u_1}(u_2)$  to indicate that the dref introduction and the co-reference condition of they, i.e.  $[u_2]; [u_2 = u_1]$  is evaluated under the scope of  $\delta_{u_1}$ .

- (56) a.  $[\text{John and Mary}]^{u_1}$  think that they $_{u_1}^{u_2}$  like each other $_{u_2}^{u_3}$ .  
 $\Rightarrow$  John and Mary think they, i.e. John and Mary, like each other.
- b.  $[\text{John and Mary}]^{u_1}$  think that they $_{u_1}^{\delta_{u_1}(u_2)}$  like each other $_{u_2}^{u_3}$ .  
 $\Rightarrow$  John thinks that he likes Mary and Mary thinks that she likes John.

In cases of short-distance reciprocals, the embedded subject is independent of the matrix subject as shown in Table 5.8. This table expresses that John thinks that John and Mary like each other and Mary also thinks that John and Mary like each other.

$H$	$u_1$	$u_2$	$u_3$
$h_1$	John	John	Mary
$h_2$	John	Mary	John
$h_3$	Mary	John	Mary
$h_4$	Mary	Mary	John

**Table 5.8:** Short-distance reiprocal

In contrast, the embedded subject is dependent on the matrix subject in cases of long-distance reciprocals as shown in Table 5.9. Note that the antecedent of “each other” is constant across these two cases. This table expresses that John thinks that John likes Mary and Mary thinks that Mary likes John.

$H$	$u_1$	$u_2$	$u_3$
$h_1$	John	John	Mary
$h_2$	Mary	Mary	John

**Table 5.9:** Long-distance reiprocal

In this way, the ambiguity of “each other” in an embedded clause is accounted for without postulating an LF-movement of “each.” Crucially, the term “long-distance reciprocals” is misleading in this approach because “each other” is constantly clause-bound and seemingly long-distance readings are due to dependent anaphora triggered by a plural pronoun at the embedded subject position.

This approach is extended to “otagai.” In Japanese, not every pronominal element behaves in parallel with plural pronouns in English. The plural long-distance reflexive “zibun” (self) disallows a long-distance reciprocal reading, whereas *pro* allows it as shown in (57) and (58).

- (57) [John-to-Mary]<sup>u1</sup>-ga [zibun-tachi<sup>u2</sup>-ga **otagai**<sup>u3</sup>-o mi-ta to] omo-tta.  
 John-and-Mary-NOM [self-PL-NOM otagai-ACC see-PAST that] think-PAST  
 a. “John and Mary thought that they, i.e. John and Mary, saw each other.”  
 b. \* “John thought that John saw Mary and Mary thought that Mary saw John.”  
 (Nishigauchi, 1992)

- (58) [John-to-Mary]<sup>u1</sup>-ga [*pro*<sup>u2</sup> **otagai**<sup>u3</sup>-o mi-ta to] omo-tta.  
 John-and-Mary-NOM [*pro* otagai-ACC see-PAST that] think-PAST  
 a. “John and Mary thought that they, i.e. John and Mary, saw each other.”  
 b. “John thought that John saw Mary and Mary thought that Mary saw John.”  
 (Nishigauchi, 1992)

Importantly, availability of long-distance reciprocal readings correlates with availability of dependent anaphora as shown in (59): when it occurs under the scope of a distributive universal quantifier, “jibun-tachi” (self-PL) cannot be co-indexed with the quantifier, while *pro* can.

- (59) dono-gakusei<sup>u1</sup>-mo [{\*zibun-tachi<sup>u2</sup>-ga / *pro*<sup>u2</sup>} ichiban kasiko-i to]  
 every-student-MO [{self-PL-NOM / *pro*} most smart-PRES that]  
 omo-tte-iru.  
 think-PROG-PRES  
 “Every student thinks that they are the smartest.”

These observations suggest that “otagai” allows long-distance reciprocal only if the embedded subject can be dependent on the matrix subject. This is expected if long-distance reciprocal readings are parasitic to dependent anaphora of a pronominal element at the embedded subject position.

The same thing applies to “sorezore” as shown in (60) and (61).

- (60) [John-to-Mary]<sup>u<sub>1</sub></sup>-ga [zibun-tachi<sup>u<sub>1</sub></sup><sup>u<sub>2</sub></sup>-ga **sorezore**<sup>u<sub>3</sub></sup>-o mi-ta to] omo-tta.  
 John-and-Mary-NOM [self-PL-NOM otagai-ACC see-PAST that] think-PAST  
 a. “John and Mary thought that they, i.e. John and Mary, saw each other.”  
 b. \*“John thought that John saw Mary and Mary thought that Mary saw John.”
- (61) [John-to-Mary]<sup>u<sub>1</sub></sup>-ga [*pro*<sup>u<sub>1</sub></sup><sup>u<sub>2</sub></sup> **sorezore**<sup>u<sub>3</sub></sup>-o mi-ta to] omo-tta.  
 John-and-Mary-NOM [*pro* otagai-ACC see-PAST that] think-PAST  
 a. “John and Mary thought that they, i.e. John and Mary, saw each other.”  
 b. “John thought that John saw Mary and Mary thought that Mary saw John.”

Summing up, I proposed that long-distance reciprocity is an illusion caused by dependent anaphora of a pronoun at the embedded subject position. This derives the ambiguity observed in Heim et al. (1991b) without predicting that “each other” takes scope over other argument positions. I extended this analysis to “otagai” and “sorezore,” showing that their long-distance construals are available only when a pronominal element at the embedded subject position allows dependent anaphora.

### Reciprocal strategies in various languages

In this section, I discuss reciprocal strategies in several languages other than Japanese. First, as I discussed in §5.2.2, “each other” encodes all the three ingredients of the semantics of reciprocity as repeated in (62).<sup>10</sup>

$$(62) \quad \llbracket \text{each other}_{u_n} \rrbracket = \lambda V_{\langle E, VT \rangle} \lambda \epsilon_V \eta(u_m); [\llbracket u_m = u_n \rrbracket; \delta_{u_n}(\llbracket u_m \cap u_n = \emptyset \rrbracket); V(\epsilon)(u_m)]$$

(Dotlačil, 2013)

Second, Kobayashi (2020) shows that Brazilian Portuguese exhibits *scattered reciprocals*, in which two items corresponding to the two components occur in different positions. This pattern is exemplified in

- (63) Eles vão **um** falar com **o outro**.  
 they will one speak with the other  
 “They will speak with each other.” (Kobayashi, 2020)

10. Note that the dependency-free dref introduction does not work with (62): if  $u_m$  and  $u_n$  are independent, but co-referential, there is necessarily an assignment in which  $u_m$  and  $u_n$  store the same value. Thus, it is important that “each other” encodes the  $\eta$  operator.

Kobayashi (2020) proposes a division of labour between “um” (one) and “o outro” (the other): the former distributes over pairs of individuals and the latter encodes the disjointness condition as shown in (64).<sup>11</sup>

- (64) a.  $\llbracket \text{um}_{u_n} \rrbracket = \lambda V_{\langle E, VT \rangle} \lambda v_E \lambda e_V [u_m]; [\llbracket u_m = u_n \rrbracket; \delta_{u_m}(\delta_{u_n}(V(\epsilon)(v)))]$   
 b.  $\llbracket \text{o outro}_{u_n} \rrbracket = \lambda Q_{\langle E, VT \rangle} \lambda e_V [u_m]; [\llbracket u_m \cap u_n = \emptyset \rrbracket; Q(\epsilon)(u_m)]$

Kobayashi (2020) claims that the scattered reciprocal in Brazilian Portuguese and “each other” in English use the same building blocks, but they differ in how they are built in syntax. His point is essentially the same as my argument here: the basic ingredients of reciprocals are similar across languages, but the way how these are built in syntax is subject to cross-linguistic variation.

Third, Faller (2007) shows that Cuzco Quechua also scatters two components to different verbal suffixes and the disjointness condition comes from Condition B with respect to sub-events. This pattern is exemplified in (65).

- (65) Hayt’a-**na**-**ku**-n-ku.  
 kick-PA-REFL-3rd person-PL  
 “They kick each other.” (Faller, 2007)

Faller (2007) analyses “na” as a pluractional morpheme and “ku” as a reflexive morpheme. Importantly, “na” alone does not convey a reciprocal reading except two cases: when it precedes the causative suffix or used in a passive participle.<sup>12</sup> When “-na” occurs alone, it marks event plurality. On the other hand, “-ku” marks reflexivity, although it has other functions. Thus, the pluractionality of “-na” provides the distributivity component, the reflexivity of “-ku” provides the anaphoricity component. Where does the disjointness component comes from? Faller (2007) proposes that this comes from the binding condition B. She proposes an eventive version of the reflexivity criterion (Langendoen & Magloire, 2003) and claims that reflexivity may hold at the level of plural individuals and does not need to entail reflexivity at the level of atomic individuals. As a result, when a sentence describes plurality of events, reflexivity may hold at either level. When “-ku” establishes reflexivity at the level of plural individuals, but not at the level of atomic individuals, the Condition B kicks in and requires disjointness reference at the level of atomic

11. Kobayashi (2020) proposes an analysis based on Plural Predicate Logic without events. Here, I translated his analysis into PCDRT with events for ease of comparison.

12. See Faller (2007) for the relevant data and discussion.

individuals. In this way, a reciprocal reading arises. Although Faller (2007) analyses these morphemes with Neo-Davidsonian event semantics, her analysis shares the same insight behind the collective co-reference condition and the distributive disjointness condition. Here, I translate her static analysis into a dynamic one under the proposed account as shown in (66).<sup>13</sup>

- (66) a.  $\llbracket \text{-na}_{u_n} \rrbracket = \lambda V_{\langle E, VT \rangle} \lambda v_E \lambda \epsilon_V \delta_{u_n}(V(\epsilon)(v))$   
 b.  $\llbracket \text{-ku}_{u_{n'}} \rrbracket = \lambda V_{\langle E, VT \rangle} \lambda v_E \epsilon_V \eta(u_m); [\llbracket u_m = u_{n'} \rrbracket; V(\epsilon)(u_m)]$   
 c.  $\llbracket \text{V-na-ku}_{u_n, u_{n'}} \rrbracket = \lambda v_E \eta(u_m); [\llbracket u_m = u_{n'} \rrbracket; \delta_{u_n}(V(\epsilon)(u_m))]$

Lastly, Cable (2014b) shows that many European languages allow a reciprocal reading, a reflexive reading and a mixed reading.<sup>14</sup>

- (67) a. Die Schüler schlugen sich. (German)  
           the students hit REFL  
           “The students slapped {themselves / each other}.”  
 b. Les étudiants se sont frappés. (French)  
           the students REFL AUX slap  
           “The students slapped {themselves / each other}.”  
 c. Los etudiantes se golpeaban. (Spanish)  
           the students REFL slap.IMPF  
           “The students were slapping {themselves / each other}.”  
 d. Os etudiantes se bateram. (Portuguese)  
           the students REFL slap.IMPF  
           “The students were slapping {themselves / each other}.”  
 e. Gli studenti si sono picchiati. (Italian)  
           the students REFL AUX slap  
           “The students slapped {themselves / each other}.” (Cable, 2014b)

13. As I mentioned in Chapter 3, I leave it open if reflexive-marking is syntactic or semantics. If one prefers to do it semantically, the  $\text{REFL}_{u_n}^{u_m}$  condition can be added to the denotation of “-ku.”

14. So far, I only used verbs with non-physical action to describe the weak truth condition of English plural reflexives. However, Cable (2014b) shows that English plural reflexives only allows a reflexive reading with “slap,” whereas reflexives in other languages induce an underspecified reading with “slap.” Although he does not discuss the difference between verbs like “slap” and verbs like “praise,” Cable (2014b) shows that reciprocal and mixed readings of English plural reflexives improve with a contrastive context. He claims that this is similar to the behaviour of ‘intensifier’ use of reflexives. Furthermore, he shows that reflexives in Turkish, Russian and Hebrew are quite similar to reflexives in English in this regard. Although I leave this as an open question, these claims in Cable (2014b) strongly suggests the importance of interaction between reflexivity and contrastivity.

Cable (2014b) proposes that cumulative predication in event semantics offers an uniform denotation for these cases. The insight of this analysis is quite similar to that of Faller (2007) and mine. In his analysis, reflexives in these examples are co-referential with the plural antecedent at the level of plural individuals, but not at the level of atomic individuals. As a result, dependency at the level of atomic individuals is underspecified, which leads to a weak truth condition. This insight can easily be implemented under PCDRT. (68) repeats the denotation of plural reflexives I proposed in Chapter 3. It is minimally sufficient to provide a weak truth condition in the style of Cable (2014b).

$$(68) \quad \lambda V_{\langle E, VT \rangle} \lambda v_E \lambda \epsilon_V \delta_{u_n}([u_m]); \text{REFL}_{u_n}^{u_m} \{\epsilon\}; [\text{NON-ATOM}\{u_m\}]; V(\epsilon)(u_m)$$

The discussion so far suggests that variety of reciprocal strategies use the same building blocks as summarised in Table 5.10.

	Distributivity	Anaphoricity	Disjointness
English	“each other”		
Brazilian Portuguese	“um”		“o outro”
Cuzco Quechua	“-na”	“-ku”	underspecified
German, French, Spanish, Portuguese, Italian	underspecified	reflexives	underspecified
Japanese	“sorezore”		underspecified
	“otagai <sub>1</sub> ”		
	“otagai <sub>2</sub> ”		underspecified
	“-au”	<i>pro</i>	underspecified

**Table 5.10:** Variations in the reciprocal strategies

Thus, the three-way decompositional approach to reciprocity not only accounts for variation of reciprocal strategies in Japanese, but also it shows that various reciprocal strategies in other languages utilises the same semantic ingredients.<sup>15</sup>

15. Note that this table does not include the following combinations: (i) the distributivity and the disjointness component, and (ii) the anaphoricity component and the disjointness component. Although I do not discuss it in this thesis, it is possible that these combinations are attested in the varieties of expressions such as “different” in English. Since Carlson (1977a), it has been noted that “different” in English allows an *external reading* as exemplified in (1a) and an *internal reading* as exemplified in (1b).

- (1) a. Mary recited ‘The Raven’. Then, Linus recited a **different** poem.  
 b. Every boy recited a **different** poem. (Brasoveanu, 2011)

Note that decompositional analyses of reciprocals is not new. Rather, it has been proposed since (Heim, Lasnik, & May, 1991a; Heim et al., 1991b), in which reciprocals are decomposed into the distributivity component and the anaphoricity component. Also, while Dotlačil (2013) argues against decomposition of “each other” to “each” + “other”<sup>16</sup>, he argues that the semantics of reciprocity consists of the anaphoricity condition and the disjointness condition. In this sense, my tripartite decomposition is regarded as a natural extension from the previous work on reciprocals.

### 5.2.5 Interim summary

In this section, I discussed non-inherent reciprocity of the bare anaphoric “sorezore” and proposed that the bare anaphoric “sorezore” is collectively anaphoric with its antecedent via the co-referential condition, but distributively evaluates a lexical relation. As a result, it induces a reciprocal reading only when it is a co-participant of its antecedent. This correctly predicts that the bare anaphoric “sorezore” has a weak truth condition when it is not a co-participant of its antecedent.

Based on this discussion on “sorezore,” I proposed that the semantics of reciprocity is decomposed into three separate components, namely the distributivity component, the anaphoricity component and the disjointness component. This three-way decompositional approach is extended to various cases of reciprocal strategies. I claimed that this approach offers a principled account for other reciprocal strategies in Japanese, long-distance reciprocals and reciprocal strategies across languages.

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(1a) is true if Linus recited a poem that is different from ‘The Raven’ and (1b) is true if for any pair of boys, the poems they recited are different from each other. If “different” takes a singular NP, it can induce an internal reading only when it is under the scope of a distributive quantifier, but if it takes a plural NP, it can induce an internal reading without being under the scope of a distributive quantifier.

- (2) a. [Mary and Linus]<sup>u1</sup> recited a different poem<sup>u2</sup>. (external-only)  
 b. [Mary and Linus]<sup>u1</sup> recited different poems<sup>u2</sup>. (internal and external)

(Brasoveanu, 2011)

Brasoveanu (2011) proposes that both readings of “different” are special instances of anaphora and the internal reading requires the  $\delta$  operator. If this analysis is on the right track, one may decompose the semantics of “different” into the anaphoric component and the disjointness component, while the distributive component is optional. See Brasoveanu (2011) for the details and cross-linguistic observation of the counterparts of “different” in several languages.

16. He does not deny cases in which “each other” functions as the combination of “each” and “other.” See Dotlačil (2013) for discussion of the cases in which “each other” can occur under the scope of another “each.” Also, see Kobayashi (2020) for a decomposition of “each other,” which does not run into the problem of scope.



### 5.3 Distributive quantification with “sorezore”

In this section, I discuss the anaphoric potential of “sorezore” when it occurs as a generalised quantifier. The main puzzle is that the anaphoric behaviour of “sorezore” differs across syntactic positions. Based on the terminology in Chapter 4, I propose that the anaphoric component is encoded as the restrictor condition of “sorezore,” i.e. the idiosyncratic property of the restrictor of “sorezore,” and the distributivity component is encoded as the scope condition, i.e. the idiosyncratic property of the scope of “sorezore.” Accordingly, the anaphoric component is realised only when “sorezore” introduces a new dref for its restrictor set. Thus, the prenominal “sorezore” and the bare anaphoric “sorezore” can have an anaphoric reading, whereas the postnominal “sorezore” and the floating “sorezore” do not. On the other hand, the distributivity component of “sorezore” is realised in each variant of “sorezore.” I propose a locality constraint on the distributivity component of “sorezore” based on the notion of the *minimal sequence of evaluation* so that it predicts that the  $\delta$  operator of “sorezore” is always co-indexed with its restrictor set whenever it takes a restrictor property and it is clause-bounded, otherwise. I also discuss a constraint on cross-sentential dependency and extension of the proposed analysis to “each” in English.

#### 5.3.1 Anaphoricity in the restrictor

First of all, I lay out the core data and the main puzzle in this section. First, “sorezore” can occur in all the three positions as shown in (69).

- (69) a. Prenominal “sorezore”:

**Sorezore**-no ginkoo<sup>u1</sup>-ga hurui kooza<sup>u2</sup>-o toketu-sita.  
 each-GEN bank-NOM old account-ACC freeze-PAST  
 “Each bank froze an old account.”

- b. Postnominal “sorezore”:

Kore-ra-no ginkoo<sup>u1</sup>-**sorezore**-ga hurui kooza<sup>u2</sup>-o toketu-sita.  
 (this-PL-GEN) bank-each-NOM old account-ACC freeze-PAST  
 “Each of these banks froze an old account.”

- c. Floating “sorezore”:

(Kore-ra-no) ginkoo<sup>u1</sup>-ga **sorezore**<sub>u1</sub> hurui kooza<sup>u2</sup>-o toketu-sita.  
 (this-PL-GEN) bank-NOM each old account-ACC freeze-PAST  
 “The(se) banks each froze an old account.”

“Sorezore” is anaphoric in different ways at different positions. First, the prenominal “sorezore” occurs at an argument position and it allows inter-sentential anaphora as shown in (70b).<sup>17</sup>

(70) Prenominal “sorezore”:

- a. Kantoku<sup>u1</sup>-ga [atarasii toosyu]<sup>u2</sup>-o takusan yato-tta.  
manager-NOM new pitcher-ACC many hire-PAST  
“The manager hired many new pitchers.”
- b. Koochi-tachi<sup>u3</sup>-wa [sorezore-no toosyu]<sup>u4</sup>-o jikkuri sodate-ta.  
coach-PL-TOP DIST-GEN pitcher-ACC carefully train  
“The coaches carefully trained each pitcher.”

Importantly, (70b) requires that the pitchers are trained one by one. In other words, it is false if each of the coaches trains some of the pitchers. This suggests that the distributivity has to be evaluated with respect to  $u_2$  and not with respect to  $u_1$ . In this sense, the  $\delta$  operator of the prenominal “sorezore” has to be co-indexed with its restrictor set.

Second, the floating “sorezore” does not occur at an argument position. However, the  $\delta$  operator of the floating “sorezore” can be co-indexed with the dref introduced with an argument which is not local to it. The floating “sorezore” at the post-object position can be associated with the subject or the object as shown in (71a), but it cannot be associated with a non-clause-mate argument as shown in (71b).

(71) Floating “sorezore”:

- a. Huta-ri-no sutahhu<sup>u1</sup>-ga mi-ttsu-no hako<sup>u2</sup>-o sorezore <sub>$u_1/u_2$</sub>   
2-CL<sub>person</sub>-GEN employee-NOM 3-CL<sub>thing</sub>-GEN box-ACC DIST  
hakon-da.  
carry-PAST  
i. “Two employees each carried three boxes.” (distributive)  
ii. “Two employees carried each of the three boxes.” (cumulative)
- b. \* Karera<sup>u1</sup>-ga [Takayuki<sup>u2</sup>-ga sorezore <sub>$u_2$</sub>  mi-ttsu-no hako<sup>u3</sup>-o hakon-da  
They-NOM [Takayuki-NOM DIST 3-CL<sub>thing</sub>-GEN box-ACC carry-PAST  
to] omo-tte-iru.  
that] think-PROG-PRES  
Lit “They think Takayuki each carried three boxes.”

17. See §5.3.4 for discussion on intra-sentential anaphora of the prenominal “sorezore.” The gist is that it can have intra-sentential anaphora only when there are more than one potential antecedents.

Lastly, the postnominal “sorezore” occurs at an argument position, but it neither allow inter-sentential anaphora as shown in (72a-ii) nor intra-sentential anaphora as shown in (72b).

(72) The postnominal “sorezore”:

- a. i. Kantoku<sup>u1</sup>-ga [atarasii toosyu]<sup>u2</sup>-o takusan yato-tta.  
           manager-NOM new       pitcher-ACC many   hire-PAST  
           “The manager hired many new pitchers.”
- ii. ?? Koochi-tachi<sup>u3</sup>-wa toosyu-sorezore<sup>u4</sup>-o jikkuri   sodate-ta.  
               coach-PL-TOP       pitcher-DIST-ACC       carefully train  
               “The coaches carefully trained each pitcher.”
- b. San-nin-no       seijika<sup>u1</sup>-ga   seijika<sup>u2</sup><sub>\*u1</sub>-sorezore-o hihan-sita.  
       3-CL<sub>Person</sub>-GEN politician-NOM politician-DIST-ACC   criticise-PAST  
       “The three politicians criticised each of the politicians.”

(72a-ii) can only mean that the coaches carefully trains pitchers in general and cannot mean that the manager trains pitchers who he newly hired.<sup>18</sup> Similarly, (72b) requires there to be a separate group of politicians from the three politicians and the three politicians criticised each of this separate group of politicians. Importantly, both (72a-ii) and (72b) only has a cumulative reading and thus the  $\delta$  operator of the postnominal “sorezore” has to be co-indexed with the restrictor set of “sorezore,” just like the prenominal “sorezore.”

The observations so far are summarised as follows. First, the restrictor set of “sorezore” is anaphoric only when it occurs at the prenominal position, putting aside the bare anaphoric “sorezore” for now. Second, the  $\delta$  operator in the scope of “sorezore” can be associated with any accessible clause-mate dref if “sorezore” does not take a restrictor NP, but if “sorezore” involves a restrictor update, the  $\delta$  operator has to be co-indexed with its restrictor set. I aim to derive these patterns from the interaction between the semantics of “sorezore” and the template of generalised quantifiers discussed in Chapter 4.

18. If the host NP is “sore-ra-no toosyu” (these pitchers), it allows the relevant inter-sentential anaphora. However, in this case, “sore-ra” (these) makes the host NP itself anaphoric. Thus, it does not mean that the postnominal “sorezore” can have inter-sentential anaphora.

### 5.3.2 “Sorezore” and generalised quantification

In this section, I define the quantificational variants of “sorezore” based on the discussion in Chapter 4. The general template of type-ambiguity of Japanese universal quantifiers is repeated in (73).

- (73) a.  $[[\text{Unary quantifier}]] = \lambda V_{\langle E, VT \rangle} \lambda \epsilon [\text{RESTRICTOR}^{u_n}; \text{MAX}^{u_m \in u_n}(\text{SCOPE}(V)(\epsilon)(u_n); \text{DET}\{u_n\}\{u_m\})]$
- b.  $[[\text{Prenominal quantifier}]] = \lambda P_{\langle ET \rangle} \lambda V_{\langle E, VT \rangle} \lambda \epsilon [\text{RESTRICTOR}^{u_n}(\delta_{u_n}(P(u_n))); \text{MAX}^{u_m \in u_n}(\text{SCOPE}(V)(\epsilon)(u_m)); \text{DET}\{u_n\}\{u_m\})]$
- c.  $[[\text{Postnominal quantifier}]] = \lambda R_{\langle \langle E, VT \rangle, \langle VT \rangle \rangle} \lambda V_{\langle E, VT \rangle} R(\lambda v \lambda \epsilon [\text{MAX}^{u_m \in v}(\text{SCOPE}(V)(\epsilon)(u_m)); \text{DET}\{v\}\{u_m\}])]$
- d.  $[[\text{Floating quantifier}]] = \lambda V_{\langle E, VT \rangle} \lambda v \lambda \epsilon [\text{MAX}^{u_m \in v}(\text{SCOPE}(V)(\epsilon)(u_m)); \text{DET}\{v\}\{u_m\}]$

In (73), the idiosyncratic properties of a quantifier are encoded as the restrictor condition `RESTRICTOR` and the scope condition `SCOPE`. I claim that the two components of “sorezore” discussed in the previous section, i.e. the anaphoric component and the distributivity component, are respectively realised as `RESTRICTOR` and `SCOPE`.

- (74) Idiosyncratic properties of “sorezore”
- a. The restrictor condition  $\text{RESTRICTOR}^{u_n}: \eta(u_n); [u_n = u'_n]$
- b. The scope condition  $\text{SCOPE}: \delta_{u'_n}(V)$

“Sorezore” is doubly anaphoric in the sense that its anaphoric component looks for an antecedent which is co-referential with its restrictor set  $u_n$  and its distributivity component looks for an antecedent which is co-indexed with the  $\delta$  operator for the scope of “sorezore.”

Based on the template (73) and the two components in (74), the four type variants of “sorezore” are defined in (75).

- (75) The four variants of “sorezore”
- a.  $[[\text{sorezore}_{u'_n, u'_m}]] = \lambda V_{\langle E, VT \rangle} \lambda \epsilon_V \eta(u_n); [u_n = u'_n]; \text{MAX}^{u_m \in u_n}(\delta_{u'_m}(V(\epsilon)(u_m))); \text{ALL}\{u_n\}\{u_m\}$  (Unary, i.e. bare anaphoric)
- b.  $[[\text{sorezore}_{u'_n, u'_m}]] = \lambda P_{\langle ET \rangle} \lambda V_{\langle E, VT \rangle} \lambda \epsilon \eta(u_n); [u_n = u'_n]; \delta_{u'_n}(P(u_n)); \text{MAX}^{u_m \in u_n}(\delta_{u'_m}(V(\epsilon)(u_m))); \text{ALL}\{u_n\}\{u_m\}$  (Prenominal)

- c.  $\llbracket \text{sorezore}_{u_{m'}} \rrbracket = \lambda R_{\langle \langle E, VT \rangle, \langle VT \rangle \rangle} \lambda V_{\langle E, VT \rangle}$   
 $R(\lambda v \lambda \epsilon [\text{MAX}^{u_m \subseteq v} (\delta_{u_{m'}} (V(\epsilon)(u_m)))]); \text{ALL}\{v\}\{u_m\}$  (Postnominal)
- d.  $\llbracket \text{sorezore}_{u_{m'}} \rrbracket = \lambda V_{\langle E, VT \rangle} \lambda v \lambda \epsilon \text{MAX}^{u_m \subseteq v} (\delta_{u_{m'}} (V(\epsilon)(u_m))); \text{ALL}\{v\}\{u_m\}$   
(Floating)

Note that the unary variant corresponds to the bare anaphoric “sorezore.” The definition in (107a) differs from the definition of the bare anaphoric “sorezore” in the previous section with respect to (i) introduction of the scope set with the  $\text{MAX}$  operator, the structural inclusion and (iii) the static GQ component  $\text{ALL}$ . However, the value of the scope set  $u_m$  has to be identical to the value of  $u_n$  in each member of a plural information state due to the structural inclusion and  $\text{ALL}$ . As a result, addition of  $u_m$  does not affect any part of the discussion in the previous discussion.

Now, note that the anaphoric component, i.e.  $\eta(u_n); [u_n = u_{n'}]$ , is realised only when “sorezore” itself introduces a new dref, whereas the distributivity component is always realised as long as “sorezore” takes an input. This follows from the general template of quantifier type-ambiguity in (73). This explains why the post-nominal “sorezore” can neither have intra-sentential nor inter-sentential anaphora even though it occurs at an argument position.

In the rest of this section, I discuss the the anaphoric potential of the distributivity component and the anaphoric component one by one.

### 5.3.3 Sequences of evaluation and locality of $\delta$

In this section, I discuss the distributivity component of “sorezore.” The generalisations are (i) if “sorezore” takes a restrictor NP, the  $\delta$  operator has to be co-indexed with its restrictor set, and (ii) the  $\delta$  operator can be co-indexed with any accessible clause-mate dref, otherwise. This pattern is reminiscent of the binding condition A. In the classical version of Condition A, a reflexive anaphor has to be bound in its *binding domain*, which is the minimal NP or TP containing the anaphor, its case-assigner and a subject which does not contain it.<sup>19</sup> Accordingly, when a reflexive occurs within an NP, its binding domain is the NP and it is a clause, otherwise. However, the  $\delta$  operator is encoded as a part of the denotation of “sorezore” and thus one cannot directly apply this syntactic binding condition to the distributivity

19. I do not discuss varieties of Condition A in this thesis. See Truswell (2014) for an overview of various syntactic analyses of binding conditions.

component of “sorezore.” Thus, I aim to define a semantic locality principle for the distributivity component of “sorezore,” which emulates the effect of Condition A. Any semantic reformulation of Condition A suffices for my purpose as long as it can deal with the locality of an operator embedded in the denotation of an expression. Here, I do not aim to propose a fully elaborated semantic reformulation of Condition A. Instead, I describe one possible implementation of Condition A for the  $\delta$  operator, which suffices for my purpose.

The informal sketch of my implementation is as follows. A lexical relation specifies a subset of drefs which are necessary for its evaluation. I call them *sequences of evaluation*.<sup>20</sup> When “sorezore” takes a restrictor property and the scope property, they each specify their sequences of evaluation. If “sorezore” specifies more than one sequences of evaluation, it picks up the shortest one. I call it the *minimal sequence of evaluation*. This minimality requirement is the reflection of the classical definition of binding domains: the binding condition of X must be the minimal NP or TP which meets the requirements.

To implement this idea, I first define sequences of evaluation as shown in (76).<sup>21</sup>

- (76) **Sequences of evaluation:** For an expression E, a set of discourse referents  $S_E = \{u_n | n \in N\}$  is *the sequence of evaluation* of E iff
- $\llbracket E \rrbracket$  does not take an event argument and  $\llbracket E \rrbracket \{u_1\} \dots \{u_n\}$ , or
  - $\llbracket E \rrbracket$  takes an event argument  $\epsilon$  as an argument and for every  $v \in S_E$ , there is a relation  $\theta$  such that  $\theta\{\epsilon\}\{v\}$  and  $\llbracket E \rrbracket \in \{\theta | \theta\{\epsilon\}\{v\} \& v \in S_E\}$ .

Note that a set of drefs specifies an  $n$ -tuple of individuals: given a set of natural numbers  $\mathbb{N}$  and an assignment  $g$ , there is a function  $\lambda n [v(u_n)(g)]$  from  $\mathbb{N}$  into the domain of individuals  $D_e$ .  $\lambda n [v(u_n)(g)]$  specifies a set of pairs of a number and an individual, i.e.  $\{\langle 1, x_1 \rangle, \langle 2, x_2 \rangle, \dots, \langle n, x_n \rangle \dots\}$ . Since this is a *family* of  $D_e$  which takes  $\mathbb{N}$  as its index set, this specifies a tuple  $\langle x_1, x_2 \dots x_n, \dots \rangle$ . A sequence of evaluation serves as a candidate of the binding domain for the  $\delta$  operator.

20. This idea might be similar to the concept of *Complete Functional Complex* (Chomsky, 1986), which is a category in which all grammatical functions compatible with its head are realized in it.

21. Note that the term “sequence of evaluation” is often used to refer to variable assignments, e.g., Schlenker (2005b). The system I adopt distinguishes these two notions. Variable assignments are entities of type  $s$  and it is associated with an  $n$ -tuple of individuals which are introduced in the discourse. Sequences of evaluation are sub-parts of such  $n$ -tuples which are necessary to determine the truth of an expression.

(76) deals with nominal predicates and verbal predicates in different ways. The denotation of a non-relational noun is basically unary and it forms a singleton sequence of evaluation as shown in (77a). I extend this assumption to the co-reference condition for pronouns and the identity condition for proper names as shown in (77b) and (77c). Verbal sequences of evaluation are tricky. The classical Davidsonian translation of a verb with  $n$ -number of arguments is an  $n + 1$ -ary relation which has one argument slot for an event. However, a fully Neo-Davidsonian logical form introduces an argument with an independent thematic relation. Thus, one has to make sure that Neo-Davidsonian conjunctions of an unary event predicate and  $n$  numbers of thematic relations form the same sequence of evaluation as its Davidsonian counterpart.

- (77) a. If  $P\{u_n\}$ ,  $S_P = \{u_n\}$   
 b. If  $[|u_n = u_m|]$ ,  $S_{[|u_n = u_m|]} = \{u_n, u_m\}$   
 c. If  $[|u_n = x|]$ ,  $S_{[|u_n = x|]} = \{u_n\}$   
 d. If  $\theta_1\{\epsilon_n\}\{u_1\} \& \dots \& \theta_n\{\epsilon_n\}\{u_n\} \& V\{\epsilon_n\}$ ,  $S_V = S_{\theta_i: 1 \leq i \leq n} = \{u_1, \dots, u_n\}$

I call sequences of evaluation without an eventive dref *nominal sequences of evaluation* and those with an eventive dref *verbal sequence of evaluation*. This distinction becomes important to make different predictions for the anaphoric potential of the  $\delta$  operator when it is in the nominal domain and when it is in the verbal domain.

Based on this definition of sequences of evaluation, the notion of the minimal sequence of evaluation as defined in (78): the minimal sequence of evaluation for  $\Sigma$  is the sequence of evaluation which involves the least number of coordinates.

- (78) **The minimal sequence of evaluation:** Given a set of expressions  $\Sigma$ ,  $S_{Min}(\Sigma)$  is the *minimal sequence of evaluation* with respect to  $\Sigma$ , iff there is no expression  $E'$  such that  $E' \in \Sigma$  and  $S_{E'} \subset S_{Min}(\Sigma)$ .

This condition emulates the minimality condition in the classical definition of binding domains. Instead of choosing the minimal category in terms of the size of projections, (78) chooses the minimal sequence in terms of the length of sequences.

Putting these ingredients together, I define a locality principle for the distributive component of “sorezore” as shown in (79). It defines the relevant local domain for the  $\delta$  operator. On one hand, the local domain has to be large enough so that the truth of an expression can be calculated in it. On the other hand, the local domain has to be small enough so that it is the smallest among the candidate sequences.

- (79) **The locality principle of distributivity:** If  $[[\text{sorezore}]](D_1) \dots (D_n)$  and  $\delta_{u_n}(D_m)$  such that  $1 < m < n$ , then  $u_n$  has to be a member of  $S_{Min}(\{D_1, \dots, D_n\})$ .

This principle serves as a possible semantic version of Condition A for the  $\delta$  operator. Instead of calculating the local domain based on the syntactic position of “sorezore,” (79) calculates the local domain based on the semantic inputs for “sorezore.” As the local domain is given as a sequence of drefs, it restricts the anaphoric potential of the  $\delta$  operator so that it can only be associated with a dref within this sequence. At this point, I propose it as a principle for “sorezore,” but I suggest that it may apply to “each” in English as well in §5.3.5.<sup>22</sup>

Let me briefly sketch how (79) works. The gist is that (79) predicts that whenever a distributive expression takes a restrictor property, the  $\delta$  operator has to be co-indexed with the restrictor set, but otherwise the  $\delta$  operator is clause-bound. (80) shows the inputs for the four variants of “sorezore.” P stands for a predicative NP of type  $\langle ET \rangle$  and R stands for an argumental NP of type  $\langle \langle E, VT \rangle, VT \rangle$ .

- (80) a.  $[[\text{sorezore}]](P)(V)$  (Prenominal)  
 b.  $[[\text{sorezore}]](R)(V)$  (Postnominal)  
 c.  $[[\text{sorezore}]](V)$  (Floating / Bare anaphoric)

I claim that both P and R provide a nominal sequence of evaluation. This is straightforward for P, but not for R. To see that an argumental NP provides a nominal sequence of evaluation, let me take the denotation of a maximal definite as an example. If P is a nominal predicate, the type-shifter  $\text{iota}$  turns it into an argument of this type as shown in (81): it introduces a new dref whose value is the maximal individual which satisfies P.

$$(81) \quad \text{iota}(P) = \lambda V_{\langle E, VT \rangle} \lambda \epsilon_V \text{MAX}^{u_n}(P(u_n)); [[\text{NOV}\{u_n\}]]V(\epsilon)(u_n)$$

The point is that an argument NP provides a restriction with a nominal predicate even though it has a higher type. Accordingly, the postnominal “sorezore” takes such nominal predicates when it takes an argument NP as its restrictor.

22. Similarly to the discussion of Condition B, (79) may also resort to a semantic representation which is distinct from the information in the discourse and the dynamic clausal denotation. One may attempt to tie this principle with the proposed formulation of Condition B, but I do not pursue it here because I need them for different reasons.



When R is a full pronoun, it does not contain a restriction with a nominal predicate, but it contains the co-reference condition  $[[u_n = u_m]]$ , instead. When R is a proper name or a demonstrative, this restriction is the identity condition, e.g.,  $[[u_n = \text{John}]]$ .

- (82) a.  $[[\text{pronoun}_{u_n}]] = \lambda V_{\langle E, VT \rangle} \lambda \epsilon_V [u_n]; [[u_n = u_{n'}]]; V(\epsilon)(u_n)$   
 b.  $[[\text{this}_{u_n}]] = \lambda V_{\langle E, VT \rangle} \lambda \epsilon_V [u_n | u_n = \text{this}]; V(\epsilon)(u_n)$

These conditions provide a nominal sequence of evaluation, too.

Now, recall that a nominal predicate forms a singleton sequence of evaluation and a verbal predicate forms a sequence of evaluation which contains all the thematic participants of an eventive dref. When “sorezore” takes both a nominal predicate and a verbal predicate, the sequence of evaluation of the nominal predicate qualifies as the minimal sequence of evaluation. This is the case with the prenominal “sorezore” and the postnominal “sorezore.” As a result, the locality principle in (79) correctly predicts that the  $\delta$  operator has to be co-indexed with the restrictor set of “sorezore” in these cases. On the other hand, when “sorezore” only takes a verbal predicate, the sequence of evaluation of the verbal predicate is automatically chosen as the minimal sequence of evaluation. Since a sequence of evaluation of a verbal predicate contains all the thematic participant of the eventive dref it takes, the  $\delta$  operator can be associated with any of those thematic participants as long as their values are defined when “sorezore” is evaluated. This is the case with the floating “sorezore.” In the following subsections, I show the details of how (79) works in each case.

### The prenominal and the postnominal “sorezore”

In this section, I explain why the  $\delta$  operator has to be associated with the host NP when “sorezore” occurs as a prenominal quantifier or a postnominal quantifier. The idea is that whenever “sorezore” involves a restrictor update, its host NP provides the minimal sequence of evaluation for the  $\delta$  operator.

Let me take (108a) and (83b) as examples.

- (83) a. San-nin-no seijika<sup>u1</sup>-ga [sorezore-no seijika]<sup>u2</sup><sub>\*u1</sub>-o hihan-sita.  
 3-CL<sub>Person</sub>-GEN politician-NOM DIST-GEN politician-ACC criticise-PAST  
 “The three politicians criticised each politician.”  
 b. San-nin-no seijika<sup>u1</sup>-ga seijika-sorezore<sup>u2</sup><sub>\*u1</sub>-o hihan-sita.  
 3-CL<sub>Person</sub>-GEN politician-NOM politician-DIST-ACC criticise-PAST  
 “The three politicians criticised each of the politician.”

The composition of the prenominal “sorezore” and its host NP in (108a) is shown in (84). I leave the index of the  $\delta$  operator unresolved for the sake of discussion. Let me put aside discussion of the anaphoricity component for now.

$$(84) \quad \lambda V_{\langle E, VT \rangle} \lambda \epsilon_V \eta(u_2); \delta_{u_2}([|u_2 = u_n|]; [|politician\{u_2\}|]); \text{MAX}^{u_3 \in u_2}(\delta_{u_n}(V(\epsilon)(u_3)))$$

(84) is combined with its scope as shown in (85).

$$(85) \quad \lambda \epsilon_V \eta(u_2); \delta_{u_2}([|u_2 = u_n|]; [|politician\{u_2\}|]); \text{MAX}^{u_3 \in u_2}(\delta_{u_n}([|theme\{\epsilon\}\{u_3\}|]; [|carry\{\epsilon\}|]))$$

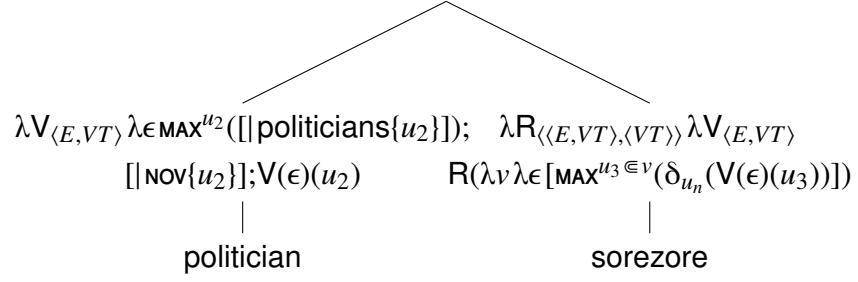
I skip the rest of the composition since it involves nothing special. The final clausal denotation is given in (86).

$$(86) \quad [| (108a) |] = [\epsilon_1]; \text{MAX}^{u_1}([|3 \text{ ATOMS}\{u_1\}|]; [|politicians\{u_1\}|]; [|NOV\{u_1\}|]; [|agent\{\epsilon_1\}\{u_1\}|]; \eta(u_2); \delta_{u_2}([|u_2 = u_n|]; [|politician\{u_2\}|]); \text{MAX}^{u_3 \in u_2}(\delta_{u_n}([|theme\{\epsilon_1\}\{u_3\}|]; [|criticise\{\epsilon_1\}|]))$$

Since  $[|politician\{u_2\}|]$ , the value of  $u_2$  is part of a singleton sequence of evaluation  $\{u_2\}$ . This is the minimal sequence of evaluation with respect to the inputs for “sorezore” because the verbal sequence of evaluation is  $\{u_1, u_3\}$ : these are both participants of  $\epsilon_1$ . Thus, (79) requires that  $u_n$  is a member of  $\{u_2\}$ , i.e.  $n = 2$ . As a result, the  $\delta$  operator has to be co-indexed with the host NP.

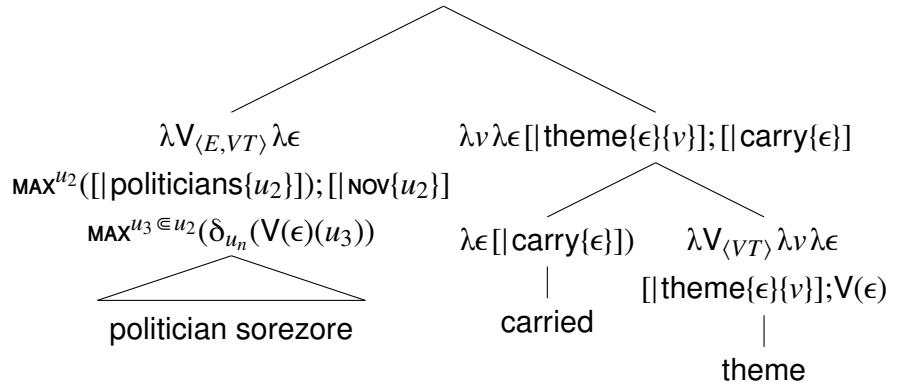
The same result holds with the postnominal “sorezore.” The composition of the postnominal “sorezore” and its host NP in (83b) is shown in (87).

$$(87) \quad \lambda V_{\langle E, VT \rangle} \lambda \epsilon \text{MAX}^{u_2}([\text{politicians}\{u_2\}]); [\text{NOV}\{u_2\}]; \text{MAX}^{u_3 \in u_2}(\delta_{u_n}(V(\epsilon)(u_3)))$$



(87) is combined with its scope as shown in (88).

$$(88) \quad \lambda \epsilon \text{MAX}^{u_2}([\text{politicians}\{u_2\}]); [\text{NOV}\{u_2\}]; \text{MAX}^{u_3 \in u_2}(\delta_{u_n}([\text{theme}\{\epsilon\}\{u_3\}]; [\text{carry}\{\epsilon\}]))$$



The final clausal denotation in (89).

$$(89) \quad \begin{aligned} \llbracket (83b) \rrbracket &= [\epsilon_1]; \text{MAX}^{u_1}([\text{3 ATOMS}\{u_1\}]; [\text{politicians}\{u_1\}]; [\text{NOV}\{u_1\}]; \\ &[\text{agent}\{\epsilon_1\}\{u_1\}]; \text{MAX}^{u_2}([\text{politician}\{u_2\}]; [\text{NOV}\{u_2\}]; \\ &\text{MAX}^{u_3 \in u_2}(\delta_{u_n}([\text{theme}\{\epsilon_1\}\{u_3\}]; [\text{criticise}\{\epsilon_1\}])) \end{aligned}$$

A similar reasoning applies to this case: the singleton sequence of evaluation of  $[\text{politician}\{u_2\}]$  qualifies as the minimal sequence of evaluation. This requires the  $\delta$  operator to be co-indexed with  $u_2$ . As a result, (79) also requires that the  $\delta$  operator is co-indexed with the host NP in cases of the postnominal “sorezore.”

Note that the same analysis applies when the postnominal “sorezore” takes a full pronoun, demonstratives or conjoined proper names as its restrictor NP. Let me take an example with a plural demonstrative pronoun as shown in (90)

$$(90) \quad \begin{aligned} \text{San-nin-no} \quad \text{seijika}^{u_1}\text{-ga} \quad \text{koitsu-ra-sorezore}^{u_2}_{*u_1}\text{-o} \quad \text{hihan-sita.} \\ \text{3-CL}_{Person}\text{-GEN} \quad \text{politician-NOM} \quad \text{this-PL-DIST-ACC} \quad \text{criticise-PAST} \\ \text{“The three politicians criticised each of these people.”} \end{aligned}$$

Its denotation is given in (91)

- (91)  $[[ (90) ]] = [\epsilon_1]; \text{MAX}^{u_1}([\text{3 ATOMS}\{u_1\}]; [\text{politicians}\{u_1\}]; [\text{NOV}\{u_1\}];$   
 $[\text{agent}\{\epsilon_1\}\{u_1\}]; [u_2|\text{these}]; [\text{PERSON}\{u_2\}]; [\text{NON-ATOM}\{u_2\}];$   
 $\text{MAX}^{u_3 \in u_2}(\delta_{u_n}([\text{theme}\{\epsilon_1\}\{u_3\}]; [\text{criticise}\{\epsilon_1\}]))$

The identity condition  $[u_2|\text{these}]$  provide a nominal sequence of evaluation, which requires the  $\delta$  operator to be co-indexed with  $u_2$ .

Summing up, whenever “sorezore” takes a restrictor property as its input, this property provides the minimal sequence of evaluation. As a result, the  $\delta$  operator has to be co-indexed with the restrictor set. Thus, the locality principle of distributivity correctly predicts that the distributivity component of the prenominal “sorezore” and the postnominal “sorezore” is always associated with their host NPs.

### The floating “sorezore”

In this section, I discuss the clause-boundedness of the  $\delta$  operator in cases of the floating “sorezore.” I claim that the floating “sorezore” only takes a verbal predicate and thus only an eventive sequence of evaluation can be the minimal sequence of evaluation for it. Since a sequence of evaluation of a verbal predicate contains all the thematic participant of the event it denotes, the  $\delta$  operator can be associated with the subject even when it occurs as the post object position.

First, (92) shows that the  $\delta$  operator of the post-object floating “sorezore” can be associated with the subject or the object.

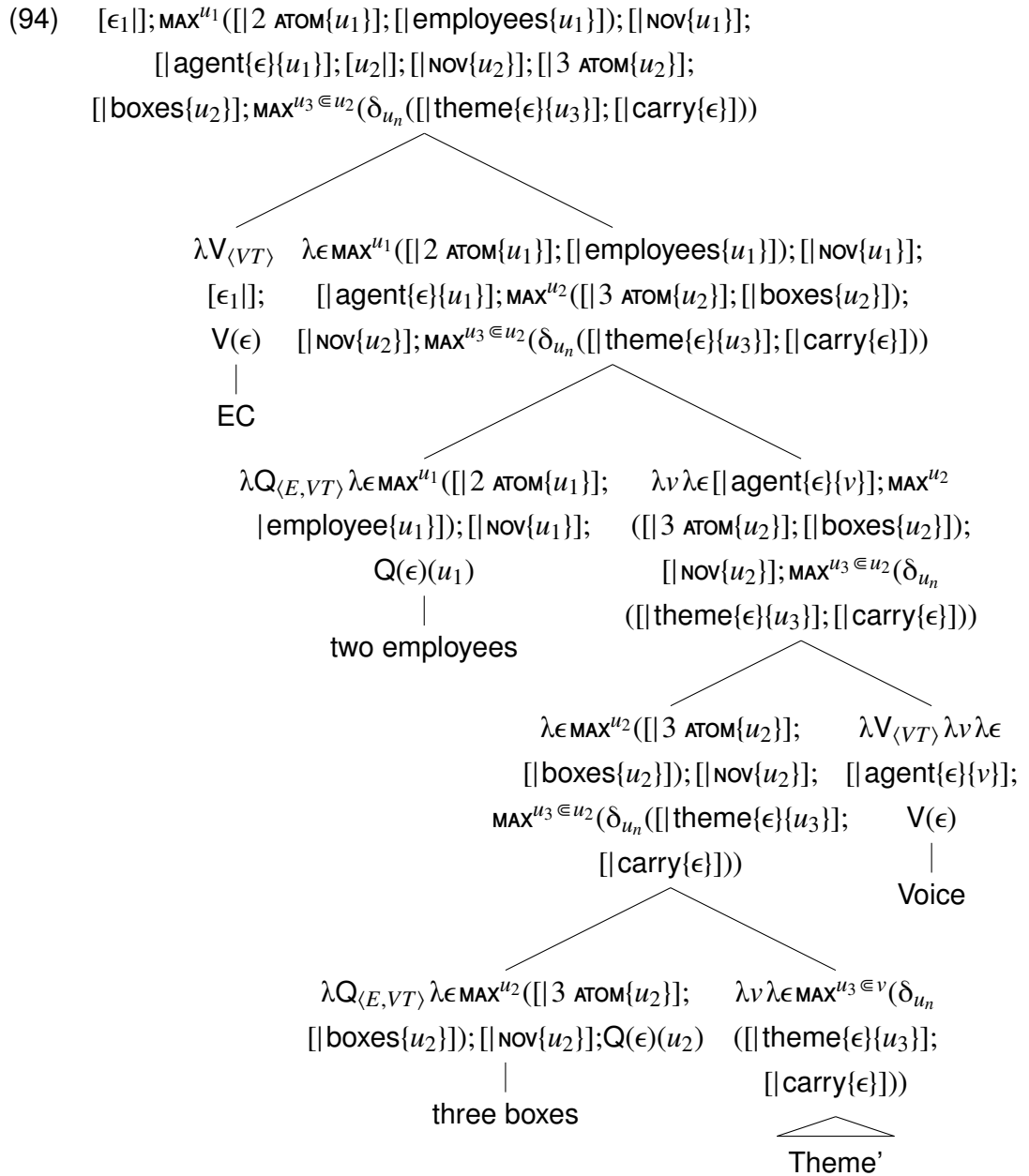
- (92) Huta-ri-no sutahhu<sup>u1</sup>-ga mi-ttsu-no hako<sup>u2</sup>-o **sorezore**<sub>u1/u2</sub> hakon-da.  
 2-CL<sub>person</sub>-GEN employee-NOM 3-CL<sub>thing</sub>-GEN box-ACC DIST carry-PAST  
 a. “Two employees each carried three boxes.” (DISTRIBUTIVE)  
 b. “Two employees carried each of the three boxes.” (CUMULATIVE)

(93) shows the composition of “sorezore” and a verbal predicate in (92).

- (93)
- $$\lambda v \lambda \epsilon \text{MAX}^{u_3 \in v}(\delta_{u_n}([\text{theme}\{\epsilon\}\{u_3\}]; [\text{carry}\{\epsilon\}]))$$
-

On this point, the minimal sequence of evaluation is determined based on the inputs for “sorezore.” However, the floating “sorezore” does not take a restrictor NP as its input, unlike the prenominal “sorezore” and the postnominal “sorezore.” Thus, even though the floating “sorezore” also involve structural inclusion, it cannot have a trivial sequence of evaluation via the denotation of its host NP. At the same time, since the trivial sequence of evaluation of the host NP is unavailable, it makes an eventive sequence of evaluation available.

The rest of the composition of (92) is given in (94).

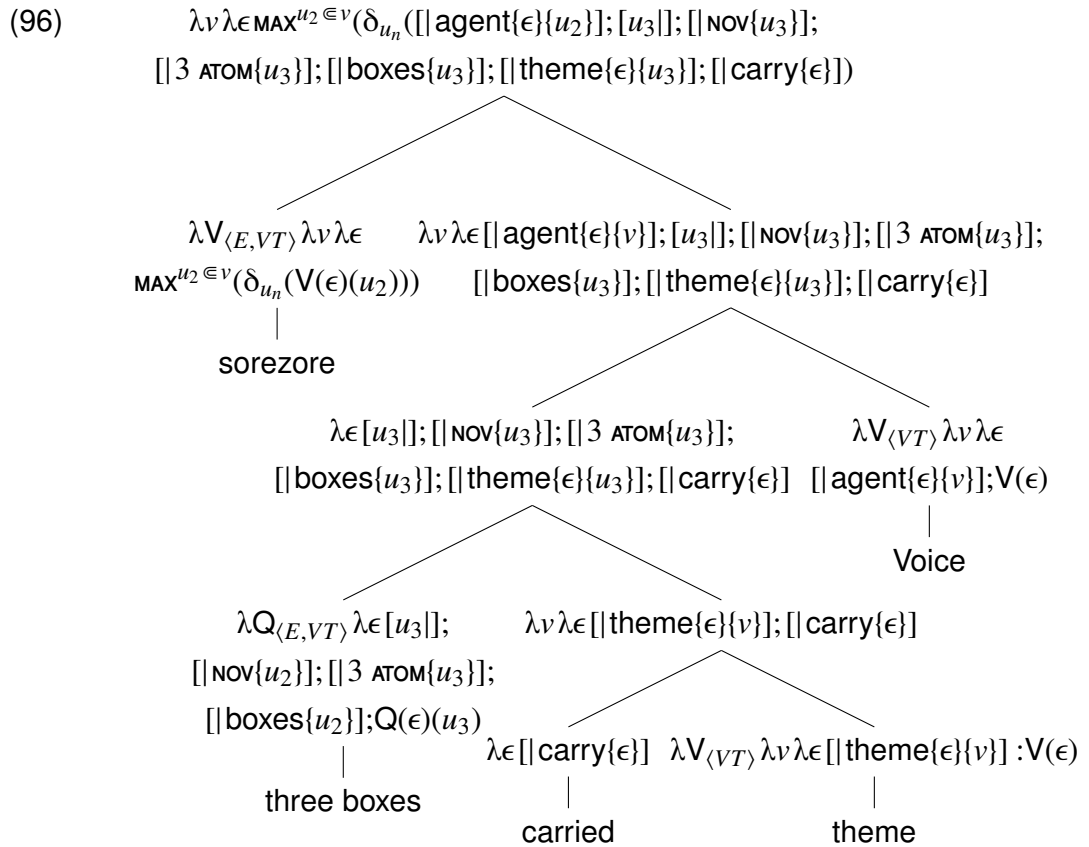


In this case,  $[[\text{agent}\{\epsilon_1\}\{u_1\}]]$ ,  $[[\text{theme}\{\epsilon_1\}\{u_3\}]]$  and  $[[\text{carry}\{\epsilon_1\}]]$  take  $\epsilon_1$  as an argument. Thus,  $S_V = \{u_1, u_3\}$ , where  $V = \lambda v \lambda \epsilon [[\text{carry}\{\epsilon\}]; [[\text{theme}\{\epsilon\}\{v\}]]$ . Since the values of  $u_1$  and  $u_3$  are already introduced when the  $\delta$  operator is evaluated ( $u_1$  and  $u_3$  occur on the left-hand side of the  $\delta$  operator), the  $\delta$  operator can be associated with  $u_1$  or  $u_3$ . This correctly predicts the ambiguity in (79).

On the other hand, if the floating “sorezore” occurs at the post-subject position, the  $\delta$  operator has to be associated with the subject as shown in (95).

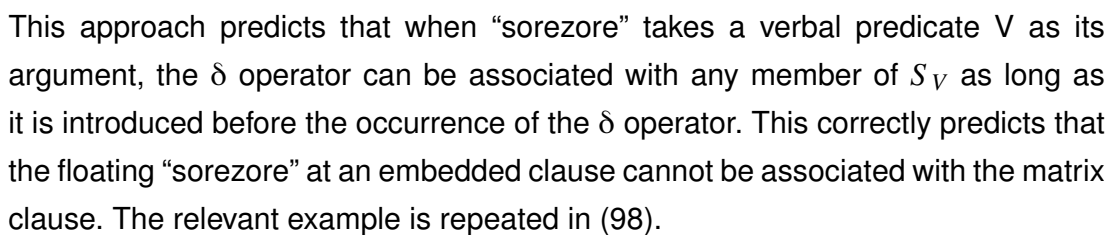
- (95) Huta-ri-no sutahhu<sup>u1</sup>-ga **sorezore**<sub>u1/\*u2</sub> mi-ttsu-no hako<sup>u2</sup>-o hakon-da.  
 2-CL<sub>person</sub>-GEN employee-NOM DIST 3-CL<sub>thing</sub>-GEN box-ACC carry-PAST  
 a. “Two employees each carried three boxes.” (distributive)  
 b. \*“Two employees carried three boxes each.” (cumulative)

The floating “sorezore” at the post-subject position adjoins to Voice’. The denotation of the Voice’ in (95) is derived as shown in (96).



Just like the post-object floating “sorezore,” the post-subject floating “sorezore” only takes a verbal predicate in (96). Thus, the minimal sequence of evaluation is determined based on the denotation of Voice’.

(97)  $[\epsilon_1]; [u_1]; [2 \text{ ATOM}\{u_1\}]; [\text{employees}\{u_1\}]; \text{MAX}^{u_2 \in u_1}(\delta_{u_n}([\text{agent}\{\epsilon_1\}\{u_1\}]; [u_3]; [\text{NOV}\{u_3\}]; [3 \text{ ATOM}\{u_3\}]; [\text{boxes}\{u_3\}]; [\text{theme}\{\epsilon_1\}\{u_3\}]; [\text{carry}\{\epsilon_1\}])$



- (98) \* Karera<sup>u1</sup>-ga [Takayuki<sup>u2</sup>-ga **sorezore**<sub>\*u1/u2</sub> mi-ttsu-no hako<sup>u4</sup>-o hakon-da  
 They-NOM [Takayuki-NOM DIST 3-CL<sub>thing</sub>-GEN box-ACC carry-PAST  
 to] omo-tte-iru.  
 that] think-PROG-PRES  
 Lit “They think Takayuki each carried three boxes.”

The denotation of the embedded clause is given in (99). “sorezore” takes the denotation of Theme’ as its input in (98). Thus, the minimal sequence of evaluation is  $S_V = \{u_2, u_4\}$  where  $V = \lambda v \lambda \epsilon [[\text{agent}\{\epsilon\}\{v\}]; [u_4]; [[4 \text{ ATOMS}\{u_4\}]; [\text{boxes}\{u_4\}]; [\text{theme}\{\epsilon\}\{u_4\}]; [\text{carry}\{\epsilon_1\}]]$ . However,  $u_4$  is not accessible to the  $\delta$  operator because  $u_4$  is introduced on the right-hand side of it.

$$(99) \quad \lambda \epsilon_V [u_2 | u_2 = \text{Takayuki}]; \text{MAX}^{u_3 \in u_2} \delta_{u_n} ([\text{agent}\{\epsilon\}\{u_3\}]; [u_4]; [\text{NOV}\{u_4\}]; \\ [\text{3 ATOMS}\{u_4\}]; [\text{boxes}\{u_4\}]; [\text{theme}\{\epsilon\}\{u_4\}]; [\text{carry}\{\epsilon\}])$$

Although a more precise treatment requires an intensional version of PCDRT, the verb “omou” (believe) takes the matrix subject and the static intension of the embedded clause as its argument as shown in (100b). Here, I assume that C head in the embedded clause shift the clausal denotation of type  $\langle VT \rangle$  to a set of worlds. Note that  $p = \lambda w [(99)(\epsilon_2)]^w$ . Crucially, there is no thematic relation which relate  $u_1$  with  $\epsilon_1$  in (100b).

$$(100) \quad \text{a. } [[C_{Embedded}]] = \lambda V_{\langle VT \rangle} \lambda w [\epsilon_2]; [V^w\{\epsilon_2\}] \\ \text{b. } [\epsilon_1]; [u_1]; [u_1 = u_m]; [\text{agent}\{\epsilon_1\}\{u_1\}]; [\text{think}\{u_1\}\{p\}]$$

Thus,  $u_1$  does not occur in the minimal sequence of evaluation which determines the possible antecedent of the  $\delta$  operator.

In this way, the sequence-based locality principle correctly predicts that the  $\delta$  operator can be associated with an accessible dref as long as it is a member of  $S_V$  such that  $[[\text{sorezore}]](V)$ . Thus, “sorezore” can be associated with a dref introduced with an NP within adjunct PP, but cannot be associated with the matrix subject when it occurs in an embedded clause.

### The bare anaphoric “sorezore”

In this section, I discuss the anaphoric potential of the  $\delta$  operator in cases of the bare anaphoric “sorezore.” The sequence-based locality principle predicts that the bare anaphoric “sorezore” is at most clause-bound and I show that this is a desirable result. In §5.2.2, I proposed (101) as the revised denotation of “sorezore” in §5.3.2.

$$(101) \quad [[\text{sorezore}_{u_n', u_m'}]] = \lambda V_{\langle E, VT \rangle} \lambda \epsilon_V \eta(u_n); [u_n = u_{n'}]; \text{MAX}^{u_m \in u_n} (\delta_{u_m'} (V(\epsilon)(u_m))); \\ \text{ALL}\{u_n\}\{u_m\}$$



The bare anaphoric “sorezore” takes  $V$  and thus  $S_V$  is automatically chosen as the minimal sequence of evaluation. When the bare anaphoric “sorezore” occurs as an argument of a verbal predicate, the sequence of evaluation contains every co-participant of  $u_m$ . As a result, the  $\delta$  operator can be associated with any  $dref$  in  $S_V$  which is introduced on the left-hand side of the  $\delta$  operator. Thus, the  $\delta$  operator is clause-bound in this case. This does not affect the discussion in §5.2.2 either. First, consider cases in which the anaphoric component of the bare anaphoric “sorezore” takes a clause-internal antecedent. The example is repeated in (102a). Now, I revise its denotation so that the index of the  $\delta$  operator is unresolved as shown in (102b).

- (102) a. San-nin-no      koohosya <sup>$u_1$</sup> -ga **sorezore** <sup>$u_2$</sup> -o hihan-sita.  
           3-CL<sub>Person</sub>-GEN candidate-NOM DIST-ACC      criticise-PAST  
           “The three candidates criticised each other.”
- b.  $[[ (102a) ]]$  =  $[\epsilon_1]; [u_1]; [3 \text{ ATOMS}\{u_1\}]; [\text{candidates}\{u_1\}]; [\text{agent}\{\epsilon_1\}\{u_1\}];$   
 $\eta(u_2); [u_2 = u_1]; \delta_{u_n}([\text{theme}\{\epsilon_1\}\{u_2\}]; [\text{criticise}\{\epsilon_1\}])$

Here, “sorezore” takes a verbal predicate  $\lambda_{v_E} \lambda_{\epsilon_V} [[\text{theme}\{\epsilon\}\{v\}]; [\text{criticise}\{\epsilon\}]]$  and does not take a restrictor property. Thus, the minimal sequence of evaluation is  $\{u_1, u_2\}$ , which is determined based on the participants of  $\epsilon_1$ . As  $u_1$  and  $u_2$  are both introduced on the left-hand side of the  $\delta$  operator,  $u_n$  can be resolved with either  $u_1$  or  $u_2$ . On this point, this choice does not matter in the sense that both options lead to the same reciprocal reading. Table 5.11 shows a possible output context of (102b). This is a strong reciprocal reading.

$H$	$\epsilon_1$	$u_1$	$u_2$
$h_1$	$e$	candidate <sub>1</sub>	candidate <sub>2</sub>
$h_2$	$e$	candidate <sub>1</sub>	candidate <sub>3</sub>
$h_3$	$e$	candidate <sub>2</sub>	candidate <sub>1</sub>
$h_4$	$e$	candidate <sub>2</sub>	candidate <sub>3</sub>
$h_5$	$e$	candidate <sub>3</sub>	candidate <sub>1</sub>
$h_6$	$e$	candidate <sub>3</sub>	candidate <sub>2</sub>

**Table 5.11:** A strong reciprocal reading

Here,  $G_{u_1=d} = \{\{h_1, h_2\}, \{h_3, h_4\}, \{h_5, h_6\}\}$ . If  $u_n$  is resolved with  $u_1$ , the  $\delta$  operator evaluates its input with respect to  $G_{u_1=d}$  and Condition B requires that for each member of  $G_{u_1=d}$ , the value of  $u_1$  is disjoint with the value of  $u_2$ . This is satisfied in Table 5.11. On the other hand,  $G_{u_2=d} = \{\{h_3, h_5\}, \{h_1, h_6\}, \{h_2, h_4\}\}$ . If  $u_n$  is resolved with  $u_2$ , the  $\delta$  operator evaluates its input with respect to  $G_{u_2=d}$  and Condition B

requires disjointness of  $u_1$  and  $u_2$  with respect to each member of  $G_{u_2=d}$ . This is also satisfied in Table 5.11. The point is that as long as  $u_1$  and  $u_2$  are collectively co-referential and a predicate which takes  $u_2$  as an argument is distributively evaluated, it makes no difference if  $u_n$  is resolved with  $u_1$  or  $u_2$ .

Cases of a weak reciprocal reading are more straightforward. Table 5.12 shows a possible output context of (102b) when it induces a weak reciprocal reading.

$H$	$\epsilon_1$	$u_1$	$u_2$
$h_1$	$e$	candidate <sub>1</sub>	candidate <sub>2</sub>
$h_2$	$e$	candidate <sub>2</sub>	candidate <sub>3</sub>
$h_3$	$e$	candidate <sub>3</sub>	candidate <sub>1</sub>

**Table 5.12:** A weak reciprocal reading

In this case,  $G_{u_1=d} = G_{u_2=d} = \{h_1, h_2, h_3\}$ . Thus, as long as the  $\delta$  operator is co-indexed with  $u_1$  or with  $u_2$ , it induces the same weak reciprocal reading.

So far, I have shown that the sequence-based locality principle predicts that the bare anaphoric “sorezore” is clause-bound when it occurs as an argument of a verbal predicate and this is a desirable result. One may wonder if this is too strong for cases in which the bare anaphoric “sorezore” is co-referential with a clause-external antecedent as repeated in (103).

- (103) Gakusya-tachi <sup>$u_1$</sup> -wa [guuguru <sub>$u_2$</sub> -ga **sorezore** <sup>$u_3$</sup>  <sub>$u_1$</sub> -o manei-ta to] it-ta.  
 scholar-PL-TOP [google-NOM DIST-ACC invite-PAST that] say-PAST  
 Lit “The scholars said that Google invited them.”

I showed that (103) induces a weak truth condition which subsumes a reciprocal reading, a reflexive reading and a mixed reading as shown in Table 5.13: as long as  $u_1$  and  $u_3$  are collectively co-referential,  $h_1$ ,  $h_2$  and  $h_3$  can assign any value to  $u_3$ . Note that  $u_1$  and  $u_3$  are not co-participants and thus Condition B does not require them to be disjoint.

$H$	$\epsilon_1$	$u_1$	$\epsilon_2$	$u_2$	$u_3$
$h_1$	$e$	scholar <sub>1</sub>	$e'$	google	scholar <sub>1/2/3</sub>
$h_2$	$e$	scholar <sub>2</sub>	$e'$	google	scholar <sub>1/2/3</sub>
$h_3$	$e$	scholar <sub>3</sub>	$e'$	google	scholar <sub>1/2/3</sub>

**Table 5.13:** A reflexive reading beyond a clausal boundary

In this case, the random dependency established with the  $\eta$  operator and the collective co-reference condition. In addition, the ambiguity of saying event with respect to distributivity is independent of the  $\delta$  operator in the embedded clause because I assume that lexical relations are cumulative as default. Thus, the  $\delta$  operator does not play a significant role with respect to value assignment of  $u_1$  and  $u_3$ . This does not mean that the  $\delta$  operator is unnecessary because a collective predicate is incompatible with the bare anaphoric “sorezore” as shown in (104).

- (104) \* Gakusya-tachi <sup>$u_1$</sup> -wa [guuguru <sub>$u_2$</sub> -ga **sorezore** <sup>$u_3$</sup> -o atsume-ta to] it-ta.  
 scholar-PL-TOP [google-NOM DIST-ACC gather-PAST that] say-PAST  
 “The scholars said that Google gathered each of them.”

Thus, there is no need to assume that the  $\delta$  operator can be associated with a clause-external antecedent. This is in line with the prediction of the sequence-based locality principle: the  $\delta$  operator encoded in the bare anaphoric “sorezore” is at most clause-bound.

When the bare anaphoric “sorezore” occurs as a possessor, it takes a possession relation. The relevant example is repeated in (105a) and its denotation with the revised definition of the bare anaphoric “sorezore” is given in

- (105) a. Dezainaa-tachi <sup>$u_1$</sup> -ga **sorezore** <sup>$u_2$</sup> -no huta-tu-no an <sup>$u_4$</sup> -o hihan-sita.  
 designer-PL-NOM DIST-GEN 2-CL-GEN plan-ACC criticise-PAST  
 “The designers criticised their two plans.”  
 b.  $[[ (105a) ]]$  =  $[\epsilon_1]; [u_1]; [|\text{NOV}\{u_1\}|]; [|\text{NON-ATOM}\{u_1\}|]; [|\text{designers}\{u_1\}|];$   
 $[|\text{agent}\{\epsilon_1\}\{u_1\}|]; [\epsilon_2]; \eta(u_2); [u_2 = u_1]; \text{MAX}^{u_3 \in 2}(\delta_{u_n'}([u_4]; [|\text{NOV}\{u_4\}|];$   
 $[|\text{2 ATOMS}\{u_4\}|]; [|\text{plans}\{u_4\}|]; [|\text{POSS}\{\epsilon_2\}\{u_3\}\{u_4\}|]); [|\text{theme}\{\epsilon_1\}\{u_4\}|];$   
 $[|\text{criticise}\{\epsilon_1\}|]$

In (105b), “sorezore” takes a possession relation as its input and the possession relation occurs under the scope of the  $\delta$  operator. Now, the possession relation  $[|\text{POSS}\{\epsilon_2\}\{u_3\}\{u_4\}|]$  specifies  $\{u_3, u_4\}$  as its sequence of evaluation. Since the possessee dref  $u_4$  is introduced under the scope of  $\delta$ , its value is not yet assigned when the  $\delta$  operator is evaluated. As a result,  $u_2$  is the only available antecedent for the  $\delta$  operator.

**Interim summary**

In this section, I proposed a sequence-based locality constraint on the  $\delta$  operator as repeated in (106).

- (106) **The locality principle of distributivity:** If  $\llbracket \text{sorezore} \rrbracket (D_1) \dots (D_n)$  and  $\delta_{u_n}(D_m)$  such that  $1 < m < n$ , then  $u_n$  has to be a member of  $S_{Min}(\{D_1, \dots, D_n\})$ .
- a. **Sequences of evaluation:** For an expression E, a family of discourse referents  $S_E = \{u_n | n \in I\}$  is *the sequence of evaluation* of E iff
    - i.  $\llbracket E \rrbracket$  does not take an event argument and  $\llbracket E \rrbracket \{u_1\} \dots \{u_n\}$ , or
    - ii.  $\llbracket E \rrbracket$  takes an event argument  $\epsilon$  and for every  $v \in S_E$ , there is a relation  $\theta$  such that  $\theta\{\epsilon\}\{v\}$  and  $\llbracket E \rrbracket \in \{\theta | \theta\{\epsilon\}\{v\} \& v \in S_E\}$ .
  - b. **The minimal sequence of evaluation:** Given a set of expressions  $\Sigma$ ,  $S_{Min}(\Sigma)$  is the *minimal sequence of evaluation* with respect to  $\Sigma$ , iff there is no expression  $E'$  such that  $E' \in \Sigma$  and  $S_{E'} \subset S_{Min}(\Sigma)$ .

This principle predicts that if “sorezore” takes a restrictor property, the  $\delta$  operator has to be associated with the restrictor set, whereas if “sorezore” only takes a scope property V, the  $\delta$  operator can be associated with any member of  $S_V$  as long as it is introduced on the left-hand side of the  $\delta$  operator. This correctly predicts the variability of the anaphoric potential of the distributivity component of “sorezore.”

**5.3.4 The anaphoric component of “sorezore”**

So far, I have been concerned with the distributivity component of “sorezore.” In this section, I discuss the anaphoricity component of “sorezore.” The denotations of the four variants of “sorezore” are repeated in (107).

- (107) a.  $\llbracket \text{sorezore}_{u_n, u_m} \rrbracket = \lambda V_{\langle E, VT \rangle} \lambda \epsilon_V \eta(u_n); [\mid u_n = u_n'];$   
 $\text{MAX}^{u_m \in u_n}(\delta_{u_m'}(V(\epsilon)(u_m))); \text{ALL}\{u_n\}\{u_m\}$  (Unary, i.e. bare anaphoric)
- b.  $\llbracket \text{sorezore}_{u_n, u_m} \rrbracket = \lambda P_{\langle ET \rangle} \lambda V_{\langle E, VT \rangle} \lambda \epsilon_V \eta(u_n); [\mid u_n = u_n']; \delta_{u_n}(P(u_n));$   
 $\text{MAX}^{u_m \in u_n}(\delta_{u_m'}(V(\epsilon)(u_m))); \text{ALL}\{u_n\}\{u_m\}$  (Prenominal)
- c.  $\llbracket \text{sorezore}_{u_m'} \rrbracket = \lambda R_{\langle \langle E, VT \rangle, \langle VT \rangle \rangle} \lambda V_{\langle E, VT \rangle}$   
 $R(\lambda v \lambda \epsilon [\text{MAX}^{u_m \in v}(\delta_{u_m'}(V(\epsilon)(u_m))]); \text{ALL}\{v\}\{u_m\}$  (Postnominal)
- d.  $\llbracket \text{sorezore}_{u_m'} \rrbracket = \lambda V_{\langle E, VT \rangle} \lambda v \lambda \epsilon \text{MAX}^{u_m \in v}(\delta_{u_m'}(V(\epsilon)(u_m))); \text{ALL}\{v\}\{u_m\}$   
 (Floating)

In 5.3.2, I claimed that the anaphoricity component of “sorezore” is encoded as the idiosyncratic property of the restrictor condition of “sorezore.” Thus, the general template of type-variants of Japanese quantifiers predict that the prenominal “sorezore” encodes the anaphoricity component, but the postnominal “sorezore” and the floating “sorezore” do not. This difference reflects their difference in terms of dref introduction to the restrictor set: the prenominal “sorezore” introduce a dref for its restrictor set, while the postnominal “sorezore” and the floating “sorezore” do not and rely on the dref introduced by their host NP. In this section, I discuss the behaviour of this anaphoric component based on comparison between the prenominal “sorezore” and the bare anaphoric “sorezore.” Specifically, I propose that the prenominal “sorezore” is subject to the economy principle of *Minimise Restrictors!* and that discourse update is performed in the way that it does not create a new dependency beyond sentential boundaries.

### Disambiguation and an economy condition

In this section, I discuss intra-sentential anaphora with the prenominal “sorezore.” At first sight, the prenominal “sorezore” seems to disallow intra-sentential anaphora. However, I claim that this is due to an economy condition and one can find cases in which the economy condition is obviated. First, consider (108a) and (108b). The prenominal “sorezore” and its antecedent occur in the same clause in (108a) and they occur in different clauses in (108b). In both cases, intra-sentential anaphora fails. Note that the bare anaphoric “sorezore” is acceptable in both cases.

- (108) a. San-nin-no seijika<sup>u1</sup>-ga **sorezore**-(\*no seijika)<sub>u1</sub>-o hihan-sita.  
 3-CL<sub>Person</sub>-GEN politician-NOM DIST-GEN politician-ACC criticise-PAST  
 “The three politicians criticised each politician.”
- b. Gakusya-tachi<sup>u1</sup>-wa [guuguru<sub>u2</sub>-ga **sorezore**(\*-no gakusya)<sub>u1</sub><sup>u3</sup>-o manei-ta  
 scholar-PL-TOP [google-NOM DIST(-GEN scholar)-ACC invite-PAST  
 to] it-ta.  
 that] say-PAST  
 Lit “The scholars said that Google invited {them / the scholars}.”

The English translation of (108b) suggests that this behaviour of the prenominal “sorezore” resembles to anaphoric definites in English: the embedded object “the scholars” cannot be co-referential with the matrix subject “the scholars” in (109).

- (109) The scholars<sup>u1</sup> said that Google<sup>u2</sup> invited {them / \*the scholars}<sub>u1</sub><sup>u3</sup>.

In the classical syntactic binding theory, R-expressions include noun phrases whose heads are “potentially” referential (Chomsky, 1986). In this definition, anaphoric definites are treated under Condition C, which requires R-expressions to be free regardless of binding domains. In this sense, it is expected that the definite plural cannot be co-referential with the matrix subject in (109): it is an R-expression and thus has to be free. Instead of claiming that the bare anaphoric “sorezore” obeys Condition B and the prenominal “sorezore” obeys Condition C, I claim that they basically follow Condition B, but the prenominal “sorezore” cannot occur in (108b) due to an independent economy principle. The intuition is that an overt restrictor cannot be added if it is redundant. This is reminiscent of the cases in which definite descriptions behaves as an R-expression as shown in (110).

- (110) a. \*? The director loves people who admire the director.  
 b. ?? John loves people who admire John. (Schlenker, 2005a)

Schlenker (2005a) proposes that this is due to the competition between a pronoun and definite descriptions, considering that pronouns are very short descriptions. He proposes the principle of *Minimize restrictors!* (Schlenker, 2005a).

- (111) **Minimize Restrictors!**: A definite description the A B [where the order of A vs. B is irrelevant] is deviant if A is redundant, i.e. if:  
 a. the B is grammatical and has the same denotation as the A (= *Referential Irrelevance*), and  
 b. A does not serve another purpose (= *Pragmatic Irrelevance*).  
 (Schlenker, 2005a)

(119) is motivated with contrasts within sentences in (112).

- (112) a. The President made important mistakes.  
 b. Context: other presidents were mentioned in the discourse:  
 The American President made important mistakes.  
 c. # The **small** American President made important mistakes.  
 d. The stupid American President made important mistakes.  
 (Schlenker, 2005a)

(112a) is the baseline case in which the definite description “the president” identifies a unique referent. In (112b), the description “American” plays a role to disambiguate the intended reference from presidents in other countries. However, the description “small” is redundant in (112c) because a unique president can be identified without it. Thus, (112c) is judged deviant. (112d) is a special case. The description “stupid” does not affect the denotation of the definite description, but it conveys the speaker’s negative attitude against the president. Thus, it does not violate Minimise Restrictors! because it serves for another purpose, i.e. pragmatically relevant. I do not discuss cases with epithets and pragmatic relevance because these are out of the scope of this thesis.

I claim that the prenominal “sorezore” is unacceptable in (108) because Minimise Restrictors! blocks it due to competition with the bare anaphoric “sorezore.” In this sense, one does not need to postulate two different binding constraints for the prenominal “sorezore” and the bare anaphoric “sorezore.” Importantly, one can find an environment in which the effect of Minimise Restrictors! is obviated. Schlenker (2005a) shows that Condition C effect of definite descriptions is obviated when it serves a disambiguating function as shown in (113).

- (113) a. A linguist<sup>*u*<sub>1</sub></sup> working on Binding Theory was so devoid of any moral sense that he<sup>*u*<sub>2</sub></sup><sub>*u*<sub>1</sub></sub> forced **a physicist working on particles**<sup>*u*<sub>3</sub></sup> to hire the linguist<sup>*u*<sub>4</sub></sup><sub>*u*<sub>1</sub></sub>’s girlfriend<sup>*u*<sub>5</sub></sup> in his<sup>*u*<sub>6</sub></sup><sub>*u*<sub>1</sub></sub> lab.
- b. \*A linguist<sup>*u*<sub>1</sub></sup> working on Binding Theory was so devoid of any moral sense that he<sup>*u*<sub>2</sub></sup><sub>*u*<sub>1</sub></sub> forced **me**<sup>*u*<sub>3</sub></sup> to hire the linguist<sup>*u*<sub>4</sub></sup><sub>*u*<sub>1</sub></sub>’s girlfriend<sup>*u*<sub>5</sub></sup> in his<sup>*u*<sub>6</sub></sup><sub>*u*<sub>1</sub></sub> lab. (Schlenker, 2005a)

In (113a), there are two potential antecedents for “his,” namely *u*<sub>1</sub>, a linguist working on Binding Theory, and *u*<sub>3</sub>, a physicist working on particles. However, the definite description “the linguist” is only compatible with *u*<sub>1</sub> and thus removes ambiguity. When such ambiguity is not present, definite descriptions cannot play this role and thus are deviant as shown in (113b).

This also applies to the competition between the prenominal “sorezore” and the bare anaphoric “sorezore.” Crucially, (114) shows that intra-sentential anaphora with the prenominal “sorezore” sounds much better when more than one potential antecedents are available.

- (114) a. Ibento-no un'ei sutahhu-tachi-ga<sup>u1</sup> toodansya-tachi<sup>u2</sup>-ni **sorezore**(?-no  
 event-GEN organising member-PL-NOM speaker-PL-DAT DIST(-GEN  
 sutahhu)<sup>u3</sup>-o shokai-sita.  
 member)-ACC introduce-PAST  
 “The organisers of the event introduced the speakers each other.”
- b. San-nin-no shin'nin kooshi-tachi<sup>u1</sup>-ga sinnyuusei-tachi<sup>u2</sup>-ni  
 3-CL<sub>Person</sub>-GEN new lecturer-PL-NOM incoming student-PL-DAT  
 [**sorezore**(?-no kooshi)<sup>u3</sup>-ga zemi<sup>u4</sup>-o kaikoo-suru to] it-ta.  
 [DIST(-GEN lecturer)-NOM seminar-ACC open-PRES that] say-PAST  
 “The three new lecturers told the incoming students that each of the  
 lecturers offer a seminar.”
- c. Men'ekigaku sen'mon-no gakusya-go-nin<sup>u1</sup>-ga tooshika-tachi<sup>u2</sup>-ni  
 immunology expertise-GEN scholar-5-CL<sub>Person</sub>-NOM investor-PL-DAT  
 [seihu<sub>u3</sub>-ga **sorezore**(?-no gakusya)<sup>u4</sup>-to sessyoku-sita to] it-ta.  
 [government-NOM DIST(-GEN scholar)-DAT contact-PAST that] say-PAST  
 “The five researchers who are experts in immunology told the investors  
 that the government contacted to each of the researchers.”

Note that the distribution of reciprocal readings with the prenominal “sorezore” is the same as the bare anaphoric “sorezore.” The prenominal “sorezore” in (114a) has a reciprocal reading, whereas the prenominal “sorezore” in (114b) and (114c) has a weak truth condition which subsumes a reciprocal reading, a reflexive reading and a mixed reading.

Thus, the generalisation is that the prenominal “sorezore” is unacceptable if (i) the bare anaphoric “sorezore” can identify the same value and (ii) there is no ambiguity in the choice of the anaphoric antecedent. Since (119) is defined based on uniqueness, I refine it based on anaphoricity as shown in (115). A is referentially irrelevant if the set of pairs of assignments  $\langle G, H \rangle$  in which  $\llbracket \alpha(A)(B) \rrbracket$  is identical with the set of pairs of assignments  $\langle G, H \rangle$  in which  $\llbracket \alpha(B) \rrbracket$  is true.

- (115) **Minimize Restrictors!** (*PCDRT version*): An expression  $\alpha(A)(B)$  is deviant if A is redundant, i.e.
- if  $\lambda G \lambda H \llbracket \alpha(A)(B) \rrbracket = \lambda G \lambda H \llbracket \alpha(B) \rrbracket$  (= *Referential Irrelevance*), and
  - A does not serve another purpose (= *Pragmatic Irrelevance*).

This principle correctly predicts that whenever one can specify the same set of referents with the bare anaphoric “sorezore,” the prenominal “sorezore” cannot be felicitously used. Compare the denotations of the prenominal “sorezore” and the bare anaphoric “sorezore” in (108b).



- (116) a.  $[[\text{sorezore}]](\text{scholar})(\text{theme invited}) = \lambda_{e \in V} \eta(u_2); [u_2 = u_1];$   
 $\delta_{u_2}([[\text{scholar}\{u_2\}]]); \text{MAX}^{u_3 \in u_2}(\delta_{u_2}([[\text{theme}\{\epsilon_1\}\{u_3\}]]); [[\text{criticise}\{\epsilon_1\}]]))$
- b.  $[[\text{sorezore}]](\text{theme invited}) = \lambda_{e \in V} \eta(u_2); [u_2 = u_1];$   
 $\text{MAX}^{u_3 \in u_2}(\delta_{u_3}([[\text{theme}\{\epsilon_1\}\{u_3\}]]); [[\text{criticise}\{\epsilon_1\}]]))$

One can see that these two denotations minimally differ with respect to the restrictor property  $[[\text{scholar}\{u_2\}]]$ . However, since  $u_1$  already stores the set of scholars, addition of this property is redundant. Thus, the set of assignment which satisfies (116a) is same as the set of assignments which satisfies (116b). This violates (115). Thus, the prenominal “sorezore” is predicted to be deviant in (108b).

However, if there is more than one potential antecedents for “sorezore,” addition of a restrictor serves for disambiguating role. Thus, it can obviate violation of (115). Thus, (115) does not predicts that the prenominal “sorezore” is deviant in (114), which is a desirable result. This story is in parallel with the competition between pronouns and definite descriptions in Schlenker (2005a).

Summing up, I discussed difference between the prenominal “sorezore” and the bare anaphoric “sorezore.” The puzzle is that the former seems to allow only cross-sentential anaphora, whereas the latter allows intra-sentential anaphora. I claimed that this is indeed misguided and showed that the prenominal “sorezore” with intra-sentential antecedent becomes more acceptable when there are multiple potential antecedents. I proposed that the prenominal “sorezore” also obeys Condition B, but it is blocked in an environment in which the bare anaphoric “sorezore” can identify the same set of values. This suggests that the prenominal “sorezore” and the bare anaphoric “sorezore” have the same anaphoric component and the seeming difference comes from a pragmatic principle.

### Inter-sentential anaphora and underspecification

In this section, I discuss an issue with inter-sentential reciprocal dependencies. The proposed denotation of the prenominal “sorezore” evaluates the co-reference condition above the  $\delta$  operator, just like the bare anaphoric “sorezore.” This makes a correct prediction: the prenominal “sorezore” in (114a) has a reciprocal reading. If the anaphoric antecedent of the prenominal “sorezore” is not a co-participant, it underspecifies the dependency between “sorezore” and its antecedent. Again, this makes a correct prediction: (114b) and (114c) induce a weak truth condition.

However, this assumption causes an independent problem with dependent anaphora. Consider (117b) as an example of dependent singular pronoun under the scope of “sorezore.” I show that the proposed analysis so far over-generates an inter-sentential reciprocal reading for (117b).

- (117) a.  $\text{Dono}^{u_1/u_2}$  seito-mo shi $^{u_3}$ -o hito-tu roodoku-sita.  
 every student-mo poem-ACC 1-CL<sub>Object</sub> recite-PAST  
 “Every student recited one poem.”
- b. **Sorezore** $^{u_4/5}_{u_1}$ -no seito-ga {sono / sore-ra-no} $^{u_6}_{u_3}$  shi-o kinii-tta.  
 DIST-GEN student-NOM {the / the-PL-GEN} poem-ACC like-PAST  
 “Each student liked {the / these} poems.”

Table 5.14 shows a possible output context of (117a).

$I$	$\epsilon_1$	$u_1$	$u_2 \subseteq u_1$	$u_3$
$i_1$	$e$	student <sub>1</sub>	student <sub>1</sub>	poem <sub>1</sub>
$i_2$	$e$	student <sub>2</sub>	student <sub>2</sub>	poem <sub>2</sub>
$i_3$	$e$	student <sub>3</sub>	student <sub>3</sub>	poem <sub>3</sub>

**Table 5.14:** The output context of (117a)

Table 5.15 is a possible output context of (117b). Note that the co-reference condition is satisfied here because  $v(u_3)(I) = v(u_1)(I) = \text{student}_1 + \text{student}_2 + \text{student}_3$ .

$H$	$\epsilon_1$	$u_1$	$u_2 \subseteq u_1$	$u_3$	$\epsilon_2$	$u_4$	$u_5 \subseteq u_4$	$u_6$
$h_1$	$e$	student <sub>1</sub>	student <sub>1</sub>	poem <sub>1</sub>	$e'$	student <sub>2</sub>	student <sub>2</sub>	poem <sub>1</sub>
$h_2$	$e$	student <sub>2</sub>	student <sub>2</sub>	poem <sub>2</sub>	$e'$	student <sub>3</sub>	student <sub>3</sub>	poem <sub>2</sub>
$h_3$	$e$	student <sub>3</sub>	student <sub>3</sub>	poem <sub>3</sub>	$e'$	student <sub>1</sub>	student <sub>1</sub>	poem <sub>3</sub>

**Table 5.15:** The output context of (117b)

The resultant reading is that each student liked a poem which someone else recited, which is not available in (117b). This problem can be stated as follows: if inter-sentential anaphora can establish an underspecified dependency between a dependent and its antecedent, it can permute the dependency established in the previous discourse. Thus, one has to ensure that random dependencies cannot be established beyond sentence boundaries. For this, I propose that discourse update is performed step-by-step: random dependencies are checked per sentence.

I implement this idea with the operation *merge* (DeVries, 2016; Nouwen, 2007), which takes two assignment functions and returns their union. However, information states are defined as primitives in CDRT and thus one cannot take the union of two information states. Thus, I define  $\cup$  as mapping from a pair of information states to an information state that satisfies the conditions as shown in (118)

- (118) a.  $g \cup h$  is defined iff  $\neg \exists v [[v(v)(g) \neq \star \& v(v)(h) \neq \star \& v(v)(g) \neq v(v)(h)]]$   
 b.  $g \cup h = k$  iff  
 i.  $\forall v' [[v(v')(g) \neq \star \& v(v')(h) = \star] \rightarrow v(v')(g) = v(v')(k)]$   
 ii.  $\forall v'' [[v(v'')(g) = \star \& v(v'')(h) \neq \star] \rightarrow v(v'')(h) = v(v'')(k)]$   
 iii.  $\forall v''' [[v(v''')(g) = v(v''')(h) = \star] \rightarrow v(v''')(k) = \star]$

The union  $k$  of two information states  $g$  and  $h$  is defined iff  $g$  and  $h$  do not assign distinct values to the same dref. If defined, whenever  $k$  assigns a non-dummy value to a dref  $u$ , this value is identical to the value of  $u$  under  $g$  or  $h$ .

Now, I define Merge of plural information states as the point-wise union of them.

- (119)  $\text{Merge}(G, H) = \{g \cup h | g \in G \& h \in H \& \forall v [[v(v)(G) \neq \star \& v(v)(H) \neq \star] \rightarrow v(v)(g) = v(v)(h)]\}$

This takes two sets of plural information states and returns the point-wise union of them such that any dref which has some values both in  $G$  and in  $H$  have the same values in  $\text{Merge}(G, H)$ . I modify it so that merge of two assignments do not permute the dependencies among drefs which have already been established in the discourse. I notate the revised version of merge as  $\bullet$  as defined in (120).

- (120)  $G \bullet H =$   
 $\{g \cup h | g \in G \& h \in H \& \forall v [[v(v)(G) \neq \star \& v(v)(H) \neq \star] \rightarrow v(v)(g) = v(v)(h)]$   
 $\& \forall v' [[\exists v'' [v(v')(G) = v(v'')(H)]] \rightarrow \exists v''' \forall d [v(v''')(G_{v=d}) = v(v''')(H_{v=d})]]\}$

(120) minimally differs from (119) in the third conjunct. It requires that for any dref  $v'$  which has a non-dummy value in  $G$ , if there is another dref  $v''$  which has the same value as  $v'$  in  $H$ , there is a dref  $v'''$  which has the same value as  $v''$  in each member of  $G$ . There are two possible cases. First, if there is no more than one dref  $v''$  such that  $v(v')(G) = v(v'')(H)$ , (120) simply requires that  $v'$  and  $v''$  to be distributively co-referential. Second, if there is more than one drefs  $v'_1, \dots, v'_n$  such

that  $v(v')(G) = v(v'')(H) = \dots = v(v'_n)(H)$ , (120) requires that  $v'$  is distributively co-referential with one of  $v'_1, \dots, v'_n$ . Thus, (119) preserves dependency without looking at the value of each dref, whereas (120) take it into consideration. In this way, (120) requires that inter-sentential co-reference have to be distributive. Let's see how it works. In basic cases, (119) and (120) produce the same result.

$G$	$u_1$	$H$	$u_2$	$I$	$u_1$	$u_2$
$g_1$	$a_1$	$h_1$	$b_1$	$i_1$	$a_1$	$b_1$
$g_2$	$a_2$	$h_2$	$b_2$	$i_2$	$a_1$	$b_2$
				$i_3$	$a_2$	$b_1$
				$i_4$	$a_2$	$b_2$

**Table 5.16:** Merging two non-overlapping plural information states

In Table 5.16,  $G \bullet H$  produces a new assignment  $I$ . Here,  $G$  and  $H$  do not share any dref nor value. In this case, both (119) and (120) produce the union of  $G$  and  $H$  such that the values of  $H$  is added to  $G$  in a point-wise fashion. As a result, both definition of merge replicate dependency-free dref introduction. If a dref in  $G$  and a dref in  $H$  specify the same value,  $G \bullet H$  produces an assignment  $I$  such that the dependency associated with these drefs is preserved in  $I$  as shown in Table 5.17

$G$	$u_1$	$u_2$	$H$	$u_3$	$u_4$	$I$	$u_1$	$u_2$	$u_3$	$u_4$
$g_1$	$a_1$	$b_1$	$h_1$	$a_1$	$c_1$	$i_1$	$a_1$	$b_1$	$a_1$	$c_1$
$g_2$	$a_2$	$b_2$	$h_2$	$a_2$	$c_2$	$i_2$	$a_2$	$b_1$	$a_2$	$c_2$
$g_3$	$a_3$	$b_3$	$h_2$	$a_3$	$c_3$	$i_3$	$a_3$	$b_1$	$a_3$	$c_3$

**Table 5.17:** Merging two value-overlapping plural information states

Table 5.18 exemplifies cases in which  $G$  and  $H$  share some drefs. Note that this situation does not arise in my analysis because I assume that pronouns introduce their own drefs. Thus, cases like Table 5.18 arise only if one assumes that a pronoun does not introduce a dref.

$G$	$u_1$	$u_2$	$H$	$u_1$	$u_3$	$I$	$u_1$	$u_2$	$u_3$
$g_1$	$a_1$	$b_1$	$h_1$	$a_1$	$c_1$	$i_1$	$a_1$	$b_1$	$c_1$
$g_2$	$a_2$	$b_2$	$h_2$	$a_2$	$c_2$	$i_2$	$a_2$	$b_1$	$c_2$
$g_3$	$a_3$	$b_3$	$h_2$	$a_3$	$c_3$	$i_3$	$a_3$	$b_1$	$c_3$

**Table 5.18:** Merging two dref-overlapping plural information states

Now, let me show how (120) disallow introduction of a random dependency across sentence boundaries. The previous pair of examples is repeated in (121).

- (121) a.  $\text{Dono}^{u_1/u_2}$  seito-mo shi $^{u_3}$ -o hito-tu roodoku-sita.  
 every student-mo poem-ACC 1-CL<sub>Object</sub> recite-PAST  
 “Every student recited one poem.”
- b. **Sorezore** $^{u_4/5}_{u_1}$ -no seito-ga {sono / sore-ra-no} $^{u_6}_{u_3}$  shi-o kinii-tta.  
 DIST-GEN student-NOM {the / the-PL-GEN} poem-ACC like-PAST  
 “Each student liked {the / these} poems.”

The output context of (121a) is shown in Table 5.19.

$I$	$\epsilon_1$	$u_1$	$u_2 \subseteq u_1$	$u_3$
$i_1$	$e$	student <sub>1</sub>	student <sub>1</sub>	poem <sub>1</sub>
$i_2$	$e$	student <sub>2</sub>	student <sub>2</sub>	poem <sub>2</sub>
$i_3$	$e$	student <sub>3</sub>	student <sub>3</sub>	poem <sub>3</sub>

**Table 5.19:** The output context of (121a)

On this point, imagine that  $u_4$  stores collectively co-referential, but distributively disjoint values with respect to  $u_1$  as shown in Table 5.20.

$J$	$\epsilon_1$	$u_4$	$u_5 \subseteq u_4$	$u_6$
$j_1$	$e$	student <sub>2</sub>	student <sub>1</sub>	poem <sub>1</sub>
$j_2$	$e$	student <sub>3</sub>	student <sub>2</sub>	poem <sub>2</sub>
$j_3$	$e$	student <sub>1</sub>	student <sub>3</sub>	poem <sub>3</sub>

**Table 5.20:** The output context of (121b)

Now, let me show that  $I \bullet J$  is undefined. Consider Table 5.21, where  $I \bullet J = H$ .

$H$	$\epsilon_1$	$u_1$	$u_2 \subseteq u_1$	$u_3$	$\epsilon_2$	$u_4$	$u_5 \subseteq u_4$	$u_6$
$h_1$	$e$	student <sub>1</sub>	student <sub>1</sub>	poem <sub>1</sub>	$e'$	student <sub>2</sub>	student <sub>2</sub>	poem <sub>1</sub>
$h_2$	$e$	student <sub>2</sub>	student <sub>2</sub>	poem <sub>2</sub>	$e'$	student <sub>3</sub>	student <sub>3</sub>	poem <sub>2</sub>
$h_3$	$e$	student <sub>3</sub>	student <sub>3</sub>	poem <sub>3</sub>	$e'$	student <sub>1</sub>	student <sub>1</sub>	poem <sub>3</sub>

**Table 5.21:** A context with inter-sentential reciprocity

In this context,  $u_3$  and  $u_6$  specify the same set of value and thus (120) requires that there is a dref which assigns the same values as  $u_6$  for each  $h \in H$ . This is met in this context because  $u_3$  and  $u_6$  are distributively co-referential. The same requirement applies to  $u_4$  because it is collectively co-referential with  $u_1$ . In this case, there has to be a dref which assigns the same value as  $u_4$  for each  $h \in H$ . However, one cannot find any: the values of  $u_1$  and  $u_4$  are different in each  $h \in H$  and there is no other dref which satisfies this requirement. Thus,  $I \bullet J$  cannot produce such a plural information state.

$I \bullet J$  can only produce a plural information state in which inter-sentential anaphora distributively preserves dependency established in  $I$  and  $J$ . For example, Table 5.22 shows a possible output of  $I \bullet J'$ , where  $J'$  is minimally different from  $J$  in the allocations of values of  $u_4$ . This plural information state meets the requirement of the  $\bullet$  operator.

$H'$	$\epsilon_1$	$u_1$	$u_2 \subseteq u_1$	$u_3$	$\epsilon_2$	$u_4$	$u_5 \subseteq u_4$	$u_6$
$h'_1$	$e$	student <sub>1</sub>	student <sub>1</sub>	poem <sub>1</sub>	$e'$	student <sub>1</sub>	student <sub>1</sub>	poem <sub>1</sub>
$h'_2$	$e$	student <sub>2</sub>	student <sub>2</sub>	poem <sub>2</sub>	$e'$	student <sub>2</sub>	student <sub>2</sub>	poem <sub>2</sub>
$h'_3$	$e$	student <sub>3</sub>	student <sub>3</sub>	poem <sub>3</sub>	$e'$	student <sub>3</sub>	student <sub>3</sub>	poem <sub>3</sub>

**Table 5.22:** A possible product of  $I \bullet J'$

In this way, the merge operator  $\bullet$  blocks random dependencies to be established across sentence boundaries and correctly account for the absence of inter-sentential reciprocal reading of (121b).

The proposed definition of the merge operator  $\bullet$  allows two options for a plural pronoun whose antecedent is “sorezore” in the previous sentence. In (122a), the bare anaphoric “sorezore” takes the subject “Aki-to-Yuki” (Aki and Yuki) as its antecedent and the object “tegami” (letter) occurs under the scope of the  $\delta$  operator. Crucially, this sentence allows two options of dependent anaphora. In (122b-i), Aki expressed the letter he wrote and Yuki expressed the letter she wrote. However, in (122b-ii), Aki read the letter Yuki wrote and Yuki read the letter Aki wrote.

- (122) a. Aki-to-Yuki <sup>$u_1$</sup> -ga **sorezore** <sup>$u_{2/3}$</sup> -ni tegami <sup>$u_4$</sup> -o kai-ta.  
 Aki-and-Yuki-NOM DIST-DAT letter-ACC write-PAST  
 “Aki and Yuki each wrote a letter to the other.”
- b. i. Karera <sup>$u_1^5$</sup> -ga **sorezore** <sup>$u_5$</sup>  sono-tegami <sup>$u_4^6$</sup> -o sokutatsu de oku-tta.  
 they-NOM DIST the-gift-ACC express-by send-PAST  
 “They each expressed the letter.”
- ii. Karera <sup>$u_1^5$</sup> -ga **sorezore** <sup>$u_5$</sup>  sono-tegami <sup>$u_4^6$</sup> -o yon-da.  
 they-NOM DIST the-letter-ACC read-PAST  
 “They each read the letter.”

I propose that the plural pronoun “karera” (they) takes “Aki-to-Yuki” (Aki and Yuki) in (122a) as its antecedent in (122b-i) and it takes the bare “sorezore” in (122a) as its antecedent in (122b-ii). The  $\bullet$  operator allows these two options. First, (122a) introduces a reciprocal dependency as shown in Table 5.23. Here,  $u_1$  and  $u_3$  store the same values, but they store different values in different subset of  $G$ .

$G$	$\epsilon_1$	$u_1$	$u_2$	$u_3 \subseteq u_2$	$u_3$
$g_1$	$e$	Aki	Yuki	Yuki	letter <sub>1</sub>
$g_2$	$e$	Yuki	Aki	Aki	letter <sub>2</sub>

**Table 5.23:** An output context of (122a)

On this point, the  $\bullet$  operator allows a plural pronoun to take  $u_1$  or  $u_3$  as its antecedent. First, Table 5.24 shows an output plural information state of (122b-i).

$H$	$\epsilon_2$	$u_5$	$u_6$
$h_1$	$e'$	Aki	letter <sub>1</sub>
$h_2$	$e'$	Yuki	letter <sub>2</sub>

$G \bullet H$	$\epsilon_1$	$u_1$	$u_2$	$u_3 \subseteq u_2$	$u_4$	$\epsilon_2$	$u_5 = u_1$	$u_6$
$g_1 \bullet h_1$	$e$	Aki	Yuki	Yuki	letter <sub>1</sub>	$e'$	Aki	letter <sub>1</sub>
$g_2 \bullet h_2$	$e$	Yuki	Aki	Auki	letter <sub>2</sub>	$e'$	Yuki	letter <sub>2</sub>

**Table 5.24:** An output plural information state of (122b-i)

In this context,  $u_5$  specifies the same set of value as  $u_1$  and  $u_{2/3}$ . Thus, the  $\bullet$  operator requires that there is a dref which assigns the same values as  $u_5$  for each  $g \in G$ . This requirement is met because  $u_1$  and  $u_5$  are distributively co-referential.

On the other hand, Table 5.25 shows an output plural information state of (122b-ii).

$H$	$\epsilon_2$	$u_5$	$u_6$
$h_1$	$e'$	Yuki	letter <sub>1</sub>
$h_2$	$e'$	Aki	letter <sub>2</sub>

$G \bullet H$	$\epsilon_1$	$u_1$	$u_2$	$u_3 \subseteq u_2$	$u_4$	$\epsilon_2$	$u_5 = u_3$	$u_6$
$g_1 \bullet h_1$	$e$	Aki	Yuki	Yuki	letter <sub>1</sub>	$e'$	Yuki	letter <sub>1</sub>
$g_2 \bullet h_2$	$e$	Yuki	Aki	Auki	letter <sub>2</sub>	$e'$	Aki	letter <sub>2</sub>

**Table 5.25:** An output plural information state of (122b-ii)

Again,  $u_5$  specifies the same set of values as  $u_1$  and  $u_{2/3}$  and the  $\bullet$  operator requires that there is a dref that assigns the same values as  $u_5$  for each  $g \in G$ . This requirement is met in Table 5.25 as  $u_{2/3}$  and  $u_5$  are distributively co-referential.

Summing up, the  $\bullet$  operator correctly predicts different dependent readings of a plural pronoun when it can take either of two drefs which are collectively co-referential but distributively disjoint.<sup>23</sup>

23. One can define a stronger version of the  $\bullet$  operator as shown in (1): it requires whenever a new dref is introduced in  $H$  and there is another dref which specifies the same value, they have to be distributively co-referential.

Now, I implement this operation of merge to the system of incremental discourse update. I revise the definition of truth in PCDRT with events so that a formula is evaluated against an input plural information state  $G$  and an output plural information state  $H$  as defined in (123).

- (123) Truth: A formula  $\phi$  is true with respect to an input plural information state  $G$  iff there is a plural information state  $H$  such that  $G \bullet H$  is an output plural information state and  $\llbracket \phi \rrbracket(G)(G \bullet H)$ .

This definition of truth explicitly distinguishes the newly added part of the output plural information state, i.e.  $H$ , from the original part, i.e.  $G$ , and requires that introduction of dependency does not go beyond the newly added part  $H$ . This blocks undesirable inter-sentential reciprocal readings, while allowing two options of dependent anaphora when a plural pronoun takes the bare anaphoric “sorezore” which occurs in the previous sentence.

### Interim Summary

In this section, I discussed the the anaphoric component of “sorezore” and compared the behaviour of the prenominal “sorezore” and the bare anaphoric “sorezore.” Seemingly, the prenominal “sorezore” and the bare anaphoric “sorezore” differ in their choice of antecedent: the prenominal “sorezore” sometimes cannot have intra-sentential antecedent. I claimed that the prenominal “sorezore” obeys the principle of *Minimise Restrictors!*: addition of an overt restrictor is disallowed when it is redundant, i.e. the prenominal “sorezore” specifies the same set of values as the bare anaphoric “sorezore” and the overt restrictor does not serve for the purpose of disambiguation. As expected, the prenominal “sorezore” can take a intra-sentential antecedent when there is more than one potential antecedent. This suggests that the anaphoric component of “sorezore” can pick up any accessible antecedent as long as it obeys Condition B and Minimize Restrictors!. This is indeed nothing special about “sorezore”: use of pronouns in English is constrained with Condition B and use of definite descriptions is constrained with Minimise Restrictors!.

- 
- (1)  $G \bullet H = \{g \cup h \mid g \in G \& h \in H \& \forall v[v(v)(G) \neq \star \& v(v)(H) \neq \star] \rightarrow v(v)(g) = v(v)(h)]$   
 $\& \forall v, v'[v(v)(G) = v(v')(H)] \rightarrow [v(v)(G_{v=d}) = v(v')(H_{v=d})]]\}$

Although this version equally works to block an inter-sentential reciprocal dependency, it wrongly predicts that both (122b-i) and (122b-ii) are unacceptable.



The proposed analysis causes an independent problem with respect to cross-sentential anaphora: it wrongly predicts that it can have a reciprocal dependency across sentence boundaries. This problem is inherent to the assumption that a pronoun introduces its own dref and the assumption that “sorezore” evaluates its co-reference condition above the  $\delta$  operator. Since these assumptions are both crucial for the proposed analysis of “sorezore,” I keep assuming these and I proposed a way to tame random dependencies. I proposed the merging operator  $\bullet$ , which prevent establishment of random dependencies beyond sentential boundaries.

### 5.3.5 Extension to English “each”

In this section, I aim to extend the sequence-based analysis to “each” in English. Similarly to “sorezore,” “each” can occur at four positions as shown in (124).

- (124) a. **Each** player drew two cards. (Determiner “each”)  
 b. **Each** of the players drew two cards. (Partitive “each”)  
 c. The players **each** drew two cards. (Floating “each”)  
 d. The players drew two cards **each**. (Binominal “each”)

I assume that the floating “each” is essentially an overt lexicalisation of the  $\delta$  operator just like “sorezore” as shown in (125).

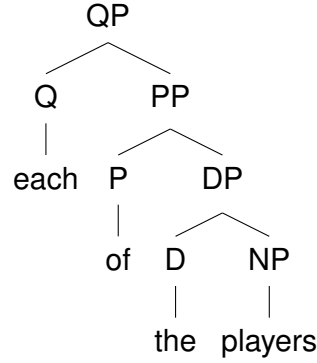
$$(125) \quad \llbracket \text{each}_{u_n} \rrbracket = \lambda V_{\langle E, VT \rangle} \lambda v \lambda \epsilon_V \text{MAX}^{u_m \in v} (\delta_{u_n} (V(\epsilon)(u_m))) \quad (\text{Floating “each”})$$

The determiner “each” and the partitive “each” respectively correspond to the prenominal “sorezore” and the postnominal “sorezore” as shown in (126). The sequence-based locality principle requires the  $\delta_{u_n}$  operator to be associated with  $u_m$  in (126a) and (126b). Thus, the antecedent of the  $\delta$  operator is fixed in these cases.

- (126) a.  $\llbracket \text{each}_{u_n} \rrbracket = \lambda P_{\langle ET \rangle} \lambda V_{\langle E, VT \rangle} \lambda \epsilon_V \text{MAX}^{u_m} (\delta_{u_n} (P(u_m))) ; \text{MAX}^{u'_m \in v} (\delta_{u_n} (V(\epsilon)(u'_m)))$   
 (Determiner “each”)  
 b.  $\llbracket \text{each}_{u_n} \rrbracket = \lambda R_{\langle \langle E, VT \rangle, \langle VT \rangle \rangle} \lambda V_{\langle E, VT \rangle} R(\lambda v_E \lambda \epsilon_V \text{MAX}^{u_m \in v} (\delta_{u_n} (V(\epsilon)(u_m)))$   
 (Partitive “each”)

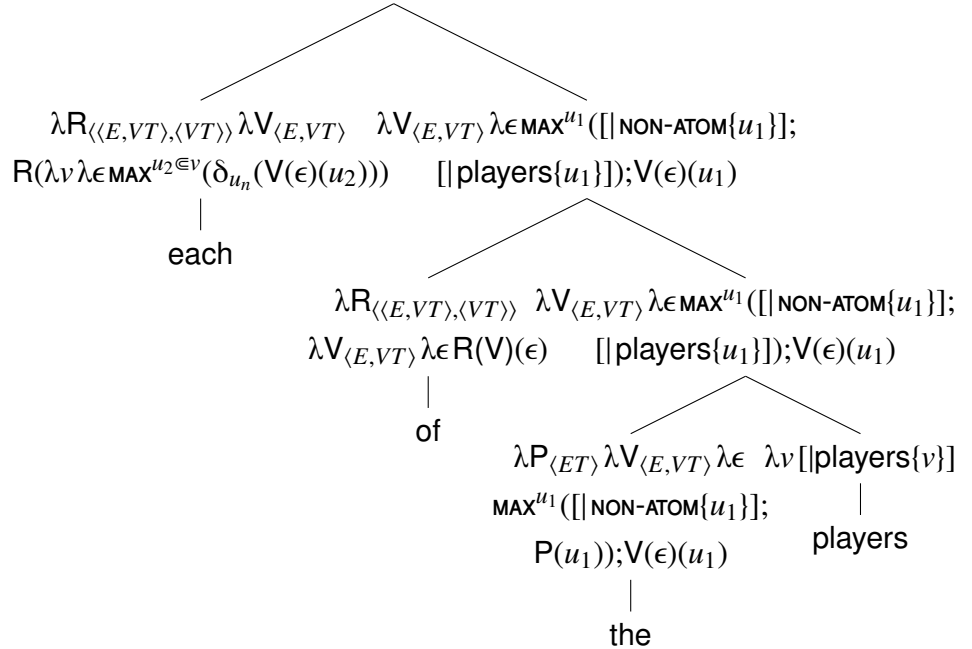
However, Japanese and English differ with respect to the denotations of common nouns: type-shifting between the predicative type and the argumental type is freely applicable in Japanese because it lacks  $D^0$ , while this is not the case with English because it has  $D^0$ . Thus, the entry of “each” in (126b) cannot be directly associated with its host NP. I propose that this is why the partitive “of” is obligatory for “each.” I assume that “of” is inserted because the DP complement of “each” is non-case marked, otherwise. I assume the structure in (127).

(127)



Based on (127), the denotation of “each of the players” is obtained as shown in (128). I assume that “of” denotes an identity function of an argument type.<sup>24</sup>

(128)  $\lambda V_{\langle E, VT \rangle} \lambda \epsilon \text{MAX}^{u_1}([\text{NON-ATOM}\{u_1\}]; [\text{players}\{u_1\}]); \text{MAX}^{u_2 \in u_1}(\delta_{u_n}(V(\epsilon)(u_2)))$



24. One may alternatively assume that “of” is inserted at the phonological/morphological component (Chomsky, 1981).

The proposed entry of the floating “each” is the same as English. Thus, the sequence-based locality principle predicts that it can be associated with any member of  $S_V$  such that  $[[\text{each}_{u_n}]](V)$  as long as it is introduced on the left-hand side of the  $\delta$  operator. However, the floating “each” cannot occur at the post-verbal position unlike the floating “sorezore” as shown in (130)

(129) \* The players drew **each** two cards.

I claim that this is not because the floating “each” is not anaphoric, but this is an instance of *Case Adjacency Effect* (Stowell, 1981, *et seq.*). (130) shows that an adverb cannot intervene between a verb and its internal argument.

- (130) a. Mary **slowly** read the book yesterday.  
 b. \* Mary read **slowly** the book yesterday.  
 c. Mary read the book **slowly** yesterday.

Although I do not aim to pick up an analysis of this effect in this thesis, as long as the floating “each” adjoins to a clausal spine, it has to follow the same constraint which blocks (130). As a result, the floating variant of “each” cannot occur at a position which intervenes an argument DP and its case assigner.<sup>25</sup>

This does not mean that one cannot see the anaphoricity of “each” in English. It has been noted that the binominal “each” requires a local antecedent (Boeckx & Hornstein, 2005; Burzio, 1986; Safir & Stowell, 1987, a.o.). In (124d), “each” follows the object, but is associated with the subject. However, the binominal “each” cannot be associated with a non-local antecedent as shown in (131). (Boeckx & Hornstein, 2005; Burzio, 1986; Safir & Stowell, 1987, a.o.)

- (131) a. \*The boys<sup>*u*<sub>1</sub></sup> said that [three women<sup>*u*<sub>2</sub></sup> each<sub>*u*<sub>1</sub></sub> had left].  
 b. \*The boys<sup>*u*<sub>1</sub></sup> expected Mary<sup>*u*<sub>2</sub></sup> [to kiss one child<sup>*u*<sub>3</sub></sup> each<sub>*u*<sub>1</sub></sub>].

(Safir & Stowell, 1987)

25. For this analysis, one has to assume that “each” does not have an option of right-adjunction.

Burzio (1986); Dotlačil (2012) proposes that the binominal “each” follows Condition A, whereas Safir and Stowell (1987) proposes that it undergoes LF-movement and its trace has to be bound by a local A'-binder. Although I leave the precise implementation for future research, I claim that the binominal “each” follow the same locality condition as “sorezore.” I propose that the binominal “each” takes a verbal predicate and a measure phrase.

It has been noted since Safir and Stowell (1987) that the binominal “each” is picky about DPs it attaches to as shown in (132).

- (132) a. The boys saw {two / at least two / more than two / a few / several / many / a lot of} movies each.  
 b. \*The boys saw { $\emptyset$  / some / a certain / the / those / few / most / all} jewels each. (Law, 2020)

Law (2020) claims that the binominal “each” requires *measurement monotonicity*, which has been observed for measurement constructions across languages Schwarzschild (2005). Monotonicity is defined as a property of measurement such that it traces the part whole-structure of noun denotations (Champollion, 2017; Krifka, 1989, 1992; Nakanishi, 2008a; Schwarzschild, 2002, 2005, 2006; Wellwood, 2015). ‘ $\subset$ ’ is a proper subset relation, ‘ $<$ ’ is a total order relation relative to the measurement dimension and  $\mu$  is a function from individuals to degrees.

- (133) Monotonicity:  $\text{Mon}(\mu) \Leftrightarrow \forall x \forall y [y \subset x \rightarrow \mu(y) < \mu(x)]$

For example, litre-measurement is monotonic: part of an entity necessarily has a smaller litre amount than the whole. However, temperature-measurement is non-monotonic: part of an entity need not have a lower temperature than the whole. Schwarzschild (2002, 2005) show that this property correlates with the syntactic distribution of measure phrases in English: pseudo-partitives allow only *monotonic* measure phrases as shown in (134).

- (134) a. two **litres** of oil (Monotonic)  
 b. \*sixty **degrees** of oil (Non-monotonic)

Law (2020); Zhang (2013) show that the binominal “each” is sensitive to measurement monotonicity as shown in (135).

- (135) a. The boys read **two books** each. (cardinality)

- b. The girls walked **three miles** each. (distance)
- c. The windows are **four feet (tall)** each. (height)
- d. The angles are **60 degrees** each. (angle)
- e. \* The drinks are **60 degrees (Fahrenheit)** each. (temperature)
- f. \*The girls walked at **three miles-per-hour** each. (speed)
- g. \*The gold rings are **24 Karat** each. (purity)
- (Zhang, 2013)

Law (2020) defines a dynamic monotonicity as shown in (136).<sup>26</sup>

$$(136) \quad \text{Mon}_{u_n, u_m}(\mu) = \lambda G \lambda H [G = H \& \forall x, x' \in v(u_n)(H) [x \subseteq x' \rightarrow \mu(v(u_m)(H_{u_n \in x}) \leq \mu(v(u_m)(H_{u_n \in x'}))] \& \exists y, y' [\mu(v(u_n)(H_{u_n \in y})) \neq \mu(v(u_n)(H_{u_n \in y'}))]]$$

I propose that the binominal “each” is a unary quantifier which takes a measure phrase as shown in (137). I assume that  $\text{Mon}_{u_n, u_m}(\mu)$  is given as presupposition (Nakanishi, 2008a).

$$(137) \quad \llbracket \text{each}_{u_n} \rrbracket = \lambda \mu_{\langle Ed \rangle} \lambda M_{\langle dT \rangle} \lambda V_{\langle E, VT \rangle} \lambda \epsilon_V \eta(u_m); \llbracket \text{Mon}_{u_n, u_m}(\mu) \rrbracket; \delta_{u_n}(\llbracket M(\mu(u_m)) \rrbracket; V(\epsilon)(u_m))$$

Although it differs from the denotation of “each” in Law (2020), I assume the same structure as hers. (138) shows a sample composition of “two pounds each.”<sup>27</sup>

$$(138) \quad \begin{array}{c} \lambda V_{\langle E, VT \rangle} \lambda \epsilon \eta(u_m); \llbracket \text{Mon}_{u_n, u_m}(\text{WEIGHT}) \rrbracket; \\ \delta_{u_n}(\llbracket \text{WEIGHT}(u_m) = 2 \text{ pounds} \rrbracket; V(\epsilon)(u_m)) \\ \swarrow \quad \searrow \\ \lambda d [d = 2 \text{ pounds}] \quad \lambda M_{\langle dT \rangle} \lambda V_{\langle E, VT \rangle} \lambda \epsilon \eta(u_m); \\ \quad \llbracket \text{Mon}_{u_n, u_m}(\text{WEIGHT}) \rrbracket; \\ \quad \delta_{u_n}(\llbracket M(\text{WEIGHT}(u_m)) \rrbracket; V(\epsilon)(u_m)) \\ \swarrow \quad \searrow \\ \text{WEIGHT} \quad \lambda \mu_{\langle Ed \rangle} \lambda M_{\langle dT \rangle} \lambda V_{\langle E, VT \rangle} \lambda \epsilon_V \eta(u_m); \\ \quad \llbracket \text{Mon}_{u_n, u_m}(\mu) \rrbracket; \delta_{u_n}(\llbracket M(\mu(u_m)) \rrbracket; V(\epsilon)(u_m)) \end{array}$$

26. See Law (2020) for implementation of a plural dynamic system with degrees.

27. She assumes that cardinal modification utilises a covert measure head which turns a common noun denotation into a degree predicate.



## 5.4 Conclusion

In this chapter, I discussed dynamic properties of “sorezore.” Firstly, I proposed that reciprocal readings of the bare anaphoric “sorezore” come from distributive evaluation of Condition B: “sorezore” evaluates the co-reference condition above the  $\delta$  operator while evaluating a verbal predicate under the scope of the  $\delta$  operator. As a result, two drefs are collectively co-referential and distributively disjoint when they are co-participant of the same event. Based on this analysis, I proposed a three-way decompositional approach to the semantics of reciprocity: reciprocity consists of (i) the distributivity component, (ii) the anaphoricity component, and (iii) the disjointness component. Comparison of various reciprocal strategies in Japanese and in several other languages show that these three components are not always lexicalised as a single expression as repeated in Table 5.26.

	Distributivity	Anaphoricity	Disjointness
English	“each other”		
Brazilian Portuguese	“um”		“o outro”
Cuzco Quechua	“-na”	“-ku”	underspecified
German, French, Spanish, Portuguese, Italian	underspecified	reflexives	underspecified
Japanese	“sorezore”		underspecified
	“otagai <sub>1</sub> ”		
	“otagai <sub>2</sub> ”		underspecified
	“-au”	<i>pro</i>	underspecified

**Table 5.26:** Variations in the reciprocal strategies

Secondly, I proposed that the two components of “sorezore” and the type-ambiguity of Japanese quantifiers interact so that the distributivity component is realised in each of the four variants and the anaphoricity component is only realised in the prenominal variant and the unary variant. Based on this, I proposed that these two components are constrained in different ways. As for the distributivity component, if “sorezore” takes a restrictor property, the  $\delta$  operator has to be associated with the restrictor set, whereas if “sorezore” only takes a scope property  $V$ , the  $\delta$  operator can be associated with any clause-mate antecedent whose value is introduced on the left-hand side of the  $\delta$  operator. I proposed a sequence-based locality principle to account for this pattern.

On the other hand, the anaphoricity component is constrained with Condition B and Minimise Restrictors!. Condition B requires two drefs to have disjoint values if they are co-participants of the same event. This predicts that “sorezore” induces a reciprocal reading when it introduces a dref which is a co-participant of its antecedent. Minimise Restrictors! governs the competition between the prenominal “sorezore” and the bare anaphoric “sorezore”: when they take the same antecedent, an overt restrictor of the prenominal “sorezore” becomes redundant. Thus, the prenominal “sorezore” is blocked unless there is more than one potential antecedent and an overt restrictor serves for the purpose of disambiguation. Note that these two principles constrain the distribution of pronouns and definite descriptions in English in the same way. They minimally differ from “sorezore” with respect to the  $\delta$  operator above the co-reference condition.

To avoid overgeneration of inter-sentential reciprocal dependencies, I further introduce the  $\bullet$  operator which merges two plural information states which prevent establishment of inter-sentential random dependencies. Accordingly, I revised the definition of truth as shown in (140).

- (140) Truth: A formula  $\phi$  is true with respect to an input plural information state  $G$  iff there is a plural information state  $H$  such that  $G \bullet H$  is an output plural information state and  $\llbracket \phi \rrbracket(G)(G \bullet H)$ .

The resultant architecture acknowledges three layers in contexts, namely (i) clausal denotations / nominal denotations, (ii) sentential denotations and (iii) the entire discourse. Importantly, these layers are distinguished based on the semantics of expressions. Different anaphoric expressions are constrained at different layers. The first layer is detected based on the minimal sequence of evaluation, i.e. a subset of drefs which is relevant to evaluate a predicate. This serves as the local domain in which co-indexation of the  $\delta$  operator and disjointness condition of Condition B are calculated. The second layer is detected with evaluation of a sentence: truth of a sentence is evaluated in a way that the newly added part in the output plural information state, i.e.  $H$ , is distinguished from the original part, i.e.  $G$ . This serves as the local domain in which random dependencies are calculated. Lastly, the entire discourse is the largest chunk of information. It serves as a general domain in which pronominal expressions seek for a value to cross-refer as long as this does not violate constraints imposed on them.



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## Chapter 6

# Distribution over situations

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### 6.1 Introduction

The previous chapters have discussed the dynamic aspects of universal quantifiers and overt distributivity. In this chapter, I discuss the semantics of “zutsu.” I show that “zutsu” exhibits the *shifted evaluation effect*: its scope can be evaluated in a situation other than the one in which the rest of the clause is evaluated. When “zutsu” occurs at the prenominal position, its scope is restricted within the nominal domain and it can be evaluated in a situation other than the one in which the rest of the clause is evaluated. However, this option is unavailable at the floating position: the scope of “zutsu” has to be evaluated in the same situation as the one in which the rest of the clause is evaluated. In this chapter, I propose a situation-based analysis of “zutsu” in a static setting. The guiding intuition is that this behaviour of “zutsu” is reminiscent of the pattern of shifted evaluation with strong DPs and adverbial quantifiers. It has been observed that a strong DP can have a shifted evaluation of its restrictor, whereas an adverbial quantifier cannot. I claim that the difference between the prenominal “zutsu” and the floating “zutsu” is another instance of the same phenomenon and show that the proposed situation-based analysis can derive all the possible readings of “zutsu” with a single lexical entry. Based on this result, I claim a way to derive this shiftability generalisation. I propose that the combination of the type-system in Schwarz (2009) and the analysis of bare nouns in Chierchia (1998) correctly predicts that insertion of a situation pronoun is triggered in the nominal domain, but not in the verbal domain. This analysis correctly predicts that an NP with the prenominal “zutsu” has to take the narrowest scope. Furthermore, I show that the adverbial universal quantifier “itsumo” shows the same pattern as “zutsu.” The proposed situation-based analysis can be extended to cover this expression as well. Finally, I conclude this chapter with a potential conjecture for cross-linguistic variation in overt distributors.

## 6.2 The shifted evaluation effect

In this section, I discuss a distributor “zutsu” in Japanese and show that it has three types of distributive readings, namely an *individual distributive reading*, an *occasion distributive reading* and a *group distributive reading*. Although individual distributive readings and occasion distributive readings have been extensively discussed (Cable, 2014a; Champollion, 2017; Oh, 2001; Zimmermann, 2002, among others), only few articles discuss group distributive readings.

### 6.2.1 Varieties of distributive readings

Zimmermann (2002) points out that overt distributors are classified into two: those which only distribute over individuals and those which can also distribute over contextually salient occasions. For example, (1) and (2) show a contrast between “each” in English and “jeweils” in German. English “each” can only distribute over individuals and thus is incompatible with a singular subject as shown in (1b), whereas German “jeweils” can distribute over contextually salient occasions and is compatible with a singular subject as shown in (2b). I call (2a-i) an *individual distributive reading* and (2a-ii) an *occasion distributive reading*.

- (1) a. Ann and Belle **each** carried three suitcases.  
       b. \*Ann **each** carried three suitcases.
- (2) a. Ann und Belle haben **jeweils** drei Koffer getragen.  
       Ann and Belle have DIST three suitcases carried  
       i. “Ann and Belle have carried three suitcases each.”  
       ii. “Ann and Belle have carried three suitcases each time.”  
       b. Ann hat **jeweils** drei Koffer getragen.  
       Ann have DIST three suitcases carried  
       “Ann has carried three suitcases each time.”

In Japanese, “sorezore” behaves in parallel with English “each”: an occasion distributive reading is not available with “sorezore” as shown in (3).

- (3) \* Shun-ga **sorezore** kaban-o san-ko hakon-da.  
       Shun-NOM DIST suitcase-ACC 3-CL<sub>things</sub> carry-PAST  
       (Lit) “Shun carried three suitcases at each occasion.”

However, Japanese has another overt distributor “zutsu,” which allows both an individual distributive reading and an occasion distributive reading.

- (4) Karera-ga kaban-o san-ko-**zutsu** hakon-da.  
 they-NOM suitcase-ACC 3-CL<sub>things</sub>-DIST carry-PAST  
 a. “They carried three suitcases each.”  
 b. “They carried three suitcases each time.”

Only an occasion distributive reading is available with a singular argument.

- (5) Shun-ga kaban-o san-ko-**zutsu** hakon-da.  
 Shun-NOM suitcase-ACC 3-CL<sub>things</sub>-DIST carry-PAST  
 “Shun carried three suitcases each time.”

In this sense, “zutsu” behaves in parallel with German “jeweils.” However, “zutsu” has yet another reading, which has gathered little attention in the previous literature.<sup>1</sup> Consider (6). I call it a *group distributive reading* and distinguish it from an individual distributive reading and an occasion distributive reading.

- (6) Daiki-ga ni-hon-**zutsu**-no aisū-o tabe-ta.  
 Daiki-NOM 2-CL<sub>bars</sub>-DIST-GEN ice cream-ACC eat-PAST  
 “Daiki ate two-bar ice cream.”  
 ~→ the kind of ice cream Daiki ate generally comes in two bars.

This reading is not an individual distributive reading because it is compatible with a singular argument as shown in (6). At the same time, this reading is not an occasion distributive reading because (6) does not entail that Daiki ate two ice cream bars at different occasions. Intuitively, this reading evaluates distributivity in a situation other than the one in which the rest of the clause is evaluated. To see this, consider the truth condition of (6) with two scenarios in (7).

- (7) Context: Daiki went to a supermarket and bought some ice cream. He bought two kinds of ice cream bars: Papico, which comes with two popsicles<sup>2</sup> and Häagen-Dazs ice cream bars, which come with just one bar.  
 a. Scenario 1: Daiki ate two Häagen-Dazs ice cream bars. ⇒ (6) is **false**

1. Miyamoto (2009) discusses this kind of readings of “zutsu,” but does not put much focus on its semantic aspect.

2. This is sold only in Japan. A papico consists of a pair of popsicles which are connected to each other. One can alternatively imagine Twix, which generally come in two bars. I thank Watatu Uegaki for bringing this to my attention.

- b. Scenario 2: Daiki split one Papico into two and ate one of them.

⇒ (6) is **true**

In (7a), Daiki ate two ice cream bars, but the kind of ice cream Daiki ate, i.e. Häagen-Dazs ice cream bars, does not generally come in two bars. In this scenario, (6) is judged false. On the other hand, in (7b), Daiki ate just one ice cream bar, but the kind of ice cream Daiki ate, i.e., Papico, generally comes in two bars. In this scenario, (6) is judged true. Thus, distributivity is still evaluated in the truth-conditional component, but it is evaluated in a shifted situation.

### 6.2.2 Conditions for a group distributive reading

In this section, I discuss the syntactic distribution and the semantic restriction of a group distributive reading of “-zutsu.” First, “zutsu” can occur at the prenominal position or at the floating position. The floating “zutsu” does not allow a group distributive reading as shown in (8a), but the prenominal “zutsu” only allows a group distributive reading as shown in (8b).

- (8) a. Floating “zutsu”:

Wataru-ga aisu-o (kinoo) ni-hon-**zutsu** tabe-ta.

Wataru-NOM ice cream-ACC (yesterday) 2-CL<sub>bars</sub>-DIST eat-PAST

- i. “Wataru ate two bars of ice cream each time (yesterday).”

- ii. \*“(Wataru ate a two-bar ice cream (yesterday).”

↪ the kind of ice cream Wataru ate generally comes in two bars.

- b. Prenominal “zutsu”:

Wataru-ga ni-hon-**zutsu**-no (\*kinoo) aisu-o tabe-ta.

Wataru-NOM 2-CL<sub>bars</sub>-DIST-GEN (yesterday) ice cream-ACC eat-PAST

- i. \*“(Wataru ate two bars of ice cream each time (yesterday).”

- ii. “(Wataru ate a two-bar ice cream (yesterday).”

↪ the kind of ice cream Wataru ate generally comes in two bars.

Co-occurrence with floating numeral quantifiers further confirms this point. The floating “zutsu” can co-occur with a floating numeral quantifier as long as they can induce a consistent reading.

- (9) Wataru-ga aisu-o ni-hon-**zutsu** ro-ppon tabe-ta.

Wataru-NOM ice cream-ACC 2-CL<sub>bars</sub>-DIST 6-CL<sub>bars</sub> buy-PAST

“Wataru ate six bars of ice cream in twos.”

(9) is true if Wataru ate ice cream bars in twos and ended up eating six bars of ice cream in total. On the other hand, (10) results in an inconsistent reading: one cannot eat ice cream bars in twos and end up eating just one.

- (10) \* Wataru-ga aisū-o ni-hon-**zutsu** i-ppon tabe-ta.  
 Wataru-NOM ice cream-ACC 2-CL<sub>bars</sub>-DIST 1-CL<sub>bars</sub> buy-PAST  
 “Wataru ate one bar of ice cream in twos.”

In contrast, the prenominal “zutsu” can have a consistent reading regardless of the cardinality of a floating numeral quantifier it co-occurs with as shown in (11).

- (11) Wataru-ga ni-hon-**zutsu**-no aisū-o {i-ppon / ro-ppon} tabe-ta.  
 Wataru-NOM 2-CL<sub>bars</sub>-DIST-GEN ice cream-ACC {1-CL<sub>bars</sub> / 6-CL<sub>bars</sub>} eat-PAST  
 lit “Wataru ate {one bar / six bars} of two-bar ice creams.”

These observations suggest that group distributive readings are restricted to the prenominal “zutsu.”

Second, group distributive readings require a contextually supplied grouping. For example, in (6), it does not suffice that the ice cream bar Daiki ate comes in twos, but (6) requires us to know that the kind of ice cream Daiki ate generally comes in twos. A similar observation applies to group nouns. For example, the group noun “keikantai” (police team) does not necessarily mean that members of a police team are always constant, but the members at each occasion share the membership as a police team. In this sense, group nouns lexically provide such knowledge of group membership. In (12), “zutsu” distributes over such groups of police teams. Again, this distribution over sub-teams is not necessarily evaluated in the current situation and (12) is true even if the thug assaulted just one of a three-member police team.

- (12) Bookan-ga san-nin-**zutsu**-no keikantai-o oso-tta.  
 Thug-NOM 3-CL<sub>persons</sub>-DIST-GEN police force-ACC assault-PAST  
 “A thug assaulted a three-member police team.”  
 ⇨ the police officers formed three-member sub-teams.

The floating “zutsu” in the same environment does not have the inference in (12) and (13) is false if the thug assaulted just one of the police team.

- (13) Bookan-ga keikantai-o san-nin-**zutsu** oso-tta.  
 Thug-NOM police force-ACC 3-CL<sub>persons</sub>-DIST assault-PAST  
 “A thug assaulted three members of a police team each time.”  
 ↗ the police officers formed three-member sub-teams.

A group distributive reading with a non-group noun is felicitous if the context provides an appropriate grouping. For example, a group distributive reading with “keikan” (police), the non-group counterpart of “keikantai” (police team) is felicitous if police officers are patrolling in threes.<sup>3</sup>

- (14) Bookan-ga san-nin-**zutsu**-no keikan-o oso-tta.  
 Thug-NOM 3-CL<sub>persons</sub>-DIST-GEN police-ACC assault-PAST  
 lit“A thug assaulted a three-person police.”

In (15), a certain portioning of tablets creates a context for a group membership among units of three tablets and it licenses a group distributive reading.

- (15) a. Scenario: I take three tablets every day: antibiotic, mucoprotective and painkiller. Today, I forgot them and asked my flatmate to bring them to my office.  
 b. Teeburu-ni san-joo-**zutsu**-no kusuri-ga ar-u kara, sore-o  
 table-at, 3-CL<sub>tablets</sub>-DIST-GEN medicine-NOM exist-PRES as, it-ACC  
 mo-tte-ki-te-kure-nai?  
 bring-CONJ-COME-CONJ-REQUEST-NEG  
 “As there are sets of three tablets on the table, could you bring them?”

In this section, I discussed the licensing conditions for a group distributive reading. This reading is restricted to the prenominal position and it requires a contextually supplied membership among individuals.

### 6.3 Partitioning situations

In this section, I propose a formal analysis of the three readings of “-zutsu” under the framework of possibilistic version of situation semantics (Elbourne, 2005; Kratzer, 1989; Schwarz, 2009, *et seq*). Note that I present an analysis with a static setting in this chapter. See Chapter 7 for an implementation of this analysis with PCDRT. The gist of the analysis is that “zutsu” partitions the value of a situation pronoun  $s_\tau$  into smaller sub-situations  $s'$ . This situation partition is sensitive to both contexts and syntactic positions. The difference among the three readings are derived from these two conditions. If “-zutsu” occurs at the nominal domain,  $s_\tau$  picks

3. I thank Wataru Uegaki (p.c.) for providing this context.

up a contextually salient situation and partition goes along with a uniquely identifiable situation-individual mapping in a given context. It derives a group distributive reading. On the other hand, if “-zutsu” occurs at the verbal domain,  $s_\tau$  picks up the same situation as the clausal denotation and partition goes along with a thematic function. It derives a weak truth condition which subsumes an individual distributive reading and an occasion distributive reading. An advantage of this analysis is that the important properties of “zutsu” come from independently motivated principles in situation semantics. Thus, it reduces construction-specific mechanisms to more general mechanisms. At the same time, it suggests that overt distributors can offer a new playground for situation semantics.

### 6.3.1 Situation semantics

In this section, I introduce the main ingredients of the analysis. I adopt the possibilistic version of situation semantics (Elbourne, 2005; Kratzer, 1989, *et seq*).

- (16) a. a proposition  $p$  is a set of situations:  $p = \{s_1, s_2, \dots\}$   
 b. the part-whole relation  $\sqsubseteq$  is defined for situations.  
 c. individuals are part of situations.

I use a mereological part-whole relation  $\sqsubseteq$  to model part-whole relations among situations and between individuals and situations.<sup>4</sup>

Situation semantics provides partiality to the evaluation of a proposition so that it is relative to a particular part of a world, instead of the entirety of a world. This partiality provides a way to restrict the domain of quantification to evaluate the uniqueness requirement of definite descriptions.

- (17) a. **The earth** is round.  $\Rightarrow$  unique in a world  
 b. **The prime minister** visits a hospital.  $\Rightarrow$  unique in a country  
 c. **The bathroom** is currently out of use.  $\Rightarrow$  unique in a house

4. In Chapter 7, I unify this with subset relation  $\subseteq$ . I use  $\subseteq$  to model part-whole relation between values stored in a plural information state and values stored in subsets of the plural information state, while I use  $\sqsubseteq$  to model part-whole relation between entities regardless of states.

In the examples in (17), the uniqueness presupposition of the definite description is satisfied relative to a particular situation. For example, there are plenty of bathrooms in a world, but if (17c) is uttered in a house with one bathroom, the definite description “the bathroom” refers to it. This uniqueness relativised to a situation plays a crucial role in the situation semantic analyses of *donkey sentences*.

(18) Every farmer who owns a donkey cherishes **the donkey**.

(18) talks about multiple farmer-donkey pairs and thus one cannot determine a unique donkey in this situation. And yet, one can find a unique donkey if one restricts attention to the *minimal* situations each of which just contains a farmer and a donkey. Thus, the restrictor of “every” introduces minimal situations and the uniqueness presupposition of “the donkey” is satisfied relative to these minimal situations. The minimality of a situation is defined with the notion of *exemplification* (Kratzer, 1989, 2007b; Schwarz, 2009). I use  $\text{EXEM}(p)(s)$  to notate it.

(19) **Exemplification:** A situation  $s$  exemplifies a proposition  $p$ , i.e.  $\text{EXEM}(p)(s)$  iff  $p$  is true in  $s$ , and (i) there is no  $s'$  such that  $p$  is true in  $s'$  and  $s'$  is part of  $s$ , or (ii) for all  $s'$  which is part of  $s$ ,  $p$  is true in  $s'$ .

If situations  $s'$  all exemplify  $p$ , then the sum of these situations  $s'$  *broadly exemplifies*  $p$  (Kratzer, 2007b). When a situation  $s$  either exemplifies or broadly exemplifies  $p$ , I notate it as  $^*\text{EXEM}(p)(s')$ .

Now, the denotation of (18) is given in (20).

$$(20) \quad \llbracket (18) \rrbracket = \lambda s \forall s' \forall x [[s' \sqsubseteq s \ \& \ \text{EXEM}(\lambda s \exists y [\text{farmer}(x)(s) \ \& \ \text{donkey}(y)(s) \ \& \ \text{own}(x)(y)(s)])(s')] \rightarrow \exists s'' [s' \sqsubseteq s'' \ \& \ s'' \sqsubseteq s \ \& \ \text{cherish}(x)(\iota y. [\text{donkey}(s'')(y)])(s'')]]$$

In this way, uniqueness relativised to minimal situations can correctly predict the availability of definite descriptions in donkey sentences.<sup>5</sup>

5. I do not discuss the details of situation semantic analyses of donkey sentences. The main point in this section is that the notion of minimal situations is a standard tool in situation semantics.



On the top of it, I adopt the notion of *situation pronoun*, which is a common mechanisms in situation semantics. Situation pronouns play a crucial role in situation semantics to analyse evaluation of quantificational DPs in a shifted world or time (Keshet, 2008, 2010; Percus, 2000; Schwarz, 2009, 2012, a.o.). For example, “every” can evaluate its restrictor in a situation other than the rest of the clause, whereas it is not possible with existential constructions.

- (21) a. Every fugitive is in jail. (Enç, 1986)  
 b. # There is a fugitive in jail. (Musan, 1995).

Under the situation semantic framework, it is due to a situation pronoun  $s_\tau$ . Just like an ordinal pronoun, situation pronouns can either be bound by a syntactic binder or take a contextual value via an assignment function. In (21a),  $s_\tau$  takes a contextual value to avoid contradiction as represented in (22).

- (22)  $\forall x [x \text{ is a fugitive in } g(s_\tau) \rightarrow x \text{ is in jail in } s]$

Lastly, I discuss basic types of predicates. Schwarz (2009) assumes that the semantic type of nouns is  $\langle e, st \rangle$ . More generally, predicates of are type  $\langle \alpha, st \rangle$ , whereas strong determiners are of type  $\langle s, \langle \langle e, st \rangle, \langle \langle e, st \rangle, st \rangle \rangle \rangle$ .<sup>6</sup>

- (23) a.  $[[\text{fugitive}]] = \lambda x \lambda s [\text{fugitive}(x)(s)]$   
 b.  $[[\text{every}]] = \lambda s_\tau \lambda P_{\langle e, st \rangle} \lambda Q_{\langle e, st \rangle} \lambda s \forall x \forall s' [[s' \sqsubseteq s_\tau \& \text{EXEM}(P(x))(s')]] \rightarrow \exists s'' [s' \sqsubseteq s'' \& s'' \sqsubseteq s \& M(s'') = x \& Q(x)(s'')]$   
 (Schwarz, 2012, p.181)

The situation pronoun  $s_\tau$  always occurs as the sister of a strong determiner,  $D^0$ .

- (24)
- 
- ```

graph TD
    DP --> D1[D]
    DP --> NP1[NP]
    D1 --> every[every]
    NP1 --> s_tau[s_tau]
    NP1 --> NP2[NP]
    NP2 --> fugitive[fugitive]
  
```

6. I would like to thank Kenta Mizutani (p.c) for helpful discussions on this point.

This contrasts with Percus (2000) and Keshet (2008, 2010). They assume that denotations of nouns are of type  $\langle s, et \rangle$ . More generally, they assume that predicates have the type  $\langle s, \alpha \rangle$ . As a result, situation pronouns are freely inserted in syntax and their distribution is governed by an independent principle.<sup>7</sup> Although one may reconstruct my analysis under this type system, I adopt Schwarz's type system in this thesis as it works better for my purpose. See §6.4 for the detailed discussion.

### 6.3.2 Situation partition and the shifted evaluation effect

In this section, I propose a situation-based analysis of a group distributive reading of “-zutsu.” The gist is that “zutsu” partitions the value of a situation pronoun  $s_\tau$ . First of all, I propose a partition (Schwarzschild, 1996) of situations. To define partitions, I introduce the notion of the *generalised sum*  $\oplus P$  of a set  $P$ .

- (25) a.  $x \circ y \Leftrightarrow \exists z [z \sqsubseteq x \& z \sqsubseteq y]$   
 b.  $\oplus P = \iota x. \forall y [P(y) \rightarrow y \sqsubseteq x] \& \forall z [z \sqsubseteq x \rightarrow \exists z' [P(z') \& z' \circ z]]$

I propose *situation partition* as defined in (26).

- (26)  $\text{Part}(s)$  is partition of a situation  $s$  iff  
 a.  $\text{Part}(s) \subseteq \{s' : s' \sqsubseteq s\}$ ,  
 b.  $\oplus \text{Part}(s) = s$ , and  
 c.  $\forall s', s'' [s', s'' \in \text{Part}(s) \rightarrow \neg \exists s''' [s''' \sqsubseteq s' \& s''' \sqsubseteq s'']]$

Following Balusu (2006); Cable (2014a); Schwarzschild (1996), I assume that a partition is contextually given.

I claim that “zutsu” partitions a situation into sub-situations so that each situation specifies a unique individual in it. I define the presupposition (70) and call it the *distributive uniqueness presupposition*. I notate it as  $\text{UQ}_{Dist}$ .

- (27)  $\text{UQ}_{Dist}(P)(s) \Leftrightarrow$   
 $[|\text{Part}(s)| > 1 \& \forall s' [s' \in \text{Part}(s) \rightarrow \exists x [P(x)(s') \& \forall y [P(y)(s') \& y \sqsubseteq x]]]]$

The  $\text{UQ}_{Dist}$  presupposition ensures that each member of  $\text{Part}(s)$  has a unique  $P$  in it. In effect, it provides one-to-one pairing from situations to individuals.

7. See Keshet (2008, 2010) for the principle of *Situation Economy*, which rules out a structure whenever there is a grammatical alternative with fewer situation pronouns.

I propose that “zutsu” has the denotation (28).  $[[\text{zutsu}]]$  takes a situation pronoun  $s_\tau$ , a numeral quantifier  $Q^8$  and a predicate  $P$  which can either be nominal or verbal.  $[[\text{zutsu}]](Q)(P)$  has the same type as  $P$ .

$$(28) \quad [[\text{zutsu}]] = \lambda s_\tau \lambda Q_{\langle e, st \rangle} \lambda P_{\langle e, st \rangle} : UQ_{Dist}(P)(s_\tau). \\ \lambda x \lambda s [P(x)(s_\tau) \& s \sqsubseteq s_\tau \& \forall s' [s' \in \text{Part}(s_\tau) \rightarrow Q(\iota y. [P(y)(s'))](s'))]]$$

Importantly, the predicate  $Q$  is attributed to the unique individual in each member of  $\text{Part}(s_\tau)$ . Let's see how it works. The  $UQ_{Dist}$  presupposition with a nominal predicate “aisu” (ice cream) and the situation pronoun  $s_\tau$  is given in (29).<sup>9</sup> It presupposes that  $s_\tau$  is partitioned into small situations each of which contains a unique unit of ice cream.

$$(29) \quad UQ_{Dist}(*\text{ice cream})(s_\tau) \Leftrightarrow [|\text{Part}(s_\tau)| > 1 \& \forall s' [s' \in \text{Part}(s_\tau) \rightarrow \\ \exists x [* \text{ice cream}(x)(s') \& \forall y [* \text{ice cream}(y)(s') \& y \sqsubseteq x]]]]$$

The value of  $s_\tau$  has to meet this requirement and it restricts the possible values of  $s_\tau$ . Consider that  $[[*\text{ice cream}]]$  has the denotation in (30), a set of individual-situation pairs, and  $s_\tau = \oplus\{s_1, s_2, s_3, s_4, \dots, s_n\}$ .<sup>10</sup>

$$(30) \quad [[*\text{ice cream}]] = \{\langle \text{bar}_1, s_1 \rangle, \langle \text{bar}_2, s_2 \rangle, \langle \text{bar}_3, s_3 \rangle, \langle \text{bar}_4, s_4 \rangle, \dots, \langle \text{bar}_n, s_n \rangle, \\ \dots, \langle \text{bar}_1 + \text{bar}_2, s_1 + s_2 \rangle, \langle \text{bar}_3 + \text{bar}_4, s_3 + s_4 \rangle, \dots\}$$

The  $UQ_{Dist}$  presupposition restrict the possible candidates of  $\text{Part}(s)$ . (31) exemplifies some of them.

$$(31) \quad \begin{aligned} \text{a. } \text{Part}(s) &= \{s_1, s_2, s_3, s_4, \dots, s_n\} \\ \text{b. } \text{Part}(s) &= \{s_1 + s_2, s_3 + s_4, \dots, s_{n-1} + s_n\} \\ \text{c. } \text{Part}(s) &= \{s_1 + s_2 + s_3, s_4 + s_5, \dots, s_{n-1} + s_n\} \end{aligned}$$

8. This analysis can be extended to numeral quantifiers with a measuring classifier. Any analysis of measure predicates is compatible with the proposed account as long as it takes an individual and returns a truth value. For example, one can alternatively assume that there is a covert mapping operator  $\langle ed \rangle$  and measure predicates denote a set of degrees  $\langle dt \rangle$ .

9. As a reminder, I assume that the denotation of lexical verbs are inherently cumulative (Kratzer, 2007a; Krifka, 1989; Landman, 1996, a.o.) and common nouns in Japanese are inherently cumulative (Chierchia, 1998, a.o.).

10. Note that I consider denotations of “aisu” (ice cream) when it is combined with the classifier “-hon” ( $CL_{Bars}$ ). Technically, one has to assume mass-to-count coercion (*universal packager*) to get the denotation in (30). It is orthogonal to the main point of the discussion and any mechanism would work as long as it derives (30) from the notional mass noun “aisu” (ice cream).

The at-issue content of “zutsu” puts further restrictions on partitions. The at-issue content of “ni-hon-zutsu-no aisū” (2-CL<sub>Bars</sub>-GEN ice cream) is given in (32).

$$(32) \quad \llbracket \text{zutsu} \rrbracket(s_\tau)(\text{two bars})(\text{ice cream}) = \lambda x \lambda s [\text{*ice cream}(x)(s_\tau) \& s \sqsubseteq s_\tau \& \\ \forall s' [s' \in \text{Part}(s_\tau) \rightarrow 2 \text{BAR}(\iota y. [\text{*ice cream}(y)(s'))(s')]]]$$

The assertion makes three claims. The first conjunct says that there is ice cream  $x$  in a situation  $s_\tau$ . The second conjunct requires  $s$  to be part of  $s_\tau$ . The third conjunct says that for each sub-situation  $s'$ , the unique individual which is P in  $s'$  satisfies the measure predicate Q. This last conjunct requires that the unique unit of ice cream in each member of  $\text{Part}(s_\tau)$  consists of two bars. For example, only (31b) satisfies this among the candidates in (31).

The denotation of the full clause is given in (33b).<sup>11</sup>

- (33) a. Daiki-ga ni-hon-**zutsu**-no aisū-o tabe-ta.  
 Daiki-NOM 2-CL<sub>bars</sub>-DIST-GEN ice cream-ACC eat-PAST  
 “Daiki ate two-bar ice cream.”  
 $\rightsquigarrow$  the kind of ice cream Daiki ate generally comes in two bars.
- b.  $\llbracket (33a) \rrbracket = \lambda s \exists x [\text{*eat}(\text{Daiki})(x)(s) \& \text{*ice cream}(x)(s_\tau) \& s \sqsubseteq s_\tau \& \\ \forall s' [s' \in \text{Part}(s_\tau) \rightarrow 2 \text{BAR}(\iota y. [\text{*ice cream}(y)(s'))(s')]]]$

The  $\text{UQ}_{Dist}$  presupposition forces  $s_\tau$  to pick up a situation in which a unique unit of ice cream is defined for each member of  $\text{Part}(s_\tau)$  and the assertive component of  $\llbracket \text{zutsu} \rrbracket$  picks them up via the  $\iota$  operator. The situation in which Daiki ate ice cream is independent of  $s_\tau$ , but since  $\text{*ice cream}(x)(s_\tau)$  holds, the ice cream Daiki ate is part of  $s_\tau$ . Then, the third conjunct requires that the unique unit of ice cream in each member of  $\text{Part}(s_\tau)$  is a two-bar ice cream. As a result, “tabe-ta” (ate) is evaluated with respect to  $s$ , but distribution over ice cream bars is evaluated with respect to  $s_\tau$ . Crucially, universal quantification over  $\text{Part}(s_\tau)$  is performed as an at-issue content. Thus, if Daiki ate ice cream bars which do not generally come in two bars, (33a) is judged false, instead of infelicitous. At the same time, one needs a context in which  $\text{Part}(s)$  can specify a set of situations each of which specifies a two bar ice cream. This requires the common knowledge that there exists a kind of ice cream which comes in two bars.<sup>12</sup> The situation partition in (33b) is visualised in Table 6.1.

11. Although I adopt Neo-Davidsonian event semantics under situation semantics in §6.5, I do not reflect that in (33b) because it does not affect the discussion on group distributive readings.

12. See also §6.4.1 for more discussion.

| $s_\tau$    | $y$ such that ice cream( $y$ ) |                            |
|-------------|--------------------------------|----------------------------|
| $s_1 + s_2$ | ice cream bar <sub>1</sub>     | ice cream bar <sub>2</sub> |
| $s_3 + s_4$ | ice cream bar <sub>3</sub>     | ice cream bar <sub>4</sub> |
| $s_5 + s_6$ | ice cream bar <sub>5</sub>     | ice cream bar <sub>6</sub> |
| ...         | ...                            | ...                        |

**Table 6.1:** Situation partition

Suppose that  $s = s_1 + s_2 + s_4$ . The ice cream Daiki ate, i.e. ice cream bar<sub>1,2,4</sub>, is part of  $s_\tau$ .  $s_\tau$  is partitioned so that each row contains two unique ice cream bars. This scenario satisfies the  $UQ_{Dist}$  presupposition and makes (33b) true. The shifted evaluation effect is observed if the value of  $s_\tau$  is distinct from the situation in which the rest of clause is evaluated.

### 6.3.3 The licensing conditions for a group distributive reading

In this section, I show that the syntactic condition and the semantic condition of group distributive readings follow from two descriptive generalisations which are independently motivated. First, the syntactic distribution of group distributive readings follows from the generalisation that the shifted evaluation is not allowed in the verbal domain. For now, I state it as a descriptive generalisation (34).<sup>13</sup>

- (34) **Non-Shiftability Generalisation in the Verbal Domain:** If a situation pronoun is combined with an adverbial quantifier, it cannot have a contextual value, i.e. it does not exhibit the shifted evaluation effect.

This can be seen in the contrast between a quantifier in the nominal domain and a quantifier in the verbal domain. Quantificational DPs allow a shifted reading as shown in (35a), whereas adverbial quantifiers do not as shown in (35b).

- (35) a. **Many professors** were in kindergarten in the 80's.  
       = Many professors now were in kindergarten in the 80's.

(Musan, 1995)

13. Percus (2000) implements this as the *Generalisation Y*, which is a binding constraint on situation pronouns. This states that the situation pronoun selected by an adverbial quantifier has to be bound by the closest  $\lambda$ -abstractor above it. However, it is not straightforward to apply this constraint to “zutsu.” See Section 6.4 for a way to derive this generalisation without postulating the Generalisation Y as an independent constraint.

- b. In 1984, my syntax professor was **always** picked first for kickball.  
 ≠ My syntax professor in 1984 is such that he is now always picked up  
 first for kickball. (Keshet, 2008)

This interpretive difference of situation pronoun between the nominal domain and the verbal domain is also observed with “zutsu.” The fact that a group distributive reading is only available at the prenominal position suggests that  $s_T$  that “zutsu” selects can take a contextual value in the nominal domain, but not in the verbal domain. This is quite reminiscent of the contrast between (35a) and (35b). For now, I just claim that any analysis which is responsible for (34) can explain why the shifted evaluation effect of “zutsu” is observed at the prenominal position, but not at the floating position. I will propose a way to derive (34) in Section 6.4.

One may wonder if (34) is too weak: (34) allows the prenominal “zutsu” to induce a shifted evaluation effect, but it does not require it. However, I show that the prenominal “zutsu” allows a reading in which a situation pronoun is co-indexed with the situation in which the rest of the clause is evaluated. In such cases, the prenominal “zutsu” induces a group distributive reading without the shifted evaluation effect.<sup>14</sup> For example, (36) is true if one rescue team formed three-member temporal sub-teams when they searched for victims. In this scenario, the team division is not inherent to the rescue team and is evaluated in a situation in which searching is evaluated.

- (36) San-nin-**zutsu**-no kyuuujotai-ga sounansya-tachi-o sousaku-sita.  
 3-CL<sub>persons</sub>-DIST-GEN rescue team-NOM victim-PL-ACC search-PAST  
 “A rescue team searched for victims.”  $\rightsquigarrow$  the rescue team formed three-member sub-teams when they search for victims.

This reading is still different from individual or occasion distributive readings. To see this, I test it with an expression “betsu” (different). English “different” has an *external reading* as exemplified in (37a) and an *internal reading* as exemplified in (37b) (Carlson, 1977a).

- (37) a. Mary recited ‘The Raven’. Then, Linus recited a **different** poem.  
 b. Every boy recited a **different** poem. (Brasoveanu, 2011)

14. I would like to thank Kenta Mizutani (p.c.) for pointing out that the Generalisation Y potentially leads to overgeneration, but suggesting that there are actually two sub-cases of group distributive readings, which correspond to two possible ways to put an index to  $s_T$ .

(37a) is true if Linus recited a poem which is different from ‘The Raven’. In contrast, (37b) is true if for any pair of boys, the poems they recited are different from each other. “betsu” (different) in Japanese also has an external reading and an internal reading. The quantificational subject allows an internal reading as shown in (38a), but the non-quantificational subject does not as shown in (38b).

(38) Context: In a lecture of poetry, the teacher recited ‘Bamboo Retreat’ and let the students choose a poem for them to recite.

- a. **Dono-seito-mo betsu-no shi-o roodoku-sita.**  
 every-student-mo different-GEN poem-ACC recite-PAST  
 i. “Every student recited a different poem.” (Internal reading)  
 ii. “Every student recited a different poem than ‘Bamboo Retreat’.”  
 (External reading)
- b. **Nana-nin-no-seito-ga betsu-no shi-o roodoku-sita.**  
 7-CL<sub>Person</sub>-GEN-student-NOM different-GEN poem-ACC recite-PAST  
 i. \*“(Seven students) recited different poems.” (Internal reading)  
 ii. “Seven students recited a different poem than ‘Bamboo Retreat’.”  
 (External reading)

This ambiguity with “betsu” (different) functions as a litmus test for group distributive readings. First of all, a group distributive reading with a contextually salient situation does not license an internal reading of “betsu” as shown in (39).

- (39) **Daiki-ga ni-hon-zutsu-no ais-u-o betsu-no mise-de ka-tta.**  
 Daiki-NOM 2-CL<sub>bar</sub>-DIST-GEN ice cream-ACC different-GEN store-at buy-PAST  
 “Daiki bought ice cream in a different store.”  $\rightsquigarrow$  the kind of ice cream Daiki bought generally comes in two bars.
- a. \*Internal reading: Daiki bought each bar of ice cream in a different store.  
 b. External reading: Daiki bought bars of ice cream at a store which is different from the one mentioned before.

Now, the contrast between (40) and (41) shows that an individual distributive reading and a group distributive reading are still different even when the prenominal “zutsu” partitions the same situation as the one in which the rest of the clause is evaluated: individual distributive readings allow an internal reading, whereas group distributive readings do not.<sup>15</sup>

- (40) Kyuujotai-ga san-nin-**zutsu** **betsu**-no sounansya-o sousaku-sita.  
 rescue team-NOM 3-CL<sub>persons</sub>-DIST different-GEN victim-ACC search-PAST  
 “A rescue team searched for different victims in threes.”
- a. Internal reading: victims are different from each other.
  - b. External reading: the victim is different from the one mentioned before.
- (41) San-nin-**zutsu**-no kyuuujotai-ga **betsu**-no sounansya-o sousaku-sita.  
 3-CL<sub>persons</sub>-DIST-GEN rescue team-NOM different-GEN victim-ACC search-PAST  
 “A rescue team searched for a different victim.”  $\rightsquigarrow$  the rescue team formed three-member sub-teams when they search for victims.
- a. \*Internal reading: victims are different from each other.
  - b. External reading: the victim is different from the one mentioned before.

This suggests that the reading in (41) evaluates distributivity of “zutsu” and the rest of the clause in the same situation, but it is still different from individual or occasion distributive readings. Thus, this reading is just a sub-case of group distributive readings. Accordingly, one just needs to allow the prenominal “zutsu” to exhibit the shifted evaluation effect and does not need to require it.

Second, the semantic condition of group distributive readings comes from the  $UQ_{Dist}$  presupposition. I claim that a group membership in a situation satisfies the  $UQ_{Dist}$  presupposition. To see this, it is useful to consider the semantics of group nouns. Pearson (2011) claims that some group nouns, which she calls *committee nouns*, have an inherently intensional semantics so that it pairs different time-space to different members of the group in it. (42b) shows a minimal pair

15. They differ in which constituent “zutsu” attaches to. (40) partitions the denotation of an NP based on the team division given in the situation, whereas partitions the denotation of a VP based on the agent relation. This leads to the contrast in availability of an internal reading. Internal readings of “different” require distributivity/plural predication (Beck, 2000; Brasoveanu, 2011; Carlson, 1987, a.o.). As the object “betsu-no sounansya” (different victim) is evaluated under the scope of universal quantifier over situations only in (40), a co-varying reading is only available in (40). I do not work out the semantics of “betsu” (different) in this section, but any analysis is compatible as long as it requires “betsu” (different) to be under the scope of distributive quantifier. Note that other similar expressions such as “chigau” and “betsubetsu” more easily allow an internal reading than “betsu.”



between an individual proper name and a committee proper name. (42a) shows that quantification with “always” fails with a proper name “John” and an individual-level predicate “has big feet.” On the contrary, (42b) shows that this is fine with a committee proper name “the Pearson family.” This is puzzling because individual level predicates constantly apply to an individual and are thus incompatible with adverbial quantification.

- (42) a. # **John** always has big feet. (INDIVIDUAL)  
 b. **The Pearson family** always have big feet. (GROUP) (Pearson, 2011)

The well-formedness of (42b) naturally follows if the subject can have different extensions in different times. As long as one is talking about a particular person, the value of  $[[\text{John}]]$  is constant across situations. Thus, quantification with “always” is vacuous in (42a). However, if “the Pearson family” specifies different members in different situations, (42b) can avoid vacuous quantification: it is true iff for each situation, the member of the Pearson family there have big feet.<sup>16</sup>

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16. Pearson (2011) assumes that adverbial quantifiers perform unselective quantification and the contrast between (42a) and (42b) is attributed to difference in terms of an additional intensional argument. “John” does not provide it and thus there is no variable which “always” can bind. On the other hand, “the Pearson family” has a world/situation variable and “always” can bind it. Although this analysis itself is not compatible with my analysis, one can reconstruct it under a different implementation. For example, Percus (2007) proposes a pragmatic constraint (i).

- i. **Pragmatic Constraint on adverbial quantifiers** (Percus, 2007): Let  $Q$  be the relevant kind of generalized quantifier, and  $A, B$  two sets. Then the statement  $Q(A)(B)$  is pragmatically deviant in a common ground  $CG$  if there is a proper subset  $A'$  of  $A$  such that  $CG \models Q(A)(B) \Leftrightarrow Q(A')(B)$ .

(i) correctly predicts that (42a) is deviant: since “has a big feet” is constantly true of John, one can always find  $A'$  for a given domain  $A$  such that truth of  $Q(A)(B)$  follows from  $Q(A')(B)$ . However, “the Pearson family” specifies different members in different situations. Suppose that a set  $A'$  contains members of the Pearson family from 1950 to 2000. Even if they are all tall in these situations, it does not guarantee that the members of the Pearson family from 2000 to 2022 are all tall in these situations. In other words, the truth of  $Q(A)(B)$  does not follow from  $Q(A')(B)$ . Thus, (i) can also account for the contrast between (42a) and (42b) without resorting to unselective quantification. Also, Chierchia (1995) proposes that individual-level predicates are inherently generic and their  $s$ -term has to be bound with a covert generic operator. Thus, an overt adverbial quantifier cannot access to it.

Similarly, Magri (2012) observes that the existence condition for a collective term is more demanding than the corresponding plural term. For example, “these dishes” just requires that several dishes exist individually, whereas “this pile of dishes” additionally requires that those dishes are arranged in a pile. Thus, the set of situations in which “this pile of dishes” can be true is a proper subset of the set of situations in which “these dishes” can be true. Magri (2012) explains why plural terms and collective terms behave differently with respect to individual predicates.

- (43) a. These dishes are tall.  $\rightarrow$  the dishes are tall, not the pile  
 b. This pile of dishes is tall.  $\rightarrow$  the pile is tall, not the dishes  
 (Magri, 2012)

(43) shows that the collective term “this pile of dishes” requires the pile to be tall and tallness of individual dishes does not contribute to the truth of (43b). Following Chierchia (1995), Magri (2012) assumes that individual-level predicates are inherently generic. (44) shows simplified representation of (43a) and (43b) with generic quantifier  $\text{Gen}_s$  over situations.

- (44) a.  $\text{Gen}_s [\text{pile of dishes}(a + b + c)(s) \& \text{tall}(a + b + c)(s)]$   
 b.  $\text{Gen}_s [\text{dishes}(a + b + c)(s) \& \text{tall}(a + b + c)(s)]$

In this representation, tallness is attributed to the collection of three dishes,  $a, b, c$ . In (44a), generic quantification is successful because  $[[\text{pile of dishes}]](a + b + c)$  specifies a set of situations in which these dishes are in a pile. On the other hand,  $[[\text{dishes}]](a + b + c)$  specifies more situation, e.g., three dishes individually exist without being piled. For those situations,  $\text{tall}(a + b + c)(s)$  is false. Thus, (44) correctly predicts the asymmetry in (43).

The conjunction of Pearson (2011) and Magri (2012) offers an insight to consider the group membership in terms of situations. First, a group term requires that there is a unique group in each situation. Second, a group term specifies a set of situations in which a certain group is formed, but this set does not include situations in which the members of this group exist individually. These are exactly what the  $\text{UQ}_{Dist}$  presupposition requires: there has to be a unique set of individuals in each member of  $\text{Part}(s)$  and the members of  $\text{Part}(s)$  do not overlap each other. Hence, sub-parts of a member of  $\text{Part}(s)$  are not members of  $\text{Part}(s)$ . In this way, “zutsu” is semantically analogous to group terms and this explains why a group distributive reading requires group nouns or contextually supplied membership.

## 6.4 Distribution of situation pronouns

So far, I have shown that “zutsu” exhibits the shifted evaluation effect. Crucially, this effect is limited to the nominal domain, which I stated as the Non-Shiftability Generalisation in the Verbal Domain. In this section, I aim to derive this generalisation from independent principles. I propose that type shifting operators  $\iota_{\alpha}$  and  $\cap$  has an additional slot for a situation and it triggers insertion of a situation pronoun. As these operators are defined for nominal predicates, they do not apply to verbal predicate. Thus, insertion of a situation pronoun is not triggered for verbal predicates and this explains lack of the shifted evaluation effect in the verbal domain.

### 6.4.1 Reduction with a type-system

The discussion so far strengthens the generalisation that the shifted evaluation effect is only allowed in the nominal domain. An obvious candidate to derive this generalisation is the Generalisation Y (Percus, 2000). In Percus (2000), the distribution and co-indexation of situation pronouns are, in principle, free. I call this hypothesis the *Free Situation Pronoun Hypothesis* following Keshet (2010).

- (45) **Free Situation Pronoun Hypothesis:** A situation pronoun may be freely inserted and indexed wherever it is the complement to a node of type  $\langle s, \alpha \rangle$ .

Based on this hypothesis, Percus (2000) filters out undesired co-indexation with independent binding constraints on situation pronouns. Two of such binding constraints are the Generalisation X and the Generalisation Y which require that a situation pronoun has to be bound by the most local  $\lambda$ -abstractor when it is selected by verbal predicates or adverbial quantifiers.

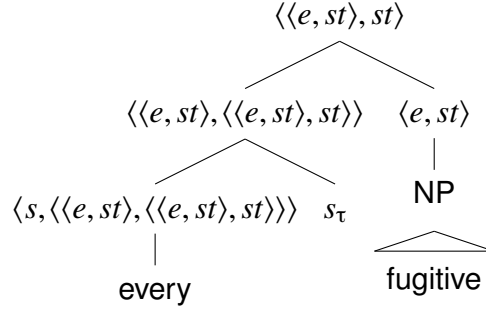
- (46) a. **Generalisation X:** The situation pronoun that a verb selects for must be co-indexed with the nearest  $\lambda$ -abstractor above it.  
 b. **Generalisation Y:** The situation pronoun that an adverbial quantifier selects for must be co-indexed with the nearest  $\lambda$ -abstractor above it.

In this sense, the Generalisation Y in Percus (2000) is defined for the class of adverbial quantifiers and not for the structural position of an adverbial quantifier. As the Generalisation Y would apply to “zutsu” regardless of its syntactic position, this version of the Generalisation Y does not explain why the shifted evaluation effect of “zutsu” is restricted to the prenominal position.

In contrast, Schwarz (2009) derives the Generalisation X and Y effect without postulating them as independent binding constraints. In his system, the distribution of situation pronouns is not free: situation pronouns can only occur as a sister of a strong determiner. Recall his DP sub-tree and entry of “every.”

- (47) a.  $[[\text{every}]] = \lambda s_\tau \lambda P_{\langle e, st \rangle} \lambda Q_{\langle e, st \rangle} \lambda s \forall x \forall s' [[s' \sqsubseteq s_\tau \& \text{EXEM}(P(x))(s')]] \rightarrow \exists s'' [s' \sqsubseteq s'' \& s'' \sqsubseteq s \& M(s'') = x \& Q(x)(s'')]]$

b.



In this analysis, verbal predicates and adverbial quantifiers do not exhibit the shifted evaluation effect simply because they cannot host a situation pronoun.

However, this analysis is not fully compatible with the proposed analysis in two aspects. First, I proposed that “zutsu” involves the same semantics in the prenominal position and the floating position. Indeed, one of the advantages of this analysis is that one can derive different readings at different positions with a single lexical entry. If a situation pronoun can only occur as the sister of a strong determiner, one has to stipulate that “zutsu” has an additional slot for a situation pronoun only at the prenominal position. This significantly subtracts the explanatory power of the analysis because it is just a restatement of a phenomenon. Second, “zutsu” does not have the semantics of a strong determiner. Thus, one has to stipulate that not only strong determiners, but also “zutsu” can also host a situation pronoun. This raises a new question of why adverbial quantifiers cannot.

And yet, I claim that Schwarz (2009) is basically on the right track. I propose that  $[[\text{Num-CL-zutsu-no NP}]]$  essentially has the semantics of bare arguments and it resorts to a type-shifting operation from a predicate to an entity. To see this, let me briefly review the analysis of bare nouns and kind-terms in Chierchia (1998). Chierchia (1998) models a kind as the sum of all the instances of it and assumes that the domain of kinds is a subset of the domain of entities, i.e.  $D_k \subseteq D_e$ . The

sorted type  $e$  variable  $x_k$  stands for kinds. Chierchia (1998) proposes a pair of operators  $\cup$  and  $\cap$  as defined in (48a) and (48b).  $k$  stands for individual-concepts of type  $\langle s, e \rangle$ . Since a kind is defined as the sum of all the instances of it,  $\cap P$  is defined only if  $P$  is cumulative.<sup>17</sup>

- (48) a.  $\cup k_{\langle se \rangle} = \lambda s \lambda x [x \sqsubseteq k(s)]$  if  $k(s)$  is defined.  $\cup k = \emptyset$ , otherwise  
 b.  $\cap P_{\langle e, st \rangle} = \lambda s \iota x. P(x)(s)$  if  $P$  is cumulative and  $\iota x. P(x)(s) \in D_k$ . It is undefined, otherwise.

Chierchia (1998) proposes that bare arguments generally utilise the  $\cap$  operator and they denote kinds. However, bare arguments do not always induce a kind reading and they also have an existential reading. He derives this reading from a mismatch between the sortal restriction of a sentential predicate and the sort of an argument. Compare (49a) and (49b).

- (49) a. Dogs are widespread.  
 b. Dogs are running.

(49a) and (49b) involve different types of predicates: “being widespread” is a *kind-level predicate*, which describes a kind, whereas “are running” is not. This means that (49b) results in violation of selectional restriction if “dogs” is a kind-referring term. Intuitively, they have different truth conditions. (49a) makes a statement about dog-kind: it is true iff the distribution of instances of dog-kind are widespread in the world. In contrast, (49b) makes a statement about some particular instances of dogs: it is true iff there are some dogs which are running. To derive existential readings such as (49b), Chierchia (1998) proposes a composition rule *Derived Kind Predication* (DKP).<sup>18</sup>

17. In Chierchia (1998),  $\cap$  can be regarded as  $\iota$  with an additional world argument. However, this distinction is lost in the version of situation semantics I adopt. The difference between  $\cap$  and  $\iota$  in this analysis is that  $\cap$  is undefined if  $\cap P$  does not have a corresponding kind, whereas  $\iota P$  is not. Although I adopt both  $\cap$  and  $\iota$  in this thesis, one can aim to eliminate  $\cap$  and utilise  $\iota$  to derive reference to kind. See Izumi (2012) for an argument in favour of such an approach.

18. The original version of Derived Kind Predication is given in (1). The crucial difference between this original version and (50) is that (50) ensures that  $x_o$  is an instance of  $x_k$  without using the  $\cup$  operator. This is because  $\cap P$  is combined with a situation pronoun in my analysis and the  $\cup$  operator is not defined for entities of type  $e$ .

(1) **Derived Kind Predication** (Chierchia, 1998): If  $P$  applies to objects and  $x_k$  is a kind, then  $P(x_k) = \exists x [\cup x_k(x) \& P(x)]$

- (50) **Derived Kind Predication** (situation semantic version): If  $P$  applies to objects and  $x_k$  is a kind, then  $P(x_k)(s) = \exists x_o [x_o \sqsubseteq x_k \& P(x_o)(s)]$

Chierchia (1998) assumes that the DKP is a repair strategy to avoid sortal mismatch: DKP is triggered when a predicate takes a kind, but the predicate is not defined for kinds. (51) shows how it works with (49b).

- (51)  $[[\text{are running}]](\cap \text{dogs})$   
 $= \exists x [\cup (\cap \text{dogs})(x) \& \text{are running}(x)]$  (DKP)  
 $= \exists x [\text{dogs}(x) \& \text{are running}(x)]$

In this way, Chierchia (1998) derives an existential reading of bare plurals.

For a revised analysis of “zutsu,” I essentially follow the analysis of kinds and bare arguments in Chierchia (1998). However, I do not commit to the *Nominal Mapping Parameter*.<sup>19</sup> Chierchia (1998) proposes that languages are parametrised based on two binary features,  $[\pm \text{Arg(ument)}]$  and  $[\pm \text{Pred(icate)}]$ .  $[\text{+Arg}]$  feature allows a noun to be mapped to an entity of type  $e$  and  $[\text{+Pred}]$  feature allows a noun to be mapped to a predicate of type  $\langle et \rangle$ . Chierchia (1998) proposes that numeral classifier languages are specified with  $[\text{+Arg}, -\text{Pred}]$ . This means that nominal predicates in a numeral classifier languages are of type  $e$ . Their predicative counterparts are derived with  $\cup k$ , which guarantees that nominal predicates in numeral classifier languages are inherently plural. On the other hand, he proposes that Germanic languages are specified with  $[\text{+Arg}, \text{+Pred}]$ . More specifically, plural nouns and mass nouns start with type  $e$ . This explains why kind-reference in English is limited to bare plurals and masses. If one adopt the Nominal Mapping Parameter, one has to apply the  $\cup$  operator to a common noun denotation to combine it with “Num-CL-zutsu” and then apply the  $\cap$  operator to the whole NP. Although this analysis can equally work for the purpose of this chapter, I assume that Japanese common noun denotations have type  $\langle e, st \rangle$ .

19. See C. Schmitt and Munn (1999) for an argument that bare singulars in Brazilian Portuguese poses a challenge to the Nominal Mapping Parameter. Although they argue against the Nominal Mapping Parameter, they crucially rely on the assumption that bare singulars in Brazilian Portuguese are number-neutral to derive their kind-reference. Indeed, they explicitly state that this number-neutrality of bare singulars conforms to Chierchia’s intuition on kinds.

The [+Arg, -Pred] behaviour of Japanese itself still follows from number-neutrality of common nouns and absence of the category of determiners in Japanese. First, the assumption that Japanese common nouns are inherently cumulative ensures that common noun denotations in Japanese are in the domain of the  $\cap$  operator. Second, the assumption that Japanese lacks the category of determiners allows various type-shifting operations for NP denotations. Chierchia (1998) proposes that presence of an overt determiner blocks application of its covert counterpart.

(52) **Blocking Principle** (Chierchia, 1998):

For any type shifting operation  $\tau$  and any  $X$ :  $^*\tau(X)$ , if there is a determiner  $D$  such that for any set  $X$  in its domain,  $D(X) = \tau(X)$ .

In other words, if a language does not have an overt article, this does not block covert type-shifting operations from a predicative denotation to an argumental denotation. There are three possible options, namely  $\cap$ ,  $\iota\tau\mathbf{A}$  and  $\exists$ .<sup>20</sup>  $\exists$  and  $\iota\tau\mathbf{A}$  respectively have the same semantics as indefinite articles and definite articles.

- (53) a.  $\cap P_{\langle e, st \rangle} = \lambda s \iota x. P(x)(s)$  if  $P$  is cumulative and  $\iota x. P(x)(s) \in D_k$ . It is undefined, otherwise.  
 b.  $\iota\tau\mathbf{A} = \lambda P_{\langle e, st \rangle} \lambda s : \exists x [P(x)(s) \& \forall y [P(y)(s) \rightarrow y \sqsubseteq x]. \iota x. [P(x)(s)]$   
 c.  $\exists = \lambda P_{\langle e, st \rangle} \lambda Q_{\langle e, st \rangle} \exists x [P(x)(s) \& Q(x)(s)]$

Chierchia (1998) proposes that whenever  $\cap$  is available, the  $\exists$ -shift is unavailable. His reasoning is that  $\cap$  is more meaning preserving than the  $\exists$ -shift because the latter additionally brings about an existential component. However, Dayal (2004) suggests that the  $\iota\tau\mathbf{A}$  should be ranked as high as  $\cap$ .

(54) Application ranking of type-shifters based on meaning preservation

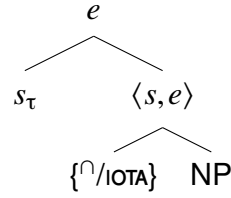
- a. Original ranking (Chierchia, 1998):  $\cap > \{\exists, \iota\tau\mathbf{A}\}$   
 b. Revised ranking (Dayal, 2004):  $\{\cap, \iota\tau\mathbf{A}\} > \exists$

20. I notate this type-shifting operator as  $\iota\tau\mathbf{A}$  to distinguish it from the  $\iota$  operator in the meta language. See also Izumi (2012) for essentially the same definition of this operator under the possibilistic version of situation semantics.

Her claim is based on the fact that bare arguments in Hindi, Russian and Mandarin allow reference to a contextually salient entities as well as reference to kinds. The same applies to Japanese: Japanese bare arguments can be used to refer to a unique individual in a situation, while its existential reading always takes the narrowest scope. I will come back to this point in §6.4.3. According to the revised ranking of type-shifting application in (54b), the  $\cap$  operator and the  $\text{IOTA}$ -shift should be the default options to turn a predicative NP to an argumental NP.

Now,  $\cap P$  and  $\text{IOTA}(P)$  are defined as an individual-concept of type  $\langle s, e \rangle$ . For it to be combined with a verbal predicate, their situation arguments have to be resolved. This motivates insertion of a situation pronoun as shown in (55).<sup>21</sup>

(55)



This creates an asymmetry between the nominal domain and the verbal domain:  $\cap$  and  $\text{IOTA}$  are defined for nominal predicates and thus they can be shifted to an entity of type  $\langle s, e \rangle$ , whereas these are not defined for verbal predicate. Accordingly, a nominal predicate can take a situation pronoun via  $\cap$  or  $\text{IOTA}$ , but this is not an option for a verbal predicate and thus it cannot take a situation pronoun.

### 6.4.2 Compositional details and definiteness

In this section, I present a revised analysis of “zutsu” with the analysis of bare arguments based on type-shifting operations. First of all, I refine the denotation of “zutsu” as shown in (56). It has just one situation argument.

$$\begin{aligned}
 (56) \quad [[\text{zutsu}]] = & \lambda Q_{\langle e, st \rangle} \lambda P_{\langle e, st \rangle} \lambda x \lambda s : \text{UQ}_{Dist}(P)(s). [P(x)(s) \ \& \ \forall s' [s' \in \text{Part}(s) \\
 & \rightarrow Q(\iota y. [P(y)(s')](s'))]]]
 \end{aligned}$$

21. This process is fully in parallel with definite descriptions. See Izumi (2012) for an analysis in which kind-terms are just special cases of definite descriptions.

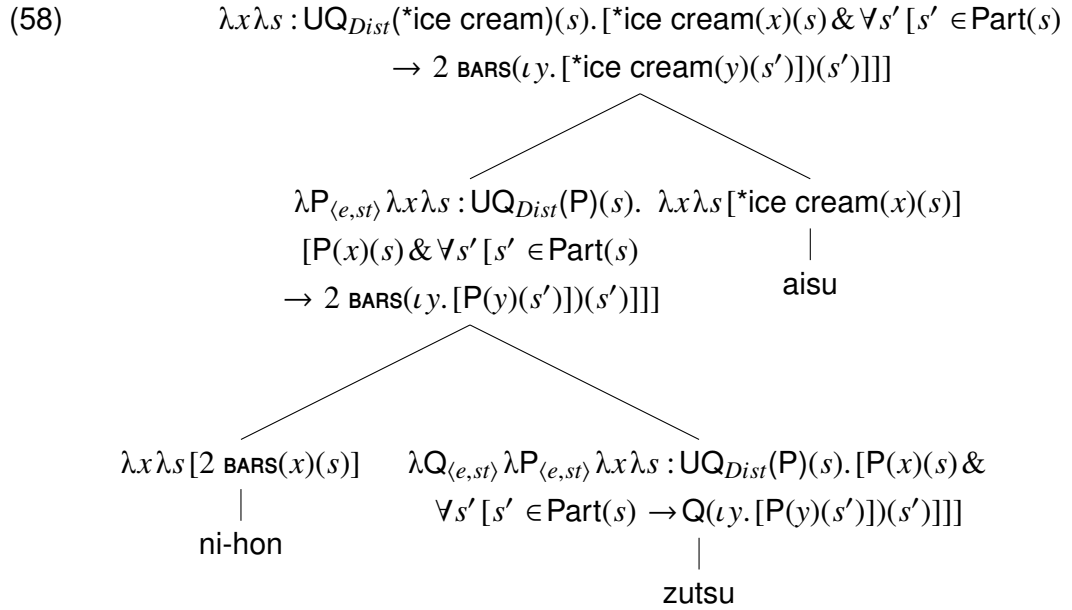


The gist of the analysis is that  $[[zutsu]](\text{Num-CL})(\text{NP})$  returns a predicate of type  $\langle e, st \rangle$  and it relies on a general mechanism to shift a predicative NP to an argumental NP, i.e.  ${}^\cap [[zutsu]](\text{Num-CL})(\text{NP})$  and  $\iota\alpha([zutsu]](\text{Num-CL})(\text{NP}))$  return an individual concept of type  $\langle se \rangle$ . When it resorts to  $\iota\alpha$ , it induces a definite reading and when it resorts to  ${}^\cap$ , it induces an indefinite reading via DKP.

Let's see how it works with the previous examples. Firstly, I consider the previous example which is repeated as (57).

- (57) Daiki-ga ni-hon-**zutsu**-no aisu-o tabe-ta.  
 Daiki-NOM 2-CL<sub>bars</sub>-DIST-GEN ice cream-ACC eat-PAST  
 “Daiki ate two-bar ice cream.”  
 $\rightsquigarrow$  the kind of ice cream Daiki ate generally comes in two bars.

I propose that “ni-hon-zutsu-no aisu” has the structure in (58).

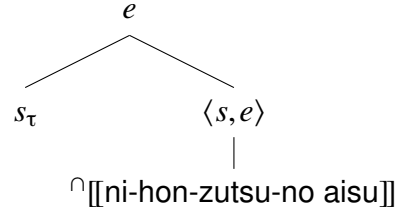


The  ${}^\cap$ -operator shifts it to an individual concept of type  $\langle s, e \rangle$ .

- (59)  ${}^\cap [[\text{ni-hon-zutsu-no aisu}]] = \lambda s : \text{UQ}_{Dist}(*\text{ice cream})(s). \iota x. [* \text{ice cream}(x)(s) \& \forall s' [s' \in \text{Part}(s) \rightarrow 2 \text{ BARS}(\iota y. [* \text{ice cream}(y)(s')](s'))]]]$

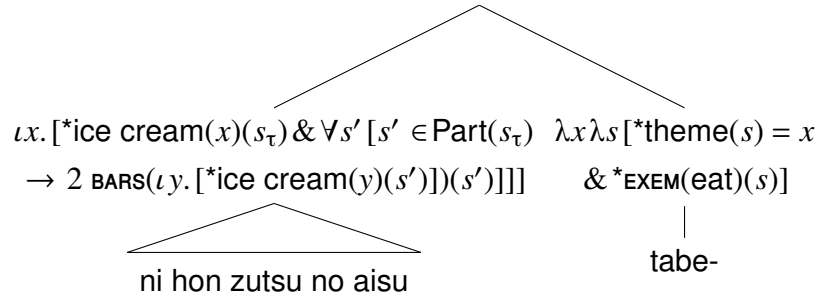
This is combined with a situation pronoun. At this point, the situation argument of the  $\text{UQ}_{Dist}$  presupposition is filled with  $s_\tau$ .

(60)



Then, the sub-tree in (60) is combined with a VP as shown in (61). This composition resorts to DKP.

(61)  $\lambda s \exists z [ * \text{theme}(s) = z \ \& \ z \sqsubseteq \iota x. [ * \text{ice cream}(x)(s_{\tau}) \ \& \ \forall s' [s' \in \text{Part}(s_{\tau})$   
 $\rightarrow 2 \text{ BARS}(\iota y. [ * \text{ice cream}(y)(s'))(s')] ] \ \& \ * \text{EXEM}(\text{eat})(s)] ]$



Omitting the rest of composition, the clausal denotation of (57) is given in (62a).

- (62) a.  $[[ (57) ]] = \lambda s \exists z [ * \text{agent}(s) = \text{Daiki} \ \& \ * \text{theme}(s) = z \ \& \ z \sqsubseteq \iota x. [ * \text{ice cream}(x)(s_{\tau}) \ \& \ \forall s' [s' \in \text{Part}(s_{\tau}) \rightarrow 2 \text{ BARS}(\iota y. [ * \text{ice cream}(y)(s'))(s')] ] \ \& \ * \text{EXEM}(\text{eat})(s)] ]$   
 b. Presupposition:  $\text{UQ}_{\text{Dist}}(* \text{ice cream})(s_{\tau})$

The presupposition is same as before. (62a) is true iff (i) Daiki ate  $y$  in  $s$ , (ii)  $y$  is an instance of  $x$  which is a kind of ice cream in  $s_{\tau}$  and (iii) each of the situations in  $\text{Part}(s_{\tau})$  contains a unique set of two bars of ice cream. In other words, (62a) defines a kind of ice cream each of whose instance in  $s_{\tau}$  comes in two bars. This captures the kind inference straightforwardly and the shifted evaluation effect is obtained without postulating an additional situation argument for “zutsu.”

Note that application of the  $\text{iota}$ -shift is also allowed in this analysis. To show this, let me consider the example which is repeated as (63).

- (63) San-nin-**zutsu**-no kyuu-jotai-ga sounansya-tachi-o sousaku-sita.  
 3-CL<sub>persons</sub>-DIST-GEN rescue team-NOM victim-PL-ACC search-PAST  
 “A rescue team searched for victims.”  
 $\rightsquigarrow$  the rescue team formed three-member sub-teams.

I show that addition of a floating numeral quantifier makes it easy to disambiguate an indefinite reading and a definite reading of (63).

- (64) San-nin-**zutsu**-no kyuuujotai-ga **go-kumi** sounansya-tachi-o  
 3-CL<sub>persons</sub>-DIST-GEN rescue team-NOM five-CL<sub>groups</sub> victim-PL-ACC  
 sousaku-sita.  
 search-PAST  
 “Five (of the) rescue teams searched for victims.”  
 ~> the rescue team formed three-member sub-teams.

(64) allows two readings. One is an existential reading, i.e. there are five rescue teams each of which consists of three members and those five teams searched for victims. The other is a partitive reading, i.e. five of the rescue teams searched for victims and each of those rescue teams consists of three members. In this reading, “san-nin-zutsu-no kyuuujotai” denotes the maximal sum of rescue teams in this situation. Although an existential reading is preferred in the out-of-blue, the narrative in (65) makes a partitive reading more salient.<sup>22</sup>

- (65) San-nin-**zutsu**-no kyuuujotai-ga **go-kumi** sounansya-tachi-o  
 3-CL<sub>persons</sub>-DIST-GEN rescue team-NOM five-CL<sub>groups</sub> victim-PL-ACC  
 sousaku-sita ga, nokori-no san-kumi-wa yamagoya-ni todoma-tta.  
 search-PAST but rest-GEN 3-CL<sub>Groups</sub>-TOP mountain lodge-at stay-PAST  
 “Five of the rescue teams searched for victims, but the remaining three teams stayed at the mountain lodge.”  
 ~> the rescue team formed three-member sub-teams.

In (65), the continuation after “ga” (but) is felicitous, suggesting that the subject and the floating numeral quantifier in (65) induce a partitive reading. Inoue (1978) argues that this type of partitive reading is observed when a floating numeral quantifier is associated with a definite argument as exemplified in (66). In (66a), the number of cars running in front of the speaker does not need to be the same as the number of cars which are arrested. (66b) is more striking in this sense: the number of tracks running side-by-side is greater than the number of tracks which clashed with a guardrail.

- (66) a. [Mae-o hashi-tte-ita jooyoosha]-ga **ni-dai** tsukama-tta.  
 [front-ACC run-PROG-PAST car]-NOM 2-CL<sub>Person</sub> be arrested-PAST  
 “Two of the cars running in front of me were arrested.”

22. I thank to Kenta Mizutani (p.c.) for providing this example.

- b. [Narande hashi-tte-ita suu-dai-no torakku]-ga gaadoreeru-ni  
 side-by-side run-Prog-Past some-CL<sub>Vehicle</sub>-Gen track-Nom guardrail-Goal  
**ni-san-dai** butsuka-tta.  
 2-or-3-CL<sub>Vehicle</sub> clash-Past  
 “Two or three tracks among some tracks that were running side-by-side  
 clashed with a guardrail.” (Inoue, 1978)

Although I do not commit to any particular analysis of partitive readings with a floating numeral quantifier, the fact that (65) allows this kind of partitive readings suggests that [[Num-CL-zutsu-no NP]] can induce a definite reading. If it behaves in parallel with other bare arguments in Japanese, this is expected because [[Num-CL-zutsu-no NP]] can undergo the  $\iota\alpha$ -shift.

Thus, the availability of both an existential reading and a partitive reading suggests that  $\cap$  and  $\iota\alpha$  are both available:  $\cap$  induces an existential reading via DKP and  $\iota\alpha$  induces a definite reading, which forces a floating numeral quantifier to induce a partitive reading. In both cases, [[Num-CL-zutsu-no NP]] is turned into an individual concept of type  $\langle se \rangle$ , motivating insertion of a situation pronoun.

### 6.4.3 The narrowest scope generalisation

In the last section, I proposed that the availability of  $\cap$  and  $\iota\alpha$  in the nominal domain makes a distinction between the prenominal position and the floating position. The core claim is that [[Num-CL-zutsu-no NP]] is turned into an argument in the same way as bare nouns are. This makes a clear prediction that an NP with the prenominal “zutsu” should behave in parallel with bare argument. I show that this prediction is borne out, providing a piece of evidence for the proposed analysis.

Since Carlson (1977b), it has been noted that bare arguments take the narrowest scope. For example, the singular indefinite “a book” can take a wide scope with respect to every, but the bare plural “books” cannot.

- (67) a. Everyone read **a book** on caterpillars. ( $\forall > \exists$  or  $\exists > \forall$ )  
 b. Everyone read **books** on caterpillars. ( $\forall > \exists$  or  $*\exists > \forall$ )

(Carlson, 1977b)

Chierchia (1998) argues that the rule of DKP accounts for this narrowest scope of bare plurals. Since DKP is an operation which locally applies to a particular step in a composition, it is not able to alter the scope relation. For example, (68a) shows a simplified representation for the narrow scope reading of “books” and (68b) shows one for the wide scope reading of “books.” Although (68a) locally triggers DKP, (68b) has to stipulate that application of DKP can be delayed until later compositional step.

- (68) a.  $\lambda x \lambda y [\text{read}(y)(x)](\cap \text{books})$   
 $\rightarrow \lambda y \exists x [\text{read}(y)(x) \& \text{books}(x)]$  (DKP)
- b.  $\forall x [\text{person}(x) \rightarrow \text{read}(\cap \text{books})(x)]$   
 $\rightarrow \exists y \forall x [\text{person}(x) \rightarrow \text{books}(x) \& \text{read}(y)(x)]$  (DKP)

Thus, this DKP-based analysis of existential readings of bare plurals can correctly predict that bare plurals take the narrowest scope.

Izumi (2012) shows that Japanese bare arguments have to take the narrowest scope, just like bare plurals in English. Compare (69a) and (69b).

- (69) a. Subete-no hito-ga **nan-biki-ka-no** **yagi-o** mi-tei-na-i.  
 All-GEN person-NOM wh-CL<sub>Animal</sub>-ka-NO goat-ACC see-PERF-Neg-PRES  
 “Every person didn’t see several goats.”
- b. Subete-no hito-ga **yagi-o** mi-tei-na-i.  
 All-GEN person-NOM goat-ACC see-PERF-Neg-PRES  
 “Every person didn’t see goats.” (Izumi, 2012)

Consider a situation in which for every person, there are some goat that the person did not see. This reading is obtained with the relative scope of  $\forall > \exists > \neg$ . Importantly, this situation allows co-variation between the universal and the indefinite. Thus, it precludes the possibility that the bare argument is interpreted as a definite or a specific indefinite. (69a) is true in this situation, but (69b) is false. If Chierchia (1998) is on the right track, Japanese bare arguments are kind-referring terms and when they are combined with non-kind-level predicates, the existential import comes from DKP. This explains the asymmetry between (69a) and (69b): (69a) gets an existential import either from the quasi-cardinal modifier or the  $\exists$ -shift, but (69b) does not and thus resorts to DKP.

Now, the question is if there is a good reason to believe that an existential reading of the prenominal “zutsu” relies on  $\cap$  and DKP. If it does, an NP associated with the prenominal “zutsu” should obligatorily take the narrowest scope. This prediction is borne out. Consider the three example in the context given in (70). (70a) has a bare argument, (70b) has an indefinite with “ikutu-ka” (some) and (70c) has an argument with the prenominal “zutsu.”

(70) Context: Some people are tasting various types of ice cream. Among them, there are several types of popsicles which come in twos. Everyone ate one type of two-bar popsicles, but no one ate all the types of two-bar popsicles there.

- a. Subete-no hito-ga      **aisu-o**              tabe-naka-tta.  
All-GEN    person-NOM ice cream-ACC eat-Neg-PAST  
“Every person didn’t eat ice cream.”  $\Rightarrow$  **false**
- b. Subete-no hito-ga      **ikutu ka-no**      **aisu-o**              tabe-naka-tta.  
All-GEN    person-NOM how much-ka-GEN ice cream-ACC eat-Neg-PAST  
“Every person didn’t eat some ice cream.”  $\Rightarrow$  **true**
- c. Subete-no hito-ga      **ni-hon-zutsu-no** **aisu-o**              tabe-naka-tta.  
All-GEN    person-NOM 2-CL<sub>Bar</sub>-zutsu-NO ice cream-ACC eat-Neg-PAST  
“Every person didn’t eat two-bar ice cream.”  $\Rightarrow$  **false**

In the situation (70), everyone ate at least some of the two-bar popsicles and those popsicles can be different. Thus, this is the reading of  $\forall > \exists > \neg$ . (70a) is false in this situation, confirming that bare arguments have to take the narrowest scope. In contrast, (70b) is true in this situation, confirming that non-bare indefinites do not need to resort to DKP. Now, consider (70c). Crucially, (70c) is false in this situation. This suggests that “ni-hon-zutsu-no aisū” (2-CL<sub>Bar</sub>-zutsu-GEN ice cream) cannot take scope over negation. This provides a piece of evidence that  $\cap$  applies to the denotation of “ni-hon-zutsu-no aisū” (2-CL<sub>Bar</sub>-zutsu-GEN ice cream) and it resorts to DKP when it is combined with a verbal predicate. Note that (70c) is still false in this scenario if  $\iota\alpha$  applies and the same thing applies to (70a). Thus, whatever account one adopts, if it correctly predicts that existential readings of bare arguments take the narrowest scope, it also accounts for the narrowest scope of NPs with the prenominal “zutsu.” For example, the application rankings of type-shifters proposed in Chierchia (1998) and Dayal (2004) both rank  $\exists$  at the lowest position. Thus,  $\exists$  can apply only when  $\cap$  and  $\iota\alpha$  are undefined.

Lastly, let me briefly discuss the existential import of cardinal modifiers. So far, I have been assuming that cardinals of the form Num-CL have predicative type. This means that they do not have an existential import by themselves. On this point, if an NP with a cardinal modifier gets an existential reading, the only options are  $\cap$  and  $\exists$ . Take the example (71) which involves a cardinal modifier.

- (71) Subete-no hito-ga **san-biki-no yagi-o** mi-tei-na-i.  
 All-GEN person-NOM 3-CL<sub>Animal</sub>-NO goat-ACC see-PERF-Neg-PRES  
 “Every person didn’t see three goats.”

Consider a situation in which for every person, there are three goats that the person did not see. This reading is obtained with the relative scope of  $\forall > \exists > \neg$ . Again, the potential co-variation between the universal and the indefinite precludes the possibility of a definite reading and a specific indefinite reading. In this situation (71) is true. This suggests that NPs with cardinal modifiers can be associated with  $\exists$ . If  $\exists$  is unavailable unless  $\cap$  is undefined, one has to consider why  $\cap$  is undefined with a nominal predicates + a cardinal modifier. This follows from the definition of  $\cap$ . Recall that  $\cap P$  is undefined if  $P$  is not closed under sum. Addition of cardinals make NP denotations non-cumulative and this makes  $\cap$  undefined. Compare the denotations of “yagi” (goat) and “san-biki-no yagi” (three goats). For an expository sake, I ignore situation arguments.

- (72) Suppose that  $x_1, x_2, x_3, \dots, x_n$  are goats
- $[[\text{yagi}]] = \lambda x [*goat(x)] = \{x_1, x_2, x_3, \dots, x_n, x_1 + x_2, x_2 + x_3, \dots, x_1 + x_2 + x_3, \dots\}$
  - $[[\text{san-biki-no yagi}]] = \lambda x [*goat(x) \& 3 \text{ ANIMAL}(x)]$   
 $= \{x_1 + x_2 + x_3, \dots, x_{n2} + x_{n1} + x_n, \dots\}$

The bare noun  $[[\text{yagi}]]$  is closed under sum: if  $[*goat(x)]$  and  $[*goat(y)]$ , then  $[*goat(x + y)]$ . Thus,  $\cap$  is defined for  $[[\text{yagi}]]$  and it blocks application of  $\exists$ . On the other hand,  $[[\text{san-biki-no yagi}]]$  is not closed under sum: if  $[*goat(x) \& 3 \text{ ANIMAL}(x)]$  and  $[*goat(y) \& 3 \text{ ANIMAL}(y)]$ , it is not the case that  $[*goat(x + y) \& 3 \text{ ANIMAL}(x + y)]$  because  $\neg[3 \text{ ANIMAL}(x + y)]$ . Thus,  $\cap$  is undefined for  $[[\text{san-biki-no yagi}]]$  and it does not block the application of  $\exists$ . As a result, (72b) does not have to take the narrowest scope as shown in (71).

The prenominal “zutsu” does not make NP denotations non-cumulative. The denotation of “ni-hon-zutsu-no aisu” is repeated in (73)

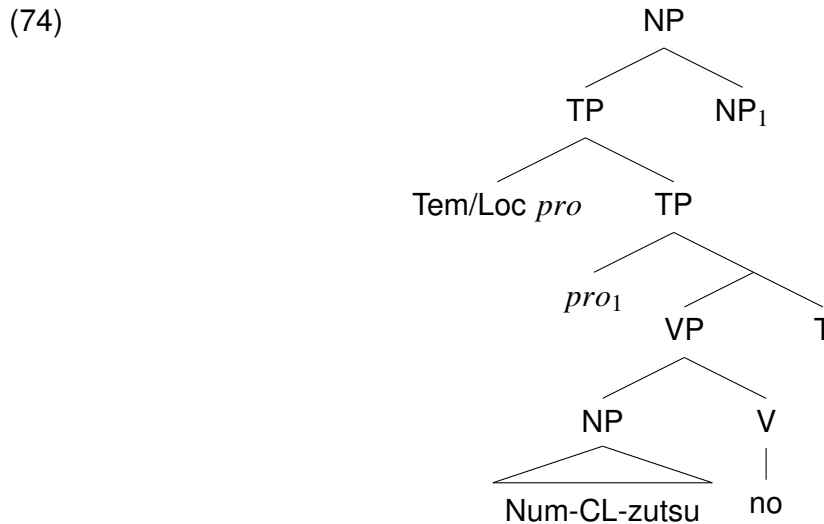
- (73)  $[[\text{ni-hon-zutsu-no aisu}]] = \lambda x \lambda s [\text{*ice cream}(x)(s) \& \forall s' [s' \in \text{Part}(s) \rightarrow$   
 $2 \text{ BARS}(\iota y [\text{*ice cream}(y)(s'))(s'))]]$

Crucially, the cardinality is evaluated with respect to the members of  $\text{Part}(s)$  and it does not directly apply to  $x$  nor  $s$ . Thus, it does not make (73) non-cumulative. Accordingly, if  $x \in [[\text{ni-hon-zutsu-no aisu}]]$  in  $s_1$ , i.e.  $x$  and  $s_1$  can be partitioned so that each member of  $\text{Part}(s_1)$  contains a unique set of two bars of ice cream, and  $y \in [[\text{ni-hon-zutsu-no aisu}]]$  in  $s_2$ , then  $x + y \in [[\text{ni-hon-zutsu-no aisu}]]$  in  $s_1 + s_2$ . This makes (73) and  $\cap$  is defined for it.

Summing up, I showed that  $[[\text{Num-CL-zutsu-no NP}]]$  has to take the narrowest scope, just like plain bare arguments in Japanese. This is expected under the proposed analysis because my main claim is that the prenominal “zutsu” modifies a predicative NP and the whole NP is turned into an argumental NP via a general type-shifting principles which deals with bare arguments.

#### 6.4.4 Predicative use of “zutsu”

In this section, I briefly review a previous syntactic analysis of the prenominal “zutsu” and discuss cases in which “zutsu” occurs as part of a sentential predicate. Miyamoto (2009) proposes that the prenominal “zutsu” occurs in a reduced relative clause which contains a temporal/locative pronoun. (74).<sup>23</sup>



23. (74) adopt an analysis of relative clauses in which the gap is *pro* which is co-indexed with the head NP. Also, his original structure involves a DP layer above the NP, but this is orthogonal to the discussion here.



Miyamoto (2009) proposes that this temporal-locative pronoun is responsible for a group distributive reading. For the sake of terminological brevity, I call it a situation pronoun, too. In support of this, he further observes that “zutsu” can be used predicatively and claims that (75) also involves a situation pronoun at TP.

- (75) Hon-ga ni-satsu-zutsu-da.  
 book-NOM 2-CL<sub>Volumes</sub>-DIST-COP  
 “The books are in twos.”

Note that Miyamoto (2009) motivates a situation pronoun with occasion distributive readings: a covert situation pronoun serves as the distributive key of “zutsu.” In this sense, my situation-based account and this analysis of Miyamoto (2009) share the insight that “zutsu” motivates a covert pronoun which ranges over occasions. These approaches differ in technical implementations of such pronouns: my analysis postulates situation pronouns in the nominal domain, whereas Miyamoto (2009) postulates situation pronouns above TP. Also, note that the core part of my analysis is orthogonal to the analysis in Miyamoto (2009): one can assume the semantics of “zutsu” with the  $UQ_{Dist}$  presupposition and situation partition under the syntax of Miyamoto (2009).<sup>24</sup> However, let me point out that the proposed situation-based analysis can offer an explanation to the interpretation of (75), which is not extensively discussed in Miyamoto (2009). Intuitively, (75) talks about the distribution of books in a particular situation: (75) is true iff books in this situation are arranged so that they are portioned into two volumes. If the subject “hon” (book) in (75) receives an existential reading, (75) should be true if there exists  $X$  such that  $X$  contains several bundles of two books. However, this is not the case. Consider the context given in (76).

- (76) Context: This book store often sells bundles of old books in a wagon.

- a. Situation 1: Today, all the books in the wagon are sold in twos.

⇒ (75) is **true**

24. Miyamoto (2009) does not commit to the semantics of distributivity and thus does not discuss differences between “zutsu” and “sorezore.” However, if a situation pronoun at Spec, TP is responsible for an occasion distributive reading and a group distributive reading, it remains unclear why “sorezore” cannot have these readings. On the other hand, “zutsu” performs universal quantification over situations, while “sorezore” performs (dynamic) distributive quantification over individuals. Thus, it is straightforward why “zutsu” can have readings which rely on situation distribution. One can incorporate this to the analysis in Miyamoto (2009), but this makes the situation pronoun in TP superfluous.

- b. Situation 2: Today, some of the books in the wagon are sold in twos, some others are sold in threes and the other are sold in fours.

⇒ (75) is **false**

In Situation 1 in (76a), all the books are portioned into containers each of which contains two books. In this situation, (75) is true. In Situation 2 in (76b), all the books are portioned into containers, but the cardinality of books differ among these containers. In this situation, (75) is false. This means that “hon” in (75) cannot receive an existential reading. Miyamoto (2009) does not offer a reason why the interpretation of the bare argument is restricted in this way when “zutsu” is used at the predicate position. One possible solution is to propose that the predicative “zutsu” takes an individual concept of type  $\langle se \rangle$ . Accordingly, it does not describe particular individuals, but it describes an arrangement of instances of a kind in a given situation. I propose (77) as an entry of the predicative “zutsu.”

$$(77) \quad [[zutsu_{Pred}]] = \lambda Q_{\langle e, st \rangle} \lambda k_{\langle s, e \rangle} \lambda s : UQ_{Dist}(\cup k)(s). \forall s' [s' \in Part(s) \rightarrow Q(\iota y. [\cup k(y)(s')])(s')]$$

The denotation of “zutsu” at non-predicative positions is repeated (78).

$$(78) \quad [[zutsu]] = \lambda Q_{\langle e, st \rangle} \lambda P_{\langle e, st \rangle} \lambda x \lambda s : UQ_{Dist}(P)(s). [P(x)(s) \& \forall s' [s' \in Part(s) \rightarrow Q(\iota y. [P(y)(s')])(s')]]]$$

Although I leave open how (77) is obtained from (78) or vice versa, the relationship between them is clear. First, (77) applies  $\cap$  to the P-argument in (78). Second, (77) has an additional individual argument  $x$  which guarantees that it behaves as a modifier, whereas it is removed in (77). In this sense,  $[[zutsu]]$  and  $[[zutsu_{Pred}]]$  only differ in semantic type and they convey the same information.

Now, let's see how it derives the reading of (75). The predicative “zutsu” takes an individual concept of type  $\langle se \rangle$  and returns a proposition of type  $\langle st \rangle$ . (79) shows the truth condition of (75).

$$(79) \quad \begin{aligned} [[(75)]] &= [[zutsu_{Pred}]](\cap \text{book}) = \lambda s : UQ_{Dist}(\cup(\cap \text{book}))(s). \forall s' [s' \in Part(s) \\ &\rightarrow 2 \text{ VOLUMES}(\iota y. [\cup(\cap \text{book})(y)(s')])(s')] \\ &= \lambda s : UQ_{Dist}(*\text{book})(s). \forall s' [s' \in Part(s) \rightarrow 2 \text{ VOLUMES}(\iota y. [*\text{book}(y)(s')])(s')] \end{aligned}$$

(79) is true iff a situation  $s$  can be partitioned into smaller sub-situations so that each of those sub-situations contains a unique set of two volumes of books. Thus, the predicative “zutsu” does not directly quantify over books, but it quantifies over sub-situations which contains books. This explains why (79) is false in (76b): there are some books  $y$  in a sub-situation  $s'$  of  $s$  such that  $y$  comes in threes or fours and thus it is not the case that every member of  $\text{Part}(s)$  contain a unique set of two volumes of books. Note that Miyamoto (2009) does not make a false prediction, but rather his analysis does not make any prediction with respect to the interpretation of the predicative “zutsu.” On the other hand, the situation-based account can offer a variant of “zutsu” which is defined for an individual concept and this variant encodes the same information as the entry of “zutsu” in the non-predicative position. In this sense, my analysis has a wider empirical coverage than Miyamoto (2009).

Summing up, my analysis and Miyamoto (2009) share the insight that “zutsu” makes use of a covert pronoun which ranges over situations and the core part of my proposal is orthogonal to his analysis. Thus, one can adopt my semantics based on his syntax.<sup>25</sup> However, I pointed out that the predicative “zutsu” is not a usual predicate for individual and proposed that the situation-based analysis can define a variant of “zutsu” which is defined for an individual concept of type  $\langle se \rangle$ . This variant derives the desired truth condition of the predicative “zutsu.”

## 6.5 A unified analysis of “zutsu”

In this section, I show that the proposed situation-based analysis can also derive an individual distributive reading and an occasion distributive reading. At the floating position, situation partition derives a weak truth condition which covers both an individual distributive reading and an occasion distributive reading. Crucially, one does not need to postulate type-variants of “zutsu” to account for the behaviour of the prenominal “zutsu” and the behaviour of the floating “zutsu.” This contrasts with “sorezore”: the semantics of “zutsu” is constant across syntactic positions and the surface difference comes from applicability of type-shifting operations and insertability of a situation pronoun.

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25. Note that if one the prenominal “zutsu” indeed has the structure of tensed relative clause as Miyamoto (2009) claims, one does not need to postulate a situation pronoun because the tense in the relative clause can specify a different set of situation than a set of situations which the main clause specifies. Thus, this alternative analysis can explain the core data which I discussed in this chapter. I do not pursue this alternative further.

### 6.5.1 Composition of the floating “zutsu”

In this section, I show how the  $UQ_{Dist}$  presupposition and situation partition are evaluated when “zutsu” occurs at the floating position. First of all, I assume that events are situations which exemplify a proposition (Kratzer, 1998, 2007b). Accordingly, eventive predicates denote sets of situations which obligatorily exemplify a proposition. I assume that thematic roles are functions from situations to individuals and they presuppose that situations are eventive.

- (80) a. Eventive predicates  $V$ :  $\lambda s [^*EXEM(V)(s)]$   
 b. Thematic relations  $\theta$ :  $\lambda p \lambda x \lambda s : ^*EXEM(p)(s). [^*\theta(s) = x \& p(s)]$

Importantly, the denotation of a verbal projection has type  $\langle e, st \rangle$ , after a thematic relation  $\theta$  is introduced. Thus, nominal predicates and verbal phrasal predicates have the same semantic type in the version of situation semantics I adopt. This allows the proposed entry of “zutsu” to be directly combined with a verbal phrasal predicates. The denotation of “zutsu” is repeated in (81)

- (81)  $[[zutsu]] = \lambda Q_{\langle e, st \rangle} \lambda P_{\langle e, st \rangle} \lambda x \lambda s : UQ_{Dist}(P)(s). [P(x)(s) \& \forall s' [s' \in Part(s) \rightarrow Q(\iota y. [P(y)(s')]) (s')]]]$

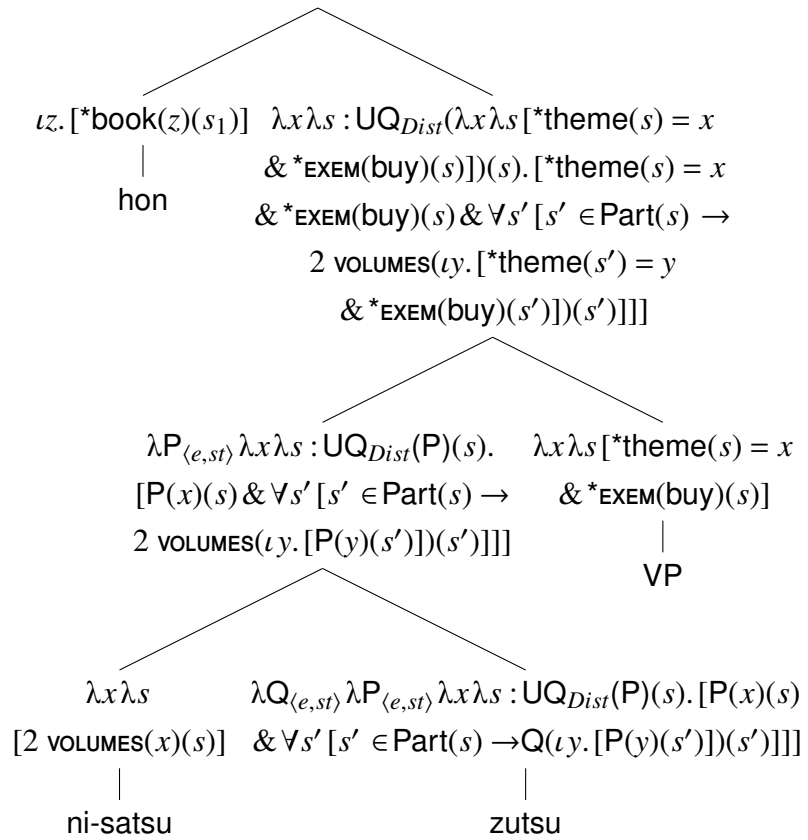
I propose that “zutsu” adjoins to a verbal projection whose denotation has type  $\langle e, st \rangle$  and the mechanism of situation partition derives both an individual distributive reading and an occasion distributive reading without additional mechanism.

Consider (82) as an example. It has an individual distributive reading and an occasion distributive reading.

- (82) Wataru-to-Yasu-ga hon-o ni-satsu-**zutsu** ka-tta.  
 Wataru-and-Yasu-NOM book-ACC 2-CL<sub>volumes</sub>-DIST buy-PAST  
 a. “Wataru and Yasu bought two books each.” (individual)  
 b. “Wataru and Yasu bought two books each time.” (occasion)

(83) shows how “zutsu” is combined with VP and the object. Note that  $[[book]]$  is a bare argument. Thus, it takes its own situation pronoun  $s_1$  and resorts to DKP.

(83)  $\lambda s : \text{UQ}_{Dist}(\lambda x \lambda s [\text{*theme}(s) = x \& \text{*EXEM}(\text{buy})(s))](s).$   
 $\exists z' [z' \sqsubseteq \iota z. [\text{*book}(z)(s_1)] \& \text{*theme}(s) = z' \& \text{*EXEM}(\text{buy})(s) \&$   
 $\forall s' [s' \in \text{Part}(s) \rightarrow 2 \text{ VOLUMES}(\iota y. [\text{*theme}(s') = y \& \text{*EXEM}(\text{buy})(s'))](s')]]$



On this point, the type of verbal predicates does not allow insertion of a situation pronoun because type shifting operators  $\iota_{TA}$  and  $\cap$  are not defined for verbal predicates. Even if one assumes that  $\iota_{TA}$  and  $\cap$  can apply to verbal predicates, it still runs into a problem. If a verbal predicate is shifted to a referential type, it cannot further be combined with a thematic predicate nor an argument. Thus, this option leads to saturation failure. As insertion of a situation pronoun is not triggered at the verbal domain, the floating “zutsu” and the rest of the clause are evaluated in the same situation.

Omitting the rest of the composition, the clausal denotation of (82) is given in (84).

$$(84) \quad \llbracket 82 \rrbracket = \lambda s : \text{UQ}_{Dist}(\lambda x \lambda s [\text{*theme}(s) = x \& \text{EXEM}(\text{*buy})(s))](s). \\ \text{*agent}(s) = \text{Wataru} + \text{Yasu} \& \exists z' [z' \sqsubseteq \iota z. [\text{*book}(z)(s_1)] \& \text{*theme}(s) = z' \\ \& \text{EXEM}(\text{buy})(s) \& \forall s' [s' \in \text{Part}(s) \rightarrow \\ 2 \text{ VOLUMES}(\iota y. [\text{*theme}(s') = y \& \text{EXEM}(\text{buy})(s'))](s'))]]]$$

The  $UQ_{Dist}$  presupposition in (84) requires that each member of  $Part(s)$  contains a unique theme of buying, i.e, the theme relation maps a unique participant to each situation. This is equivalent to the *Unique Role Requirement* (Carlson, 1984; Landman, 2000; Parsons, 1990).

**(85) The Unique Role Requirement:**

if a thematic role is specified for an event, it is uniquely specified.

If one takes it as a general requirement for thematic relations, the  $UQ_{Dist}$  presupposition is trivially satisfied in cases of the floating “zutsu.”<sup>26</sup>

Now, let’s see the at-issue content of (82). (84) is true iff Wataru and Yasu bought books and this situation can be partitioned into sub-situation each of which contains a unique set of two books. Table 6.2 and Table 6.3 show two possible scenarios in which (84) is true. Table 6.2 corresponds to an individual distributive buying and table 6.3 corresponds to an occasion distributive buying.

|        |             |                      |
|--------|-------------|----------------------|
| $s$    | Wataru+Yasu | books ( $x$ )        |
| $s'_1$ | Wataru      | two books ( $x'_1$ ) |
| $s'_2$ | Yasu        | two books ( $x'_2$ ) |

**Table 6.2:** An individual distributive scenario

|        |             |                      |
|--------|-------------|----------------------|
| $s$    | Wataru+Yasu | books ( $x$ )        |
| $s'_1$ | Wataru+Yasu | two books ( $x'_1$ ) |
| $s'_2$ | Wataru+Yasu | two books ( $x'_2$ ) |

**Table 6.3:** An occasion distributive scenario

Importantly, (84) only requires that  $s$  is partitioned into smaller situations each of which contains a unique set of two books. Thus, both of these scenarios can make (84) true. As a result, the proposed entry of “zutsu” defined in (81) induces a weak truth condition which subsumes an individual distributive scenario and an occasion distributive scenario.

26. Note that it is not uncontroversial if (85) is really a requirement. Krifka (1992) claims that the uniqueness of participants is not always guaranteed. For example, one “can see a zebra and, with the same event of seeing, see the mane of the zebra as well” (Krifka, 1992, p. 44). If this is on the right track, then the  $UQ_{Dist}$  presupposition of the floating “zutsu” requires the uniqueness of participants in a non-trivial way.

### 6.5.2 Comparision with previous approaches

So far, I have shown that the proposed situation-based analysis derives a group distributive reading, an individual distributive reading and an occasion distributive reading in a unified manner. I further claim that this situation-based analysis makes better empirical predictions than the previous analyses do. To see this, I first review two types of analyses of JEWELS-type distributors and compare the proposed account with them. Zimmermann (2002) and Champollion (2017) make crucial use of free variables whose values are contextually given. For example, Champollion (2017) defines “jewels” as in (86).  $\theta$  is resolved with a function from events, e.g., thematic relations, the runtime function  $\tau$  and so on.  $C$  takes a contextually salient cumulative property.

$$(86) \quad \llbracket \text{jeweils} \rrbracket^{\theta, C} = \lambda V_{\langle vt \rangle} \lambda e [e \in * \lambda e' [V(e') \& C(\theta(e'))] \& [C \neq \text{ATOM} \rightarrow \oplus C = \theta(e)]]$$

(Champollion, 2017)

To see how it works, recall an example of German “jewels” under an occasion distributive reading. With (86), (87) denotes (88).

- (87) Ann und Belle haben **jeweils** drei Koffer getragen.  
 Ann and Belle have DIST three suitcases carried  
 a. “Ann and Belle have carried three suitcases each.” (individual)  
 b. “Ann and Belle have carried three suitcases each time.” (occasion)

$$(88) \quad \llbracket (87) \rrbracket = \exists e [* \text{agent}(e) = \text{Ann+Belle} \& e \in * \lambda e' [\exists x [* \text{theme} = x \& 3 \text{ suitcases}(x) \& * \text{carry}(e)] \& C(\theta(e'))] \& [C \neq \text{ATOM} \rightarrow \oplus C = \theta(e)]]$$

When  $\theta$  is resolved with the theme relation and  $C$  is resolved with  $\text{ATOM}$ , an individual distributive reading arises. On the other hand, when  $\theta$  is resolved with a relation other than the theme relation and  $C$  is resolved with some contextually salient property, an occasion distributive reading arises.

Note that their analyses treat individual distributive readings and occasion distributive readings as distinct readings. On the other hand, Balusu (2006) and Cable (2014a) utilise the same mechanism of event partition to derive an individual distributive reading and an occasion distributive reading. Cable (2014a) discusses

distributive numerals in Tlingit and proposes that these readings are just sub-cases of a weak truth condition. His analysis uses two ingredients. First, a participant relation holds between an event and some thematic participant of it. Second, the *binary maximality operator* offers the maximal sum of pairs.

- (89) a. **Binary maximality operator:**  $\sigma\langle x, y \rangle. R(x)(y) = \langle \alpha, \beta \rangle$  such that  $\langle \alpha, \beta \rangle \in * \{ \langle x, y \rangle : R(x)(y) \}$  if  $\langle \gamma, \delta \rangle \in * \{ \langle x, y \rangle : R(x)(y) \}$ , then  $\gamma \sqsubseteq \alpha$  &  $\delta \sqsubseteq \beta$ .
- b. **Pair addition:**  $\langle x_1, x_2 \rangle + \langle y_1, y_2 \rangle = \langle x_1 + y_1, x_2 + y_2 \rangle$

With the notions of a participant relation and the binary maximality, the semantics of Cable (2014a) gives (87) the denotation (90). If there are two events  $e_1$  and  $e_2$  each of which has three suitcases as its theme, (90) is true. The scenario for an individual distributive reading (90b) and the scenario for an occasion distributive reading (90c) are two possible situations which make (90) true, but these are not distinguished in the semantic representation.

- (90)  $[[ (87) ]] = \exists y \exists e [ * \text{agent}(e) = \text{Ann+Belle} \ \& \ * \text{theme} = y \ \& \ * \text{carry}(e) \ \& \ \langle e, y \rangle = \sigma_{\langle e' z \rangle} . [ z \sqsubseteq y \ \& \ 3 \text{ suitcase}(z) \ \& \ e' \sqsubseteq e \ \& \ \text{Participant}(e')(z) ] ]]$
- a.  $\langle e, y \rangle = \langle e'_1 z_1 \rangle + \langle e'_2 z_2 \rangle$
- b. Individual distributive:  $\text{agent} = \{ \langle e'_1 \text{ Ann} \rangle, \langle e'_2 \text{ Belle} \rangle \}$
- c. Occasion distributive:  $\text{agent} = \{ \langle e'_1 \text{ Ann+Belle} \rangle, \langle e'_2 \text{ Ann+Belle} \rangle \}$

Balusu (2006) proposes an analysis based on partition of an event and thus it is quite similar to mine. The difference is if there is an additional presupposition which restricts the candidates of partitions.

Thus, these analyses differ in (i) distinction between the two readings and (ii) contextual dependency of distributive readings. The proposed account differs from each of the previous analyses in one aspect, as summarised in Table 6.4.

|                                         | Two readings          | Context dependency                   |
|-----------------------------------------|-----------------------|--------------------------------------|
| Zimmermann (2002)<br>Champollion (2017) | Ambiguous             | C-variable                           |
| Cable (2014a)                           | Underspecified        | No contextual dependency             |
| Balusu (2006)                           | Underspecified        | Partition                            |
| <b>The proposed account</b>             | <b>Underspecified</b> | Partition + <b>UQ<sub>Dist</sub></b> |

**Table 6.4:** The comparison of the proposed account with the previous analyses



I claim that these aspects of the proposed account make right predictions with respect to “zutsu.” First, if individual distributive readings and occasion distributive readings are sub-cases of a weak truth condition, “zutsu” should allow a mixed reading between the two. This prediction is borne out.

- (91) a. Scenario: Ken and Rika are receptionists in a hotel. Today, too many visitors arrived at the same time. So, they decided to allow at most two visitors to be in the reception. Sometimes, each of them deals with one visitor. Sometimes, they collectively deal with a couple. Sometimes, either Ken or Rika has to leave the reception and the other has to deal with two visitors at the same time.
- b. Ken-to-Rika-ga kyaku-o huta-ri-**zutsu** sabai-ta.  
 Ken-and-Rika-NOM visitor-ACC 2-CL<sub>persons</sub>-DIST deal with-PAST  
 “Ken and Rika dealt with visitors two by two.”

(91a) involves neither pure distribution over individuals nor pure distribution over occasion. And yet, (91b) is judged true in this scenario. Table 6.5 shows a possible example of situations described in (91a).

| $s$    | Ken+Rika | visitors ( $x$ )        |
|--------|----------|-------------------------|
| $s'_1$ | Ken      | two visitors ( $x'_1$ ) |
| $s'_2$ | Ken+Rika | two visitors ( $x'_2$ ) |
| $s'_3$ | Rika     | two visitors ( $x'_3$ ) |
| $s'_4$ | Ken+Rika | two visitors ( $x'_4$ ) |
| $s'_5$ | Rika     | two visitors ( $x'_5$ ) |

**Table 6.5:** A mixed scenario

If individual distributive readings and occasion distributive readings are distinguished in the LF, (91b) is not predicted to be true in this scenario. However, the situation-based analysis makes a right prediction:  $s$  is partitioned so that each sub-situation contains a unique set of two visitors. This provides another piece of evidence for the underspecification analysis of these two readings.

Second, the proposed situation-based analysis involve the  $UQ_{Dist}$  presupposition, which ensures plurality of situations. This predicts that the plurality of situations shows the presuppositional behaviour. This prediction is borne out, too. One cannot felicitously deny an assertion with “zutsu” by negating plurality of situation as shown in (92b).

- (92) a. Wataru-ga hon-o ni-satsu-**zutsu** kawa-naka-tta.  
 Wataru-NOM book-ACC 2-CL<sub>Volumes</sub>-DIST buy-NEG-PAST  
 “Wataru didn’t buy two books at each occasion.”
- b. # Nazenara, kare-wa ni-satsu-sika kawa-naka-tta kara-da.  
 Because, he-TOP 2-CL<sub>Volumes</sub>-only buy-NEG-PAST because-COP  
 “This is because he only bought two (books).”

This is not due to the scopal interaction between negation and the at-issue content of “zutsu.” Rather, “zutsu” always takes the surface scope pattern and does not take scope over negation. (93a) only allows a reading in which “zutsu” takes scope over negation. In this scenario, (93b) is infelicitous. Compare it with (93c), which is also true in this scenario.

- (93) a. Scenario: A serial killer always targets a rich family and kills all but two of each family so that those two will remember him forever.
- b. # Sono-satsujinki-wa higaisya-o huta-ri-**zutsu** korosa-na-i.  
 the-serial killer-TOP victim-ACC 2-CL<sub>person</sub>-DIST kill-NEG-PRES  
 “The serial killer does not kill two of the victims each time.”
- c. Sono-satsujinki-wa higaisya-o huta-ri-**zutsu** ikas-u.  
 the-serial killer-TOP victim-ACC 2-CL<sub>person</sub>-DIST let survive-PRES  
 “The serial killer makes two of the victims alive each time.”

(93b) becomes felicitous in a different scenario. The scenario in (94a) only allows a reading in which negation takes scope over “zutsu.” This scenario is compatible with an occasion distributive reading with respect to killing, but it is not the case that each sub-situation contains two victims.

- (94) a. Scenario: A serial killer always targets a rich family and kills all but some of each family so that those survivors will remember him forever. However, he has never made exactly two victims alive because of his traumatic memory.
- b. Sono-satsujinki-wa higaisya-o huta-ri-**zutsu** korosa-na-i.  
 the-serial killer-TOP victim-ACC 2-CL<sub>person</sub>-DIST kill-NEG-PRES  
 “The serial killer does not kill two of the victims each time.”

Thus, the infelicity of (92b) is attributed to the presupposition projection of the UQ<sub>Dist</sub> presupposition.

Summing up, I have shown that the situation-based analysis of “zutsu” derives non-group distributive readings in a uniform manner. Essentially, this analysis differs from the previous analysis in terms of underspecification of individual and occasion distributive readings and presuppositionality of the plurality condition on situations. Both aspects of the analysis make a right prediction and this shows that the situation-based analysis makes a better prediction than the previous analyses, at least with respect to “zutsu.”

## 6.6 Adverbial quantifiers and situation partition

In this section, I discuss adverbial quantifiers in Japanese and show that the adverbial universal quantifier “itsumo” (always) exhibits the shifted evaluation effect, just like “zutsu.” I claim that “itsumo” is a distributive universal quantifier over situations and propose an analysis based on situation partition. The shifted evaluation effect follows from a covert type-shifting operation from a predicative NP to an argumental NP. When the  $\iota$ -shift applies,  $[[\text{itsumo-no NP}]]$  induces a definite reading. When the  $\cap$  applies, it induces a subkind reading, interacting with a pragmatic principle and the constraint on the domain of kinds.

### 6.6.1 Syntactic distribution and distributivity

First of all, Japanese has an adverbial universal quantifier “itsumo.”

- (95) Ryo-wa **itsumo** jaketto-o ki-tei-ru.  
 Ryo-TOP always jacket-ACC wear-PROG-PRES  
 “Ryo always wears a jacket.”

“Itsumo” (always) allows an internal reading of “betsu” (different). The scenario (96a) is only compatible with an internal reading of “betsu” and (96b) is true in this scenario.

- (96) a. Scenario: Ryo gives a lecture every Wednesday. He wears a different jacket every week.  $\Rightarrow$  (96b) is **true**  
 b. Ryo-wa **itsumo** betsu-no jaketto-o ki-tei-ru.  
 Ryo-TOP always different-GEN jacket-ACC wear-PROG-PRES  
 “Ryo always wears a different jacket.”

Now, consider if those adverbial quantifiers can occur at the prenominal position. (97) shows that only “itsumo” (always) can occur at the prenominal position. For the sake of terminological consistency, I call “itsumo” (always) in (95) the floating “itsumo” and the one in (97) the prenominal “itsumo.”

- (97) Ryo-wa **itsumo**-no jaketto-o ki-tei-ru.  
 Ryo-TOP always-GEN jacket-ACC wear-PROG-PRES  
 Lit “Ryo wears the always-jacket.”

Intuitively, the floating “itsumo” requires the clause in which it occurs to denote a set of situations in each of which Shun wears a jacket, while the prenominal “itsumo” just requires it to include one situation in which Shun wears a jacket and universal quantification over situations is evaluated in a different situation. This is reminiscent of the shifted evaluation effect.

Indeed, the prenominal “itsumo” exhibits the shifted evaluation effect. Compare the truth conditions of (95) and (97) in the two scenarios given in (98). (95) is true iff Shun wears a jacket in all of the contextually relevant situations. Thus, (95) is true in (98a), but false in (98b). In contrast, (97) is true iff Shun wears the jacket which he always wears. Thus, it is false in (98a), but true in (98b).

- (98) Context: Ryo has a navy blue jacket, a blown jacket and a gray jacket.
- a. Scenario 1: whenever Ryo gives a lecture, he wears one of the three types of jacket.  $\Rightarrow$  (95) is **true** and (97) is **false**
  - b. Scenario 2: when Ryo gives syntax lectures, he gray jacket and when Ryo gives semantics lectures, he does not wear a jacket. Today, he wears a gray jacket.  $\Rightarrow$  (95) is **false** and (97) is **true**

This suggests that universal quantification over situations is still evaluated as an at-issue content with the prenominal “itsumo,” but this is done in a different situation.

The prenominal “itsumo” and the floating “itsumo” further differ in the availability of an internal reading of “betsu” (different). Take (96b) as an example.

- (99) Ryo-wa **itsumo**-no jaketto-o betsu-no koogi-de ki-te-iru.  
 Ryo-TOP always-GEN jacket-ACC different-GEN lecture-at wear-PROG-PRES  
 “Ryo wears the always-jacket at a different lecture.”
- a. \*Internal reading: Ryo always wears the blown jacket at a different lecture.

- b. External reading: Ryo always wears the blown jacket at the same lecture, but he wears this jacket at a different lecture this time.

(96b) does not license an internal reading of “betsu” (different) as shown in (99).

(100) Context: Ryo has a navy blue jacket, a blown jacket and a gray jacket.

- a. Scenario 1 (internal reading): when Ryo gives syntax lectures, he always wears a navy blue jacket, when he gives semantics lectures, he always wears a brown jacket and when he gives morphology lectures, he wears a gray jacket.  $\Rightarrow$  (99) is **false**
- b. Scenario 2 (external reading): when Ryo gives syntax lectures, he always wears a navy blue jacket and when Ryo gives semantics lectures, he usually does not wear a jacket. Today, he is giving a semantics lecture, but he is wearing a navy blue jacket.  $\Rightarrow$  (99) is **true**

Thus, the prenominal “itsumo” behaves in parallel with the prenominal “zutsu”: both of these expressions evaluate distributivity over situations in a situation other than the one in which the rest of the clause is evaluated.

### 6.6.2 Situation partition with adverbial quantifiers

In this section, I extend the situation partition analysis of “-zutsu” to “itsumo” (always). I do not aim to propose the best analysis of adverbial universal quantifiers. Instead, I modify the situation-based analysis of adverbial universal quantification with situation partition. Elbourne (2013) proposes a situation-based entry of “always” as defined in (101).<sup>27</sup>

$$(101) \quad [[\text{always}]] = \lambda p_{\langle st \rangle} \lambda q_{\langle st \rangle} \lambda s \forall s' [[s' \sqsubseteq s \ \& \ \text{EXEM}(p)(s')] \rightarrow \exists s'' [s' \sqsubseteq s'' \ \& \ s'' \sqsubseteq s \ \& \ \text{EXEM}(q)(s'')]]$$

If the domain restriction is overtly given with an *if*-clause, the  $p$  term takes the denotation of an *if*-clause. When it is not, I assume that a context variable  $C$  provides the relevant set of situations (von Stechow, 1994).

27. Elbourne (2013) adopts the notion of minimality, but I changed it to exemplification for the sake of notational consistency. Also, he decomposes (101) into (i) and (ii) so that (ii) functions as the common component across “always” and “sometimes.”

i.  $[[\text{always}]] = \lambda p_{\langle st \rangle} \lambda q_{\langle s, st \rangle} \lambda s \forall s' [[s' \sqsubseteq s \ \& \ \text{EXEM}(p)(s')] \rightarrow q(s)(s')]$   
 ii.  $[[\text{QA}]] = \lambda p_{\langle st \rangle} \lambda s \lambda s' \exists s'' [s' \sqsubseteq s'' \ \& \ s'' \sqsubseteq s \ \& \ \text{EXEM}(p)(s'')]$

Now, I modify this situation-based semantics of an adverbial universal quantifier with situation partition. I start with an entry of “itsumo” defined in (102). It takes a (possibly covert) restrictor clause and takes a predicate of type  $\langle st \rangle$ .

$$(102) \quad \llbracket \text{itsumo} \rrbracket = \lambda p_{\langle st \rangle} \lambda q_{\langle st \rangle} \lambda s \forall s' \exists s'' \left[ [s' \in \text{Part}(s) \& \text{EXEM}(p)(s') \& s'' \sqsubseteq s'] \right. \\ \left. \rightarrow \exists s''' [s'' \sqsubseteq s''' \& s''' \sqsubseteq s' \& \text{EXEM}(q)(s''')] \right] \quad (\text{to be revised})$$

(102) minimally differs from (101) in terms of situation partition. This is not only for the parallelism between “-zutsu” and “itsumo.” I claim that the disjointness requirement of situation partition emulates the role of *matching function* (Rothstein, 1995). Rothstein (1995) observes that there has to be at least as many events of Mary opening the door as there are events of the bell ringing in (103).

(103) Mary opens the door every time the bell rings. (Rothstein, 1995)

Rothstein (1995) proposes that there is a function *M* from the main clause events onto the adjunct clause events.

$$(104) \quad \forall e \left[ [\text{ring}(e) \& \text{theme}(e) = \text{the bell}] \rightarrow \exists e' [\text{open}(e') \& \text{agent}(e') = \text{Mary} \& \right. \\ \left. \text{theme}(e') = \text{the door} \& \mathbf{M}(e') = e] \right] \quad (\text{Rothstein, 1995})$$

In their Footnote 44, Beaver and Clark (2003) observe the same effects with *always*: there has to be at least as many adjunct clause events as matrix clause events in (105b) and (105c).

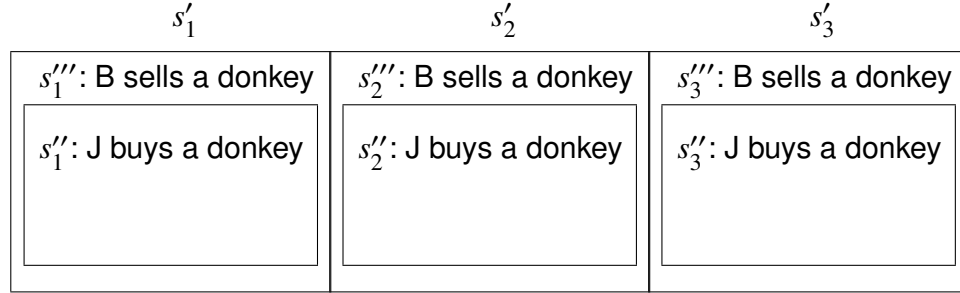
- (105) a. Every time Bill buys a donkey, John sells one. (Rothstein, 1995)  
 b. If John buys a donkey, Bill **always** sells one.  
 c. Sometimes John buys a donkey. Bill **always** sells one.  
 (Beaver & Clark, 2003)

Although I do not postulate an explicit function in the semantic representation, (102) is tantamount to saying that each situations in which *q* is true is paired with a distinct situation in which *p* is true. This is due to the disjointness requirement of situation partition. Assuming that “always” denotes (102), a simplified representation of (105b) is given in (106). (107) is a more transparent notation.

$$(106) \quad \llbracket (105b) \rrbracket = \lambda s \forall s' \exists s'' \left[ [s' \in \text{Part}(s) \& \text{EXEM}(\lambda s \exists x [* \text{agent}(s) = \text{John} \& \right. \\ \left. * \text{theme}(s) = x \& \text{donkey}(x)(s) \& * \text{EXEM}(\text{buy})(s))](s'') \& s'' \sqsubseteq s'] \rightarrow \right. \\ \left. \exists s''' [s'' \sqsubseteq s''' \& s''' \sqsubseteq s' \& \text{EXEM}(\lambda s \exists y [* \text{agent}(s) = \text{Bill} \& * \text{theme}(s) = y \& \right. \\ \left. \& \text{donkey}(y)(s) \& * \text{EXEM}(\text{sell})(s))](s''')] \right]$$

- (107)  $\lambda s \forall s' \exists s'' [[s' \in \text{Part}(s) \& \text{EXEM}(p)(s'') \& s'' \sqsubseteq s'] \rightarrow \exists s''' [s'' \sqsubseteq s''' \& s''' \sqsubseteq s' \& \text{EXEM}(q)(s''')]]]$ , where  
 $p : \lambda s \exists x [* \text{agent}(s) = \text{John} \& * \text{theme}(s) = x \& \text{donkey}(x)(s) \& * \text{EXEM}(\text{buy})(s)]$   
 $q : \lambda s \exists y [* \text{agent}(s) = \text{Bill} \& * \text{theme}(s) = y \& \text{donkey}(y)(s) \& * \text{EXEM}(\text{sell})(s)]$

(106) and (107) are true iff for every  $s'$  in  $\text{Part}(s)$ , if  $s'$  contains an exemplifying situation  $s''$  in which John buys a donkey,  $s'$  is an exemplifying situation in which Bill sells a donkey. Crucially, members of  $\text{Part}(s)$  have to be disjoint from each other. The situation partition in (106) and (107) is exemplified in Figure 6.1.  $s'_1$ ,  $s'_2$  and  $s'_3$  are members of  $\text{Part}(s)$  and do not overlap with each other. Accordingly,  $s''_1$ ,  $s''_2$  and  $s''_3$  do not overlap with each other, too. As a result, for each situation in which Bill sells a donkey, there is a different situation in which John buys a donkey. This ensures that there are at least as many events of Bill selling a donkey as there are events of John buying one.



**Figure 6.1:** Situation partition with “always”

On the top of this, I assume a type-variant of “itsumo” which applies to a predicate of type  $\langle e, st \rangle$  as shown in (108). It is minimally different from (102) with respect to an additional individual argument.

- (108)  $[[\text{itsumo}]] = \lambda p_{\langle st \rangle} \lambda P_{\langle e, st \rangle} \lambda x \lambda s \forall s' \exists s'' [[s' \in \text{Part}(s) \& \text{EXEM}(p)(s'') \& s'' \sqsubseteq s'] \rightarrow \exists s''' [s'' \sqsubseteq s''' \& s''' \sqsubseteq s' \& \text{EXEM}(P(x))(s''')]]]$

The clausal denotation of (109a) is given in (109b). In this case, the restrictor is covertly given via  $C$  variable.<sup>28</sup>

- (109) a. Ryo-wa **itsumo** jaketto-o ki-tei-ru.  
 Ryo-TOP always jacket-ACC wear-PROG-PRES  
 “Ryo always wears a jacket.”

28. The bare indefinite “jaketto” resorts to DKP in this case, but I do not clarify this process for notational brevity. This does not affect the main point of the discussion.

- b.  $[[ (109a) ] ] = \lambda s \forall s' \exists s'' [s' \in \text{Part}(s) \& \text{EXEM}(C)(s'') \& s'' \sqsubseteq s']$   
 $\rightarrow \exists s''' [s'' \sqsubseteq s''' \& s''' \sqsubseteq s' \& \text{EXEM}(\lambda s \exists x [ * \text{agent}(s) = \text{Ryo}$   
 $\& * \text{theme}(s) = x \& * \text{jacket}(x)(s) \& * \text{EXEM}(\text{wear})(s) ])(s''') ] ] ]$

The two scenarios are repeated as (110). The existential quantifier for “jaketto” (jacket) is under the scope of universal quantifier over  $s'$ . Thus, (109a) is true as long as Ryo wears a possibly different jacket in each situation as shown in (110a). At the same time, (109b) requires that whenever Ryo gives a lecture, he wears a jacket. This explains why (109a) is false in (110b).

(110) Context: Ryo has a navy blue jacket, a blown jacket and a gray jacket.

- a. Scenario 1: whenever Ryo gives a lecture, he wears one of the three types of jacket.  $\Rightarrow$  (109a) is **true**
- b. Scenario 2: when Ryo gives syntax lectures, he gray jacket and when Ryo gives semantics lectures, he does not wear a jacket. Today, he wears a gray jacket.  $\Rightarrow$  (109a) is **false**

Summing up, the situation partition-based analysis of “itsumo” derives the desired truth conditions for the floating “itsumo.” Situation partition requires that each member of  $\text{Part}(s)$  do not overlap with each other. This non-overlapping requirement emulates the effect of the matching function in Rothstein (1995).

### 6.6.3 Shifted evaluation effect and adverbial quantification

In this section, I discuss the cases with the prenominal “itsumo.” The denotation of “itsumo-no jaketto” (always-jaketto) is given in (111).<sup>29</sup>

29. Note that adverbial quantification over individual level predicate is disallowed.

- (1) \*John is always tall.

Nominal sentential predicates behave in a similar way and it poses a potential problem for the representations like (111). However, Chierchia (1995) makes a distinction between nouns in the sentential predicate position and in the restrictor position. He claims that individual level predicates are inherently generic and the situation variable in (2a) has to be bound by a genericity operator, but nouns in the restrictor position “internalises” its situation argument as shown in (2b)

- (2) a.  $[[ \text{NP} ] ] = \lambda x \lambda s [ \text{NP}(x)(s) ]$  (predicate)  
 b.  $[[ \text{NP} ] ] = \lambda x \text{GENS} [ \text{NP}(x)(s) ]$  (argument)

And yet, the shifted reading of (3) suggests that (2b) is too strong.

- (3) Every fugitive is in jail. (Enç, 1986)



$$(111) \quad [[\text{itsumo-no jaketto}]] = \lambda x \lambda s \forall s' \exists s'' [[s' \in \text{Part}(s) \& \text{EXEM}(C)(s'') \& s'' \sqsubseteq s'] \rightarrow \exists s''' [s'' \sqsubseteq s''' \& s''' \sqsubseteq s' \& \text{EXEM}(\lambda s [*jacket(x)(s)])(s''')]]]$$

In (111), the exemplification condition applies to  $\lambda s [*jacket(x)(s)]$ . This requires consideration on what it means for a situation to exemplify a nominal predicate. Kratzer (2007b) discusses examples in (112) to demonstrate exemplification.<sup>30</sup>

- (112) a. There is mud:  
 $\lambda s \exists x [\text{mud}(x)(s)]$   
 b. There are three teapots:  
 $\lambda s \exists x [*teapot(x)(s) \& 3 \text{ INDS}(x)(s)]$

Kratzer (2007b) prepares two situations for (112a):  $s_1$  consists of mud and only mud, while  $s_2$  consists of some mud, some moss and nothing else.  $s_1$  exemplifies (112a): since  $s_1$  only contains mud, (112a) is true in any sub-situation of  $s_1$ . On the contrary,  $s_2$  does not: there are sub-situations which consist of moss and (112a) is not true in those sub-situation. Similarly, Kratzer (2007b) prepares two situations for (112b):  $s_3$  consists of three teapots and nothing else, while  $s_4$  consists of three teapots and scissors.  $s_3$  exemplifies (112b): (112b) is true in  $s_3$ , but none of its sub-situations contains three teapots.<sup>31</sup> On the contrary,  $s_4$  does not: it additionally

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Thus, it is plausible that insertion of GEN for a nominal predicate is only motivated when it is used as a sentential predicate. It is more consistent with the classical assumption that the GEN is a covert adverbial quantifier. If inherent genericity is not motivated for nouns in an argument position, (1) does not pose a problem for (111).

Although I do not commit to how (1) should be accounted for, Magri (2009) offers an analysis without lexical specification of inherent genericity. He derives the properties of individual level predicates from interaction between homogeneity of a predicate and an obligatory scalar implicature which is blind to the common knowledge. For example, he claims that (1) competes with (4) which involves the GEN operator.

- (4) John is GEN tall.

Following Fintel (1997), Magri (2009) assumes that GEN conveys the homogeneity presupposition, i.e. either John is tall at every time he is alive or he is never tall. Since (1) and (4) compete by assumption, (1) generates implicated presupposition which is the negation of the homogeneity presupposition, i.e. John is tall not at every time he is alive and he is sometimes tall. This contradicts with the common knowledge and thus (1). See Magri (2009) for the detail and related discussions.

30. I modified the logical translations according to the notational convention I adopt.

31. One has to prohibit to shrink  $s_3$  by chopping off a small part of a teapot so that the three objects are still recognisable as three teapots, e.g.,  $s'_3$  does not contain handles of the three teapots. To avoid this, Kratzer (2007b) proposes that counting privileges maximal self-connected entities (Casati & Varzi, 1999; Spelke, 1990). Although this proposal is compatible with the analysis in this chapter, I do not discuss further as this is orthogonal to the main point of the discussion.

contain scissors and thus one can find a sub-situation of  $s_4$  in which (112b) is true. At the same time, there are sub-situations in which (112b) is not true, e.g., a situation which consists of two teapots or a situation which consists of scissors. Thus,  $s_4$  does not exemplify (112b).

The relevance of this discussion is that  $C$  has to be chosen so that (111) can avoid trivial falsity. For a situation  $s'$  to exemplify  $\lambda s[*\text{jacket}(x)(s)]$ ,  $s'$  has to contain a jacket and only a jacket. However, the restrictor situation  $s''$  has to be a sub-part of  $s'$ . Thus,  $s''$  has to consist of a jacket and only jacket, too. Otherwise,  $\text{EXEM}(\lambda s[*\text{jacket}(x)(s)])(s')$  is trivially false. So, I suggest that  $C$  ranges over situations which consists of a jacket and nothing else in the case of (111).

(111) has to be turned to an argument type via a type-shifting operation. In this section, let me consider the option with the  $\text{iota}$ -shift as shown in (113). Since it is of type  $\langle se \rangle$ , it motivates insertion of a situation pronoun.

$$(113) \quad \text{iota}([\text{itsumo-no jaketto}]) = \lambda s : \exists x [[[\text{itsumo-no jaketto}]](x)(s) \& \\ \forall y [[[\text{itsumo-no jaketto}]](y)(s) \rightarrow y \sqsubseteq x]. \iota x. \forall s' \exists s'' [[s' \in \text{Part}(s) \& \\ \text{EXEM}(C)(s'') \& s'' \sqsubseteq s'] \rightarrow [\text{EXEM}(\lambda s[*\text{jacket}(x)(s)])(s')]]$$

After it takes a situation pronoun, (113) is combined with a verbal predicate. The full clausal denotation is given in (114b).

- (114) a. Ryo-wa **itsumo**-no jaketto-o ki-tei-ru.  
 Ryo-TOP always-GEN coffee-ACC drink-PROG-PRES  
 Lit “Ryo wears the always-jacket.”
- b.  $[[ (114a) ] ] = \lambda s [* \text{agent}(s) = \text{Ryo} \& * \text{theme}(s) = \iota x. \forall s' \exists s'' [[s' \in \text{Part}(s_\tau) \& \\ \text{EXEM}(C)(s'') \& s'' \sqsubseteq s'] \rightarrow [\text{EXEM}(\lambda s[*\text{jacket}(x)(s)])(s')]] \& * \text{EXEM}(\text{wear})(s)]$

I assume that  $s_\tau$  takes the sum of situations in which Ryo gives a lecture and  $C$  takes a set of contextually salient situations which consist of a jacket and nothing else. (114b) is true iff Ryo wears  $x$  which is a unique jacket  $x$  such that whenever a situation of Ryo giving a lecture contains a situation which consists of a jacket and nothing else,  $x$  is the minimal jacket there. Thus, universal quantification over contextually determined set of situations is evaluated in  $s_\tau$ , but the clausal denotation just overlaps with  $s_\tau$  with respect to  $x$ . This captures the intuition that (114a) reports that Ryo wears the jacket which he always wears. In addition, the  $C$  variable ranges over situations which consist of a jacket and nothing else. Thus, existence

of a situation in which Ryo is not wearing a jacket does not matter for evaluation of (114b). Thus, the shifted evaluation effect of the prenominal “itsumo” follows from (108). This analysis is in parallel with the way how a group distributive reading of “zutsu” is derived.

#### 6.6.4 Subkind readings

In the last section, I discussed definite readings of  $\llbracket \text{itsumo-no NP} \rrbracket$ . However, the prenominal “itsumo” induces a sub-kind reading in some contexts. (115) reports that Shun drinks the kind of coffee he always drinks.

- (115) Shun-wa **itsumo**-no koohii-o non-da.  
 Shun-TOP always-GEN coffee-ACC drink-PRES  
 Lit “Shun drank always-coffee.”

Imagine that Shun always drinks Flat White whenever he goes to a cafe. Technically, it is impossible to claim that the cups of Flat White Shun drinks consists of the same entities because those cups of Flat White are consumed in each drinking event. In this sense, what (115) reports is that cups of coffee Shun drinks in a cafe belong to the same subkind. Note that the noun “jaketto” (jacket) can also induce a subkind reading in a different context.

- (116) Ryo-wa **itsumo**-no jaketto-o ka-tta.  
 Ryo-TOP always-GEN jacket-ACC buy-PAST  
 Lit “Ryo bought the always-jacket.”

In (116), it is quite hard to imagine that Ryo bought a jacket he had already gotten. Instead, the most natural reading of (116) is that Ryo always buys the same kind of jacket in a clothing store and he bought another instance of it this time.

I claim that this sub-kind reading comes from the  $\cap$ -operator. However, I claim that this reading interacts with the principle of *Minimise Restrictors!* (Schlenker, 2005a) and the *kind disjointness condition* (Carlson, 1977a).<sup>32</sup> First, the denotation of  $\cap \llbracket \text{itsumo-no koohii} \rrbracket$  is shown in (117).

- (117)  $\cap \llbracket \text{itsumo-no koohii} \rrbracket = \lambda s \lambda x. \forall s' \exists s'' \llbracket [s' \in \text{Part}(s) \& \text{EXEM}(C)(s'') \& s'' \sqsubseteq s'] \rightarrow \exists s''' [s'' \sqsubseteq s''' \& s''' \sqsubseteq s' \& \text{EXEM}(\lambda s [* \text{coffee}(x)(s)](s''')) \rrbracket$

32. This is often called *disjointness condition* in the literature, but I change this term to avoid confusion of this term with the disjointness condition I used in Chapter 5 in the discussion of reciprocals.

In (117), the same entity  $x$  is a coffee in each situation  $s'$ . For the  $\cap$ -operator to be defined,  $x$  has to be a kind in a situation  $s$  which is the sum of  $s' \in \text{Part}(s)$ . Accordingly, the value of  $x$  has to be a kind-level entity. Otherwise, the  $\cap$ -operator is undefined. This makes a sharp contrast with “zutsu”: “zutsu” partitions  $x$  via the  $\text{UQ}_{Dist}$  presupposition and the  $\iota$  operator, whereas “itsumo” does not.

If  $x$  has to be kind-level, there are several possible candidates for  $x$ . Among them,  $\cap(*\text{coffee})$  is the maximal one and it contains various subkinds of coffee. On this point, Carlson (1977a) claims that the expression “kind” obeys the *Kind Disjointness Condition*. I adopt a version from Mendia (2019).<sup>33</sup>

(118) **Kind Disjointness Condition** (Mendia, 2019): A kind-referring expression can only refer to a contextually defined subset of all the possible sub-kinds that the noun is true of, such that:

- a. the subkinds in this subset are disjoint and share no realizations,
- b. the subkinds collectively cover all the space of realizations of the kind

According to (118), the maximal kind  $\cap(*\text{coffee})$  can be partitioned into subkinds so that (i) their sum is identical to  $\cap(*\text{coffee})$  and (ii) they do not overlap with each other.<sup>34</sup> For example,  $\cap(*\text{coffee}) = \oplus\{\cap(*\text{Espresso}), \cap(*\text{Latte}), \cap(*\text{Flat White}) \dots\}$ .

If  $x$  takes one of the subkinds, (117) denotes a subkind of coffee which is part of each member of  $\text{Part}(s')$ . This derives the desired truth condition of (116). However, one can also choose the maximal kind  $\cap(*\text{coffee})$ . I claim that the semantics of “itsumo” and the  $\cap$  operator allows this option, but this nullifies the semantic contribution of “itsumo.” Consider  $\cap[[\text{itsumo-no koohii}]]$  denotes the maximal kind of coffee in a situation  $s$ . On this point, the bare noun “koohii” (coffee) also denotes the maximal kind of coffee via the  $\cap$  operator. Therefore,  $\cap[[\text{itsumo-no koohii}]] = \cap[[\text{koohii}]]$  in this case. Intuitively, this is quite non-cooperative to use “itsumo” without narrowing down the possible values of an expression. For an implementation, I adopt the principle of *Minimise Restrictors!* (Schlenker, 2005a) to prohibit such a vacuous modification.

33. One can also adopt the *taxonomic structure* (Kay, 1971, 1975) for sub-kinds. See Dayal (2004) for an analysis of kind referring definite singulars based on taxonomic structure of kinds. See also, Grimm and Levin (2017); Sutton and Filip (2018). I do not discuss it further here because (118) suffices for my purpose.

34. This is essentially the same as the defining conditions for a partition. Indeed, Mendia (2019) utilises partition of kinds to derive *ad hoc* kind readings in English.

- (119) **Minimize Restrictors!**: A definite description the A B [where the order of A vs. B is irrelevant] is deviant if A is redundant, i.e. if:
- a. the B is grammatical and has the same denotation as the A (= *Referential Irrelevance*), and
  - b. A does not serve another purpose (= *Pragmatic Irrelevance*).
- (Schlenker, 2005a)

In chapter 5, I adopted a generalised version of (119) to account for the anaphoric potential of “sorezore.” I follow the essentially the same version of it to account for the sub-kind readings of the prenominal “itsumo,” although it is refined under the static semantic framework in this chapter.

- (120) **Minimize Restrictors! (modified)**: An expression  $\alpha(A)(B)$  [where the order of A vs. B is irrelevant] is deviant if A is redundant, i.e. if:
- a.  $\alpha(B)$  is grammatical and  $\llbracket \alpha(A)(B) \rrbracket = \llbracket \alpha(B) \rrbracket$  (= *Referential Irrelevance*), and
  - b. A does not serve another purpose (= *Pragmatic Irrelevance*).

Now, the particular choice of  $x$  leads to violation of (120): if the value of  $x$  is the maximal kind of coffee,  $\cap \llbracket \text{itsumo-no koohii} \rrbracket = \cap \llbracket \text{koohii} \rrbracket$ , which violates (120). Therefore,  $x$  has to be chosen from various subkinds of coffee.

The rest of composition is straightforward. After it takes a situation pronoun, (117) is combined with a verbal predicate.  $\cap \llbracket \text{itsumo-no koohii} \rrbracket$  and a verbal predicate is combined via DKP. The full clausal denotation is given in (121b).

- (121) a. Shun-wa **itsumo**-no koohii-o non-da.  
 Shun-TOP always-GEN coffee-ACC drink-PRES  
 Lit “Shun drank always-coffee.”
- b.  $\llbracket (121a) \rrbracket = \lambda s \exists y \text{*agent}(s) = \text{Shun} \ \& \ \text{*theme}(s) = y \ \& \ y \sqsubseteq \iota x. \forall s' \exists s'' [\llbracket s' \in \text{Part}(s_\tau) \rrbracket \ \& \ \text{EXEM}(C)(s'') \ \& \ s'' \sqsubseteq s'] \rightarrow [\text{EXEM}(\lambda s [\text{*coffee}(x)(s)](s')) \ \& \ \text{*EXEM}(\text{drink})(s)]$

I assume that  $s_\tau$  takes the sum of situations in which Shun goes to a cafe and  $C$  takes a set of contextually salient situations which consist of coffee and nothing else. (114b) is true iff Shun drinks  $y$  which is an instantiation of a subkind of coffee  $x$  which exists in each situation of Shun going a cafe. Again, universal quantification over contextually determined set of situations is evaluated in  $s_\tau$ , but the clausal denotation just overlaps with  $s_\tau$  with respect to  $x$ .

Note that the particular choice of subkind is context-dependent. There are cases in which  $\cap$ [[itsumo-no NP]] refers to a not well established kind.

- (122) **Itsumo**-no chaahan-ni aki-ta ra, kono supaisu-o ire-te-mi-ru  
 always-GEN fried rice-DAT get bored-PAST if, this spice-ACC put-CONJ-see-PRES  
 to ii.  
 that good  
 Lit “If you are bored with the always-fried rice, you can use this spice.”

(122) does not necessarily imply a fine-grained classification of subkinds of fried rice. Rather, (122) classifies fried rice in terms of ingredients and suggests that addition of this spice gives the addressee an opportunity to taste a different kind of fried rice. This type of subkind specification still adheres the Kind Disjointness Condition and the Minimise Restrictors. In this case,  $\cap(*\text{fried rice}) = \oplus\{\cap(*\text{fried rice with spice}_1), \cap(*\text{fried rice with spice}_2), \dots\}$ .<sup>35</sup> The maximal kind cannot be chosen as the value of  $x$  to avoid redundancy.

Summing up, the  $\cap$  operator is also an option for the prenominal “itsumo” and it induces a subkind reading in this case. This process interacts with the way how the domain of kinds is structured and avoidance of redundancy in modification.

### 6.6.5 Absence of the predicative “itsumo”

In this section, I briefly revisit an alternative analysis with a relative clause. Recall that Miyamoto (2009) propose an analysis of the prenominal “zutsu” with a reduced relative clause based on the predicative use of “zutsu.”

- (123) Hon-ga ni-satsu-zutsu-da.  
 book-NOM 2-CL<sub>Volumes</sub>-DIST-COP  
 “The books are in twos.”

Unlike “zutsu,” “itsumo” does not have a predicative use as shown in (124).

35. This is similar to *ad hoc* kind reference discussed in Mendia (2019).

- (1) a. The lions that eat people are widespread.  
 b. The dogs that bite are dangerous. (Mendia, 2019)

Such subkinds are not natural kinds. However, instances of the lions that eat people still belong to the same category which is formed based on the description in the relative clause. Mendia (2019) accounts for this kind of *ad hoc* kind reference with (118), assuming an explicit subkind forming operator  $k+$  between a head noun and a relative clause. I leave comparison of my analysis and Mendia (2019) for future work.

- (124) a. \* (Kono) jaketto- $\{ga / wa\}$  itsumo-da.  
           (this) jacket- $\{NOM / TOP\}$  always-COP  
           “(This) jacket is always.”
- b. \* (Kono) koohii- $\{ga / wa\}$  itsumo-da.  
           (this) coffee- $\{NOM / TOP\}$  always-COP  
           “(This) coffee is always.”

This poses a problem for an analysis of the prenominal “itsumo” based on a reduced relative clause. For such an analysis to work, one has to stipulate that the predicative “itsumo” is only acceptable in a relative clause. On the other hand, if the prenominal “itsumo” occurs as a simple prenominal modifier, the problem with (124) does not arise.

## 6.7 Conclusion

In this chapter, I discussed the shifted evaluation effect of an overt distributor “zutsu” and the adverbial universal quantifier “itsumo” in Japanese. They induce distributive interpretation which can be evaluated in a situation other than the one in which the rest of the clause is evaluated. Crucially, “zutsu” and “itsumo” induce the shifted evaluation effect in the prenominal position, but not in the floating position. I proposed a situation-based analysis with situation partition and situation pronoun. This situation-based analysis of distributivity allows a single uniform entry of “zutsu” and “itsumo” to derive this difference between two positions in terms of the shifted evaluation effect. More specifically, I claim that this difference in shiftability is analogous to shiftability of evaluation of strong DPs and non-shiftability of adverbial quantifiers. I claimed that this difference comes from availability of a situation pronoun: an NP with the prenominal “zutsu” or “itsumo” is turned into a kind-term via  $\cap$  and  $\iota$ , both of which triggers insertion of a situation pronoun, whereas this is not an option for a verbal phrase with the floating “zutsu” or “itsumo” and thus insertion of a situation pronoun is not motivated. As consequences, the discussion in this chapter shows that theories of distributivity and theories of situations can merit each other and that insertion of a situation pronoun is also motivated with Japanese bare argument via covert type-shifting operators.

The discussion in this chapter suggests that “zutsu” quantifies over situations and they do not directly quantify over individuals. This makes a clear distinction between “zutsu” and “sorezore.” In Chapter 5, I proposed that “sorezore” shows different interpretive properties in different syntactic positions and this is tied with difference in their restrictor update. In this chapter, I showed that “zutsu” also shows different interpretive properties in different syntactic positions. However, this difference is tied with difference in the insertability of situation pronoun. This suggests that “zutsu” is not a generalised quantifier and its semantics is analogous to the semantics of adverbial quantifiers.

Before closing this chapter, let me briefly discuss one remaining issue. One may ask why Japanese has expressions such as “zutsu” and “itsumo,” whereas other languages such as English do not. This question can be decomposed into two sub-questions, namely (i) which languages can have overt distributors analogous to “zutsu,” and (ii) which languages can use an overt distributor in the nominal domain and induce a group distributive reading. Although the first question is often addressed in the literature (Champollion, 2017; T. Nakamura & Oda, 2022; Zimmermann, 2002), the second question has not been addressed yet. Group distributive readings have not been discussed in the previous literature and it has not been examined which languages can have this reading. One can define an entry of an overt distributor which is minimally different from “zutsu” with respect to selectional restrictions: “zutsu” is defined for both nominal predicates and verbal predicates, but other overt distributors are not. There are several ways to do so. One is to assume that some overt distributors are syntactically adverbial and thus can only be combined with verbal predicates. In this option, other overt distributors can be defined in the same way as “zutsu” and the question about cross-linguistic variation is attributed to cross-linguistic variation in syntactic manifestations of lexical categories. Another option is to assume that some overt distributors are only defined for events, making a distinction between situations and events. For example, one can postulate a sorted variable  $s^{ev}$  which ranges over a subset of situations that only contains events as shown in (125).

- (125) a.  $[[zutsu]] = \lambda Q_{\langle e, st \rangle} \lambda P_{\langle e, st \rangle} \lambda x \lambda s : UQ_{Dist}(P)(s).$   
 $[P(x)(s) \& \forall s' [s' \in Part(s) \rightarrow Q(\lambda x. [P(x)(s')])(s')]]$
- b.  $[[DIST]] = \lambda Q_{\langle e, st \rangle} \lambda P_{\langle e, s^{ev} t \rangle} \lambda x \lambda s : UQ_{Dist}(P)(s).$   
 $[P(x)(s) \& \forall s' [s' \in Part(s) \rightarrow Q(\lambda x. [P(x)(s')])(s')]]$



The implication of this option is similar to that of the first option: whether an overt distributor allows a group distributive reading or not depends on whether the overt distributor is only defined for eventive predicates or not.

The last option is more complicated, but makes a different implication to the cross-linguistic variation with respect to a group distributive reading. One can assume that Japanese lexicon acquired the predicative “zutsu” first and then extended it to the non-predicative use of “zutsu.” Recall that  $[[zutsu_{Pred}]](Num-CL)$  is defined as a kind-level predicate and it attributes  $[[Num-CL]]$  to each instance of a kind in a given situation. On this point, note that “zutsu” can be seen as a sequence of two occurrences of the general classifier “tsu” ( $CL_{Things}$ ).<sup>36</sup> Chierchia (2015, 2021) propose that classifiers denote a function from a kind to its corresponding property. Now, if “zutsu” is indeed a reduplication of “tsu” ( $CL_{Things}$ ), one can suggest that this is a plural version of function from a kind to its properties: each instance of a kind has to be plural and the corresponding property has to be true of non-atomic individuals. Then, it lost its original status as a classifier and became being associate with Num-CL so that  $[[Num-CL]]$  is attributed to each instance of a kind. This option implies that “zutsu” is special in the sense that (i) it is a classifier reduplication and (ii) it has lost the original status as a classifier. Although this story can explain the theoretical intuition behind the semantics of “zutsu” from the perspective of the semantics of kinds and classifiers, this is nothing more than a pure speculation at this point. Accumulation of cross-linguistic data is necessary to tackle this issue of cross-linguistic variation with respect to group distributive reading.

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36. However, it raises a question of why the first consonant of the first occurrence of “tsu” ( $CL_{Things}$ ) is voiced. When reduplication triggers voicing in Japanese, it triggers voicing of the first consonant of the second occurrence, e.g, “hito” (person) → “hitobito” (people), “ki” (tree) → “kigi” (trees).

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## Chapter 7

# PCDRT with situations and the two types of overt distributors

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### 7.1 Introduction

So far, I have discussed the semantics of “sorezore” and “zutsu.” In this chapter, I finally compare the semantics of “sorezore” and the semantics of “zutsu.” To compare them, I incorporate the situation-based analysis proposed in Chapter 6 into the PCDRT by enriching it with situations. This version of PCDRT with situations serves as a unified framework in which one can theoretically pin down the difference between “sorezore” and “zutsu.” This unified framework is not only of theoretical interest, but it also sheds light on an important contrast between “sorezore” and “zutsu.” I show that “zutsu” is ‘intermediately’ dynamic: it introduces a new dependency to the context, but it cannot retrieve an old dependency. This raises a puzzle. If “zutsu” only statically partitions a situation, it wrongly predicts that it cannot introduce a new dependency. However, if “zutsu” evaluates its scope with the  $\delta$  operator, it wrongly predicts that it can retrieve an old dependency. To solve this dilemma, I propose that “zutsu” introduce new drefs under the scope of  $\delta$ , but relations under the scope of “zutsu” is statically evaluated, i.e. it is distributive with respect to a situation, but not with respect to a plural information state.

To implement this, I propose a version of PCDRT that models a context as pairs of a plural information state and a set of situations. The resultant system of PCDRT with situations distinguishes two types of information, namely the *anaphoric content* and the *propositional content* in the sense of Heim (1982). In this system, “sorezore” is distributive with respect to the anaphoric content, i.e. it partitions a plural information state, and “zutsu” is distributive with respect to the propositional content, i.e. it partitions a set of situations. The static analysis presented in Chapter

6 can easily be implemented in PCDRT with situations while preserving the compositional process employed in the static analysis. Especially, the revised entry of “zutsu” achieves the same compositional process both at the floating position and at the prenominal position. Thus, PCDRT with situations solves a puzzle on the intermediate dynamics of “zutsu” and serves as a unified framework in which situation semantic notions and dynamic semantic notions co-exist.

## 7.2 A puzzle: quantifier dependency with “zutsu”

In this section, I discuss differences between “sorezore” and “zutsu” with respect to introduction and retrieval of quantifier dependencies. This discussion serves as a litmus test to see if one should apply a dynamic analysis of “zutsu.” I show that the result is intermediate and it raises a new puzzle concerning the dynamic status of “zutsu.” A solution I propose is to let “zutsu” dynamically introduce new dependent values while statically inducing a distributive reading. This suggests that one needs both a dynamic notion of distributivity with the  $\delta$  operator and a static notion of distributivity with a situation partition, which motivates incorporation of situation semantics to PCDRT.

### 7.2.1 Intermediate dynamic status of “zutsu”

One of the strongest motivation for a plural dynamic analysis of “sorezore” comes from the fact that it licenses cross-sentential dependent anaphora as shown in (1b).

- (1) a. *Dono-kodomo<sup>u1</sup>-mo sakkaa sensyu<sup>u2</sup>-o hito-ri eran-da.*  
       which-child-also     football player-ACC 1-CL<sub>Person</sub> choose-PAST  
       “Every child chose one football player.”
- b. *Karera<sub>u1</sub>-wa sorezore sono-sensyu<sub>u2</sub>-to a-tta.*  
       they-TOP     sorezore the-player-with meet-PAST  
       “They each met the player.”

(1b) is true if for each child  $x$ ,  $x$  chose a football player  $y$  and met  $y$ . Thus, the child-football player correspondence introduced in (1a) is retrieved in (1b).

Now, observe that “zutsu” does not license this type of dependent anaphora as shown in (2b).

- (2) a. Dono-kodomo<sup>u1</sup>-mo sakkaa sensyu<sup>u2</sup>-o hito-ri eran-da.  
 which-child-also football player-ACC 1-CL<sub>Person</sub> choose-PAST  
 “Every child chose one football player.”
- b. \* Karera<sub>u1</sub>-wa hito-ri-**zutsu** sono-sensyu<sub>u2</sub>-to a-tta.  
 they-TOP one-CL<sub>Person</sub>-zutsu the-player-with meet-PAST  
 “They each met the player.”

In (2b), the singular pronoun “sono-sensyu” (the player) cannot find a suitable antecedent. Importantly, it does not have the dependent reading that (1b) has. Note that this dependent reading is the most natural one in this context. Thus, the infelicity of (2b) strongly suggests that “zutsu” does not make reference to the quantifier dependency introduced in (2a).<sup>1</sup>

This seems to suggest that the semantics of “zutsu” is fully static and its distributivity has nothing to do with quantifier dependencies in the discourse. However, “zutsu” can still introduce a quantifier dependency as shown in (3a).

- (3) a. Kodomo-tachi<sup>u1</sup>-ga sakkaa sensyu<sup>u2</sup>-o hito-ri-**zutsu** eran-da.  
 child-PL-NOM football player-ACC 1-CL<sub>Person</sub>-zutsu choose-PAST  
 “The children chose one football player each.”
- b. Karera<sub>u1</sub>-wa **sorezore** sono-sensyu<sub>u2</sub>-to a-tta.  
 they-TOP sorezore the-player-with meet-PAST  
 “They each met the player.”

1. Kenta Mizutani (p.c.) pointed out that this reading is possible with an inanimate noun. He told me that he accepts “sono-shi” (the poem) in (1b) with a dependent reading, although I do not.

- (1) a. Dono-gakusei<sup>u1</sup>-mo shi<sup>u2</sup>-o hito-tsu eran-da.  
 which-student-also poem-ACC 1-CL<sub>Object</sub> choose-PAST  
 “Every student chose one poem.”
- b. % Karera<sub>u1</sub>-wa hito-ri-**zutsu** sono-shi<sub>u2</sub>-o roodoku-sita.  
 they-TOP one-CL<sub>Person</sub>-zutsu the-poem-ACC recite-PAST  
 “They each recited the poem.”

He agreed that (2b) is infelicitous and pointed out that he can interpret “sono-shi” (the poem) as a plural anaphora, whereas he cannot interpret “sono-sensyu” (the player) as a plural anaphora. In this sense, (1b) is analogous to (2b) for those who accept the dependent reading in (1b).

- (2) a. Every student<sup>u1</sup> chose one poem<sup>u2</sup>.  
 b. They<sub>u1</sub> recited the poems<sub>u2</sub>.

This case does not require distributivity and the dependent reading of (1b) can be analysed without assuming that “zutsu” retrieves the dependency stored in (1a). Thus, existence of speakers who can take “sono-shi” (the poem) as a plural anaphora and accept (1a) does not pose a problem for the claim that “zutsu” does not retrieve the dependency stored in the discourse.

The individual distributive reading of (3a) is true iff each of the children chose one football player. (3b) shows that “sorezore” can retrieve this child-football player dependency cross-sententially. Note that “sorezore” can also introduce a new dependency as I discussed in Chapter 2.

- (4) a. Kodomo-tachi<sup>u1</sup>-ga **sorezore** sakkaa sensyu<sup>u2</sup>-o hito-ri eran-da.  
 child-PL-NOM sorezore football player-ACC 1-CL<sub>Person</sub> choose-PAST  
 “The children each chose one football player.”
- b. Karera<sub>u1</sub>-wa **sorezore** sono-sensyu<sub>u2</sub>-to a-tta.  
 they-TOP sorezore the-player-with meet-PAST  
 “They each met the player.”

This suggests that distributivity of “zutsu” is still dynamic in the sense that it introduce a new dependency. Recall that cumulative readings do not always introduce a new dependency or never do it as I discussed in Chapter 3. The same effect is observed in Japanese as exemplified in (5).

- (5) a. San-nin-no Kodomo<sup>u1</sup>-ga nana-nin-no sakkaa sensyu<sup>u2</sup>-o eran-da.  
 3-CL<sub>Person</sub>-GEN child-NOM 7-CL<sub>Person</sub>-GEN football player-ACC choose-PAST  
 “Three children chose seven football players.”
- b. \* Karera<sub>u1</sub>-wa **sorezore** sono-sensyu-tachi<sub>u2</sub>-to a-tta.  
 they-TOP sorezore the-player-PL-with meet-PAST  
 “They each met the player.”

Imagine that one child chose three football players and the other two each chose two football players. (5a) is true in this scenario. If cumulative readings introduce a new dependency, (5b) should be felicitous under the reading in which each child met a set of football players they chose. However, (5b) is marginal at best. The contrast between (3b) and (5b) shows that “zutsu” play an active role to introduce a new dependency to the discourse.

So far, I focused on individual distributive readings of “zutsu,” but occasion distributive readings also introduce a new dependency as shown in (6).

- (6) Context: A new cake shop held a tasting event in which customers can try two cakes. The tasting event is held weekly and the cake master Yamada participates every week. He is always satisfied with his choice.
- a. Yamada-san<sup>u1</sup>-ga keeki<sup>u2</sup>-o huta-tu-**zutsu** eran-da.  
 Yamada-Mr-NOM cake-ACC 2-CL<sub>Object</sub>-zutsu choose-PAST.  
 “Mr. Yamada chose two cakes at each salient occasion.”

- b. Kare<sub>u<sub>1</sub></sub>-wa \*(itsumo) **sono-huta-tu-no keeki**<sub>u<sub>2</sub></sub>-o jikkuri ajiwa-tta.  
 he-TOP (always) the-2-CL<sub>Object</sub>-GEN keeki-ACC carefully taste-PAST.  
 “He always tasted the two cakes carefully.”

In this context, (6a) introduces dependency between weekly tasting events and a set of two cakes. Then, (6b) can retrieve this dependency with the help of “itsumo.” Retrieval of dependencies is not possible in this case.

(7) In the same context:

- a. Yamada-san<sup>u<sub>1</sub></sup>-ga keeki<sup>u<sub>2</sub></sup>-o hito-tu-**zutsu** eran-da.  
 Yamada-Mr-NOM cake-ACC 1-CL<sub>Object</sub>-zutsu choose-PAST.  
 “Mr. Yamada chose one cake at each salient occasion.”
- b. i. Kare<sub>u<sub>1</sub></sub>-wa itsumo **sono-keeki**<sub>u<sub>2</sub></sub>-o jikkuri ajiwa-tta.  
 he-TOP always the-keeki-ACC carefully taste-PAST.  
 ii. \* Kare<sub>u<sub>1</sub></sub>-wa **sono-keeki**<sub>u<sub>2</sub></sub>-o hito-tsu-**zutsu** jikkuri ajiwa-tta.  
 he-TOP the-keeki-ACC one-CL<sub>Object</sub> carefully taste-PAST.  
 “He always tasted the cake carefully.”

The observations so far suggest that “zutsu” is ‘intermediately’ dynamic in the sense that it can introduce a new dependency to the discourse, but it cannot retrieve an old dependency from the discourse. This effect is observed with both an individual distributive reading and an occasion distributive reading.

### 7.2.2 A necessity for two types of distributivity

In this section, I discuss the reason why the intermediate dynamic status of “zutsu” raises a puzzle and claim that this suggests that we need two types of distributivity. First, if situation partition of “zutsu” does not partition a plural information state, the resultant plural information states look like Table 7.1.

| $J$ | $\epsilon_1$ | $u_1$                  | $u_2$                   |
|-----|--------------|------------------------|-------------------------|
|     | $s$          | child <sub>1,2,3</sub> | player <sub>1,2,3</sub> |

**Table 7.1:** A fully static version of the dependency in (3a)

The one-to-one correspondence between the children and the players comes from the static situation partition of  $s$ . However, this is problematic because  $u_2$  is not dependent on  $u_1$  in Table 7.1 and it wrongly predicts that a pronoun cannot retrieve the dependency between  $u_1$  and  $u_2$ .

On the other hand, if situation partition of “zutsu” partitions a plural information state, the resultant plural information states look like Table 7.2.

| $J$   | $\epsilon_1$ | $u_1$              | $u_2$               |
|-------|--------------|--------------------|---------------------|
| $j_1$ | $s$          | child <sub>1</sub> | player <sub>1</sub> |
| $j_2$ | $s$          | child <sub>2</sub> | player <sub>2</sub> |
| $j_3$ | $s$          | child <sub>3</sub> | player <sub>3</sub> |

**Table 7.2:** A fully dynamic version of the dependency in (3a)

Later in (3b), “sono-sensyu” (the player) is evaluated under the scope of  $\delta$  encoded in “sorezore” and thus it can access the values of  $u_2$  stored in  $j_1 \bullet h_1$ ,  $j_2 \bullet h_2$  and  $j_3 \bullet h_3$  as exemplified in Table 7.3.

| $J \bullet H$     | $\epsilon_1$ | $u_1$              | $u_2$               | $\epsilon_2$ | $u_3$              | $u_4$               |
|-------------------|--------------|--------------------|---------------------|--------------|--------------------|---------------------|
| $j_1 \bullet h_1$ | $s$          | child <sub>1</sub> | player <sub>1</sub> | $s''$        | child <sub>1</sub> | player <sub>1</sub> |
| $j_2 \bullet h_2$ | $s$          | child <sub>2</sub> | player <sub>2</sub> | $s''$        | child <sub>2</sub> | player <sub>3</sub> |
| $j_3 \bullet h_3$ | $s$          | child <sub>3</sub> | player <sub>3</sub> | $s''$        | child <sub>3</sub> | player <sub>3</sub> |

**Table 7.3:** An output plural information state for (3b)

As “sono-sensyu” (the player) is evaluated under the scope of  $\delta$  encoded in “sorezore,” the singularity condition is evaluated with respect to each subset of  $J \bullet H$ , i.e. “sono-sensyu” looks for a singular antecedent in each of  $j_1 \bullet h_1$ ,  $j_2 \bullet h_2$  and  $j_3 \bullet h_3$ . As a result, it succeeds in licensing cross-sentential dependent anaphora.

However, this leads to overgeneration: if “zutsu” evaluates its scope with respect to subsets of a plural information state, it evaluates “sono-sensyu” (the player) with respect to those subsets of a plural information state in (2b), too. It wrongly predicts that “zutsu” can retrieve an old dependency. To avoid this, one has to assume that a pronoun is collectively evaluated under the scope of “zutsu.” At the same time, “zutsu” requires a distributive reading. This is a dilemma: introduction of new drefs and relations are distributively evaluated, but pronouns must not be. This is not due to a constraint on pronouns because pronouns are evaluated under the scope of  $\delta$  when it occurs under the scope of “sorezore.” This is the point in which a unification of situation semantics and PCDRT is motivated. I propose a dynamic version of situation partition which introduces new drefs under the scope of  $\delta$  operator. However, it does not evaluate its scope under the scope of  $\delta$ . Instead, the distributive readings with “zutsu” comes from partition of situations. As a result, a pronoun under the scope of “zutsu” is evaluated outside the scope of  $\delta$  and thus it cannot pick up values stored in the subsets of a plural information state.

In the next section, I propose a system of PCDRT with situations. In §7.3, I define a general architecture of PCDRT with situations so that it emulates static situation semantic analyses under PCDRT terms. I discuss how quantifiers over individuals and quantifiers over situations are analysed under PCDRT with situations respectively in §7.4 and in §7.5. After discussing the general architecture and its functionality, I come back to the issue of intermediate dynamics in §7.6.

## 7.3 PCDRT with situations

In this section, I implement a version of PCDRT with situations such that (i) it has an expressive power to define a situation pronoun within an object language, and (ii) it stores propositional information and anaphoric information separately in the discourse. The first one is necessary to implement the situation semantic analysis in Chapter 6 under PCDRT and the second one helps me explicate the difference between “sorezore” and “zutsu.” As for the first point, PCDRT with events fortunately has both type  $\nu$  entities for events and sorted registers of type  $\epsilon$ . Thus, one can simply reuse these entities to model situations instead of events. This enables one to emulate the compositional processes in the possibilistic situation semantics within PCDRT with events. As for the second point, I assume that the context consists of pairs of a set of situations and a plural information state. The former stores a set of propositions which are true in the context and the latter stores entities which have been introduced in the context. The resultant system of PCDRT with situations preserves the compositional process of PCDRT with events and the static situation semantics while preserving the Montagovian sub-clausal compositionality of PCDRT.

### 7.3.1 Logic of Change with situations

In this section, I enrich the logic of change to define PCDRT with situations. First of all, recall the basic types in the PCDRT with events:  $t$  stands for truth values,  $e$  stands for entities,  $\nu$  stands for events,  $s$  stands for states and  $\pi$  stands for registers. Recall that states model variable assignments and registers model discourse referents. Variables of type  $\pi$  are sorted for individuals or for events:  $u_n$  is a variable of an individual-level dref and  $\epsilon_n$  is a variable of an event-level dref. I maintain these types use  $\nu$  to model situations, instead of events. Accordingly,  $\epsilon_n$  is used as a variable of a situation-level dref. The basic types are summarised in Table 7.4.



| Types | Names       | Variables                                                   | Constants         |
|-------|-------------|-------------------------------------------------------------|-------------------|
| $t$   | truth value |                                                             | 1, 0              |
| $e$   | entities    | $x, y, z, \dots$                                            | Ann, Belle, Chris |
| $v$   | situations  | $s, s', s'', \dots$                                         |                   |
| $s$   | states      | $g, h, i, \dots$                                            |                   |
| $\pi$ | registers   | $v, v', v'', \dots, \epsilon, \epsilon', \epsilon'', \dots$ | $u_n, \epsilon_n$ |

**Table 7.4:** The basic types in PCDRT with situations

One may additionally add type  $w$  entities to model possible worlds. The reason why I do not adopt them is because I take them to be maximal situations as I assumed in Chapter 6 and also I do not use type  $w$  entities to define a fragment of a language in this thesis.<sup>2</sup> That being said, one can reinterpret my analysis in a system with type  $w$  entities. Although I leave open the ontological nature of situations, there are several ways to make the definition of a situation more precise. For example, a situation can be thought of as a member of a Cartesian product of the temporal domain and the spatial domain or a set of points in a four-dimensional Euclidean space. In this analogy, one can take the maximal sum of situations as a world. This way of thinking about situations is quite akin to that of events. Indeed, the readers may feel free to read ‘situation’ in my prose as ‘event’. This difference does not make much difference in several empirical phenomena. I adopt the term situation because this is a more suited entity to store truth conditional information. This aspect will be crucial for me to distinguish informativity based on the truth conditional aspect of meanings and informativity based on the anaphoric aspect of meanings.

### 7.3.2 Two types of information in the discourse

In this section, I revise the definition of truth in PCDRT so that it makes reference to both a set of situations and a plural information state. I assume that the discourse stores two different types of information following Heim (1982). Her famous examples, which are attributed to Barbara Partee, are given in (8) and (9).

- (8) a. One of the ten marbles is not in the bag.  
b. It is probably under the sofa.

2. In this thesis, I do not discuss cases which involves intensional operators. However, one can use PCDRT with situations as a version of Intensional PCDRT (Brasoveanu, 2007, 2010). Similarly, I do not aim to discuss interrogatives in this thesis, too, but see Dotlačil and Roelofsen (2021); Li (2020, 2021) for the semantics of interrogatives with plural variable assignments.

- (9) a. Nine of the ten marbles are in the bag.  
 b. ?? It is probably under the sofa.

(8a) and (9a) are true in exactly the same set of world or situations. Thus, they are truth conditionally equivalent. And yet, only (8a) allows “it” to pick up the value of one marble which is not in the bag. In this sense, (8a) and (9a) convey the same information with respect to their truth conditions, but they convey different information with respect to the active referents in the discourse. The File Change Semantics (Heim, 1982) models a context as world-assignment pairs so that the set of worlds represent the truth conditional informativity and the set of assignment represent the anaphoric informativity. In this chapter, I assume that the truth conditional information is stored as a set of situations and the anaphoric information is stored as a set of plural information states. To implement this, I assume that the context consists of pairs of a set of situations and a plural information state.

First of all, I adopt the notion of Stalnakerian context set. In the standard assumption, the context set stores a set of possible worlds which are members of the intersection of true propositions. Since I model a proposition as a set of situations, I need to adjust the system so that the update of the propositional content is done with respect to situations. I assume that a context set stores a set of situations which are the union of true propositions.<sup>3</sup> Thus, a context set expands when a new proposition is added.<sup>4</sup> I further assume that the initial state of a context set is a singleton set of a maximal situation, which is not part of any other situations. Although I do not assume possible worlds as a primitive entity, this maximal set plays a role of a possible world. An update with respect to situations fails if a newly added situation is not part of the maximal situation of an input context set. I notate a context set as  $\sigma$ . A context set is defined in (10).

- (10) A set of situations  $\sigma$  is a context set iff
- a.  $\exists s[s \in \sigma \& \forall s'[s' \sqsubseteq s \rightarrow s' = s]]$  (Existence of the maximal situation)
  - b.  $\forall s[s \in \sigma \rightarrow \exists s'[s \sqsubseteq s']]$  (Existence of the common sum)

3. This analysis is similar to the Update Semantics with situations proposed in Sudo (2017). His motivation is to define different notions of entailment for assertions and presuppositions to account for the cases of felicitous redundancy. As this is orthogonal to the main point of this chapter, I do not discuss it further.

4. This means that the update of the context set is not *eliminative*: an update  $v$  is eliminative iff for any state  $i$ ,  $v(i) \subset i$ , i.e. an update always results in shrinking the context (Groenendijk & Stokhof, 1990; Rothschild & Yalcin, 2016). See also Sudo (2017) for a dynamic system with situations which is not eliminative.

Now, I model a context as pairs of a context set and a plural information state, i.e.  $\langle \sigma, G \rangle$  of type  $\langle vt \times st \rangle$ . Accordingly, an update from an input context to a set of output contexts is a relation between pairs of functions from states to truth values and functions from situations to truth values, which has type  $\langle \langle vt \times st \rangle, \langle \langle vt \times st \rangle, t \rangle \rangle$ . From now on, I use the meta-type  $T$  as an abbreviation of type  $\langle \langle vt \times st \rangle, \langle \langle vt \times st \rangle, t \rangle \rangle$ , while maintaining other meta-types, i.e.  $E$  for  $\pi$  entities sorted for individual-level drefs and  $V$  for  $\pi$  entities sorted for situation-level drefs. The abbreviations are revised accordingly.<sup>5</sup>

(11) Abbreviation 1 (Conditions):

- a.  $R\{\epsilon_1, \dots, \epsilon_n, u_1, \dots, u_n\} = \lambda\langle \sigma, G \rangle [R(v(\epsilon_1)(G)) \dots (v(\epsilon_n)(G))(v(u_1)(G)) \dots (v(u_n)(G))]$
- b.  $[u_1 = u_2] = \lambda\langle \sigma, G \rangle [v(u_1)(G) = v(u_2)(G)]$

(12) Abbreviation 2 (Negation, disjunction and material implication):

- a.  $\text{not } D = \lambda\langle \sigma, G \rangle \neg \exists \langle \sigma', H \rangle [D(\langle \sigma, G \rangle)(\langle \sigma', H \rangle)]$
- b.  $D \text{ or } D' = \lambda\langle \sigma, G \rangle \exists \langle \sigma', H \rangle [D(\langle \sigma, G \rangle)(\langle \sigma', H \rangle) \vee D'(\langle \sigma, G \rangle)(\langle \sigma', H \rangle)]$
- c.  $D \Rightarrow D' = \lambda\langle \sigma, G \rangle \forall \langle \sigma'', I \rangle [D(\langle \sigma, G \rangle)(\langle \sigma'', I \rangle) \rightarrow \exists \langle \sigma', J \rangle [D'(\langle \sigma'', I \rangle)(\langle \sigma', J \rangle)]]$

(13) Abbreviation 3 (DRS):

$$[\epsilon_1, \dots, \epsilon_n, u_1, \dots, u_n | C_1, C_2, \dots, C_n] = \lambda\langle \sigma, G \rangle \lambda\langle \sigma', H \rangle [G[\epsilon_1, \dots, \epsilon_n, u_1, \dots, u_n] H \& \sigma' = (\sigma \cup v(\epsilon_1)(H) \cup \dots \cup v(\epsilon_n)(H)) \& C_1(H) \& C_2(H) \& \dots \& C_n(H)]$$

(14) Abbreviation 4 (Sequencing):

$$D; D' = \lambda\langle \sigma, G \rangle \lambda\langle \sigma', H \rangle \exists \langle \sigma'', K \rangle [D(\langle \sigma, G \rangle)(\langle \sigma'', K \rangle) \& D'(\langle \sigma'', K \rangle)(\langle \sigma', H \rangle)]$$

DRSs in PCDRT with situations are relations between pairs of a context set and a plural information state. However, not every update accesses a context set. Abbreviation 1 is essentially the same as Abbreviation 1 in PCDRT with events.<sup>6</sup> Abbreviation 2 and Abbreviation 4 are straightforward extension from the original definitions: they introduce incrementality to both the first coordinate and the second

5. In Abbreviation 2, I stick with the definition of disjunction in CDRT (Muskens, 1996), but one may feel free to adopt their favourite theory of dynamic disjunction.

6. Sometimes, one may be interested in the static truth condition of a formula. For this, one can adopt the unary function **tr** (Muskens, 1996) in (1), which gives the static truth condition of a formula. Assuming that drefs of type  $\pi$  and individual variables of type  $e$  are numerically ordered,  $\dagger$  function maps a dref to an individual variable, i.e.  $u_n^\dagger = x_n$ .

(1)  $\text{tr}(R\{u_1, \dots, u_n\}) = R(u_1^\dagger) \dots (u_n^\dagger)$

coordinate of a context. It is worth elaborating on Abbreviation 3. Introduction of individual-level drefs and evaluation of conditions do not make reference to a context set. However, introduction of situation-level drefs adds their values to the input context set  $\sigma$ . Importantly, the resulting output set  $\sigma$  may be larger than  $\sigma$ .<sup>7</sup>

Next, let me discuss the definition of truth in PCDRT with situations. In Chapter 5, I proposed that discourse update is performed with Merge operator  $\bullet$  whose definition is repeated as (15). It concatenates two plural assignments in a way that it preserves a dependency among drefs if it has been established in a prior discourse, but it does not introduce a new dependency.

$$(15) \quad G \bullet H = \\ \{g \cup h \mid g \in G \ \& \ h \in H \ \& \ \forall v [[v(v)(G) \neq \star \ \& \ v(v)(H) \neq \star] \rightarrow v(v)(g) = v(v)(h)] \\ \ \& \ \forall v' [[\exists v'' [v(v'')(G) = v(v'')(H)]] \rightarrow \exists v''' \forall d [v(v''')(G_{v=d}) = v(v''')(H_{v=d})]]]\}$$

Considering that  $G$  is the input assignment, the dynamic truth of a formula  $\phi$  is evaluated with respect to  $G$  and  $G \bullet H$  as shown in (16), i.e. it explicitly distinguishes the old sub-sequence and the newly added sub-sequence.

$$(16) \quad \text{Truth: A formula } \phi \text{ is true with respect to an input context } \langle \sigma, G \rangle \text{ iff there is a plural information state } H \text{ and a context set } \sigma' \text{ such that } \langle \sigma', G \bullet H \rangle \text{ is an output context and } [[\phi]](\langle \sigma, G \rangle)(\langle \sigma', G \bullet H \rangle).$$

In some sense, the merging operator  $\bullet$  puts a condition on the possible output plural information states for sentential denotations.

In addition, Muskens (1996) defines a two-place function **wp**, which gives a formula of predicate logic if one feeds it a DRS and a first-order formula.  $\chi$  ranges over first-order formulae and the tautology  $\top$  takes its place unless **wp** takes negation, conditional, disjunction and conjunction.

$$(2) \quad \mathbf{wp}([u_1, \dots, u_n \mid C_1, \dots, C_n], \chi) = \exists x_1, \dots, x_n (\mathbf{tr}(\mathbf{C}_1) \ \& \ \dots \ \& \ \mathbf{tr}(\mathbf{C}_n) \ \& \ \chi)$$

See Muskens (1996) for the full array of definitions of **tr** and **wk**.

With these techniques, I define the  $\downarrow$  function from predicates of type  $\langle E, \dots, \langle VT \rangle \rangle$  to predicates of type  $\langle e, \dots, \langle st \rangle \rangle$  as shown in (3).

$$(3) \quad \downarrow (\lambda \epsilon \lambda u_1, \dots, \lambda u_m [R(\epsilon_1, u_1, \dots, u_m, u_{m+1}, \dots, u_n)]) \\ = \lambda s_1 \lambda x_1 \dots \lambda x_m \exists x_{m+1}, \dots, x_n [R(\epsilon_1^\dagger)(u_1^\dagger) \dots (u_m^\dagger) \dots (u_n^\dagger)]$$

Although I do not utilise this function in the main prose, this is useful to deal with static conditions because (3) shifts a PCDRT abbreviation to its unabbreviated counterpart during the composition.

7. Those who are familiar with Kratzerian situation semantics may favour the notion of *Austinian topic situation*. Although this is orthogonal for my purpose, one may define the **topic** operator (Schwarz, 2009) in PCDRT with situations.

Lastly, let me clarify my assumption on not-at-issue contents in PCDRT with situations. I adopt the unary presupposition operator  $\partial$  (Beaver, 1992) so that it makes a DRS evaluated with respect to its input context as shown in (17).<sup>8</sup>

$$(17) \quad \partial(D) = \lambda\langle\sigma, G\rangle\lambda\langle\sigma', H\rangle[D(\langle\sigma, G\rangle)(\langle\sigma', H\rangle)].$$

The  $\partial$  operator requires a presupposition to be evaluated with respect to the input context set  $\sigma$  while allowing it to make reference to the output plural information state  $H$ . In a similar manner, one can define an operator that makes a DRS be evaluated as a *post-supposition*, which is a not-at-issue content which is evaluated after at-issue contents are evaluated (Brasoveanu, 2013; Henderson, 2014).<sup>9</sup>

$$(18) \quad \xi(D) = \lambda\langle\sigma, G\rangle\lambda\langle\sigma', H\rangle[D(\langle\sigma', H\rangle)(\langle\sigma', H\rangle)].$$

I adopt Stalnaker's Bridge as a pragmatic condition that makes falsity of presupposition induce infelicity. One may feel free to adopt different assumptions to make falsity of not-at-issue contents lead to a truth value gap, e.g., by making Logic of Change trivalent or partial.

(19) **Stalnaker's Bridge:**

- a. If a DRS  $D$  presupposes  $D'$ , i.e.  $D = D_1; \dots; D_n; \partial(D')$ , then  $D$  can felicitously update  $\langle\sigma, G\rangle$  to  $\langle\sigma', H\rangle$  only if  $\langle\sigma, G\rangle[\partial(D)]\langle\sigma', H\rangle$ .
- b. If a DRS  $D$  post-supposes  $D'$ , i.e.  $D = D_1; \dots; D_n; \xi(D')$ , then  $D$  can felicitously update  $\langle\sigma, G\rangle$  to  $\langle\sigma', H\rangle$  only if  $\langle\sigma, G\rangle[\xi(D)]\langle\sigma', H\rangle$ .

### 7.3.3 Definitions of nouns, verbs and some operators

In this section, I refine the denotations of nominal predicates, verbal predicates and some operators in PCDRT with situations. First, nominal predicates are defined as type  $\langle E, VT \rangle$  in the PCDRT with situations, i.e. nominal predicates have an additional argument for a situation as shown in (20). The semantic type of nouns in PCDRT with situations is homomorphic to the semantic type of nouns in the version of situation semantics I adopt in Chapter 6.

8. Beaver (1992) discusses several versions of  $\partial$ , comparing their functions with analyses of presuppositions in Cooper (1983); Heim (1983b). (17) is the plainest one among them. Although one may use a different version of unary presuppositional operators, the definition in (17) is useful to analyse the cross-sentential dependent anaphora with adverbial quantifiers.

9. See §7.7 for an alternative definition of post-suppositions and the relevant discussion.

$$(20) \quad \llbracket \text{NP} \rrbracket = \lambda_{v_E} \lambda_{\epsilon_V} [\llbracket \text{NP}\{\epsilon\}\{v\} \rrbracket]$$

In contrast, the semantic type of verbal predicates stays the same. However, they encode an additional requirement that they obligatorily exemplify a situation. For this, I refine the exemplification condition in PCDRT as shown in (20), where  $p$  is a variable for a predicate of type  $\langle VT \rangle$ .

$$(21) \quad \mathcal{E}_\epsilon(p(\epsilon)) \Leftrightarrow \lambda G \lambda H [\text{EXEM}(\lambda s [p(s)])(v(\epsilon)(H))]$$

Essentially, (21) plays exactly the same role as its static counterpart: it takes a function from a situation-level register (type  $\epsilon$ ) to a relation between plural information states (type  $T$ ), but it express that the value of  $\epsilon$  under a plural information state  $H$  (type  $s$ ) is an exemplifying situation with respect to  $p$ .

One may alternatively write it as (22). Although this notation is more transparent, it gets messier when  $p$  is complex. Thus, I adopt (21) for notational brevity.

$$(22) \quad \mathcal{E}(\lambda \epsilon' [p(\epsilon')])(\epsilon) \Leftrightarrow \lambda G \lambda H [\text{EXEM}(\lambda s [p(s)])(v(\epsilon)(H))]$$

Based on (21), the denotations of lexical verbs and thematic relations are defined in parallel with those in Chapter 6. Lexical verbs take a situational dref and thematic relations takes an individual dref and a situation dref.

$$(23) \quad \begin{array}{ll} \text{a.} & \llbracket V \rrbracket = \lambda_{\epsilon_V} \mathcal{E}_\epsilon(V(\epsilon)) \\ \text{b.} & \llbracket \theta \rrbracket = \lambda V_{\langle VT \rangle} \lambda_{v_E} \lambda_{\epsilon_V} [\llbracket \theta\{\epsilon\}\{v\} \rrbracket; \llbracket V\{\epsilon\} \rrbracket] \end{array}$$

So far, I discuss the denotations of nouns and verbs in PCDRT with situations. Essentially, they are defined so that PCDRT with situations emulates the composition in the version of situation semantics I adopt in Chapter 6.

One can easily define a situation pronoun in PCDRT with situations as shown in (24). It introduces a constant of type  $\pi$  sorted as  $\epsilon$ . Just like situation pronouns in a static setting, it can be freely co-indexed with a situational dref.

$$(24) \quad \llbracket pro_s \rrbracket = \epsilon_n$$

Note that the PCDRT with situations does not utilise a  $\lambda$ -abtractor for situation pronoun binding, but this is harmless because the analysis in Chapter 6 does not rely on  $\lambda$ -abtractor.<sup>10</sup>

Note that insertion of situation pronouns is not the only way to access to the set of situations stored in the context. Presuppositions are evaluated with respect to the input context set. Thus, presuppositional conditions always make reference to situations which have already been introduced to the context. I will come back to this point when I discuss A-quantifiers in §7.5.

Lastly, the definitions of the dynamic maximality operator  $\text{max}$  and the dynamic distributivity operator  $\delta$  are refined so that it takes pairs of a context set and a plural information state.

$$(25) \quad \text{max}^{u_n}(D) = \lambda\langle\sigma, G\rangle\lambda\langle\sigma', H\rangle[\sigma = \sigma' \ \& \ \langle\sigma, G\rangle[[u_n]]; D]\langle\sigma', H\rangle \ \& \\ \forall\langle\sigma', K\rangle[\langle\sigma, G\rangle[[u_n]]; D]\langle\sigma', K\rangle \rightarrow \cup u_n(K) \subseteq \cup u_n(H)]$$

$$(26) \quad \text{a. } G_{u_n=d} = \{g : g \in G \ \& \ v(u_n)(g) = d\} \\ \text{b. } \delta_{u_n}(D) = \lambda\langle\sigma, G\rangle\lambda\langle\sigma', H\rangle[\sigma = \sigma' \ \& \ v(u_n)(G) = v(u_n)(H) \ \& \\ \forall d \in v(u_n)(G) [D(\langle\sigma, G_{u_n=d}\rangle)(\langle\sigma', H_{u_n=d}\rangle)]]$$

This refinement does not alter their semantics. The  $\text{max}$  operator introduces a new dref  $u_n$  whose value is maximal among all the possible output contexts that can be updated from the input context with a DRS  $D$ . The  $\delta$  operator update a DRS  $D$  with respect to subsets  $H_{u_n=d}$  of the plural information state  $H$ .

Summing up, I defined a system of PCDRT with situations in this section. It differs from PCDRT with events in two ways. Firstly, type  $v$  entities are used to model situations and sorted variables  $\epsilon$  are used to model situation-level dref. Secondly, a context is modelled as a pair of a context set, i.e. a set of situations, and a plural information state. Refinement of meta-type convention enables one to emulate the

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10. There are several alternative ways to incorporate the notion of situations to PCDRT. For example, Muskens (1989) defined a four-valued logic with a relational type system, which emulates partiality of situation semantics in Barwise and Perry (1983). However, this logic does not have an expressive power to utilise situation variables in its object language and cannot define a situation pronoun. Thus, this approach requires an additional mechanism to account for the shifted evaluation effect of “zutsu” and “itsumo.”

compositional process of PCDRT with events and static situation semantics with minimal modification. In addition, this system can define a situation pronoun as an expression in its object language as well as access to the contextually given set of situations via presupposition.

## 7.4 D-quantification in PCDRT with situations

In this section, I show how dynamic selective generalised quantification is performed in the PCDRT with situations. Following the terminological convention, I call quantifiers over individuals *D-quantifiers* and quantifiers over situations *A-quantifiers*. I refine the definition of quantificational determiners so that their restrictor can be evaluated in a situation other than the one in which the rest of the clause is evaluated. The denotations of quantifiers over individuals in Japanese are also refined, accordingly.

### 7.4.1 Determiners in English

In this section, I discuss the semantics of determiners in PCDRT with situations. I start with the denotations of articles in English. In PCDRT with events, I defined the denotations of articles in English as shown in (27). Note that the indefinite article has the atomicity condition while the definite article does not.

- (27) a.  $\llbracket a \rrbracket(P) = \lambda V_{\langle E, VT \rangle} \lambda \epsilon [u_n]; [\llbracket \text{NOV}\{u_n\} \rrbracket; [\llbracket \text{ATOM}\{u_n\} \rrbracket; P(u_n); V(\epsilon)(u_n)]$   
 b.  $\llbracket \text{the}_{UQ} \rrbracket(P) = \lambda V_{\langle E, VT \rangle} \lambda \epsilon \text{MAX}^{u_n}(P(u_n)); V(\epsilon)(u_n); [\llbracket \text{NOV}\{u_n\} \rrbracket]$

In these definitions, the indefinite article and the uniqueness definite article are minimally different with respect to maximality. Recall that I distinguish the uniqueness definite article and the anaphoric definite article. The denotation of the anaphoric definite article is repeated in (28).

- (28)  $\llbracket \text{the}_{u_n'} \rrbracket(P) = \lambda V_{\langle E, VT \rangle} \lambda \epsilon \text{MAX}^{u_n}(P(u_n)); [\llbracket u_n = u_n' \rrbracket; V(\epsilon)(u_n)]$

Addition of situation pronouns leads to another difference between indefinites and uniqueness definites: the uniqueness definite article motivates insertion of a situation pronoun while the indefinite article does not. This suggests revision of (27) to (29). This difference in terms of an additional slot for a situation pronoun reflects the static situation semantic analysis in Chapter 6.



- (29) a.  $\llbracket a \rrbracket(P_{\langle E, VT \rangle}) = \lambda V_{\langle E, VT \rangle} \lambda \epsilon [u_n]; [\llbracket \text{NOV}\{u_n\} \rrbracket; [\llbracket \text{ATOM}\{u_n\} \rrbracket; P(\epsilon)(u_n); V(\epsilon)(u_n)]$   
 b.  $\llbracket \text{the} \rrbracket(P_{\langle E, VT \rangle}) = \lambda \epsilon' \lambda V_{\langle E, VT \rangle} \lambda \epsilon \text{MAX}^{u_n}(P(\epsilon')(u_n)); [\llbracket \text{NOV}\{u_n\} \rrbracket; V(\epsilon)(u_n)]$

To see how it works, consider the example shown in (30).

- (30) The mayor arrived.

The denotation of (30) is given in (31).  $\epsilon_n$  comes from  $pro_s$  and the atomicity condition comes from the singular morphology of “mayor.”

- (31)  $\llbracket (30) \rrbracket = \lambda \epsilon \text{MAX}^{u_1}([\llbracket \text{mayor}\{\epsilon_n\}\{u_1\} \rrbracket; [\llbracket \text{ATOM}\{u_1\} \rrbracket]; [\llbracket \text{NOV}\{u_1\} \rrbracket; [\llbracket \text{agent}\{\epsilon\}\{u_1\} \rrbracket]; \mathcal{E}_\epsilon([\llbracket \text{arrive}\{\epsilon\} \rrbracket])$

The dynamic maximisation process is unpacked in (32).

- (32)  $\text{MAX}^{u_1}([\llbracket \text{mayor}\{\epsilon_n\}\{u_1\} \rrbracket]) = \lambda G \lambda H [G[u_1 | \text{mayor}\{\epsilon_n\}\{u_1\}]; [\llbracket \text{ATOM}\{u_1\} \rrbracket]] H$   
 $\& \forall K [G[u_1 | \text{mayor}\{\epsilon_n\}\{u_1\}]; [\llbracket \text{ATOM}\{u_1\} \rrbracket]] K \rightarrow v(u_n)(K) \subseteq v(u_n)(H)]$

(32) requires that the value of  $u_1$  under  $H$  is maximal relative to the value of  $u_1$  under other possible output assignments  $K$ . In other words,  $v(u_1)(H)$  is the largest individual which is a mayor in a situation  $v(\epsilon_n)(H)$ . Because of the atomicity condition, this maximality leads to uniqueness requirement. Note that this dynamic maximisation is still relative to situation, i.e.  $\text{MAX}^{u_1}([\llbracket \text{mayor}\{\epsilon_n\}\{u_1\} \rrbracket])$  and  $\text{MAX}^{u_1}([\llbracket \text{mayor}\{\epsilon_m\}\{u_1\} \rrbracket])$  may specify different values.

Next, I discuss the semantics of quantificational determiners in English under PCDRT with situations. The general template of quantificational determiners in the PCDRT with events is repeated in (33).

- (33)  $\llbracket Q\text{-det} \rrbracket = \lambda P_{\langle ET \rangle} \lambda V_{\langle E, VT \rangle} \lambda \epsilon [\text{MAX}^{u_n}(\delta_{u_n}(P(u_n))); \text{MAX}^{u_m} \subseteq u_n(V(\epsilon)(u_m)); \text{DET}\{u_n\}\{u_m\}]$

(33) first takes a maximal set of individuals which distributively satisfy the restrictor property  $P$  and then check if a structured subset of it satisfies the scope property  $V$  in the way that the two sets stand in the relation denoted by the static quantificational determiner. I refine it as (34): it is of type  $\langle V, \langle \langle E, VT \rangle, \langle \langle E, VT \rangle, VT \rangle \rangle \rangle$ . Note that this meta-type corresponds to the static type of  $\langle s, \langle \langle e, st \rangle, \langle \langle e, st \rangle, st \rangle \rangle \rangle$ , which is the type of strong determiners in Schwarz (2009, 2012).

$$(34) \quad [[Q\text{-det}]] = \lambda\epsilon'_V \lambda P_{\langle E, VT \rangle} \lambda V_{\langle E, VT \rangle} \lambda \epsilon_V [\text{MAX}^{u_n}(\delta_{u_n}(P(\epsilon')(u_n))); \text{MAX}^{u_m \in u_n}(V(\epsilon)(u_m)); \text{DET}\{u_n\}\{u_m\}]]$$

(34) is minimally different from (33) with respect to the type of restrictor and an additional  $\epsilon$  argument. The first difference is a direct consequence from the assumption that nominal predicates have type  $\langle E, VT \rangle$  in the PCDRT with situations. The second difference is motivated with shifted readings of the restrictor of a strong determiner. The additional  $\epsilon$  argument hosts a situation pronoun which allows the restrictor of a quantifier to induce a shifted reading. (35) repeats an example of the relevant reading.

$$(35) \quad \text{Every fugitive is in jail.} \quad (\text{Enç, 1986})$$

As the world knowledge makes it contradictory that someone is a fugitive and in jail at the same time, the felicity of (35) suggests that the restrictor property of “every” can be evaluated in a situation other than the topic situation. I will show how (34) derives this shifted reading.

First, (36) shows the composition of the DP “every fugitive.”

$$(36) \quad \begin{array}{c} \lambda V_{\langle E, VT \rangle} \lambda \epsilon [\text{MAX}^{u_1}(\delta_{u_1}([fugitive\{\epsilon_n\}\{u_1\}]); \\ \text{MAX}^{u_2 \in u_1}(\delta_{u_2}(V(\epsilon)(u_2))); \text{ALL}\{u_1\}\{u_2\}]] \\ \swarrow \quad \searrow \\ \begin{array}{c} \lambda P_{\langle E, VT \rangle} \lambda V_{\langle E, VT \rangle} \lambda \epsilon [\text{MAX}^{u_1}(\delta_{u_1}(P(\epsilon_n)(u_1))); \text{MAX}^{u_2 \in u_1}(\delta_{u_2}(V(\epsilon)(u_2))); \text{ALL}\{u_1\}\{u_2\}]] \\ \swarrow \quad \searrow \\ \begin{array}{c} \lambda \epsilon' \lambda P_{\langle E, VT \rangle} \lambda V_{\langle E, VT \rangle} \lambda \epsilon [\text{MAX}^{u_1}(\delta_{u_1}(P(\epsilon')(u_1))); \text{MAX}^{u_2 \in u_1}(\delta_{u_2}(V(\epsilon)(u_2))); \text{ALL}\{u_1\}\{u_2\}]] \\ \downarrow \\ \text{every} \end{array} \quad \begin{array}{c} \epsilon_n \\ \downarrow \\ \text{pro}_s \end{array} \end{array} \quad \begin{array}{c} \lambda v \lambda \epsilon [fugitive\{\epsilon\}\{v\}] \\ \downarrow \\ \text{NP} \\ \downarrow \\ \text{fugitive} \end{array} \end{array}$$

In (36), the denotation of the DP is type  $\langle \langle E, VT \rangle, \langle VT \rangle \rangle$ , which is the same as the type of generalised quantifiers discussed in Chapter 4. However, the restrictor property is evaluated in  $\epsilon_n$ , which is provided with the situation pronoun  $\text{pro}_s$ . This situation dref can be co-indexed with one of the other situation drefs which have already been introduced to the discourse.

(37)

$$\begin{array}{c} [\epsilon_1]; [\text{MAX}^{u_1}(\delta_{u_1}([\text{fugitive}\{\epsilon_n\}\{u_1\}]))]; \\ \text{MAX}^{u_2 \in u_1}(\delta_{u_2}(\mathcal{E}_\epsilon([\text{is in a jail}\{\epsilon\}]))); \text{ALL}\{u_1\}\{u_2\} \end{array}$$

$\lambda V_{\langle VT \rangle}$        $\lambda E_V [\text{MAX}^{u_1}(\delta_{u_1}([\text{fugitive}\{\epsilon_n\}\{u_1\}]));$   
[ $\epsilon_1$ ];       $\text{MAX}^{u_2 \in u_1}(\delta_{u_2}([\text{agent}\{\epsilon\}\{u_2\}]);$   
 $V(\epsilon)$        $\mathcal{E}_\epsilon([\text{is in a jail}\{\epsilon\}]))]; \text{ALL}\{u_1\}\{u_2\}$

|  
EC

$\lambda V_{\langle E, VT \rangle} \lambda E_V [\text{MAX}^{u_1}(\delta_{u_1}$        $\lambda v_E \lambda E_V [[\text{agent}\{\epsilon\}\{v\}];$   
( $[\text{fugitive}\{\epsilon_n\}\{u_1\}])$ );       $\mathcal{E}_\epsilon([\text{is in a jail}\{\epsilon\}])$

$\text{MAX}^{u_2 \in u_1}(\delta_{u_2}(V(\epsilon)(u_2))))$ ;     

ALL{ $u_1$ } { $u_2$ }

|  
NP  
every fugitive

$\lambda V_{\langle VT \rangle} \lambda v \lambda E$        $\lambda E \mathcal{E}_\epsilon([\text{is in a jail}\{\epsilon\}])$   
[[agent{ $\epsilon$ }{ $v$ }}];      |  
[[V{ $\epsilon$ }}]      VP  
|  
Voice      is in a jail

On this point, suppose that there is a situation-level dref which stores a set of situations in which the individuals stored in  $u_1$  are escaping. The situation pronoun  $\epsilon_n$  can be co-indexed with this situation-level dref. Now the clausal denotation in (37) is dynamically true iff (i) there is a maximal set of individuals which are fugitives in a contextually salient situations  $s'$  such that those situations are members of  $v(H)(\epsilon_1)$ , (ii) the maximal subset of these fugitives in  $s'$  are all in a jail in another situation  $s$  which are members of  $v(H)(\epsilon_2)$  and (iii) a set of fugitives in  $s'$  is a subset of a set of individuals which are in a jail in  $s$ . As a result, the restrictor property is evaluated with respect to  $\epsilon_1$ , while the scope property is evaluated with respect to  $\epsilon_2$ . This is a shifted reading. In this way, addition of situation pronouns to the PCDRT allows it to account for the shifted readings of the restrictor properties of strong determiners.

11. Here, I treat the predicate “is in a jail” syncategorematically just for an expository sake. Also, one may argue that agent-relation is only defined for intentional actions and thus not defined for “is in a jail.” One can assume that this predicate takes an individual dref without agent-relation and this alternative does not affect the main point of this discussion.

### 7.4.2 D-quantification in Japanese and type shifting principles

In this section, I discuss D-quantification in Japanese with PCDRT with situations. In Chapter 4, I proposed that the prenominal quantifiers take a predicative restrictor and the semantics of the prenominal quantifiers in Japanese is the same as quantificational determiners in English. In this sense, the revision on the definition of quantificational determiners in the PCDRT with situation directly applies to the definition of the prenominal quantifiers in Japanese.

$$(38) \quad \llbracket \text{Prenominal GQ} \rrbracket = \lambda \epsilon'_V \lambda P_{\langle E, VT \rangle} \lambda V_{\langle E, VT \rangle} \lambda \epsilon_V [\text{MAX}^{u_n}(\delta_{u_n}(P(\epsilon')(u_n)))]; \\ \text{MAX}^{u_m} \in u_n (V(\epsilon)(u_m)); \text{DET}\{u_n\}\{u_m\}]$$

On the other hand, the postnominal quantifiers take an argumental restrictor. Throughout the thesis, I assume that an argumental NP has higher type  $\langle \langle E, VT \rangle, VT \rangle$ . Recall that I assume that covert type-shifting from a predicative NP to an argumental NP is freely available in Japanese. The definitions of the relevant type-shifters  $\exists$  and  $\text{iota}$  are defined under PCDRT with events as shown in (39).

$$(39) \quad \text{a. } \exists(P) = \lambda V_{\langle E, VT \rangle} \lambda \epsilon [u_n]; [\llbracket \text{NOV}\{u_n\} \rrbracket; P(u_n); V(\epsilon)(u_n)] \\ \text{b. } \text{iota}(P) = \lambda V_{\langle E, VT \rangle} \lambda \epsilon \text{MAX}^{u_n}(P(u_n)); [\llbracket \text{NOV}\{u_n\} \rrbracket; V(\epsilon)(u_n)]$$

Now, these definitions are revised in PCDRT with situations. I refine (39) as shown in (40). They are covert counterparts of overt articles.

$$(40) \quad \text{a. } \exists(P_{\langle E, VT \rangle}) = \lambda V_{\langle E, VT \rangle} \lambda \epsilon [u_n]; [\llbracket \text{NOV}\{u_n\} \rrbracket; P(\epsilon)(u_n); V(\epsilon)(u_n)] \\ \text{b. } \text{iota}(P_{\langle E, VT \rangle}) = \lambda \epsilon' \lambda V_{\langle E, VT \rangle} \lambda \epsilon \text{MAX}^{u_n}(P(\epsilon')(u_n)); [\llbracket \text{NOV}\{u_n\} \rrbracket; V(\epsilon)(u_n)]$$

I have been assuming that an argument nominal in Japanese resorts to  $\exists$ -shift to be combined with a sentential predicate until Chapter 5. However, as I discussed in Chapter 6, Derived Kind Predication (DKP) is another option. Indeed, DKP correctly predicts the scopal behaviour of bare arguments. Here, I propose an implementation of kind-reference and derived kind predication in PCDRT with situations. Recall the static definitions of the  $\cap$  operator and the  $\cup$  operator as repeated in (41).

$$(41) \quad \text{a. } \cup k_{\langle se \rangle} = \lambda s \lambda x [x \sqsubseteq k(s)] \text{ if } k(s) \text{ is defined. } \cup k = \emptyset, \text{ otherwise} \\ \text{b. } \cap P_{\langle e, st \rangle} = \lambda s \lambda x. P(x)(s) \text{ if } P \text{ is cumulative and } \lambda x. P(x)(s) \in D_k. \text{ It is un-} \\ \text{defined, otherwise.}$$

I maintain them as operations on type  $e$  entities and define a dynamic type-shifter which makes reference to them. First, I define the kind condition as shown in (42).

$$(42) \quad \text{KIND}(u_n) = \lambda G \lambda H [\nu(u_n)(H) \in D_k]$$

(42) connects kind drefs of type  $E$  and kind individuals of type  $e$ . With this condition, I propose that PCDRT kind-terms have the same type as uniqueness definites of type  $\langle V, \langle \langle E, VT \rangle, VT \rangle \rangle$ .  $\mathbb{N}$  is a dynamic version of  $\cap$  as defined in (43).

$$(43) \quad \mathbb{N}P = \lambda \epsilon' \lambda V_{\langle E, VT \rangle} \lambda \epsilon \text{MAX}^{u_n}(P(\epsilon')(u_n)); [\text{KIND}\{u_n\}]; [\text{NON-ATOM}\{u_n\}]; V(\epsilon)(u_n)$$

When a dref that stores a kind occurs as an argument of non-kind level predicate, it triggers the Derived Kind Predication (DKP). To define DKP in PCDRT with situations, I define another version of the novelty condition, which is sensitive to the subset relation between drefs as shown in (44).

$$(44) \quad \text{NOV}_{u'}(u) = \lambda G \lambda H \forall v [v \neq u' \ \& \ \nu(v)(G) = \nu(v)(H) \neq \star \rightarrow [\nu(v)(H) \cap \nu(u)(H) = \emptyset]]$$

Now, the definition of DKP in PCDRT with situations is given in (45). It introduces a new dref  $u'$  whose value is a subset of  $u$  and does not overlap with the values of discourse-old drefs other than  $u$ .

$$(45) \quad \textbf{Derived Kind Predication (PCDRT version):} \text{ If } P \text{ applies to an individual and } \text{KIND}\{u\}, \text{ then } P(\epsilon)(u) = [u']; [u' \subseteq u]; [\text{NOV}_u\{u'\}]; P(\epsilon)(u')$$

Just like the static DKP, (45) is a repair strategy to avoid sortal mismatch. Thus, it only applies locally, forcing the narrowest scope reading of bare arguments.

Now, I recall the definition of the postnominal quantifiers in Japanese which is repeated as (46).

$$(46) \quad [\text{Postnominal GQ}] = \lambda R_{\langle \langle E, VT \rangle, \langle VT \rangle \rangle} \lambda V_{\langle E, VT \rangle} R(\lambda v \lambda \epsilon [\text{MAX}^{u_m \subseteq v}(V(\epsilon)(u_m)); \text{DET}\{v\}\{u_m\}])$$

(46) takes an argumental restrictor of type  $\langle \langle E, VT \rangle, \langle VT \rangle \rangle$ . This type restriction motivates insertion of a situation pronoun before the host NP is combined with a postnominal quantifier.

## 7.5 Dynamic generalised adverbial quantification

In this section, I refine the situation-based semantics of adverbial quantification within the framework of the PCDRT with situations. Since Karttunen (1969), it has been noticed that adverbial quantifiers can also license cross-sentential dependent singular anaphora. I propose that quantification over situations can derive it without assuming that adverbial quantifiers are anaphoric. For this analysis, it is crucial that PCDRT with situations allows an expression to make reference to the discourse old situations stored in the context set via presupposition. I further show that the proposed semantics of an adverbial quantifier account for the behaviour of the prenominal “itsumo” in exactly the same way as the static situation semantic analysis in Chapter 6 does.

### 7.5.1 Dynamic effect of quantification over situations

In this section, I discuss dynamic effect of adverbial quantifiers. Karttunen (1969) points out that adverbial quantifiers license inter-sentential dependent anaphora.

- (47) a. Kate<sup>*u*<sub>1</sub></sup> accompanies a post-doc<sup>*u*<sub>3</sub></sup> to every conference<sup>*u*<sub>2</sub></sup>.  
 b. She<sub>*u*<sub>3</sub></sub> **always** looks tired.

(adopted from Karttunen, 1969, with modification)

(47a) has a reading in which there is a possibly different post-doc for every conference such that Kate accompanies the post-doc to the conference. (47b) has a reading in which the pronoun “she” is dependent on *u*<sub>3</sub>: for every conference there is a post-doc such that Kate accompanies her to the conference and she looks tired. This leads Brasoveanu (2007, 2010) to analyse adverbial quantifiers in parallel with dynamic selective generalised quantifiers. For example, Brasoveanu (2010) proposes an entry of “always” shown in (47).

$$(47) \quad [[\text{always}_u]] = \lambda P_{\langle ET \rangle} \delta_u(P(u))$$

(47) performs a dynamic selective universal quantification over anaphorically retrieved restrictor *u*. In (47b), “always” is anaphoric to *u*<sub>3</sub> and it updates its scope with respect to subsets of assignments each of which assigns *u*<sub>3</sub> a different conference. Thus, the dependent reading of “she” is derived when it is evaluated under the scope of “always” and picks up the value of *u*<sub>1</sub> in each of those subsets.

Although (47) accounts for the dependent anaphora in (47b) in parallel with the way how dependent anaphora arises under the scope of quantifiers over individuals, it stands in opposition to another tradition in the semantics of adverbial quantifiers. Lewis (1986) claims that adverbial quantifiers such as *a/ways* quantify over cases, i.e. sequences of entities which are necessary to evaluate a sentence, and he suggests that adverbial quantifiers are unselective quantifiers, which can bind any variables which occur free in its nuclear scope.

As I did in Chapter 6, I keep adopting a situation-based account of adverbial quantifiers. In this sense, I do not assume that they are unselective quantifiers. To define situation-based entries of adverbial quantifiers, I first define the mereological part-whole relation  $\sqsubseteq$  as shown in (48).

$$(48) \quad [|u \sqsubseteq u'] = \lambda\langle\sigma, G\rangle [\nu(u)(G) \sqsubseteq \nu(u')(G)]$$

I use  $\sqsubseteq$  to establish relation between a situation and its sub-situations. Now, situation-based adverbial quantification in the PCDRT with situations is defined in (49).<sup>12</sup>

$$(49) \quad \begin{aligned} [[Q \text{ adv}]] &= \lambda p_{\langle ST \rangle} \lambda q_{\langle ST \rangle} \lambda \epsilon \delta_{\epsilon}([ \epsilon' ]; [ \epsilon' \sqsubseteq \epsilon ]; \mathcal{E}_{\epsilon'}(p(\epsilon'))); \\ &\quad \text{MAX}^{\epsilon'' \in \epsilon} (\delta_{\epsilon''}(\mathcal{E}_{\epsilon''}(q(\epsilon'')))); \text{DET}\{\epsilon\}\{\epsilon''\} \end{aligned}$$

The restrictor set can also be supplied covertly with *C* variable (von Stechow, 1994) as I assume in Chapter 6. I assume that *C* is evaluated as a presupposition in PCDRT with situations. Since *C* is often used to model contextually salient situations, this assumption is faithful to the original motivation for *C*-variables.

$$(50) \quad \begin{aligned} \text{a. } \mathcal{E}_{\epsilon}(C(\epsilon)) &= \lambda\langle\sigma, G\rangle \lambda\langle\sigma', H\rangle [\nu(\epsilon)(H) \subseteq \sigma' \& \text{EXEM}(C)(\nu(\epsilon)(H))] \\ \text{b. } \partial(\mathcal{E}_{\epsilon}(C(\epsilon))) &= \lambda\langle\sigma, G\rangle \lambda\langle\sigma', H\rangle [\nu(\epsilon)(H) \subseteq \sigma \& \text{EXEM}(C)(\nu(\epsilon)(H))] \end{aligned}$$

Just like dynamic selective generalised quantifiers,  $\text{DET}$  expresses various relation between two sets of situations.

12. In this Chapter, I do not discuss cases which involves an overt restrictor. One can alternatively adopt (1) as a general template of dynamic selective adverbial quantifiers.

$$(1) \quad [[Q \text{ adv}_{\epsilon_n}]] = \lambda p_{\langle ST \rangle} \lambda \epsilon [\epsilon \in \epsilon_n]; \delta_{\epsilon}(\mathcal{E}_{\epsilon}(p(\epsilon))); \text{DET}\{\epsilon_n\}\{\epsilon\}$$

In cases where an overt restrictor clause is given, one has to assume that the anaphoric index  $\epsilon_n$  is co-indexed with the situation *dref* introduced in the restrictor clause. However, one can immediately notice a problem with the Generalisation Y. Essentially, (1) has a built-in situation pronoun and it re-introduces a puzzle of why a situation pronoun selected by an adverbial quantifier does not exhibit the shifted evaluation effect.

- (51) a.  $[[\text{always}]] = \lambda p_{\langle ST \rangle} \lambda q_{\langle ST \rangle} \lambda \epsilon \delta_{\epsilon}([\epsilon']]; [\epsilon' \sqsubseteq \epsilon]; \mathcal{E}_{\epsilon'}(p(\epsilon'))$   
 $\text{MAX}^{\epsilon''} \sqsubseteq^{\epsilon} (\delta_{\epsilon''}(\mathcal{E}_{\epsilon''}(q(\epsilon'')))); \text{ALL}\{\epsilon\}\{\epsilon''\}$
- b.  $[[\text{usually}]] = \lambda p_{\langle ST \rangle} \lambda q_{\langle ST \rangle} \lambda \epsilon \delta_{\epsilon}([\epsilon']]; [\epsilon' \sqsubseteq \epsilon]; \mathcal{E}_{\epsilon'}(p(\epsilon'))$ ;  
 $\text{MAX}^{\epsilon''} \sqsubseteq^{\epsilon} (\delta_{\epsilon''}(\mathcal{E}_{\epsilon''}(q(\epsilon'')))); \text{MOST}\{\epsilon\}\{\epsilon''\}$

The restrictor situation  $\epsilon'$  stores a set of situations each of which is a sub-part of  $\epsilon$  and exemplifies the restrictor property  $p$ , the scope situation  $\epsilon$  stores a set of situations each of which exemplifies the scope property  $q$ , and these two sets of situations stand in a relation  $\text{DET}$ . This is essentially an emulation of the static adverbial quantifier  $I$  defined in Chapter 6.

- (52)  $[[\text{always}]] = \lambda p_{\langle st \rangle} \lambda q_{\langle st \rangle} \lambda s \forall s' \exists s'' [[s' \in \text{Part}(s) \& \text{EXEM}(p)(s'') \& s'' \sqsubseteq s']$   
 $\rightarrow \exists s''' [s'' \sqsubseteq s''' \& s''' \sqsubseteq s' \& \text{EXEM}(q)(s''')]]]$

In (49), dynamic distributivity with  $\delta$  is constantly evaluated with respect to the  $\epsilon$  variable and structured subset relation do not hold between the restrictor situations and the scope situations in (49). Instead, (49) requires each member of the scope situations to be a subpart of the corresponding member of the restrictor situations. One can alternatively jettison the exemplification condition and assimilate adverbial quantifiers with quantificational determiners as shown in (53).

- (53)  $[[Q \text{ adv}]] = \lambda p_{\langle ST \rangle} \lambda q_{\langle ST \rangle} \lambda \epsilon \text{MAX}^{\epsilon'}(\delta_{\epsilon'}(p(\epsilon'))); \text{MAX}^{\epsilon''} \sqsubseteq^{\epsilon'}(\delta_{\epsilon''}(q(\epsilon''))); [\epsilon'' = \epsilon];$   
 $\text{DET}\{\epsilon'\}\{\epsilon''\}$

Although (53) is a reasonable situation-based definition of adverbial quantifiers in the PCDRT with situations, I adopt (49) in this thesis. As I claim in the following discussion, the exemplification condition plays a crucial role to derive the cross-sentential dependent anaphora without assuming that an adverbial quantifier is anaphoric to a situation nor an individual.

There are two possible compositional implementations for (47b). One is to assume that “always” adjoins to VoiceP as shown in (54). The subject is then raised to Spec, TP, which derives the word order in (54). Note that the cross-sentential dependent anaphora of “she” in (47b) is attested if the subject is reconstructed.

- (54) always [<sub>VoiceP</sub> she<sub>u2</sub> looks tired ]

The other is to assume a type-variant of “always” quantifiers as shown in (55). This is in parallel with my analysis of “itsumo” in Chapter 6.



$$(55) \quad \llbracket \text{always} \rrbracket = \lambda p_{\langle ST \rangle} \lambda P_{\langle E, ST \rangle} \lambda v \lambda \epsilon \delta_{\epsilon}([\epsilon']; [\epsilon' \sqsubseteq \epsilon]; \mathcal{E}_{\epsilon'}(p(\epsilon'))); \\ \text{MAX}^{\epsilon'' \in \epsilon}(\delta_{\epsilon''}(\mathcal{E}_{\epsilon''}(P(\epsilon'')(v))))); \text{ALL}\{\epsilon\}\{\epsilon''\}$$

In either way, this generalised quantification over situations derives the cross-sentential dependent anaphora observed in (47b).

Now, I show how this dynamic generalised quantification over situations derives the cross-sentential dependent anaphora. Firstly, I analyse the semantics of (47a). To keep track of dependency between individuals and situations under the scope of  $\delta$ , I modify the denotation of “every” as shown in (56).<sup>13</sup>

$$(56) \quad \llbracket \text{every} \rrbracket = \lambda \epsilon'_V \lambda P_{\langle E, VT \rangle} \lambda V_{\langle E, VT \rangle} \lambda \epsilon_V [\text{MAX}^{u_1}(\delta_{u_1}(P(\epsilon')(u_1)))); \\ \text{MAX}^{u_2 \in u_1}(\delta_{u_2}([\epsilon'' \sqsubseteq \epsilon]; V(\epsilon)(u_2)))); \text{ALL}\{u_1\}\{u_2\}$$

The denotation of (47a) is given in (57). I leave the index of situation pronoun unresolved as it does not matter.

$$(57) \quad \llbracket (47a) \rrbracket = [\epsilon_1]; [u_1]; [u_1 = \text{Kate}]; [\text{agent}\{\epsilon\}\{u_1\}]; \\ \text{MAX}^{u_2}([\text{conference}\{\epsilon_n\}\{u_2\}]); \text{MAX}^{u_3 \in u_2}(\delta_{u_2}([\epsilon_2 | \epsilon_2 \sqsubseteq \epsilon]; [u_4]; [\text{ATOM}\{u_4\}]; \\ [\text{post-doc}\{\epsilon_2\}\{u_4\}]; [\text{theme}\{\epsilon_2\}\{u_4\}]; [\text{to}\{\epsilon_2\}\{u_3\}]; \mathcal{E}_{\epsilon_2}([\text{bring}\{\epsilon_2\}]))$$

(57) introduces values to  $\epsilon_1$ ,  $\epsilon_2$ ,  $u_1$ ,  $u_2$ ,  $u_3$  and  $u_4$ . Among them,  $\epsilon_2$  and  $u_4$  are dependent on  $u_3$ . Table 7.5 shows a possible output plural information state of (57). For an expository sake, I notate  $u_2$  and  $u_3$  simply as  $u_3 \in u_2$ . Also, I do not represent a context set in a table hereafter for ease of exposition. When it is relevant, I refer to a context set in a prose.

13. This modification is unnecessary if one assumes that the lexical verb introduces a situation dref. To do this, one may modify the denotation of verbs as follows as briefly discussed in a footnote in Chapter 3.

(1)  $\llbracket V \rrbracket = \lambda \epsilon_V [\epsilon']; [\epsilon' \sqsubseteq \epsilon]; \mathcal{E}_{\epsilon'}(V(\epsilon'))$

(1) introduces a situation dref  $\epsilon'$ . The value of  $\epsilon'$  is a subset of another situation  $\epsilon$ , which is introduced via existential closure. Thus, introduction of  $\epsilon'$  is performed under the scope of any quantifier at an argument position. The point of this modification is closely tied with an issue in event semantics that the existential quantifier for an event variable has to be under the scope of quantifiers and negation. One may feel free to adopt an approach for this issue available in the market by refining it under PCDRT with situations. See Champollion (2015); Landman (2000, a.o.) for such approaches and related discussions.

| $I$   | $\epsilon_1$ | $u_1$ | $u_3 \subseteq u_2$     | $\epsilon_2$ | $u_4$                 |
|-------|--------------|-------|-------------------------|--------------|-----------------------|
| $i_1$ | $s$          | Kate  | conference <sub>1</sub> | $s'_1$       | post-doc <sub>1</sub> |
| $i_2$ | $s$          | Kate  | conference <sub>2</sub> | $s'_2$       | post-doc <sub>2</sub> |
| $i_3$ | $s$          | Kate  | conference <sub>3</sub> | $s'_3$       | post-doc <sub>3</sub> |

**Table 7.5:** An output plural information state of (57)

Now, let me consider the denotation of (47b). In this case, the restrictor of “always” is not overt. Thus, it resorts to the  $C$  variable. In this context, I take  $C$  to be the set of situations in which Kate accompanies a post-doc to a conference. The denotation of (47b) is given in (58).

$$(58) \quad \llbracket 47b \rrbracket = [\epsilon_3]; \delta_{\epsilon}([\epsilon_4]; [\epsilon_4 \sqsubseteq \epsilon]; \partial(\mathcal{E}_{\epsilon_4}(\llbracket C\{\epsilon_4\} \rrbracket)); \text{MAX}^{\epsilon_5 \sqsubseteq \epsilon}(\delta_{\epsilon_5}(\mathcal{E}_{\epsilon_5}(\llbracket u_5 \rrbracket); \text{ATOM}\{u_5\}); [\cup u_5 = \cup u_4]; [\text{agent}\{\epsilon_5\}\{u_5\}]; \mathcal{E}_{\epsilon_5}(\llbracket \text{look tired}\{\epsilon_5\} \rrbracket)); \text{ALL}\{\epsilon\}\{\epsilon_5\}$$

(58) updates an input context  $\langle \sigma, I \rangle$  to an output context  $\langle \sigma', I \bullet H \rangle$ . Let me spell out what  $H$  looks like. This is exemplified in Table 7.6.

| $H$   | $\epsilon_3$ | $\epsilon_4$ | $\epsilon_5$ | $u_5$            |
|-------|--------------|--------------|--------------|------------------|
| $h_1$ | $s''_1$      | $s'_1$       | $s''_1$      | she <sub>1</sub> |
| $h_2$ | $s''_2$      | $s'_2$       | $s''_2$      | she <sub>2</sub> |
| $h_3$ | $s''_3$      | $s'_3$       | $s''_3$      | she <sub>3</sub> |

**Table 7.6:** An output plural information state of (58)

This output state  $H$  is merged with the input state  $I$  via the  $\bullet$  operator. On this point,  $C$  specifies the exemplifying situations of Kate accompanying a post-doc to a conference. As this is presupposed, the content of  $C$  has to be a member of a context set  $\sigma'$  such that  $\langle \sigma', I \rangle$  is an output context of (57). In this context,  $\sigma' = \{s, s'_1, s'_2, s'_3, \dots\}$  and  $C = \{s'_1, s'_2, s'_3\}$ . Now, recall that the  $\bullet$  operator merges two plural information states so that if two drefs store the same collective value, they also store the same distributive values. In this case,  $\epsilon_2$  and  $\epsilon_4$  store the same set of situations in which Kate accompanies a post-doc to a conference. As a result,  $I \bullet H$  looks like Table 7.7.

| $I \bullet H$     | $\epsilon_1$ | $u_1$ | $u_3 \subseteq u_2$     | $\epsilon_2$ | $u_4$                 | $\epsilon_3$ | $\epsilon_4$ | $\epsilon_5$ | $u_5$                 |
|-------------------|--------------|-------|-------------------------|--------------|-----------------------|--------------|--------------|--------------|-----------------------|
| $i_1 \bullet h_1$ | $s$          | Kate  | conference <sub>1</sub> | $s'_1$       | post-doc <sub>1</sub> | $s''_1$      | $s'_1$       | $s''_1$      | post-doc <sub>1</sub> |
| $i_2 \bullet h_2$ | $s$          | Kate  | conference <sub>2</sub> | $s'_2$       | post-doc <sub>2</sub> | $s''_2$      | $s'_2$       | $s''_2$      | post-doc <sub>2</sub> |
| $i_3 \bullet h_3$ | $s$          | Kate  | conference <sub>3</sub> | $s'_3$       | post-doc <sub>3</sub> | $s''_3$      | $s'_3$       | $s''_3$      | post-doc <sub>3</sub> |

**Table 7.7:** An example of  $I \bullet H$

Since  $\epsilon_2$  and  $\epsilon_4$  store the same value,  $\bullet$  merges  $I$  and  $H$  so that the value of  $\epsilon_2$  and  $\epsilon_4$  are the same in each sub-assignment of  $I \bullet H$ . The value of  $\epsilon_4$  is a sub-part of the value of  $\epsilon_3$  for each sub-assignment and  $\epsilon_5$  is a structure-preserving subset of  $\epsilon_3$ . Now, the co-reference condition between  $u_4$  and  $u_5$  is evaluated under the scope of  $\delta_{\epsilon_5}$ . Accordingly, “she” picks up different post-docs relative to the sub-assignments  $j_1$ ,  $j_2$  and  $j_3$ .

In this way, the dependent singular anaphora with an adverbial quantifier is derived in parallel with dependent anaphora with quantifiers over individuals. However, the crucial difference is that this analysis of dependent singular anaphora with adverbial quantifiers does not utilise any pronominal element other than one singular pronoun for individuals. Instead, interaction between the structural preservation of the  $\bullet$  operator and presupposition of exemplification with  $C$  variable provide the appropriate antecedent for a singular pronoun under the scope of the  $\delta$  operator. Thus, one does not need to stipulate that an adverbial quantifier is anaphoric to a set of individuals.

### 7.5.2 Composition of the prenominal “itsumo”

In this section, I implement the situation-based analysis of the adverbial universal quantifier “itsumo” with the PCDRT with situations. The behaviour of the prenominal “itsumo” provides another reason to maintain the exemplification condition in the PCDRT entry of adverbial quantifiers.

I adopt the dynamic entry of “itsumo” in (59). It predicts the same truth condition as “always” when it occurs at the floating position.

$$(59) \quad \llbracket \text{itsumo} \rrbracket = \lambda p_{\langle ST \rangle} \lambda P_{\langle E, ST \rangle} \lambda v \lambda \epsilon \delta_{\epsilon}([\epsilon']; [\epsilon' \sqsubseteq \epsilon]; \mathcal{E}_{\epsilon'}(p(\epsilon'))); \\ \text{MAX}_{\epsilon'' \in \epsilon} (\delta_{\epsilon''}(\mathcal{E}_{\epsilon''}(P(\epsilon'')(v)))); \text{ALL}\{\epsilon\}\{\epsilon''\}$$

After it takes a restrictor set of situations, (59) takes a scope property of type  $\langle E, VT \rangle$  and returns a predicate of type  $\langle E, VT \rangle$ . Recall the example of the prenominal “itsumo” which is repeated in (60).

- (60) Ryo-wa **itsumo**-no jaketto-o ki-tei-ru.  
 Ryo-TOP always-GEN jacket-ACC wear-PROG-PRES  
 Lit “Ryo wears the always-jacket.”

The denotation of “itsumo-no jacket” (always-jacket) is given in (61).

$$(61) \quad \llbracket \text{itsumo-no jaketto} \rrbracket = \lambda v \lambda \epsilon (\delta_{\epsilon}(\llbracket \epsilon_2 \rrbracket; \partial(\mathcal{E}_{\epsilon_2}(\llbracket C\{\epsilon_2\} \rrbracket)); [\epsilon_2 \sqsubseteq \epsilon])); \\ \text{MAX}^{\epsilon_3 \sqsubseteq \epsilon}(\delta_{\epsilon_3}(\mathcal{E}_{\epsilon_3}(\llbracket \text{jacket}\{\epsilon_3\}\{v\} \rrbracket)); \text{ALL}\{\epsilon\}\{\epsilon_3\})$$

As I have discussed in Chapter 6, the members of  $C$  has to contain a jacket and only jacket so that (61) avoids trivial falsity:  $\mathcal{E}(\llbracket \text{jacket}\{v\}\{\epsilon\} \rrbracket)(\epsilon)$  is trivially false if the value of  $\epsilon$  contains something other than a jacket.

Now, (61) is shifted to an argumental denotation via type-shifting principles which are repeated below.

$$(62) \quad \text{a. } \text{IOTA}(P_{\langle E, VT \rangle}) = \lambda \epsilon' \lambda V_{\langle E, VT \rangle} \lambda \epsilon \text{MAX}^{u_n}(P(\epsilon')(u_n)); [\text{NOV}\{u_n\}]; V(\epsilon)(u_n) \\ \text{b. } {}^{\mathfrak{N}}P = \lambda \epsilon' \lambda V_{\langle E, VT \rangle} \lambda \epsilon \text{MAX}^{u_n}(P(\epsilon')(u_n)); [\text{KIND}\{u_n\}]; [\text{NON-ATOM}\{u_n\}]; V(\epsilon)(u_n)$$

$\text{IOTA}$ -shift returns a unique jacket which Ryo always wears in contextually salient situations as shown in (63).

$$(63) \quad \text{IOTA}(\llbracket (60) \rrbracket)(pro_s) = \lambda V_{\langle E, VT \rangle} \lambda \epsilon \text{MAX}^{u_1}(\delta_{\epsilon_n}(\llbracket \epsilon_2 \rrbracket; [\epsilon_2 \sqsubseteq \epsilon_n]; \partial(\mathcal{E}_{\epsilon_2}(\llbracket C\{\epsilon_2\} \rrbracket)); \\ \text{MAX}^{\epsilon_3 \sqsubseteq \epsilon_n}(\delta_{\epsilon_3}(\mathcal{E}_{\epsilon_3}(\llbracket \text{jacket}\{\epsilon_3\}\{u_1\} \rrbracket)); [\text{NOV}\{u_1\}]; \text{ALL}\{\epsilon_n\}\{\epsilon_3\}]); V(\epsilon)(u_1)$$

(63) introduces the maximal dref  $u_1$  such that (i)  $u_1$  is a jacket in  $\epsilon_3$  which is a structure-preserving subset of a contextually salient situation  $\epsilon_n$ , (ii) for each value of  $\epsilon_n$ ,  $\epsilon_2$  stores a situation which is part of  $\epsilon_n$  and consists of a jacket and nothing else, (iii) every situation which can be a value of  $\epsilon_n$  can also be a value of  $\epsilon_3$ , i.e. the restrictor situations are subset of the scope situations. In short, these jointly express that  $u_1$  is a maximal jacket which exists in all the situations which  $\epsilon_n$  stores and contains a jacket. Essentially, (63) emulates the static analysis presented in Chapter 6 in a dynamic setting.

On the other hand, the  $\mathfrak{N}$ -shift derives a sub-kind reading. Recall the previous example with a sub-kind reading of the prenominal “itsumo.”

$$(64) \quad \text{Shun-wa } \textbf{itsumo}\text{-no } \text{koohii-o } \text{non-da.} \\ \text{Shun-TOP always-GEN coffee-ACC drink-PRES} \\ \text{Lit “Shun drank always-coffee.”}$$

The denotation of “itsumo-no koohii” (always coffee) is given in (65). It returns a kind of coffee which Shun always drinks in contextually salient situations.

$$(65) \quad {}^{\mathfrak{N}}P(\llbracket (64) \rrbracket)(pro_s) = \lambda V_{\langle E, VT \rangle} \lambda \epsilon \text{MAX}^{u_1}(\delta_{\epsilon_n}(\llbracket \epsilon_2 \rrbracket; [\epsilon_2 \sqsubseteq \epsilon_n]; \partial(\mathcal{E}_{\epsilon_2}(\llbracket C\{\epsilon_2\} \rrbracket)); \\ \text{MAX}^{\epsilon_3 \sqsubseteq \epsilon_n}(\delta_{\epsilon_3}(\mathcal{E}_{\epsilon_3}(\llbracket \text{coffee}\{\epsilon_3\}\{u_1\} \rrbracket)); \text{ALL}\{\epsilon_n\}\{\epsilon_3\}]); [\text{KIND}\{u_1\}]; [\text{NON-ATOM}\{u_1\}]; \\ V(\epsilon)(u_1)$$

The composition in (65) is mostly the same as (63): both picks up the maximal dref  $u_1$  which is coffee which exists in every contextually relevant situation with coffee. The only difference is that (65) additionally requires  $u_1$  to store the kind-level values. As  $u_1$  has to take a kind-level value, it can be a sub-kind of coffee or the maximal kind of coffee. However, if  $u_1$  picks up the maximal coffee kind, this makes the contribution of “itsumo” vacuous. This violates the principle of Minimise Restrictors!, which prohibits vacuous restriction. Since I recast the analysis of the prenominal “itsumo” in a dynamic setting, I repeat the PCDRT version of Minimise Restrictors!, which I adopt in Chapter 5.

(66) **Minimize Restrictors!** (*PCDRT version*): An expression  $\alpha(A)(B)$  is deviant if  $A$  is redundant, i.e.

- a. if  $\lambda G \lambda H [[\alpha(A)(B)]] = \lambda G \lambda H [[\alpha(B)]]$  (= *Referential Irrelevance*), and
- b.  $A$  does not serve another purpose (= *Pragmatic Irrelevance*).

This principle correctly predicts that whenever one can specify the same set of referents as “itsumo-no koohii” (always coffee) with the bare argument “koohii,” the prenominal “itsumo” cannot be felicitously used. Compare (65) with (67).

(67)  ${}^{\mathfrak{N}}P[[\text{koohii}]](pro_s) = \lambda V_{\langle E, VT \rangle} \lambda \epsilon \text{MAX}^{u_1} ([[\text{coffee}\{\epsilon\}\{u_1\}]]; [[\text{KIND}\{u_1\}]]; [[\text{NON-ATOM}\{u_1\}]]; V(\epsilon)(u_1))$

Although they come with different conditions, if  $u_1$  picks up the maximal coffee kind, (65) and (67) specify the same value. Thus, the principle of Minimise Restrictors! correctly predicts the unavailability of a maximal kind reading with the prenominal “itsumo.” The remaining option for (65) is to pick up a sub-kind of coffee. Recall that sub-kinds are defined so that they collectively exhaust the maximal kind and do not overlap with each other.

(68) **Kind Disjointness Condition** (Mendia, 2019): A kind-referring expression can only refer to a contextually defined subset of all the possible sub-kinds that the noun is true of, such that:

- a. the subkinds in this subset are disjoint and share no realizations,
- b. the subkinds collectively cover all the space of realizations of the kind

Thus,  $u_1$  in (65) picks up a sub-kind of coffee which always exists in contextually salient situations  $\epsilon_n$ .

### 7.5.3 Interim Summary

In this section, I discussed adverbial quantification in PCDRT with situations. I suggested that adverbial quantifiers perform generalised quantification over situations, exemplifying both the restrictor property and the scope property. When a restrictor is covertly given, this is achieved with presupposed exemplification over  $C$  variable. This presupposed exemplification of the restrictor property accounts for cross-sentential dependent singular anaphora without assuming that adverbial quantifiers are anaphoric to a set of individuals nor a set of situations.

At the same time, the proposed definition of “itsumo” (always) maintains the essential situation semantic features that explains the interpretations of the prenominal “itsumo.” Thus, the definite readings and the sub-kind readings of the prenominal “itsumo” are both derived in the same way as they are in the static situation semantic analysis in Chapter 6.

## 7.6 Dynamic situation-based distributivity

I have defined the system of PCDRT with situations and showed how it deals with D-quantification and A-quantification. This version of PCDRT serves as a unified framework which ties different pieces of my proposal together. In this framework, one can compare “sorezore” and “zutsu” to theoretically pin down their difference. In this section, I refine the denotation of “zutsu” in PCDRT with situations and solve the puzzle of the intermediate dynamics of “zutsu.” I claim that “zutsu” introduces a new dref under  $\delta$ , but it does not evaluate lexical relations under  $\delta$ . Instead, the distributive inference of “zutsu” comes from situation partition and the  $UQ_{Dist}$  condition, which are static conditions for situations. As a result, the values of a new dref that “zutsu” introduces can be retrieved at a later stage of the discourse, but it is not possible for “zutsu” to retrieve an old dependency because it does not evaluate its scope with the  $\delta$  operator. Considering that a context consists of a context set and a plural information state, one can say that “zutsu” performs distributive update with respect to the first coordinate of the context, i.e. context sets, while “sorezore” performs distributive update with respect to the second coordinate of the context, i.e. plural information states.

### 7.6.1 Dynamic situation partition

In this section, I define the situation partition in PCDRT with situations. The aim is to dynamicise this analysis so that it can account for the intermediate dynamic behaviour of “zutsu.” (69) repeats the definition of situation partition in Chapter 6.

- (69)  $\text{Part}(s)$  is partition of a situation  $s$  iff
- $\text{Part}(s) \subseteq \{s' : s' \sqsubseteq s\}$ ,
  - $\oplus \text{Part}(s) = s$ ,
  - $\forall s', s'' [s', s'' \in \text{Part}(s) \rightarrow \neg \exists s''' [s''' \sqsubseteq s' \& s''' \sqsubseteq s'']]$

In Chapter 6, I proposed that “zutsu” utilises situation partition with the  $\text{UQ}_{Dist}$  presupposition which is repeated in (70).

- (70)  $\text{UQ}_{Dist}(\text{P})(s) \Leftrightarrow$   
 $[|\text{Part}(s)| > 1 \& \forall s' [s' \in \text{Part}(s) \rightarrow \exists x [\text{P}(x)(s') \& \forall y [\text{P}(y)(s') \& y \sqsubseteq x]]]]$

I refine these notions under PCDRT with situations. First, I define a dynamic situation partition condition  $\text{Part}^{\epsilon'}\{\epsilon\}$  as shown in (71).

- (71)  $\text{Part}^{\epsilon'}\{\epsilon\} = \lambda\langle\sigma, G\rangle\lambda\langle\sigma', H\rangle [G[\eta(\epsilon')]H \& \text{Part}(\nu(\epsilon)(H)) = \nu(\epsilon')(H)]$

It introduce a new situation-level dref  $\epsilon'$  such that the value of  $\epsilon'$  is a situation partition of  $\epsilon'$ . Crucially, introduction of a partition dref is performed with the  $\eta$  operator.  $\text{Part}(s)$  is a bundle of conditions as shown in (69).

With this definition of situation partition in PCDRT with situations, I refine the definition of  $\text{UQ}_{Dist}$  as shown in (72).<sup>14</sup>

- (72)  $\text{UQ}_{Dist:\epsilon}\{\lambda\nu[\text{P}(\epsilon)(\nu)]\} = \lambda\langle\sigma, G\rangle\lambda\langle\sigma', H\rangle [\nu(\epsilon)(H) \in \sigma \& \exists S [|\text{Part}(\nu(\epsilon)(H))| > 1 \& \forall s' [s' \in S \rightarrow \exists x [\text{P}(x)(s') \& \forall y [\text{P}(y)(s') \& y \sqsubseteq x]]]]]$

14. In (72), the left-hand side  $\text{P}$  is an abbreviation with type  $\langle E, VT \rangle$  and the right-hand side  $\text{P}$  is not, i.e. type  $\langle e, st \rangle$ . One may alternatively fully stativise  $\text{P}$  with the  $\downarrow$  function defined in Footnote 7.3.2. This alternative makes a different prediction. If some arguments of  $\text{P}$  are introduced within a test, the  $\text{UQ}_{Dist}$  post-supposition is predicted to be false, i.e. those arguments of  $\text{P}$  are undefined when the  $\text{UQ}_{Dist}$  is evaluated. However, if  $\text{P}$  is stativised with the  $\downarrow$  function, this problem does not arise because the saturated arguments of  $\text{P}$  are replaced with existentially quantified individual variables of type  $e$ . I leave the precise empirical status of this prediction for future research.

(72) requires that there is a non-trivial partition of the value of  $\epsilon$  such that for each member  $s'$  of the partition, there is a unique entity  $x$  such that  $P(x)(s')$ . Its function is essentially the same as the static version of the  $UQ_{Dist}$ . Note that I take (72) to be a variant of a more transparent notation (73), it takes a predicate of type  $\langle ET \rangle$  and a situation dref. I choose (72) for notational brevity.

$$(73) \quad UQ_{Dist}\{\lambda\epsilon'\lambda v[P(\epsilon')(v)]\}\{\epsilon\} = \lambda\langle\sigma, G\rangle\lambda\langle\sigma', H\rangle[v(\epsilon)(H) \in \sigma \& \exists S [|S| > 1 \& S = \text{Part}(v(\epsilon)(H)) \& \forall s' [s' \in S \rightarrow \exists x[P(x)(s') \& \forall y[P(y)(s') \& y \sqsubseteq x]]]]]$$

I claimed that the plurality condition for situations of “zutsu” is a not-at-issue content and treated it as a presupposition. In this chapter, I assume that it is post-suppositional. It is for a technical reason: the  $UQ_{Dist}$  is responsible for imposing the plurality condition and it is sometimes applied to situations which are newly introduced in a clause. However, if the  $UQ_{Dist}$  is presuppositional, it can only look at situations which are already stored in the input context set. Thus, I chose to take it as a post-supposition so that such cases can also be covered.

I embed the  $UQ_{Dist}$  condition under the  $\xi$  operator so that it is evaluated as a post-supposition as shown in (74). It requires  $\epsilon$  to store plural situations after at-issue contents are evaluated. While (73) requires  $v(\epsilon)(H)$  to be a member of the input context set  $\sigma$ , (74) requires it to be a member of the output context set  $\sigma'$ . This ensures that the  $UQ_{Dist}$  condition is also applicable to situations which are newly introduced in a clause.

$$(74) \quad \xi(UQ_{Dist:\epsilon}\{\lambda v[P(\epsilon)(v)]\}) = \lambda\langle\sigma, G\rangle\lambda\langle\sigma', H\rangle[v(\epsilon)(H) \in \sigma' \& \exists S [|S| > 1 \& S = \text{Part}(v(\epsilon)(H)) \& \forall s' [s' \in S \rightarrow \exists x[P(x)(s') \& \forall y[P(y)(s') \& y \sqsubseteq x]]]]]$$

As (74) is evaluated with respect to the output context, it is expected to be projective: even when (71) introduces a partition within a test, e.g., under the scope of negation, (74) requires that  $P$  is evaluated against a situation partition. Otherwise, (74) is automatically satisfied.

Now, I propose a PDCRT entry of “zutsu” as shown in (75).

$$(75) \quad \llbracket \text{zutsu} \rrbracket = \lambda Q_{\langle E, ST \rangle} \lambda P_{\langle E, ST \rangle} \lambda v \lambda \epsilon \text{Part}^{\epsilon'}\{\epsilon\}; \delta_{\epsilon'}([u_n]; [u_n \subseteq v]; [\llbracket Q(\epsilon')(u_n) \rrbracket]; [\llbracket P(\epsilon')(u_n) \rrbracket]; \xi(\llbracket UQ_{Dist:\epsilon}\{\lambda v[P(\epsilon)(v)]\} \rrbracket)]$$



In short, (75) evaluates Q in a dynamically distributive way and evaluates P in a statically distributive way. Let me explain it one by one. Firstly, (75) introduces  $\epsilon'$  whose value is a situation partition of  $\epsilon$ . Then, it evaluates some DRSs under  $\delta_{\epsilon'}$ , i.e. introduction of a dref  $u_n$  whose value is a subset of the value of  $v$  and evaluation of Q with respect to  $u_n$ . In this part of (75), “zutsu” introduces a new dependency. On the other hand, P is evaluated outside the scope of  $\delta_{\epsilon'}$ . This is the key part of (75) to prevent “zutsu” from retrieving an old dependency. Lastly, the  $UQ_{Dist}$  post-supposition is checked against the output context in which the rest of the conditions of  $[[zutsu]]$  has already been evaluated. The combination of  $Part^{\epsilon'}\{\epsilon\}$  and  $UQ_{Dist:\epsilon}\{\lambda v[P(\epsilon)(v)]\}$  requires that P is distributively evaluated with respect to situations, but not with respect to situation drefs. Thus, even if a pronoun occurs as part of P, it cannot be evaluated under the scope of  $\delta$  and it cannot access the values stored in subsets of a plural information state.

Let me show how it works. (76) allows two types of distributive readings.

- (76) Wataru-to-Yasu-ga hon-o ni-satsu-**zutsu** ka-tta.  
 Wataru-and-Yasu-NOM book-ACC 2-CL<sub>volumes</sub>-DIST buy-PAST  
 a. “Wataru and Yasu bought two books each.” (individual)  
 b. “Wataru and Yasu bought two books each time.” (occasion)

The denotation of (76) is given in (77).

- (77)  $[[ (76) ]] = [\epsilon_1]; [u_1 | u_1 = W+Y]; [agent\{\epsilon_1\}\{u_1\}]; [u_2]; [book\{\epsilon_1\}\{u_2\}];$   
 $[Part^{\epsilon_2}\{\epsilon_1\}]; \delta_{\epsilon_2}([u_3]; [u_3 \subseteq u_2]; [2 \text{ VOLUME}\{\epsilon_2\}\{u_3\}]); [theme\{\epsilon_2\}\{u_3\}];$   
 $\mathcal{E}_{\epsilon_2}([read\{\epsilon_2\}]); \xi([UQ_{Dist:\epsilon_1}\{\lambda v[[theme\{\epsilon_1\}\{v]\}]; \mathcal{E}_{\epsilon_1}([read\{\epsilon_1\}])])]$

I show that this denotation achieves the weak truth condition I argued for in Chapter 6. I claim that the same denotation can express an individual distributive reading or an occasion distributive reading, but one can distinguish these readings by looking at different kinds of output plural information states (77) permits.

I will start with an occasion distributive reading for a reason I describe later. Table 7.8 shows a possible plural information state of (77) before evaluation of “zutsu.”

| <i>I</i> | $\epsilon_1$ | $u_1$ | $u_2$                   |
|----------|--------------|-------|-------------------------|
|          | <i>s</i>     | W+Y   | book <sub>1,2,3,4</sub> |

**Table 7.8:** A plural information state before evaluating “zutsu”

This is the simplest case among possible plural information states: pluralities are all expressed as domain plurals and this plural information state just contain one assignment. One may represent the values of  $u_2$  so that no sub-assignment contains a domain plurality. Importantly, such a representation still lacks dependency among  $\epsilon_1$ ,  $u_1$  and  $u_2$  and the same result can be obtained.

Table 7.9 shows a plural information state of (77) after evaluation of “zutsu.” Part <sup>$\epsilon_2$</sup>  introduces  $\epsilon_2$  whose value is a partition of the value of  $\epsilon_1$ .

| $H$   | $\epsilon_1$ | $u_1$ | $u_2$                   | $\epsilon_2$ | $u_3 \subset u_2$   |
|-------|--------------|-------|-------------------------|--------------|---------------------|
| $h_1$ | $s$          | W+Y   | book <sub>1,2,3,4</sub> | $s'_1$       | book <sub>1,2</sub> |
| $h_2$ | $s$          | W+Y   | book <sub>1,2,3,4</sub> | $s'_2$       | book <sub>3,4</sub> |

**Table 7.9:** A plural information state after evaluating “zutsu”

In Table 7.9,  $\epsilon_2$  itself is not dependent on  $\epsilon_1$  nor  $u_2$ , but it creates dependency between the subparts of  $v(\epsilon_1)(H)$  and the subparts of  $v(u_2)(H)$ . This correctly predicts an occasion distributive reading:  $s$  is partitioned into two situations in each of which Wataru and Yasu together bought two books at different situations.<sup>15</sup>

Then, I turn to an individual distributive reading. Since the dynamic situation partition is defined with the  $\eta$  operator as shown in (71), it allows  $\epsilon_2$  to be dependent on the previously introduced drefs. I propose that an individual distributive reading arises when Part <sup>$\epsilon_2$</sup>  introduces a new dependency. Table 7.10 shows another possible plural information state before “zutsu” is evaluated, which leads to an individual distributive reading. This table differs from Table 7.8 in that the values of  $u_1$  are allocated to different subsets of  $I$ . The dependency-free dref introduction permits this kind of plural information states. One can see that  $\epsilon_1$ ,  $u_1$  and  $u_2$  are still independent of each other in this table.

| $I$   | $\epsilon_1$ | $u_1$ | $u_2$                   |
|-------|--------------|-------|-------------------------|
| $i_1$ | $s$          | W     | book <sub>1,2,3,4</sub> |
| $i_2$ | $s$          | Y     | book <sub>1,2,3,4</sub> |

**Table 7.10:** A plural information state before evaluating “zutsu”

15. Table 7.9 is still compatible with an individual distributive reading. Although  $\epsilon_1$  and  $u_1$  are independent, the agent relation expresses a static cumulative dependency between Wataru+Yasu and sub-parts of  $s$ , i.e.  $\text{*agent}(s)(\text{Wataru+Yasu})$ , because  $[\text{agent}\{\epsilon_1\}\{u_1\}] = \lambda\langle\sigma, G\rangle[\text{*agent}(v(\epsilon)(G))(v(u_1)(G))]$ . Thus, Table 7.9 predicts that “zutsu” has an individual distributive reading which does not introduce a new dependency. I do not examine if this is a welcome prediction. At least, presence of such a reading is harmless because the proposed analysis can also generate an individual distributive reading which introduces a new dependency.

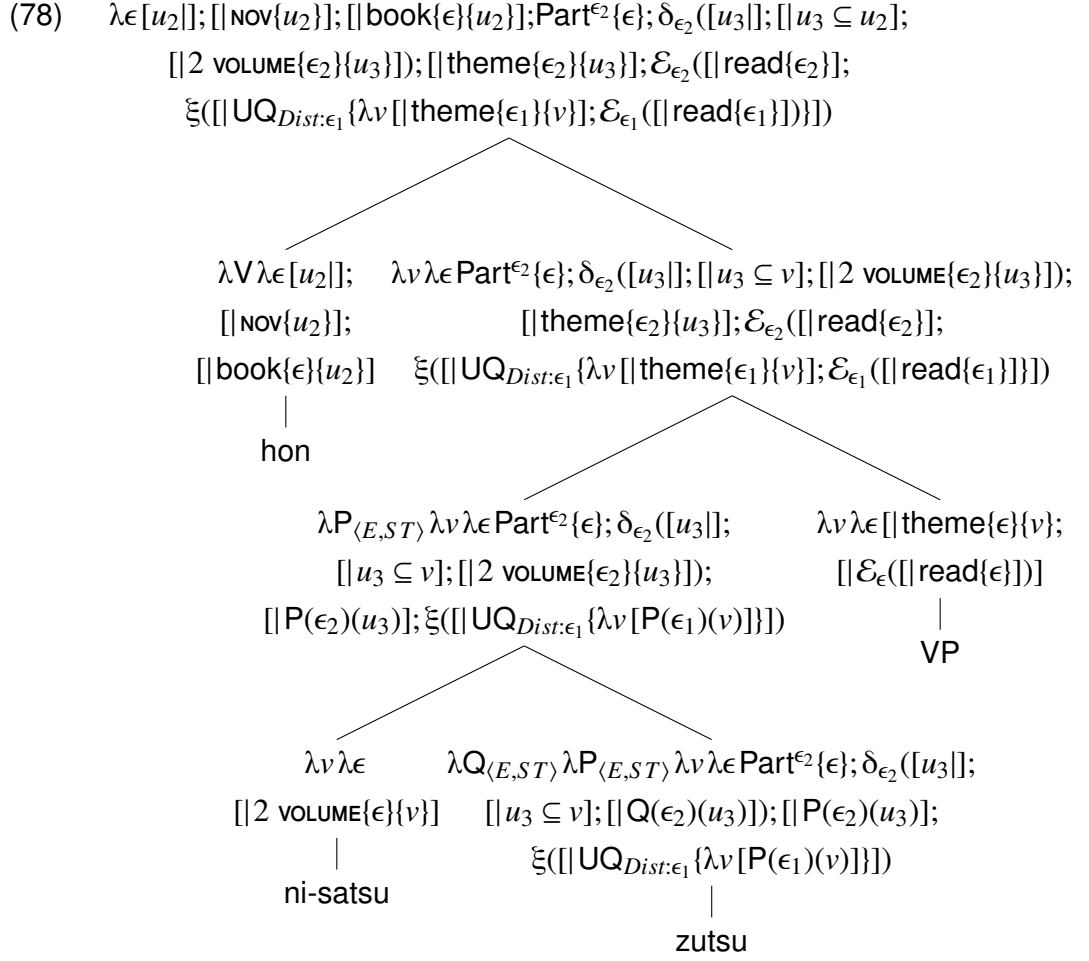
On this point, the  $\eta$  operator introduces a random dependency and  $\text{Part}^{\epsilon_2}$  has an option to make  $\epsilon_2$  dependent on  $u_1$ . Thus, the semantics of “zutsu” permits plural information states exemplified in Table 7.11. This express a partition of  $s$  to  $s'_1$  and  $s'_2$ : Wataru bought two books in  $s'_1$  and Yasu bought two books in  $s'_2$ .

| $H$   | $\epsilon_1$ | $u_1$ | $u_2$                   | $\epsilon_2$ | $u_3 \subset u_2$   |
|-------|--------------|-------|-------------------------|--------------|---------------------|
| $h_1$ | $s$          | W     | $\text{book}_{1,2,3,4}$ | $s'_1$       | $\text{book}_{1,2}$ |
| $h_2$ | $s$          | Y     | $\text{book}_{1,2,3,4}$ | $s'_2$       | $\text{book}_{3,4}$ |

**Table 7.11:** A plural information state after evaluating “zutsu”

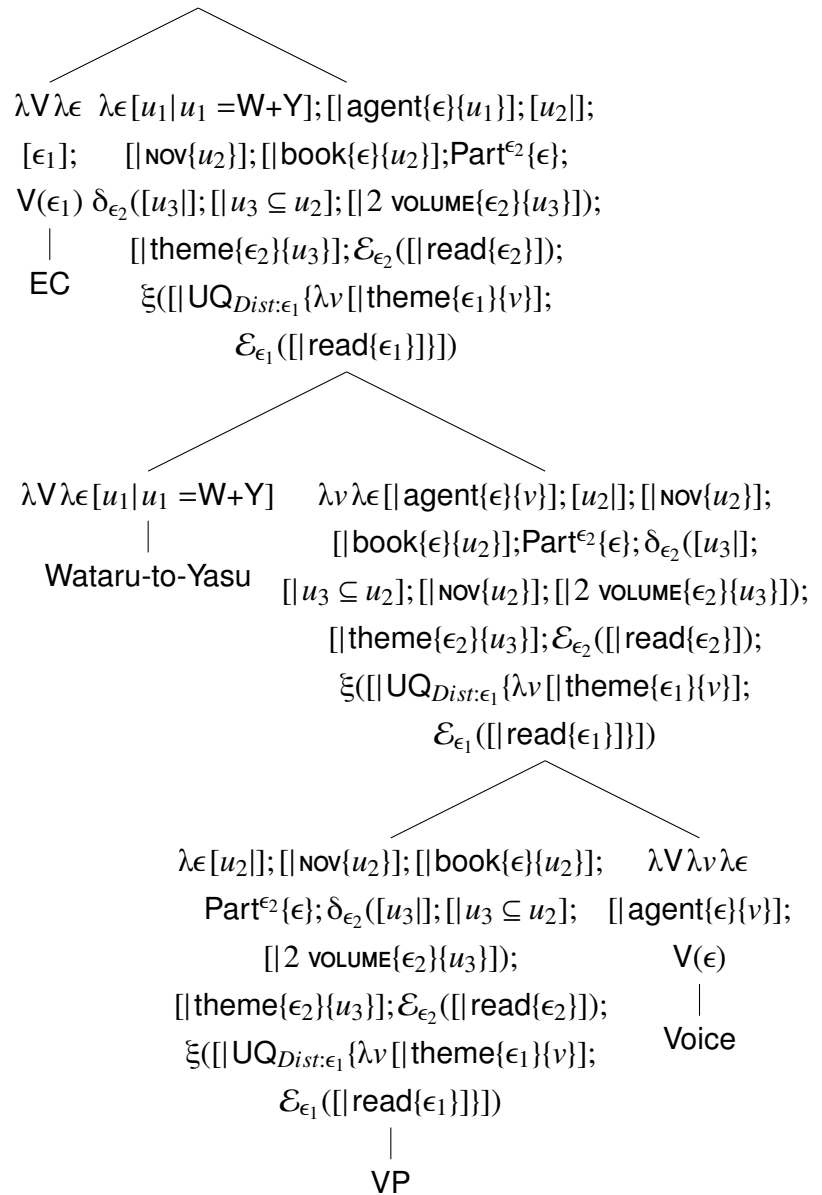
In this way, the static situation-based account of “zutsu” can be recast under PCDRT with situations. The revised entry of “zutsu” still expresses two types of distributive readings with the same semantic representation. These readings differ in if the partition dref is dependent on another dref in the same clause.

Lastly, this analysis of “zutsu” in PCDRT with situations emulates the compositional process of clauses with “zutsu” in the static situation semantics. (78) shows how “zutsu” is combined with VP and the object. I treat the object as a simple indefinite, but as it is a bare argument, it is shifted to a kind via  $\mathfrak{n}$ , a situation pronoun is inserted and then DKP applies when it is combined with the theme relation.



(78) is combined with Voice<sup>0</sup> and the subject as shown in (79).

(79)  $[\epsilon_1]; [u_1 | u_1 = \mathbf{W} + \mathbf{Y}]; [\text{agent}\{\epsilon_1\}\{u_1\}]; [u_2]; [\text{nov}\{u_2\}]; [\text{book}\{\epsilon_1\}\{u_2\}];$   
 $\text{Part}^{\epsilon_2}\{\epsilon_1\}; \delta_{\epsilon_2}([u_3]; [u_3 \subseteq u_2]; [2 \text{ volume}\{\epsilon_2\}\{u_3\}]); [\text{theme}\{\epsilon_2\}\{u_3\}];$   
 $\mathcal{E}_{\epsilon_2}([\text{read}\{\epsilon_2\}]); \xi([\text{UQ}_{Dist:\epsilon_1}[\lambda v [\text{theme}\{\epsilon_1\}\{v\}]; \mathcal{E}_{\epsilon_1}([\text{read}\{\epsilon_1\}])])$



### 7.6.2 Intermediate dynamics

In this section, I aim to offer an account for the intermediate dynamic effect of “zutsu”: it introduces a new dependency, but does not retrieve an old dependency. First, let me discuss introduction of dependencies. As I have just shown, “zutsu” creates a new dependency with the  $\delta$  operator. Thus, it is expected that this dependency can be retrieved at a later stage. Recall the previous examples.

- (80) a. Kodomo-tachi<sup>u<sub>1</sub></sup>-ga sakkaa sensyu<sup>u<sub>2</sub></sup>-o hito-ri-**zutsu**<sup>u<sub>3</sub>, $\epsilon_2$</sup>  eran-da.  
 child-PL-NOM football player-ACC 1-CL<sub>Person</sub>-zutsu choose-PAST  
 “The children chose one football player each.”
- b. Karera<sup>u<sub>1</sub></sup>-wa **sorezore**<sup>u<sub>4</sub></sup> sono-sensyu<sup>u<sub>5</sub></sup>-to a-tta.  
 they-TOP sorezore the-player-with meet-PAST  
 “They each met the player.”

I added the indices of dref that “zutsu” introduces and the information about the drefs that pronouns introduce. (80a) introduces a dependency between  $u_1$  and  $u_3$  and (80b) retrieves it. (80a) outputs plural information states similar to Table 7.11. Table 7.12 exemplifies them.

| $H$   | $\epsilon_1$ | $u_1$              | $u_2$                   | $\epsilon_2$ | $u_3 \subset u_2$   |
|-------|--------------|--------------------|-------------------------|--------------|---------------------|
| $h_1$ | $s$          | child <sub>1</sub> | player <sub>1,2,3</sub> | $s'_1$       | player <sub>1</sub> |
| $h_2$ | $s$          | child <sub>2</sub> | player <sub>1,2,3</sub> | $s'_2$       | player <sub>2</sub> |
| $h_3$ | $s$          | child <sub>3</sub> | player <sub>1,2,3</sub> | $s'_3$       | player <sub>3</sub> |

**Table 7.12:** An output plural information state for (80a)

In this table,  $u_3$  is dependent on  $u_1$ . This is due to the  $\eta$  operator. We are interested in the reading in which  $u_4$  is co-referential with  $u_1$  and  $u_5$  is co-referential with  $u_2$ . On this point,  $u_4$  is the only available antecedent for the floating “sorezore.” Accordingly, the singular anaphora “sono sensyu” (the player) is evaluated under the scope of  $\delta_{u_4}$ . Thus, it can access to the values of  $u_3$  stored under  $h_1$ ,  $h_2$  and  $h_3$ . Table 7.13 exemplifies the output plural information states of (80b).

| $H \bullet J$     | $\epsilon_1$ | $u_1$              | $u_2$                   | $\epsilon_2$ | $u_3 \subset u_2$   | $\epsilon_3$ | $u_4$              | $u_5$               |
|-------------------|--------------|--------------------|-------------------------|--------------|---------------------|--------------|--------------------|---------------------|
| $h_1 \bullet j_1$ | $s$          | child <sub>1</sub> | player <sub>1,2,3</sub> | $s'_1$       | player <sub>1</sub> | $s''$        | child <sub>1</sub> | player <sub>1</sub> |
| $h_2 \bullet j_2$ | $s$          | child <sub>2</sub> | player <sub>1,2,3</sub> | $s'_2$       | player <sub>2</sub> | $s''$        | child <sub>2</sub> | player <sub>2</sub> |
| $h_3 \bullet j_3$ | $s$          | child <sub>3</sub> | player <sub>1,2,3</sub> | $s'_3$       | player <sub>3</sub> | $s''$        | child <sub>3</sub> | player <sub>3</sub> |

**Table 7.13:** An output plural information state for (80b)

In this way, one can retrieve the dependency that “zutsu” introduced. Cases with occasional distributive readings can be explained in an analogous way.

- (81) a. Yamada-san<sup>u<sub>1</sub></sup>-ga keeki<sup>u<sub>2</sub></sup>-o huta-tu-**zutsu**<sup>u<sub>3</sub>, $\epsilon_2$</sup>  eran-da.  
 Yamada-Mr-NOM cake-ACC 2-CL<sub>Object</sub>-zutsu choose-PAST.  
 “Mr. Yamada chose two cakes at each salient occasion.”
- b. Kare<sub>u<sub>1</sub></sub>-wa \*(itsumo) **sono-huta-tu-no keeki**<sub>u<sub>3</sub></sub>-o jikkuri ajiwa-tta.  
 he-TOP (always) the-2-CL<sub>Object</sub>-GEN keeki-ACC carefully taste-PAST.  
 “He always tasted the two cakes carefully.”

The possible output plural information states of (81a) are exemplified in Table 7.14.

| $H$   | $\epsilon_1$ | $u_1$  | $u_2$                       | $\epsilon_2$ | $u_3 \subset u_2$   |
|-------|--------------|--------|-----------------------------|--------------|---------------------|
| $h_1$ | $s$          | Yamada | cake <sub>1,2,3,4,5,6</sub> | $s'_1$       | cake <sub>1,2</sub> |
| $h_2$ | $s$          | Yamada | cake <sub>1,2,3,4,5,6</sub> | $s'_2$       | cake <sub>3,4</sub> |
| $h_3$ | $s$          | Yamada | cake <sub>1,2,3,4,5,6</sub> | $s'_3$       | cake <sub>5,6</sub> |

**Table 7.14:** An output plural information state for (81a)

In this table,  $u_3$  is dependent on  $\epsilon_2$ . This allows the anaphoric expression “sono-hutatsu-no keeki” (the two cakes) under the scope of “itsumo” to access it in a way I discussed in §7.5.1. First, the covert restrictor of “itsumo” is given as  $\partial(\mathcal{E}(C))$ . Thus, its restrictor set is chosen from situations which are already part of a context set  $\sigma'$  paired with  $H$ . In this case, “itsumo” can take a set  $\{s'_1, s'_2, s'_3\}$  as its restrictor. Due to dependency-preservation of the  $\bullet$  operator, the restrictor dref of “itsumo” is fully dependent on  $\epsilon_2$ . As the scope of “itsumo” is evaluated with respect to each member of this restrictor set, an anaphoric expression under the scope of “itsumo” can have a dependent reading with respect to  $u_3$ .

So far, I have shown that the proposed entry of “zutsu” introduces a new dependency both in cases of an individual distributive reading and an occasion distributive reading. This is expected as “zutsu” utilises the  $\delta$  operator and introduce a new dref under its scope. However, if “zutsu” utilises the  $\delta$  operator, it is puzzling why it cannot retrieve an old dependency as repeated in (82b).

- (82) a. Dono-kodomo <sup>$u_1$</sup> -mo sakkaa sensyu <sup>$u_2$</sup> -o hito-ri eran-da.  
           which-child-also      football player-ACC 1-CL<sub>Person</sub> choose-PAST  
           “Every child chose one football player.”
- b. \* Karera <sub>$u_1$</sub> -wa hito-ri-zutsu sono-sensyu <sub>$u_2$</sub> -to a-tta.  
           they-TOP      one-CL<sub>Person</sub>-zutsu the-player-with meet-PAST  
           “\*They each met the player.”

On this point, recall that the  $\delta$  operator of “zutsu” only scopes over the cardinality condition. In this case, “zutsu” distributively evaluates “hito-ri” (1-CL<sub>Person</sub>) and nothing else. This means that “sono-sensyu” (the player) does not occur under the scope of  $\delta$ . The denotation of (82b) is given in (83).

- (83)  $\llbracket (82b) \rrbracket = [\epsilon_2]; [u_3]; [u_3 = u_1]; \text{Part}^{\epsilon_3}\{\epsilon_2\}; \delta_{\epsilon_3}([u_4]; [u_4 \subseteq u_3];$   
 $[1 \text{ PERSON}\{u_4\}\{\epsilon_3\}]); [\text{agent}\{\epsilon_3\}\{u_4\}]; [u_5]; [\text{ATOM}\{u_5\}]; [u_5 = u_2];$   
 $[\text{theme}\{\epsilon_3\}\{u_5\}]; \mathcal{E}_{\epsilon_3}([\text{meet}\{\epsilon_3\}]); \xi([\text{UQ}_{Dist;\epsilon_2}\{\lambda v [\text{agent}\{\epsilon_2\}\{v\}]; [u_5];$   
 $[\text{ATOM}\{u_5\}]; [u_5 = u_2]; [\text{theme}\{\epsilon_2\}\{u_5\}]; \mathcal{E}_{\epsilon_2}([\text{meet}\{\epsilon_2\}])])$

The crucial part of (83) is that the semantic contribution of “sono-sensyu” (the player) is evaluated outside the scope of  $\delta_{\epsilon_3}$ . As a result, it looks for a dref with an atomic value at the collective level. Let me consider with an example plural information state in Table 7.15.

| $I \bullet H$     | $\epsilon_1$ | $u_1$              | $u_2$               | $\epsilon_2$ | $u_3$              | $\epsilon_3$ | $u_4$              | $u_5$               |
|-------------------|--------------|--------------------|---------------------|--------------|--------------------|--------------|--------------------|---------------------|
| $i_1 \bullet h_1$ | $s$          | child <sub>1</sub> | player <sub>1</sub> | $s'$         | child <sub>1</sub> | $s''_1$      | child <sub>1</sub> | player <sub>1</sub> |
| $i_2 \bullet h_2$ | $s$          | child <sub>2</sub> | player <sub>2</sub> | $s'$         | child <sub>2</sub> | $s''_2$      | child <sub>2</sub> | player <sub>2</sub> |
| $i_3 \bullet h_3$ | $s$          | child <sub>3</sub> | player <sub>3</sub> | $s'$         | child <sub>3</sub> | $s''_3$      | child <sub>3</sub> | player <sub>3</sub> |

**Table 7.15:** An output plural information state of (82b)

The information stored in this table is compatible with (83) except the atomicity condition of “sono-sensyu” (player). Since this is not evaluated under the scope of  $\delta$ , the atomicity condition is evaluated with respect to  $I \bullet H$ . However, one cannot find an appropriate antecedent at this level. Thus, (83) results in infelicity due to failure of anaphora resolution. If the singular anaphora is replaced with a plural anaphora, the dependency can be observed as shown in (84b).

- (84) a. Dono-kodomo <sup>$u_1$</sup> -mo sakkaa sensyu <sup>$u_2$</sup> -o hito-ri eran-da.  
           which-child-also      football player-ACC 1-CL<sub>Person</sub> choose-PAST  
           “Every child chose one football player.”
- b. Karera <sup>$u_1$</sup> -wa hito-ri-**zutsu**      sono-sensyu-tachi <sup>$u_2$</sup> -to a-tta.  
           they-TOP      one-CL<sub>Person</sub>-zutsu the-player-PL-with      meet-PAST  
           “**They** each met the players.”

This reading can be obtained without distributivity. Thus, “zutsu” does not block a dependency retrieval of pronouns nor alter the dependency.<sup>16</sup>

As I have shown, the proposed entry of “zutsu” under PCDRT with situations correctly predicts that it introduces a new dependency, but does not retrieve an old dependency. This is achieved by letting “zutsu” distributively evaluate introduction of a subset dref and the cardinality condition, but nothing else. Since the subset dref is introduced under the  $\delta$  operator, it introduces a new dependency which can later be retrieved. At the same time, this  $\delta$  operator does not scope over anaphoric

16. Here, I assume that the whole expression “sono-sensyu-tachi” (the players) is anaphoric and look for a plural antecedent. However, one may alternatively parse it in the way that “sono-sensyu” is anaphoric and “-tachi” attaches to it as an associative plural morpheme. Although I allow this option, in general, this parse results in infelicity because there is no accessible singular antecedent for “sono-sensyu” in (84b) just like (82b). In this sense, presence of the option of associative plurals does not pose a problem for my analysis. I do not discuss the associative semantics of “-tachi” in this thesis, but see Nakanishi and Tomioka (2004) for the relevant discussion and a proposal.



expressions in the same clause and thus it does not license a dependent singular anaphora. On this point, it is crucial that the distributive inference of the scope of “zutsu” comes from situation partition and the  $UQ_{Dist}$  condition, which are static conditions for situations. These conditions enables “zutsu” to induce distributive readings without predicting that it can retrieve an old dependency. In this sense, this analysis hinges on acknowledgement of the two notions of pluralities: the  $\delta$  operator introduces evaluation plurals by partitioning a plural information state and situation partition introduces domain plurals by partitioning a situation. Thus, presence of an overt distributor such as “zutsu” suggests that theories of overt distributors have to allow an option to distribute over domain plurals, but not over evaluation plurals.

### 7.6.3 The shifted evaluation effect of the prenominal “zutsu”

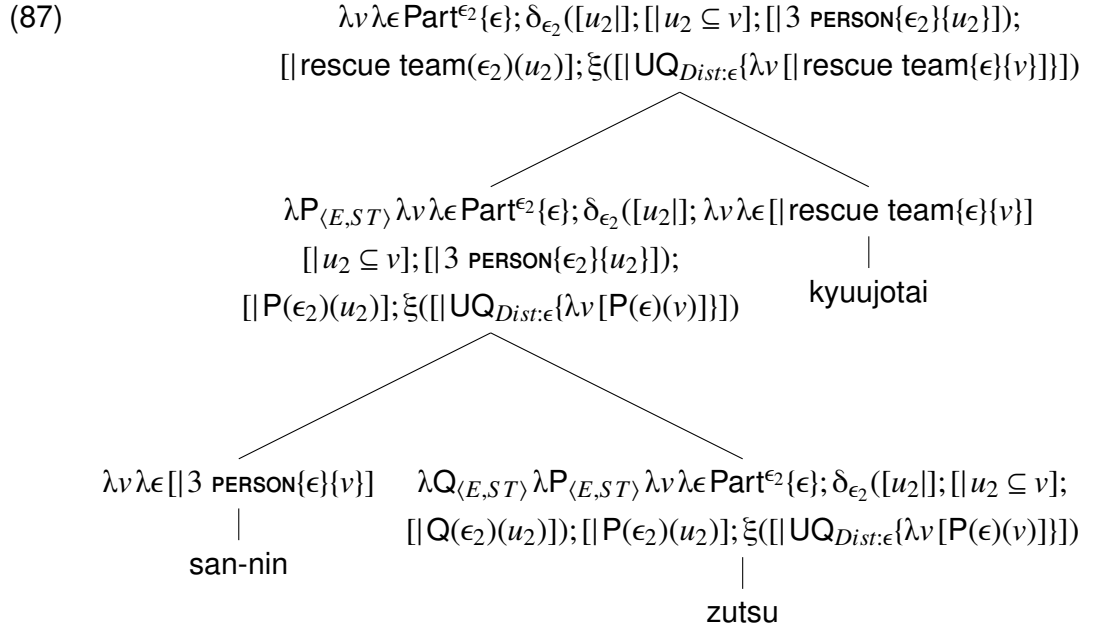
In this section, I discuss the way to deal with the prenominal “zutsu” in PCDRT with situations. Recall the denotation of “zutsu.”

$$(85) \quad \llbracket \text{zutsu} \rrbracket = \lambda Q_{\langle E, ST \rangle} \lambda P_{\langle E, ST \rangle} \lambda v \lambda \epsilon \text{Part}^{\epsilon'} \{ \epsilon \}; \delta_{\epsilon'}([u_n]); \llbracket u_n \subseteq v \rrbracket; \llbracket Q(\epsilon')(u_n) \rrbracket; \\ \llbracket P(\epsilon')(u_n) \rrbracket; \xi(\llbracket UQ_{Dist:\epsilon} \{ \lambda v [P(\epsilon)(v)] \} \rrbracket)$$

Essentially, (101) has type  $\langle \langle E, VT \rangle, \langle \langle E, VT \rangle, \langle E, VT \rangle \rangle \rangle$ . This is homomorphic to the semantic type of the static entry of “zutsu,” which is  $\langle \langle e, st \rangle, \langle \langle e, st \rangle, \langle e, st \rangle \rangle \rangle$ . Since nominal predicates are defined as predicates of type  $\langle E, VT \rangle$  in PCDRT with situations,  $\llbracket \text{Num-CL-zutsu} \rrbracket$  can be combined with a nominal predicate. Let me take one of the previous examples to demonstrate it.

- (86) San-nin-**zutsu**-no kyuu-jotai-ga sounansya-tachi-o sousaku-sita.  
 3-CL<sub>persons</sub>-DIST-GEN rescue team-NOM victim-PL-ACC search-PAST  
 “A rescue team searched for victims.”  
 $\rightsquigarrow$  the rescue team formed three-member sub-teams.

The denotation of “san-nin-zutsu-no kyuu-jotai” (three member rescue teams) is combined as shown in (87).



(87) has a predicative denotation and it has to be shifted to an argument type via the  $\text{iota}$ -shift or the  $\text{in}$  operator.

- (88) a.  $\text{iota}(P_{\langle E, VT \rangle}) = \lambda \epsilon' \lambda V_{\langle E, VT \rangle} \lambda \epsilon \text{MAX}^{u_n}(P(\epsilon')(u_n)); V(\epsilon)(u_n)$   
 b.  $\text{in}P = \lambda \epsilon' \lambda V_{\langle E, VT \rangle} \lambda \epsilon \text{MAX}^{u_n}(P(\epsilon')(u_n)); [[\text{KIND}\{u_n\}]; [\text{NON-ATOM}\{u_n\}]; V(\epsilon)(u_n)]$

These two operations respectively correspond to the definite reading and the indefinite reading of (86) as I discussed in Chapter 6. Let me first discuss the definite reading of (86). The result of applying the  $\text{iota}$ -shift to (87) is given in (89).

- (89)  $\text{iota}(87)(pro_{\epsilon_n}) = \lambda V_{\langle E, VT \rangle} \lambda \epsilon \text{MAX}^{u_1}(\text{Part}^{\epsilon_2}\{\epsilon_n\}; \delta_{\epsilon_2}([u_2]; [u_2 \subseteq u_1];$   
 $[[3 \text{ PERSON}\{\epsilon_2\}\{u_2\}]); [\text{rescue team}\{\epsilon_2\}\{u_2\}]); [\text{NOV}\{u_1\}];$   
 $\xi([[\text{UQ}_{Dist:\epsilon_n}\{\lambda v [[\text{rescue team}\{\epsilon_n\}\{v\}]]]])]; V(\epsilon)(u_n)$

The  $\text{iota}$ -shift gives a maximal individual  $u_2$  in the situation  $\epsilon_n$  such that there is a partition  $\epsilon_2$  of  $\epsilon_n$  such that  $u_3$ , a subset of  $u_2$  comes in three people in each member of  $\epsilon_2$  and the sum of  $u_3$  across those situations are a rescue team. The full clausal denotation of (86) is given in (90)

- (90)  $[[86]] = [\epsilon_1]; \text{MAX}^{u_1}(\text{Part}^{\epsilon_2}\{\epsilon_n\}; \delta_{\epsilon_2}([u_2]; [u_2 \subseteq u_1]; [3 \text{ PERSON}\{\epsilon_2\}\{u_2\}]);$   
 $[[\text{rescue team}\{\epsilon_2\}\{u_2\}]); [\text{NOV}\{u_1\}]; \xi([[\text{UQ}_{Dist:\epsilon_n}\{\lambda v [[\text{rescue team}\{\epsilon_n\}\{v\}]]]])];$   
 $[[\text{agent}\{\epsilon_1\}\{u_1\}]; [u_3]; [\text{victim}\{\epsilon_1\}\{u_3\}]); [\text{theme}\{\epsilon_1\}\{u_3\}]; \mathcal{E}_{\epsilon_1}([\text{search}\{\epsilon_1\}])$

Next, let me discuss the indefinite reading of (86). The result of applying the  $\cap$  operator to (87) is shown in (91).

(91) is identical to (89) except that (i) the value of  $u_1$  is a kind and (ii)  $u_1$  has to store a non-atomic value in (91). As  $u_1$  stores a kind, it violates sortal restriction when it is combined with a non-kind-level predicate. This triggers Derived Kind Predication, which is repeated in (92).

This operation locally applies to an DRS in which a sort-crash occurs. In this case, the DRS with the agent relation which is shown in (93a). DKP repairs the sort-crash as shown in (93b).

With DKP, the full clausal denotation of (86) is given in (94).

(94)  $\llbracket (86) \rrbracket = [\epsilon_1]; \text{MAX}^{u_1}(\text{Part}^{\epsilon_2}\{\epsilon_n\}; \delta_{\epsilon_2}(\llbracket u_2 \rrbracket; [\llbracket u_2 \subseteq u_1 \rrbracket; [\llbracket 3 \text{ PERSON}\{\epsilon_2\}\{u_2\}\rrbracket; \\ [\llbracket \text{rescue team}\{\epsilon_2\}\{u_2\}\rrbracket]; \xi(\llbracket \text{UQ}_{Dist:\epsilon_n} \{\lambda v [\llbracket \text{rescue team}\{\epsilon_n\}\{v\}\rrbracket]\rrbracket); [\llbracket \text{KIND}\{u_1\}\rrbracket; \\ [\llbracket \text{NON-ATOM}\{u_1\}\rrbracket; [\llbracket u_3 \rrbracket; [\llbracket u_3 \subseteq u_1 \rrbracket; [\llbracket \text{agent}\{\epsilon_1\}\{u_3\}\rrbracket; [\llbracket \text{NOV}_{u_1}\{u_3\}\rrbracket; [\llbracket u_4 \rrbracket; \\ [\llbracket \text{victim}\{\epsilon_1\}\{u_4\}\rrbracket]; [\llbracket \text{theme}\{\epsilon_1\}\{u_4\}\rrbracket]; \mathcal{E}_{\epsilon_1}(\llbracket \text{search}\{\epsilon_1\}\rrbracket))$

(94) introduces  $u_1$  which stores a kind and  $u_2$  is introduced under the scope of the  $\delta$  operator. The former models a kind of rescue teams and the latter models instances of the kind of rescue teams. However, the actual agent of  $\epsilon_1$  is  $u_3$  which is an instance of  $u_1$ . This is due to DKP. As a result, (94) can successfully updates the input context iff there is a kind of rescue teams each of which comes in three members and an instance of it is the agent of  $\epsilon_1$ . Again, dynamic situation partition is evaluated with respect to  $\epsilon_n$ .

This analysis can explain the original example of the shifted evaluation effect which is repeated as (95).

- (95) Daiki-ga ni-hon-**zutsu**-no aisu-o tabe-ta.  
 Daiki-NOM 2-CL<sub>bars</sub>-DIST-GEN ice cream-ACC eat-PAST  
 “Daiki ate two-bar ice cream.”  
 $\rightsquigarrow$  the kind of ice cream Daiki ate generally comes in two bars.

The denotation of “ni-hon-zutsu-no aisu” (two volume ice cream) is given in (96).

- (96)  $\llbracket \text{ni-hon-zutsu-no aisu} \rrbracket = \lambda v \lambda \epsilon \text{Part}^{\epsilon_2} \{ \epsilon \}; \delta_{\epsilon_2}([u_3]; [u_3 \subseteq v];$   
 $\llbracket 2 \text{ BAR} \{ \epsilon_2 \} \{ u_3 \} \rrbracket; \llbracket \text{ice cream} \{ \epsilon_2 \} \{ u_3 \} \rrbracket; \xi(\llbracket \text{UQ}_{Dist: \epsilon} \{ \lambda v \llbracket \text{ice cream} \{ \epsilon \} \{ v \} \rrbracket \rrbracket)$

The result of applying the  $\mathfrak{M}$  operator to (96) is given in (97).

- (97)  $\mathfrak{M} \llbracket (96) \rrbracket (pro_{\epsilon_n}) =$   
 $\lambda V_{\langle E, VT \rangle} \lambda \epsilon \text{MAX}^{u_2} (\text{Part}^{\epsilon_2} \{ \epsilon_n \}; \delta_{\epsilon_2}([u_3]; [u_3 \subseteq u_2]; \llbracket 2 \text{ BAR} \{ \epsilon_2 \} \{ u_3 \} \rrbracket;$   
 $\llbracket \text{ice cream} \{ \epsilon_2 \} \{ u_3 \} \rrbracket; \xi(\llbracket \text{UQ}_{Dist: \epsilon_n} \{ \llbracket \text{ice cream} \{ \epsilon_n \} \{ v \} \rrbracket \rrbracket); V(\epsilon)(u_n)$

The full clausal denotation of (95) is given in (98).

- (98)  $\llbracket (95) \rrbracket = [\epsilon_1]; [u_1 | u_1 = \text{Daiki}]; [\text{agent} \{ \epsilon_1 \} \{ u_1 \}]; \text{MAX}^{u_2} (\text{Part}^{\epsilon_2} \{ \epsilon_n \}; \delta_{\epsilon_2}([u_3];$   
 $[u_3 \subseteq u_2]; [\text{NOV}_{u_2} \{ u_3 \}]; \llbracket 2 \text{ BAR} \{ \epsilon_2 \} \{ u_3 \} \rrbracket; \llbracket \text{ice cream} \{ \epsilon_2 \} \{ u_3 \} \rrbracket; \xi(\llbracket \text{UQ}_{Dist: \epsilon_n}$   
 $\{ \lambda v \llbracket \text{ice cream} \{ \epsilon_n \} \{ v \} \rrbracket \rrbracket); [u_4]; [u_4 \subseteq u_2]; [\text{theme} \{ \epsilon_1 \} \{ u_4 \}]; \mathcal{E}_{\epsilon_1}(\llbracket \text{eat} \{ \epsilon_1 \} \rrbracket)$

(98) can successfully updates the input context iff there is a kind of ice cream  $u_2$  each of its instance comes in two bars and its instance  $u_4$  is the theme of  $\epsilon_1$ . Importantly, the relation between  $u_1$  and  $u_1$  is a plain subset relation. Thus, it allows various possible values for  $u_4$ . For example, the value of  $u_4$  can be three bars of ice creams as long as they are subset of the values of  $u_1$ . Essentially, this explanation

is exactly the same as the one I proposed in Chapter 6. Only the difference is that the composition is now done with meta-types in PCDRT with situations. In this sense, the analysis of “zutsu” in PCDRT with situations does not lose the insight of the static situation-based analysis I proposed in Chapter 6.

#### 7.6.4 Lack of the postnominal “zutsu” and “itsumo”

Now that I defined a dynamic entry of “zutsu,” one can compare it with quantifiers over individuals, including “sorezore.” In this section, I propose that lack of the postnominal variant of “zutsu” and “itsumo” follows from their semantics. First of all, recall that “zutsu” cannot occur at the postnominal position as repeated in (99).<sup>17</sup>

- (99) \* Karera-ga aisū-ni-hon-**zutsu**-o                      tabe-ta.  
           they-NOM ice cream-2-CL<sub>long object</sub>-DIST-ACC eat-PAST  
 a. “They ate two bars of ice cream each.”                      (individual distributive)  
 b. “They ate two bars of ice cream each time.”                      (occasion distributive)  
 c. “They ate two-bar ice cream.”                      (group distributive)

As I discussed in Chapter 1 and 4, the postnominal position is limited to quantificational expressions in Japanese as repeated in (100).

- (100) Ringo-{mi-ttu / subete / hotondo / \*kore-ra / \*boku-no / \*aka-i}-ga  
         apple-{(3-CL<sub>thing</sub> / all / most / this-PL-GEN / I-GEN / red-ADJ)-NOM  
         ure-ta.  
         sell-PAST  
         “{Three / all / most / these / my / red} apples were sold.”

I proposed that the postnominal order requires  $Q^0$ , which takes a postnominal quantifier as its sister. Thus, the observation that “zutsu” cannot occur at the postnominal position suggests that “zutsu” lacks a postnominal variant. On this point, recall that I defined quantifiers over individuals as expressions which introduce both the restrictor set, the scope set and the structural inclusion relation between them. On this point, recall the denotation of “zutsu” which is repeated in (101).

- (101)  $[[zutsu]] = \lambda Q_{\langle E, ST \rangle} \lambda P_{\langle E, ST \rangle} \lambda v \lambda \epsilon \text{Part}'\{\epsilon\}; \delta_{\epsilon'}([u_n]); [u_n \subseteq v]; [Q(\epsilon')(u_n)];$   
 $[P(\epsilon')(u_n)]; \xi([UQ_{Dist:\epsilon'}\{\lambda v [P(\epsilon)(v)]\}])$

17. Also, recall that Miyamoto (2009) accepts examples with the postnominal “zutsu” and some native speakers of Japanese reported that the postnominal “zutsu” is not completely unacceptable. Although I leave this issue for future research, one may assume that some speakers acquires an entry of “zutsu” which performs situation partition, but employs D-quantificational strategy.

Importantly, the proposed analysis of “zutsu” does not resort to type-ambiguity: “zutsu” is a modifier of type  $\langle\langle E, VT \rangle, \langle E, VT \rangle\rangle$  and the same entry in (101) derives an individual distributive reading and an occasion distributive reading at the floating position and a group distributive reading at the prenominal position. Furthermore, “zutsu” differs from “sorezore” and quantifiers over individuals in terms of dref introduction. When it occurs at the prenominal position, “zutsu” does not turn a predicative NP into an argument. Rather, it is crucial for my analysis that  $[[\text{Num-CL-zutsu-no NP}]]$  is predicative and it is shifted to an argument via type-shifters  $\iota_{TA}$  and  $\mathbb{N}$ . In contrast, when “sorezore” and quantifiers over individuals occur at the prenominal position, they introduce a dref for their restrictor set. Considering that type-ambiguity of D-quantifiers is tied with introduction of the restrictor set, there is no reason that “zutsu” has to be type-ambiguous. Thus, I propose that “zutsu” cannot occur at the postnominal position simply because it does not quantify over individuals and it does not require a restrictor set.

This reasoning applies to “itsumo” as well. Its denotation is repeated in (102).

$$(102) \quad [[\text{itsumo}]] = \lambda p_{\langle ST \rangle} \lambda P_{\langle E, ST \rangle} \lambda v \lambda \epsilon \delta_{\epsilon}([ \epsilon' ]; [ \epsilon' \sqsubseteq \epsilon ]; \mathcal{E}_{\epsilon'}(p(\epsilon'))); \\ \text{MAX}_{\epsilon'' \in \epsilon} (\delta_{\epsilon''}(\mathcal{E}_{\epsilon''}(P(\epsilon'')(v)))); \text{ALL}\{\epsilon\}\{\epsilon''\}$$

“Itsumo” is an adverbial quantifier and I proposed that it performs a generalised quantification over situations. Thus, it is straightforward that it does not require the restrictor set of individuals. As expected, “itsumo” cannot occur at the postnominal position. (103) shows that “itsumo” cannot occur at the postnominal position regardless of which reading it induces.

- (103) \* Ryo-ga jaketto-**itsumo**-o ki-te-iru.  
           Ryo-NOM jacket-always-ACC wear-PROG-PRES  
       a. “Ryo always wears a jacket.”  
       b. “Ryo wears the jacket he always wears.” (definite reading)  
       c. “Ryo wears the kind of jacket he always wears.” (subkind reading)

Thus, the unavailability of “zutsu” and “itsumo” at the postnominal position follows from their semantics: they quantify over situations and thus they do not take a set of individuals as its restrictor set. As a result, they are not type-ambiguous because they do not need to take a restrictor NP as its argument. Accordingly, they cannot have the semantic type of a postnominal quantifier, explaining why they cannot occur at the postnominal position.

## 7.7 Distributivity within distributivity

In this section, I discuss some issues that I have been putting aside. Sometimes, “sorezore” and “zutsu” can felicitously occur under another distributive quantifier. Although I do not aim to test every possible combination and give a full-fledged implementation, I discuss two puzzles concerning this issue and informally describe a possible solution to them. The first puzzle is that when a bare anaphoric “sorezore” occurs under the scope of another bare anaphoric “sorezore,” it allows a reciprocal reading, while “sorezore” cannot occur under another distributive quantifier in general. The second issue is that the plurality condition of “zutsu” is often trapped under the scope of another distributive quantifier, but it can project under the scope of “sorezore.” I claim that these puzzles dissolve if we treat post-suppositions as tests indexed with the output context and assume two types of the  $\delta$  operator.

I start with “sorezore” under another distributive expression. First, the floating “sorezore” cannot occur under another distributive expression as shown in (104).

- (104) \* *Dono-kyooju<sup>u1</sup>-mo sorezore<sub>u1</sub> gakusei<sup>u2</sup>-o hito-ri suisen-sita.*  
           which-professor-also sorezore student-ACC 1-CL<sub>Person</sub> recommend-PAST  
           Lit “Every professor each recommended one student.”

Second, the bare anaphoric “sorezore” cannot occur under the scope of “dono-NP” as shown in (104).

- (105) \* *Dono-seijika<sup>u1</sup>-mo sorezore<sub>u1</sub><sup>u2</sup>-o hihan-sita.*  
           which-politician-also sorezore-ACC criticise-PAST  
           Lit “Every politician criticised each other.”

These cases can be easily explained. In general, a distributive expression cannot choose a singular argument as its sorting key.

- (106) a. \* John each bought an ice cream.  
        b. \* John like each other.

Thus, one has to require that the  $\delta$  operator has to be co-indexed with a non-atomic dref. This modification is necessary in anyway. However, addition of this condition creates a new puzzle. The bare anaphoric “sorezore” can occur under the scope of another bare anaphoric “sorezore” and be co-referential with it as shown in (107). Consider that the subject “sorezore” takes a discourse antecedent.

- (107) Sorezore<sup>u<sub>1</sub></sup>-ga sorezore<sup>u<sub>2</sub></sup>-o hihan-sita.  
 SOREZORE-NOM SOREZORE-ACC criticise-PAST  
 Lit “Each other criticised each other.”

This raises a dilemma: on one hand, one has to prevent “sorezore” from occurring under the scope of  $\delta$  operator, but on the other hand, one has to allow “sorezore” to occur under the scope of another “sorezore.” What is worse, the fact that (107) allows a reciprocal reading suggests that the co-reference condition of the object “sorezore” is evaluated above the  $\delta$  operator of the subject “sorezore,” while taking the subject “sorezore” as its antecedent.

To solve this dilemma, I propose the following revisions. First, I assume that the co-reference condition of the bare anaphoric “sorezore” is post-suppositional. Second, I assume that “sorezore” encodes the  $\delta$  operator which lets post-suppositions project from its scope, while “dono-NP” encodes the  $\delta$  operator which traps them.

To implement these revisions, I first need to treat post-suppositions as tests which are co-indexed with the output plural information state (Brasoveanu, 2013; Henderson, 2014). Brasoveanu (2013) notates a set of test as  $\xi$  and assumes that the interpretation function is not simply  $\llbracket \cdot \rrbracket^{(g,h)}$ , but  $\llbracket \cdot \rrbracket^{(g[\xi],h[\xi'])}$ , where  $\xi \subseteq \xi'$ . I mark post-suppositions with an overline following Henderson (2014). A post-supposition passes on a test to the set of test indexed with the output context.

- (108)  $\llbracket \overline{\phi} \rrbracket^{(g[\xi],h[\xi'])}$  is true iff  $\phi$  is a test,  $g = h$  and  $\xi' = \xi \cup \{\phi\}$

Brasoveanu (2013) define truth relative to post-suppositions.

- (109) Truth: a formula  $\phi$  is true relative to an input context  $g[\emptyset]$ , where  $\emptyset$  is the empty set of tests, iff there is an output assignment  $h$  and a (possibly empty) set of tests  $\{\xi_1, \dots, \xi_m\}$  such that (a)  $\llbracket \phi \rrbracket^{(g[\emptyset],h[\{\xi_1, \dots, \xi_m\}])}$  is true, and (b)  $\llbracket \{\xi_1, \dots, \xi_m\} \rrbracket^{(h[\emptyset],h[\emptyset])}$  is true

(109) postpones evaluation of post-suppositions until the context have been updated with the at-issue contents. This can be incorporated to the definition of truth in PCDRT with situations.

- (110) Truth: A formula  $\phi$  is true with respect to an input context  $\langle \sigma, G[\emptyset] \rangle$  iff there is a plural information state  $H$  and a (possibly empty) set of tests  $\{\xi_1, \dots, \xi_m\}$  such that  $\langle \sigma', G \bullet H \rangle$  is an output context in which (a)  $\llbracket \phi \rrbracket(\langle \sigma, G \rangle)(\langle \sigma', G \bullet H \rangle)$ , and (b)  $\llbracket \xi_1 \& \dots \& \xi_m \rrbracket(\langle \sigma', G \bullet H \rangle)(\langle \sigma', G \bullet H \rangle)$



Brasoveanu (2013) notes that the distributivity operator traps post-suppositions and defined it so that it discharges all the post-suppositions under its scope. However, Henderson (2014) proposes that the distributivity operator pass through post-suppositions. Although I do not aim to answer why, the puzzle I introduce above potentially suggests that both types of distributive operators can be seen in natural language. Informally speaking, “dono-NP” traps post-suppositions under its scope, while “sorezore” does not. Once we assume that the co-reference condition of “sorezore” is post-suppositional, we can correctly predict that the co-reference condition ‘projects’ from the scope of “sorezore,” but not from the scope of “dono-NP.” Here, I define simple-minded version of those two types of  $\delta$  operator as shown in (111) and (112). “sorezore” utilises (111) and “dono-NP” utilises (112).

- (111) Projective  $\delta$ :  $\delta(D)(\langle\sigma, G[\xi]\rangle)(\langle\sigma', H[\xi']\rangle)$  iff  

$$\delta_{u_n}(D) = \lambda\langle\sigma, G\rangle\lambda\langle\sigma', H\rangle[\xi = \xi' \ \& \ \sigma = \sigma' \ \& \ v(u_n)(G) = v(u_n)(H) \ \& \\ \forall d \in v(u_n)(G)[D(\langle\sigma, G_{u_n=d}\rangle)(\langle\sigma', H_{u_n=d}\rangle)]]$$
- (112) Non-projective  $\delta_N(D)(\langle\sigma, G[\xi]\rangle)(\langle\sigma', H[\xi']\rangle)$  iff  

$$\delta_{u_n}(D) = \lambda\langle\sigma, G\rangle\lambda\langle\sigma', H\rangle[\sigma = \sigma' \ \& \ v(u_n)(G) = v(u_n)(H) \ \& \\ \forall d \in v(u_n)(G)[D(\langle\sigma, G_{u_n=d}\rangle)(\langle\sigma', H_{u_n=d}\rangle) \ \& \ \xi'(\langle\sigma', H_{u_n=d}\rangle)(\langle\sigma', H_{u_n=d}\rangle)]]$$

(111) is ignorant about post-suppositions, while (112) discharges the post-supposition under its scope. If the co-reference condition  $[i \cup u_n = \cup u_m]$  of “sorezore” is post-suppositional, then (111) lets this be evaluated at the collective level, i.e. with respect to  $H$ , but (112) evaluates it at the distributive level, i.e. with respect to subsets of  $H$ , i.e.  $H_{u_n}$ . As a result, a bare anaphoric “sorezore” can have a reciprocal reading with (111), but not with (112).<sup>18</sup>

Indeed, this solution can be applied to another puzzle concerning “zutsu.” First, when “zutsu” occurs under the scope of ‘dono-NP,’ it allows two readings, in principle. Distributivity is neutralised in one reading, i.e., (113) is equivalent to an alternative without “zutsu,” and not in the other reading, i.e. “zutsu” is evaluated with respect to each value of  $u_1$ . This is exemplified in (113).

18. Another possible approach is to let the bare anaphoric “sorezore” only scopes over a thematic relation and nothing else. Although this modification prevents the object “sorezore” in (107) from being under the scope of  $\delta$ , it cannot predict that an expression under the c-command domain of the subject “sorezore” has a co-variation reading with it (see Chapter 5 for the discussion). Thus, this approach cannot explain why only the co-reference condition of “sorezore” can escape from the scope of  $\delta$ . Alternatively, one can argue that the co-variation reading is illusory and we can maintain the claim that “sorezore” distributes over a thematic relation and nothing else. To assess it, more empirical investigation is awaited.

- (113) *Dono-kyooju*<sup>u1</sup>-mo *gakusei*<sup>u2</sup>-o hito-ri-zutsu *suisen-sita*.  
 which-professor-also student-ACC 1-CL<sub>Person</sub>-zutsu recommend-PAST  
 a. ? “Every professor recommended one student.”  
 b. “Every professor recommended some students one by one.”

This asymmetry is flipped under the scope of “sorezore” as shown in (114).

- (114) *Kyooju-tachi*<sup>u1</sup>-ga *sorezore* *gakusei*<sup>u2</sup>-o hito-ri-zutsu *suisen-sita*.  
 Professor-PL-NOM *sorezore* student-ACC 1-CL<sub>Person</sub>-zutsu recommend-PAST  
 a. “Every professor recommended one student.”  
 b. ? “Every professor recommended some students one by one.”

This difference between “sorezore” and “dono-NP” can be explained in a similar way: “sorezore” let post-suppositions be evaluated outside its scope, whereas “dono-NP” traps them. Now, recall that the  $UQ_{Dist}$  condition is defined as a post-supposition. Once it is defined as a test indexed to the output context, it correctly predicts that the  $UQ_{Dist}$  post-supposition is trapped under the scope of “dono-NP” because it encodes the non-projective  $\delta_N$  (112), but it projects from the scope of “sorezore” because it encodes the projective  $\delta$  (111).

Note that I have to admit that we have not yet reached the stage in which we can classify different types of post-suppositional meanings. For example, it is crucial that post-suppositions are trapped under negation for the analysis of modified numerals in Brasoveanu (2013). However, it is the opposite for the analysis of negative concord in Kuhn (2021). See Kuhn (2021) for a taxonomy of post-suppositions in which post-suppositions are classified into blind ones, context-sensitive ones and assertive ones. This taxonomy classified the post-supposition of modified numerals as assertive, whereas the post-supposition of negative concord items as blind. Considering that the falsity of the plurality condition of “zutsu” leads to undefinedness and, it is not assertive.<sup>19</sup> However, a more thorough investigation is necessary for a precise classification and I leave this issue for future research. Also, note that the theoretical status of post-suppositions is not yet clear. For example, Charlow (2017); Kuhn (2021) analyse post-suppositional meanings with a general split-scope mechanism which can postpone the evaluation of a sub-component of

19. Kuhn (2021) classified post-suppositions of dependent indefinite (Henderson, 2014) as blind post-suppositions. Although I do not make a strong commitment on if “zutsu” should be an instance of dependent indefinite, assessment of the post-supposition of “zutsu” is necessary to ask this question.

an expression. In this sense, they do not need to index post-suppositional tests to the output context and ‘post-supposition’ can be treated as an instance of general scope phenomena. One can recast the approach I sketched in this section with a different way to implement post-suppositional meanings as long as projection of post-supposition is dependent on the dynamic definition of an operator in which a post-suppositional DRS occurs.

## 7.8 Conclusion

In this chapter, I have incorporated the situation-based analysis of distributivity to the PCDRT. This incorporation is not only motivated with a theoretical interest, but also there is an analytical puzzle which motivates it. I have shown that “zutsu” is intermediately dynamic in the sense that it introduces a new dependency to the discourse, but it does not retrieve an old dependency from the discourse. This suggests that the static analysis in Chapter 6 has to be dynamicised to some extent, but it should not be treated fully in parallel with “sorezore.” To achieve this, I defined a dynamic system which has situation drefs and models a context as pairs of a set of situations and a plural information state. The resultant system, PCDRT with situations, achieves D-quantification and A-quantification in the same way as the static situation semantics in Chapter 6 does. Under this PCDRT with situations, I refine the semantics of “zutsu” so that it introduces a new dependent dref to the discourse with the dynamic situation partition, while it distributively evaluates its scope in a static way with the  $UQ_{Dist}$  post-supposition. With this entry, one can introduce a new dependency, while preventing pronouns under the scope of “zutsu” from accessing to the antecedents stored in a subset of a plural information state. This analysis hinges on the assumption that one can obtain a distributive reading by distributing over domain pluralities of situations.

The claim that distributivity may arise with respect to domain pluralities of situations leads us to the main claim of this thesis: there are two types of overt distributivity in natural language semantics, one of which distributes over variable assignments and the other distributes over situations. In PCDRT with situations, this dichotomy is understood as a natural consequence of the bipartite structure of the context. Distribution over variable assignment is modelled as partition for a plural information state and distribution over situations is modelled as partition for situations.

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# Chapter 8

## Conclusion

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In this thesis, I addressed two questions concerning the semantics of overt distributors. These questions are repeated in (1).

- (1) a. **Distributional question:**  
what interface mechanism underlies the systematic interpretive difference of “sorezore” and “zutsu” across different syntactic positions?
- b. **Key resolution question:**  
what mechanism underlies the semantics of “sorezore” and “zutsu” so that “sorezore” only takes an overt individual as its sorting key, whereas “zutsu” can take a covert situation as its sorting key?

As a case study, I discussed two overt distributors “zutsu” and “sorezore” in Japanese and gave the following answers to these research questions.

- (2) a. **Answer to the distributional question:** the denotation of quantifiers over individuals is type-ambiguous with respect to their restrictor update, whereas the denotation of quantifiers over situations is constant across different syntactic positions.
- b. **Answer to the key resolution question:** there are two types of overt distributivity, one of which partitions variable assignments and the other partitions situations. “Sorezore” and “zutsu” respectively represent these two types of overt distributivity.

These two answers each shed light on the syntax-semantics interface and semantics-discourse interface of overt distributors.

As for the distributional puzzle, I proposed that quantifiers over individuals and quantifiers over situations employ different interface strategies: quantifiers over individuals come with four type-variants, which differ with respect to their restrictor NP, but quantifiers over situations has the same denotation across different syntactic positions. I showed that quantifiers over individuals in Japanese has four type-variants of generalised quantifiers, i.e. the unary variant, the prenominal variant, the postnominal variant and the floating variant. I proposed that they differ in (i) whether they take a local restrictor NP or not, and (ii) whether their restrictor NP is predicative or argumental. I further claimed that idiosyncratic properties of quantifiers over individuals are encoded in (i) how they introduce their restrictor set and (ii) what condition they impose on their scope update. Realisation of idiosyncratic properties interacts with the type-ambiguity of quantifiers over individuals. Crucially, the idiosyncratic property associated with the restrictor update is observed only when a quantifier itself introduces a dref for its restrictor set, i.e. when it is the unary variant and the prenominal variant. This explains why “sorezore” behaves as a prenominal element only when it occurs at the prenominal position or when it occurs without an overt host NP.

On the other hand, quantifiers over situations are not type-ambiguous. For example, “itsumo” can occur at the floating position and the prenominal position, and its interpretation is different in each position. However, I proposed that a unified analysis is possible if one assumes that it quantifies over situations. In this analysis, the semantics of “itsumo” is constant, but its interpretation depends on whether it takes a verbal predicate or a nominal predicate. Thus, “zutsu” and “itsumo” are essentially a modifier and they are not type-ambiguous, unlike quantifiers over individuals. The unavailability of the postnominal variant of “zutsu” and “itsumo” is a natural consequence of it: the postnominal position is limited to quantifiers over individuals, but “zutsu” and “itsumo” are not quantifiers over individuals.

Although quantifiers over individuals and quantifiers over situations employ different interface strategies, they both obey the economy principle of Minimise Restrictors!. This principle prohibits addition of redundant property and I proposed that this offer a solution to (i) lack of the prenominal variant of “zen’in” and “min’na”, (ii) limited availability of intra-sentential anaphora for the prenominal “sorezore,” and (iii) lack of the maximal kind reading for the prenominal “itsumo.”

As for the key resolution puzzle, I proposed that “sorezore” encodes the dynamic distributivity operator  $\delta$  (Brasoveanu, 2008; Nouwen, 2007; van den Berg, 1996, a.o.) and “zutsu” encodes the mechanism of situation partition. I discussed several anaphoric properties of “sorezore” and claimed that these properties require a dynamic analysis which is equipped with pluralities of variable assignments. I presented an analysis based on a version of PCDRT (Brasoveanu, 2007, 2008) which comes with eventive discourse referents. On the other hand, I discussed several properties of “zutsu,” which suggest that “zutsu” always distributes over situations and its seeming distribution over individuals is only indirect. I presented an analysis of “zutsu” based on a version of the possibilistic situation semantics (Elbourne, 2005; Kratzer, 1989; Schwarz, 2009, a.o.).

I further showed that “zutsu” is not fully static, but not fully dynamic. To account for this intermediate dynamics of “zutsu,” I incorporated situation semantics into PCDRT. The resultant system, PCDRT with situations, serves as a unified framework in which PCDRT notions and situation semantic notions are defined in a single system. In PCDRT with situations, “sorezore” and “zutsu” are understood as two basic strategies to evaluate a formula with respect to subsets of a coordinate of the discourse: the anaphoric content is modelled with a plural information state and the propositional content is modelled with a set of situations. “Sorezore” partitions the former and “zutsu” partitions the latter. If this analysis is on the right track, the observed dichotomy of overt distributivity is a reflection of the bipartite architecture of the discourse.

The discussion in this thesis raises one broad theoretical question concerning anaphora and dependencies. Traditionally, two kinds of approaches have been prominently discussed for the phenomenon of donkey anaphora, namely the dynamic approaches (Groenendijk & Stokhof, 1991; Kamp, 1981, a.o.) and the situation-driven E-type approaches (Elbourne, 2005, 2013, a.o.). These approaches are often treated as two opponent views on the same set of phenomena and researchers provide pros and cons for both approaches. Or for some researchers, they are notational variants of the same theory.<sup>1</sup> However, Schwarz (2009, 2013) submits an argument based on the morpho-syntactic variation within the category of definite articles. He shows that a number of languages make a morphological distinction between uniqueness definites and anaphoric definites. He proposes an ac-

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1. See Kuhn (2015); Schlenker (2011) for the related discussion and also cases in which these strategies diverge.

count which utilises the situation-driven E-type strategy and index-driven anaphoric strategy. Although he himself does not advocate to a dynamic analysis of index-driven anaphoric strategy, his discussion may suggest that the situation-based E-type strategy and the assignment function-driven dynamic strategy are neither the two competing theories nor the notational variants of the same theory. Rather, it suggests the possibility that two distinct strategies are allowed in natural language semantics to express the concept of definiteness. The discussions in my thesis can be placed in this line of thoughts. One high-level claim of this thesis is that one has to acknowledge two different strategies of overt distributivity if one wishes to properly capture the semantic properties of “sorezore” and “zutsu.” In the current market of semantic theories, these two strategies most naturally correspond to the dynamic approach and the situation-driven approach. On this point, what is at stake is that “sorezore” partitions entities which concern the anaphoric information, i.e. variable assignments, and “zutsu” partitions entities which concern the propositional information, i.e. situations. In this sense, this dichotomy is orthogonal to the debate between dynamic approaches versus static approaches and the debate between index-driven approaches versus E-type approaches. Thus, one may recast my analysis under different frameworks, e.g., fully static approaches or index-free approaches. Then, the question is how the above mentioned dichotomy is maintained in such variants. At this point, it seems that the dichotomy is rooted in the distinction between variable assignments and situations, which can sometimes be taken as the two notational variants of the same notion. This leads to an important contribution of this thesis. Crucially, the contrast and similarity of variable assignments and situations have mainly discussed with donkey anaphora. However, the arguments developed so far shed light on this issue from a different angle and provide brand-new reasons to believe that variable assignments and situations are both necessary.

Still, one may worry about the redundancy resulting from the proposed system. For example, the proposed system of PCDRT with situations allows a pronoun to resort to the anaphoric strategy based on variable assignments or uniqueness strategy based on situations. Especially, I assumed that English definite article is lexically ambiguous between the uniqueness definite article and the anaphoric definite article. Although this assumption is harmless for the primary purpose of this thesis, this may seem too powerful or redundant. A similar concern may apply to pronouns. This leads us to another broad theoretical question concerning

the division of labour between the situation-driven uniqueness strategy and the assignment-driven anaphoric strategy. It opens up a number of open empirical questions and further cross-categorical and cross-linguistic investigation is awaited to see what is hidden there.

Lastly, let me mention two further research questions raised by the proposed semantics of overt distributors. One is concerning the typology of overt distributors and the other is concerning the typology of discourse plurals. As for the typology of overt distributors, T. Nakamura and Oda (2022) shows that morpho-syntactic variation with respect to  $D^0$  correlates with availability of an overt distributor which can have an occasion distributive reading. First of all, they call overt distributors that have an occasion distributive reading *situation distributors* and classify them into two categories as shown in (3).

- (3) a. **Complex Situation Distributor (CSD)**: an overt distributor that requires an overt expression that denotes a set of situations, e.g., “time,” for occasion distributive readings, e.g., English “each.”
- b. **Simplex Situation Distributor (SSD)**: an overt distributor that has an occasion distributive reading without an overt expression such as “time,” e.g., Japanese “zutsu.” (T. Nakamura & Oda, 2022)

Based on (3), T. Nakamura and Oda (2022) observe that Romanian, Bulgarian, Czech, Polish, Russian, Korean, Japanese, and Tlingit have an SSD, while English, German,<sup>2</sup> Dutch, French, Italian, Brazilian Portuguese, Icelandic, Norwegian, Albanian, Russian, Latin and Japanese have a CSD.<sup>3</sup> Crucially, those languages which do not have an SSD either lack a definite article or have affixal definite articles. This makes them propose an generalisation (4).

- (4) **An Implicational Hierarchy on situation distributors**: Languages that have an SSD either lack definite articles or have affixal definite articles.

(T. Nakamura & Oda, 2022)

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2. Note that T. Nakamura and Oda (2022) classify German “jeweils” as a CSD following Zimmermann (2002). Zimmermann (2002) decomposes “jeweils” into three parts: “je” is an overt distributor, “weil” is an NP pro-form and “-s” is the genitive marking. In this sense, “jeweils” corresponds to “each time” in English and differs from “zutsu” in Japanese.

3. See Zimmermann (2002) and Champollion (2017) for some of the relevant data.



This is one-way hierarchy and still allows affixal article languages and article-less languages to have a CSD. Indeed, Japanese has “sorezore” which is classified as a CSD and “zutsu” which is classified as an SSD. Thus, Japanese is a language which has both an SSD and a CSD. Russian also has both an SSD and a CSD.

T. Nakamura and Oda (2022) relates this implicational hierarchy with Bošković’s (2008; 2012) NP/DP language distinction, in which languages with definite articles behave differently from languages without definite articles in a number of respects. More specifically, they follow Dubinsky and Tasseva-Kurktchieva (2018); Talic (2015), which show that languages with affixal definite articles sometimes behave like languages without non-affixal definite articles. The gist of their proposal is that the DP projection is necessary in those languages which have a non-affixal definite articles, but it may be absent in those languages which either lack a definite article or have an affixal definite article.

In Chapter 4, I claimed that it is necessary for D-quantifiers to have a restrictor set. Japanese D-quantifiers may occur at the postnominal position and at the floating position because Japanese bare NPs can be argumental by itself and thus D-quantifiers in Japanese have an option to not introduce a new dref for its restrictor set by themselves. From this perspective, the correlation between the availability of an SSD and the optionality of the DP projection may suggest that if a language requires the DP projection, it can only have an overt distributor which is categorised as  $D^0$  and distributes over individuals. This calls for further development of a theory of syntax-semantics interface with respect to D-quantification.

Furthermore, Zimmermann (2002) proposes a generalisation on the interpretation of overt distributors across languages as shown in (5).

- (5) **Zimmermann’s generalisation** (Zimmermann, 2002): An overt distributor which can occur as a determiner can only distribute over individuals, whereas an overt distributor which cannot occur as a determiner can also distribute over salient occasions.

I have shown that English “each” can only distribute over individuals, whereas German “jeweils” can also distribute over salient occasions. Now, (5) states that this availability of occasion distributive readings correlates with their syntactic distribution. English “each” can occur as a determiner as shown in (6a), whereas German “jeweils” cannot as shown in (6b).

- (6) a. **Each** boy carried three suitcases.  
 b. { Jeder / \***Jeweils** } Junge hat drei Koffer getragen.  
 { Each.SG.MASC / DIST } boy has three suitcases carried  
 “Each boy carried three suitcases.”

Note that the fact that an item can occur at the prenominal position does not entail that this item is a determiner. I have shown that an NP with the prenominal “zutsu” has to take the narrowest scope and it does not license an external reading of “betsu” (different). Thus, the behaviour of the prenominal “zutsu” is quite different from other D-quantifiers and thus it is quite hard to argue that this is an instance of a determiner. In the proposed account, “zutsu” has a modifier type and it requires the  $\cap$  operator when it is used in the nominal domain. Thus, if my proposal is on the right track, the prenominal “zutsu” is not a determiner.

This generalisation makes perfect sense if situation distributors, whether it is complex or simplex, are all quantifiers over situations as I claimed in this thesis. Coupled with the remaining question about the syntax-semantics interface with respect to D-quantification in various languages, the cross-linguistic variation of overt distributor sheds light on how the semantics of overt distributivity and quantification correlates with morpho-syntactic properties of a given language.

The second question which this thesis further raises is about variation of grammatical marking of discourse plurality. Recall that Japanese common nouns can be used to express an atomic individual or a plural individual. I adopted the familiar assumption that Japanese common noun denotations are cumulative as default. However, Japanese has an optional strategy of grammatical marking of plurality, e.g., optional plural marker and reduplication. Firstly, Japanese has a semi-productive process of reduplication to mark plurality as exemplified in (7b).

- (7) a. Shuji-ga yama-o nobo-tta.  
 Shuji-NOM mountain-ACC climb-PAST  
 “Shuji climbed (a) mountain(s).”  
 b. Shuji-ga **yamayama**-o nobo-tta.  
 Shuji-NOM mountain mountain-ACC climb-PAST  
 “Shuji climbed mountains.”

On this point, one may notice that “sorezore” is the reduplicative form of “sore,” which is used as a pronominal expression in Japanese.<sup>4</sup> In my proposal, it is crucial that “sorezore” evaluates its scope with the  $\delta$  operator. In other words, “sorezore” introduces discourse plurality. This makes perfect sense if “sorezore” is the plural form of “sore”: reduplication of a common noun bears domain plurality, but reduplication of an anaphoric expression bears discourse plurality.

One can find this connection between reduplication and discourse plurality with different expressions.<sup>5</sup> For example, “betsu” (different) has a reduplicative form “betsubetsu.” They differ in the licensing condition of an internal reading. Although “betsu” (different) has to be under the scope of a distributive quantifier, “betsubetsu” does not have to be.<sup>6</sup>

- (8) a.  $\text{Dono}^{u1}$ -otokonoko-mo **betu**-no  $\text{shi}^{u2}$ -o roodoku-sita.  
 every-boy-MO different-GEN poem-ACC recite-PAST  
 “Every boy recited a different poem.” (internal and external)
- b.  $[\text{Mari-to-Linus}]^{u1}$ -ga **betu**-no  $\text{shi}^{u2}$ -o roodoku-sita.  
 Mari-and-Linus-NOM different-GEN poem-ACC recite-PAST  
 “Mari and Linus recited a different poem.” (external only)
- (9)  $[\text{Mari-to-Linus}]^{u1}$ -ga **betu**-no  $\text{shi}^{u2}$ -o roodoku-sita.  
 Mari-and-Linus-NOM different-GEN poem-ACC recite-PAST  
 “Mari and Linus recited a different poem.” (internal only)

This may suggest that “betsubetsu” is a discourse plural version of “betsu.” To see this, let me briefly discuss Brasoveanu’s (2011) uniform analysis of external readings and internal readings. He analyses an external reading as an instance of inter-sentential anaphora and an internal reading as an instance of *quantifier-*

4. I speculate that the first consonant of the second reduplicant is voiced as a result of *rendaku* (sequential voicing). A similar sequential voicing can be found with reduplication, e.g., “hito” (person) and “hitobito” (people), “ki” (tree) and “kigi” (trees).

5. Some of them are quite similar to “sorezore,” e.g., “onoono,” “meimei.” I leave comparison among these kinds of expressions for future.

6. “Betsu” and “betsubetsu” further differ in terms of availability of an external reading: “betsu” can have an external reading, whereas “betsubetsu” cannot.

- (1) a.  $\text{Mari}^{u1}$ -ga  $\text{shi}^{u2}$ -o roodoku-sita.  $\text{Linus}^{u3}$ -wa **betu**-no  $\text{shi}^{u4}$ -o roodoku-sita.  
 Mari-NOM poem-ACC recite-PAST LINUS-TOP different-GEN poem-ACC recite-PAST  
 “Mari recited a poem. Linus recited a different poem.” (external only)
- b. ??  $\text{Mari}^{u1}$ -ga  $\text{shi}^{u2}$ -o roodoku-sita.  $\text{Linus}^{u3}$ -wa **betubetu**-no  $\text{shi}^{u4}$ -o roodoku-sita.  
 Mari-NOM poem-ACC recite-PAST LINUS-TOP different-GEN poem-ACC recite-PAST  
 “Mari recited a poem. Linus recited different poems.”

*internal* anaphora.<sup>7</sup> In short, “different” may find its antecedent within another subset of assignment under the scope of  $\delta$  and an internal reading arises in this case. Crucially, he proposes that “different” with a singular NP has to be under the scope of  $\delta$  to induce an internal reading, but “different” with a plural NP does not have to because it may optionally accompany its own  $\delta$  operator.

- (10) a. [Mary and Linus]<sup>u<sub>1</sub></sup> recited a different poem<sup>u<sub>2</sub></sup>. (external-only)  
 b. [Mary and Linus]<sup>u<sub>1</sub></sup> recited different poems<sup>u<sub>2</sub></sup>. (internal and external)  
 (Brasoveanu, 2011)

If Brasoveanu (2011) is on the right track, one may explain the contrast between “betsu” and “betsubetsu” by saying that “betsu” is discourse singular, but “betsubetsu” is discourse plural and already have its own  $\delta$  operator. Thus, “betsubetsu” provides another reason to believe that reduplication of an anaphoric expression bears discourse plurality.

However, not every plural marking strategy leads to discourse plurality. I adopted the assumption that English plural pronoun may optionally evaluate its co-reference condition under the  $\delta$  operator. This is crucial to account for inter-sentential dependent singular/plural anaphora and long-distance reciprocals. On this point, note that “zibun” (self) in Japanese allows dependent singular anaphora, while disallowing dependent plural anaphora as shown in (11).

- (11) dono-gakusei<sup>u<sub>1</sub></sup>-mo [{zibun / \*zibun-tachi}<sup>u<sub>2</sub></sup>]-ga ichiban kasiko-i to]  
 every-student-MO [{self / self-PL}-NOM most smart-PRES that]  
 omo-tte-iru.  
 think-PROG-PRES  
 “Every student thinks that they are the smartest.”

To get a dependent reading, one has to use “zibun.” If one uses “zibun-tachi,” it only has a reading that all the students think that all of them are the smartest as a group. This suggests that “zibun-tachi” does not license dependent plural anaphora, while “zibun” licenses dependent singular anaphora. If my analysis is on the right track, this contrast suggests that “tachi” in Japanese does not introduce discourse plurality.

7. To be more precise, he employs a different co-indexing mechanism for “different” than the one which pronouns use. However, this is not important for my purpose here.

Summing up, Japanese has at least two ways to grammatically mark plurality, namely reduplication and “tachi.” Although reduplication can introduce discourse plurality, “tachi” cannot. This suggests that not every strategy of domain plurality marking can also be used as a strategy of discourse plurality marking. This raises a new question of grammatical marking of discourse plurality. Furthermore, this question has a potential to uncover new typological universals/variations. For example, English plural pronouns can bear discourse plurals, whereas most of the Japanese plural pronouns cannot. Also, English does not directly mark plurality on “different” and its discourse plurality is dependent on the NP it is combined with, but Japanese directly mark plurality on “betsu” via reduplication. This difference would be related with difference between Japanese and English with respect to cumulativeness of common noun denotations. Thus, this research question offers a new dimension to linguistic typology, while being related with one of the most extensively studied dimension of linguistic variation, namely the typology of domain plurality.

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