Distribution Relative to Events in Dynamic Semantics[1]

Yusuke YAGI — *University of Connecticut*

Abstract. The goal of this paper is to introduce a new way of implementing distributivity to dynamic semantics. Novel evidence that supports the necessity of the new apparatus is provided from Japanese and English. The evidence comes from a split antecedence in conjunction, which has not been discussed or accounted for in the literature. The proposed system accounts for the referential dependency by distributing over events and, in turn, over the participants of events.

Keywords: Dynamic Semantics, Distributivity, Split Antecedent, Japanese, English

1. Introduction: Distributivity with Conjunction

This paper aims to introduce to dynamic semantics a new way of implementing distributivity. Distributivity has been discussed in the development of dynamic semantics by Beaver (1994) and Brasoveanu (2007, 2008) (under the label of *slicing* by Beaver and *distributive update* by Brasoveanu). I will present novel data for which the above theories do not have an account.

The data point is represented by the Japanese sentences in (1)[2] and the English sentences in (2).[3] Throughout this paper, anaphoric relations are explicated by superscript and subscript indices: antecedents carry a superscript index, and anaphors carry a subscript index.

(1) a. *Alex*^{u_1}*-ga* *saru*^{u_2}*-o* *mi-te,* *Bill*^{u_3}*-ga* *roba*^{u_4}*-o* *mi-ta.*
Alex-NOM monkey-ACC see-AND Bill-NOM donkey-ACC see-PAST
'Alex saw a monkey, and Bill saw a donkey.'

b. *Dotiramo* *sore*$_{??}$*-o* *tsukamae-ta.*
Each it-ACC catch-PAST
'Each of them caught it.'

(2) a. Alex^{u_1} saw a^{u_2} monkey, and Bill^{u_3} saw a^{u_4} donkey.

b. Each of them$_{u_1,\, u_3}$ caught it$_{??}$.

The (b)-sentences mean that 'for every *x* such that *x* is either Alex or Bill, *x* caught the animal (*x* saw).' Under the currently available theories cited above, no way of indexing *it* / *sore* results in this reading. Either u_2 or u_4 alone is insufficient because the pronouns have to refer to both the monkey and the donkey. Indexing them with u_2 and u_4 both does not result in a satisfactory result for two reasons. Firstly, the indexation goes against the singular morphology of the pronouns. Secondly, even if this indexing were allowed, the sentence would not receive the intended reading. Replacing the singular pronoun with a plural pronoun, which uncontroversially bears more than one index, the sentence would have a different reading from the above

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[2]Below, all non-English examples are in Japanese.

[3]The acceptability of this sentence varies across English speakers. For some speakers, the example with temporal pronouns in (8) is more acceptable. I set this variance aside for now, aiming at characterizing a grammar of English that allows this reading. As long as the reading in question is obtained with *it*, the parallel reading is also obtained with personal pronouns. Probably for pragmatic reasons, the reading in question is degraded when the antecedents of pronouns are proper names. I also have to leave this fact untouched below.

sentence, as shown in (3) and (4). The salient reading of the (b)-sentences is the one which is true if Alex and Bill caught both the monkey and the donkey. This reading arguably results from indexing the plural pronouns with u_2 and u_4. Now, in (1) and (2), if the singular pronouns can carry two indices and if these singular pronouns are interpreted as if they were plural pronouns, the sentences should also receive this reading. This prediction is not borne out. The plural interpretation is not available in (1) or (2).

(3) a. *Alex*^{u_1}*-ga saru*^{u_2}*-o mi-te, Bill*^{u_3}*-ga roba*^{u_4}*-o mi-ta.*
Alex-NOM monkey-ACC see-AND Bill-NOM donkey-ACC see-PAST
'Alex saw a monkey, and Bill saw a donkey.'

b. *Dotiramo sore-ra*$_{u_2,\, u_4}$*-o tsukamae-ta.*
Each it-PL-ACC catch-PAST
'Each of them caught them.'

(4) a. Alex^{u_1} saw a^{u_2} monkey, and Bill^{u_3} saw a^{u_4} donkey.

b. Each of them$_{u_1,\, u_3}$ caught them$_{u_2,\, u_4}$.

A critical aspect of the reading of (1)/(2) in question is that it hinges on the quantifier (*dotiramo / each*) in the subject position. The sentences do not receive the reading in parallel sentences not containing a quantifier, as in (5) and (6). In section 2, I pursue a dynamic system that predicts the reading of (1)/(2) with a single index on the pronouns. The proposal relies on quantification, so the behavior observed here is predicted.

(5) a. Alex saw a monkey, and Bill saw a donkey.

b. #The boys took a picture of it.

(6) a. *Alex-ga saru-o mi-te, Bill-ga roba-o mi-ta.*
Alex-NOM monkey-ACC see-and Bill-NOM donkey-ACC see-PAST
'Alex saw a monkey, and Bill saw a donkey.'

b. #*Karera-wa sore-o tsukamae-ta.*
They it-ACC catch-PAST
'They caught it.'

It is worth noting here that the same paradigm is obtained with temporal, locational, and event pronouns. Sentence (7b), for instance, means that 'for each x such that x is either Alex or Bill, x got a phone call at a time t at which x is in the station or the park.' These sentences also raise the indexation issue. The analysis proposed below also accounts for these sentences.

(7) a. *Alex-wa 5-ji*$^{\tau_1}$*-ni eki-ni i-te, Bill-wa 6-ji*$^{\tau_2}$*-ni kooen-ni i-ta.*
Alex-TOP 5-time-at station-in be-and Bill-TOP 6-time-at park-in be-PAST
'Alex was in the station at 5, and Bill was in the park at 6.'

b. *Dotiramo sono*$_{??}$*-toki denwa-wo to-tta.*
Each that-time call-ACC take-PAST
'Each of them took a phone call then.'

(8) a. Alex was in the station at 5$^{\tau_1}$, and Bill was in the park at 6$^{\tau_2}$.

b. Each of them got a phone call at that time$_{??}$ / then$_{??}$.

(9) a. Alex was in the park at five, and Bill was in the station at six.
b. Each of them saw a weird animal there.

(10) a. Alex caught a monkey, and Bill caught a donkey.
b. Each of them did it quickly.

Two comments are in order here about the novelty of the data presented in (1)/(2). Firstly, a similar sentence was pointed out by Stone (1992) and has been discussed by Elbourne (2001, 2005) and Brasoveanu (2007) under the label of *split antecedent*. The sentence is in (11a). A crucial difference between this sentence and (1)/(2) is that the former has a disjunction (in the antecedent of the conditional), while the latter has a conjunction (in the (a)-sentences). The difference is crucial because the explanation given for (11a) does not apply in the case of conjunction. In particular, Brasoveanu (2007) achieved a dynamic analysis of the sentence with the indexation shown in (11b), where the two indefinites in the disjunct share the same index and the pronoun *it* retrieves a reference through that index. In section 3.1, I will outline how this analysis works and why it does not extend to (1)/(2). For now, it is sufficient to note that Brasoveanu's analysis hinges on the assumption that disjunction is not internally dynamic, which is not the case for conjunction.

(11) a. If Alex sees a monkey or a donkey, he waves to it.
b. If Alex^{u_1} sees a^{u_2} monkey or a^{u_2} donkey, he$_{u_1}$ waves to it$_{u_2}$.

Secondly, the pronouns in (1)/(2) should not be analyzed as paycheck pronouns, at least in Japanese. This is because, as Kurafuji (1998) observes, a paycheck interpretation is not available for *sore*. A theory should have an account of the reading without appealing to the paycheck resolution.

(12) a. *Taro-igaino-daremo-ga zibun-no kurejittokaado-o tsuma-ni watasi-ta.*
Taro-except-everyone-NOM self-GEN credit.card-ACC wife-DAT give-PAST
'Everyone except Taro gave his credit card to his wife.'
b. #*Taro-wa sore-o haha-ni watasita.*
Taro-TOP it-ACC mother-DAT gave
Intended: 'Taro gave it (= his credit card) to his mother.'

The rest of this paper is organized as follows. In section 2.1, I introduce Compositional Discourse Representation Theory (Muskens 1996) on which my proposal is based. Then in section 2.2. I present the proposal to account for (2). Section 3 is devoted to discussion. In section 3.1, I compare the current proposal with the pluralized dynamic system in Brasoveanu (2007, 2008), which accounts for the split antecedence with disjunction; in section 3.2 I compare the proposal with a *d*-type analysis of anaphora (Cooper 1979; Heim 1990; Elbourne 2001, 2005). Section 3.3 points out some remaining issues. Section 4 concludes.

2. Proposal

2.1. Compositional DRT

I base my proposal on Compositional Discourse Representation Theory (CDRT; Muskens 1996), which is a compositional extension of DRT (Kamp 1979, 1981; Kamp and Reyle 1993).

CDRT represents the meaning of a sentence using the collapsed box notation as in (14a), which has the DRT correlate in (14b).

(13) A student came in. He sang.

(14) a. $[\, u \mid \texttt{student}\{u\},\ \texttt{came\_in}\{u\},\ \texttt{sang}\{u\}]$

b. $\boxed{\begin{array}{l} \quad\quad u \\ \texttt{student}(u) \\ \texttt{came\_in}(u) \\ \texttt{sang}(u) \end{array}}$

The collapsed box notation is compositionally built using Muskens's (1996) Dynamic Ty2 logic. I illustrate necessary definitions and abbreviations.

The dynamic Ty2 has the set of basic types in (15). I extend Muskens's (1996) set by adding v and i to basic types. Unlike other dynamic analyses (e.g., Heim 1982b; Groenendijk and Stokhof 1991), it takes assignment functions as of basic type s. An assignment should be regarded not as a function but as a labeled list of entities. Complex types are built in the same way as the usual Ty2. I abbreviate the complex types frequently used as in (16).

(15) Basic types
- a. t for truth values
- b. e for individuals
- c. v for events
- d. i for times
- e. s for assignments

(16) Abbreviations: Types
- a. $\mathbf{t} : \langle s, \langle s, t \rangle \rangle$
- b. $\mathbf{e} : \langle s, e \rangle$
- c. $\mathbf{v} : \langle s, v \rangle$
- d. $\mathbf{i} : \langle s, i \rangle$

Discourse referents (drefs) for individuals $u, u_1, u_2, ...$ are of type $\mathbf{e}$, i.e., se, a function from assignments to individuals. Similarly, drefs for events $\varepsilon, \varepsilon_1, \varepsilon_2 ...$ are of type $\mathbf{v}$ (sv), drefs for times $\tau, \tau_1, \tau_2 ...$ are of type $\mathbf{i}$ (si). In the definitions of the following abbreviations, I use δ as a meta-variable to represent a dref of some type. That is, δ is of type $\mathbf{e}$, $\mathbf{v}$, or $\mathbf{i}$ (where δ_1 and δ_2, for instance, are not necessarily of the same type).

The collapsed box notation has the form (17a), an abbreviation of (17b).

(17) a. $[\delta_1, ..., \delta_n \mid C_1, ..., C_m]$
b. $[\delta_1]\,; ...\,; [\delta_n]\,; [C_1]\,; ...\,; [C_m]$

$[\delta]$ is an introduction of a new dref (i.e., updating an input assignment f into g such that g differs from f at most in the value assigned to δ; $f \rightarrow_\delta g$). $C_1, ..., C_n$ are conditions of type st, and $[C_1], ..., [C_m]$ are DRS of type $\mathbf{t}$ (s, st).

(18) $[\delta] \ := \ \lambda f_s.\lambda g_s.\ f \rightarrow_\delta g,$
where $f \rightarrow_\delta g$ iff g differs from f at most in the value assigned to δ

(19) Atomic Conditions
- a. $R\{\delta_1, ..., \delta_n\} \ := \ \lambda f_s.\ R(\delta_1(f), ..., \delta_n(f))$
- b. $\delta_1 = \delta_2 \ := \ \lambda f_s.\ \delta_1(f) = \delta_2(f)$

(20) Atomic DRS

a. $[R\{\delta_1,...,\delta_n\}] := \lambda f_s.\lambda g_s.\ f = g \wedge R\{\delta_1,...,\delta_n\}(g)$

b. $[\delta_1 = \delta_2] := \lambda f_s.\lambda g_s.\ f = g \wedge \delta_1(f) = \delta_2(f)$

For D_1, D_2 of type **t**, $D_1;D_2$ is a dynamic conjunction.

(21) Dynamic Conjunction

$D_1;D_2 := \lambda f_s.\lambda g_s.\ \exists h_s : D_1(f)(h) \wedge D_2(h)(g)$

Given the above definitions, the box in (14) is interpreted as (22), using the definitions in (23). (I assume a sequence of sentences is conjoined by dynamic conjunction.)

(22) $[\ u \mid \texttt{student}\{u\},\ \texttt{came\_in}\{u\},\ \texttt{sang}\{u\}]$

$\rightsquigarrow \lambda f_s.\lambda g_s.\ f \rightarrow_u g \wedge \texttt{student}(u(g)) \wedge \texttt{came\_in}(u(g)) \wedge \texttt{sang}(u(g))$

(23) a. $a^u \rightsquigarrow \lambda P_{\mathbf{et}}.\lambda Q_{\mathbf{et}}.\ [u] ; P(u) ; Q(u)$

b. $student \rightsquigarrow \lambda u_{\mathbf{e}}.\ [\texttt{student}\{u\}]$

c. $came\_in \rightsquigarrow \lambda u_{\mathbf{e}}.\ [\texttt{came\_in}\{u\}]$

d. $sang \rightsquigarrow \lambda u_{\mathbf{e}}.\ [\texttt{sang}\{u\}]$

e. $he_u \rightsquigarrow \lambda f_s.\ u(f)$

The truth of a DRS is defined in (24). A DRS is true w.r.t. an input assignment f iff there is an output assignment g such that g meets the conditions. This is the case in (22) iff there is some g (that differs from f at most in the value assigned to u and) that assigns to u some individual x such that x is a student, x came in, and x sang. The truth condition necessitates the existence of such x. Hence, the 'existential force' of an indefinite is encoded in the system.

(24) Truth

A DRS $D_{s,st}$ is *true* w.r.t. an input assignment f iff there is an assignment g such that $D(f)(g) = 1$.

Other connectives and quantifications are also defined in the standard DRT way. Relevant to the present purpose is the dynamic conditional on which the definition of the universal quantification is built.

(25) Dynamic Conditional

$D_1 \Rightarrow D_2 := \lambda f_s.\ \forall g_s : D_1(f)(g) \rightarrow \exists h_s : D_2(g)(h)$

(25) states that for all ways of updating f into g by D_1, there must be some h such that h makes D_2 true w.r.t. g. Based on this, we can define an English universal quantifier *every*. It calls for a test of whether for all outputs g produced by introducing a new dref, subject to restrictor P, there is some assignment h that makes the scope Q true.

(26) *every*

$\rightsquigarrow \lambda P_{\mathbf{et}}.\lambda Q_{\mathbf{et}}.\ ([u] ; P(u)) \Rightarrow Q(u)$

In order to treat plural pronouns such as *them* in *each of them*, I take the domain of individuals (D_e) to contain plural individuals. Plural individuals are sums of two or more individuals (Link

1983: among many others). The sum of individuals $\mathtt{a}$ and $\mathtt{b}$ is expressed as $\mathtt{a} \oplus \mathtt{b}$. For this study, I define *they/them* as (27).[4]

(27) *they/them*$_{u_1 \oplus u_2} \rightsquigarrow \lambda f_s.\ u_1(f) \oplus u_2(f)$

Combining the definition of universal quantification and the plural pronouns, we can define *each* (in *each of them*) as follows. It calls for a test of whether for all output g produced by introducing a new dref u', if the new dref is an atomic part of u, there is some assignment h that makes the scope $P(u')$ true.

(28) *each* $\rightsquigarrow \lambda u_{\mathbf{e}}.\lambda P_{\mathbf{et}}.\ ([u']\,;\,[u' <_A u]) \Rightarrow P(u')$ (To be revised)

(29) $u' <_A u \rightsquigarrow \lambda f_s.u'(f) <_A u(f)$ ($<_A$ is the *atomic-part-of* relation.)

Now we can see the issue raised in the previous section. Consider (2) with the following indexation. Sentence (b) is translated into (30).

(2) a. Alex^{u_1} saw a^{u_2} monkey, and Bill^{u_3} saw a^{u_4} donkey.

b. Each of them$_{u_1,\ u_3}$ caught it$_{??}$.

(30) $([u'];[u' <_A u_1 \oplus u_3]) \Rightarrow [\mathtt{caught}\{u', u_{??}\}]$
$\rightsquigarrow\ [u' \mid u' <_A u_1 \oplus u_3] \Rightarrow [\mathtt{caught}\{u', u_{??}\}]$

(30) calls for a test whether for any way of updating f into g by introducing u', where u' is an atomic part of $u_1 \oplus u_3$, there is some h that renders $\mathtt{caught}(u', u_{??})(g)(h)$ to be true. The process is visualized as (31). To get the intended reading in the current theory, the index for *it* has to vary: it should be u_2 when $\mathtt{c} = \mathtt{a}$, and u_4 when $\mathtt{c} = \mathtt{b}$. It is unclear how to achieve this.

(31) a. (a saw m, b saw d)

	u_1	u_2	u_3	u_4
f	a	m	b	d

b. ($\mathtt{c} <_A \mathtt{a} \oplus \mathtt{b}$)

	u_1	u_2	u_3	u_4	u'
g	a	m	b	d	c

2.2. Proposal: CDRT with Events and Event Distribitivity

I propose to solve the problem posed by (1) and (2) by (i) introducing event drefs (Kamp 1979, 1981) and (ii) letting *each* quantify over individuals and events. In addition to the individual restrictor *of them*, *each* optionally obtains a second restrictor, E. I take E as a covert plural event pronoun. Then *each* with the two restrictors calls for the following test:

[4]For simplicity, I analyze the plural pronouns as of type **e**. The definition can be altered to introduce plural drefs (Brasoveanu 2007, 2008) as (i). If we do so, we should change the definition of *each* accordingly.

(i) *they/them*$^{u}_{u_1 \oplus u_2} \rightsquigarrow \lambda P_{\mathbf{et}}.\ \lambda f_s.\ [u];[u = u_1 \oplus u_2];P(u)$

(ii) *each* $\rightsquigarrow \lambda \mathbb{P}_{\mathbf{et,t}}.\lambda Q_{\mathbf{et}}.\ ([u'];\mathbb{P}(\lambda u.\ [u' <_A u])) \Rightarrow Q(u')$

(32) each of [them$_{u',u''}$, E$_{\varepsilon',\varepsilon''}$], P

a. For every way of updating the input f into g by
$[u,\ \varepsilon \mid u <_A u' \oplus u'',\ \varepsilon < \varepsilon' \oplus \varepsilon'',\ \underline{\theta(\varepsilon, u)}]$ (Restrictor)

b. There is some h: g is updated into h by $\underline{[\delta_1, ..., \delta_n \mid \theta(\varepsilon, \delta_1)\ , ...,\ \theta(\varepsilon, \delta_n)},\ P(u)]$ (Scope)

The crucial parts are underlined. Since *each* quantifies over individuals and events, in processing the restrictor it introduces two new drefs, u and ε, where u is an atomic part of $them_{u',u''}$, and ε is of $E_{\varepsilon',\varepsilon''}$. The two drefs are further conditioned to have some thematic relation, represented as $\theta(\varepsilon, u)$. In processing the scope, it further introduces an arbitrary number of drefs $\delta_1, ..., \delta_n$, all of which have a thematic relation with ε. Finally, $P(u)$ is processed.[5]

The proposal works in the following way. Let verbs introduce an event dref. Then the indexation in (33a) results in the assignment (33b).

(33) a. Alex^{u_1} saw$^{\varepsilon_1}$ a^{u_2} monkey, and Bill^{u_3} saw$^{\varepsilon_2}$ a^{u_4} donkey.

b.

	u_1	u_2	ε_1	u_3	u_4	ε_2
f	a	m	$\mathtt{e}_1$	b	d	$\mathtt{e}_2$

($\mathtt{e}_1$: a saw m, $\mathtt{e}_2$: b saw d)

At this point, notice that a and m are 'paired' through a thematic relation to $\mathtt{e}_1$, and b and d are 'paired' through a thematic relation to $\mathtt{e}_2$. These 'pairings' are visualized as (34). The relations will be important in deriving the reading of (1)/(2) in question.

(34) a. $\mathtt{a} \leftrightarrow_\theta \mathtt{e}_1 \leftrightarrow_\theta \mathtt{m}$

b. $\mathtt{b} \leftrightarrow_\theta \mathtt{e}_2 \leftrightarrow_\theta \mathtt{d}$

Each is restricted by $them_{u_1,\ u_3}$ and $E_{\varepsilon_1,\ \varepsilon_2}$. Processing the restrictor of *each* introduces u_5 and ε_3 to f in (33b). u_5 must be an atomic part of $u_1 \oplus u_3$, and ε_3 must be an atomic part of $\varepsilon_1 \oplus \varepsilon_2$. There are four ways to value u_5 and ε_3 then: $\langle \mathtt{a}, \mathtt{e}_1 \rangle$, $\langle \mathtt{a}, \mathtt{e}_2 \rangle$, $\langle \mathtt{b}, \mathtt{e}_1 \rangle$, $\langle \mathtt{b}, \mathtt{e}_2 \rangle$. However, u_5 and ε_3 are further subject to the thematic-relation condition. This thematic relation limits the valuation, and we only obtain two of the four, namely $\langle \mathtt{a}, \mathtt{e}_1 \rangle$ and $\langle \mathtt{b}, \mathtt{e}_2 \rangle$. (35) visualizes the thematic relations.

(35) $u_5 \leftrightarrow_\theta \varepsilon_3$

a. $\mathtt{a} \leftrightarrow_\theta \mathtt{e}_1$

b. $\mathtt{b} \leftrightarrow_\theta \mathtt{e}_2$

Processing the restrictor thus results in g in (36). By the thematic rleations, $\mathtt{c} = \mathtt{a}$ iff $\mathtt{e}_3 = \mathtt{e}_1$, and $\mathtt{c} = \mathtt{b}$ iff $\mathtt{e}_3 = \mathtt{e}_2$.

[5]It is easy to restrict the arbitrariness of the introduction of $\delta_1, ..., \delta_n$. For instance, if we impose a presupposition that $\delta_i \neq u$, for any $1 \leq i \leq n$, then each δ_i has to store an entity different from u does, preventing a reintroduction of the entity stored in u. Also, we can impose $\delta_i \neq \delta_j$ if $i \neq j$. This prevents the same entity from being stored in multiple positions in $\delta_1, ..., \delta_n$. The combinations of these two presuppositions require that processing the scope introduces (at most) all and only drefs distinct from u and thematically related to ε.

(36)

	u_1	u_2	ε_1	u_3	u_4	ε_2	u_5	ε_3
g	a	m	$\mathtt{e}_1$	b	d	$\mathtt{e}_2$	c	$\mathtt{e}_3$

$(\mathtt{c} <_A \mathtt{a} \oplus \mathtt{b},\ \mathtt{e}_3 <_A \mathtt{e}_1 \oplus \mathtt{e}_2,\ \theta(\mathtt{c}, \mathtt{e}_3)\ )$

Processing the scope introduces an arbitrary number of drefs. These drefs introduced in the scope are all subject to the thematic condition. These drefs must be thematically related to the event stored in ε_3. Suppose here that the scope introduces one individual dref, u_6. u_6 stores some individual f. Suppose further that the pronoun in question *it* has u_6 as an index. Since *it* is a pronoun for non-humans, its use is felicitous when u_6 stores a non-human, here m or d. The value of u_6 is again determined by the thematic condition. When ε_3 stores $\mathtt{e}_1$, u_6 stores m; when ε_3 stores $\mathtt{e}_2$ ε_3 stores d. The thematic relation is visualized as in (37), and the output of processing the scope is schematized as in (38).

(37) $u_5 \leftrightarrow_\theta \varepsilon_3 \leftrightarrow_\theta u_6$

a. $\mathtt{a} \leftrightarrow_\theta \mathtt{e}_1 \leftrightarrow_\theta \mathtt{m}$

b. $\mathtt{b} \leftrightarrow_\theta \mathtt{e}_2 \leftrightarrow_\theta \mathtt{d}$

(38)

	u_1	u_2	ε_1	u_3	u_4	ε_2	u_5	ε_3	u_6	ε_4
h	a	m	$\mathtt{e}_1$	b	d	$\mathtt{e}_2$	c	$\mathtt{e}_3$	f	$\mathtt{e}_4$

$(\theta(\mathtt{f}, \mathtt{e}_3)$, $\mathtt{e}_4$: c caught f)

Thus, the test is passed and the sentence is true iff a catches m and b catches d, deriving the intended reading.

Summarizing the proposal, the sentence in question should obtain the following indexation.

(39) a. Each of [them$_{u_1,\ u_3}$ E$_{\varepsilon_1,\ \varepsilon_2}$] caught$^{\varepsilon_4}$ it$_{u_6}$.

b.

	u_1	u_2	ε_1	u_3	u_4	ε_2	u_5	ε_3
g	a	m	$\mathtt{e}_1$	b	d	$\mathtt{e}_2$	c	$\mathtt{e}_3$

$(\mathtt{c} <_A \mathtt{a} \oplus \mathtt{b},\ \mathtt{e}_3 <_A \mathtt{e}_1 \oplus \mathtt{e}_2,\ \theta(\mathtt{c}, \mathtt{e}_3)\ )$

c.

	u_1	u_2	ε_1	u_3	u_4	ε_2	u_5	ε_3	u_6	ε_4
h	a	m	$\mathtt{e}_1$	b	d	$\mathtt{e}_2$	c	$\mathtt{e}_3$	f	$\mathtt{e}_4$

$(\theta(\mathtt{f}, \mathtt{e}_3)$, $\mathtt{e}_4$: c caught f)

The crucial aspect of the proposal is the introduction of u_5, ε_3, and u_6, which are subject to the thematic-relation condition. Unpacking the quantification, it effectively creates assignments h and h' below and distributively updates these assignments by the scope. Thus, I call it *event distribution*. Note that the current proposal only requires a single index, u_6 here, for *it* to obtain the intended reading.

(40) a.

	u_1	u_2	ε_1	u_3	u_4	ε_2	u_5	ε_3	u_6	
h	a	m	$\mathtt{e}_1$	b	d	$\mathtt{e}_2$	a	$\mathtt{e}_1$	m	$\leftarrow$ *u_5 caught it$_{u_6}$*

	u_1	u_2	ε_1	u_3	u_4	ε_2	u_5	ε_3	u_6	
h'	a	m	$\mathtt{e}_1$	b	d	$\mathtt{e}_2$	b	$\mathtt{e}_2$	d	$\leftarrow$ *u_5 caught it$_{u_6}$*

Two comments are in order here. First, notice that the index u_6 in (41) is *familiar* in the sense of Heim (1982a). The index is already in the domain of an input assignment against which the sentence containing u_6 is evaluated (because of the dref introduction in the scope), so it is not novel. Secondly, the proposal predicts the five readings for (41b). Below, the ordered pair $\langle \mathtt{x}, \mathtt{y} \rangle$ represents the `talked_to` relation.

(41) a. Alex saw Bill, and Chris saw Dan.
b. Each of them talked to him.
(i) $\langle \mathtt{a}, \mathtt{b} \rangle, \langle \mathtt{c}, \mathtt{d} \rangle$
(ii) $\langle \mathtt{a}, \mathtt{a} \rangle, \langle \mathtt{b}, \mathtt{b} \rangle$
(iii) $\langle \mathtt{a}, \mathtt{b} \rangle, \langle \mathtt{d}, \mathtt{b} \rangle$
(iv) $\langle \mathtt{b}, \mathtt{a} \rangle, \langle \mathtt{c}, \mathtt{d} \rangle$
(v) $\langle \mathtt{b}, \mathtt{a} \rangle, \langle \mathtt{d}, \mathtt{c} \rangle$

Reading (i) is what we have been pursuing. Reading (ii) is predicted but not available for the sentence. I argue that this reading is ruled out by Binding Condition B, especially by the version of Reinhart and Reuland (1993). In their definition, a semantically reflexive predicate must be reflexive-marked by an inherently reflexive predicate or a reflexive pronoun. Reading (ii) is reflexive, but the predicate is not reflexive-marked. Hence the reading is ruled out.

The remaining three readings should be predicted and available. It's worth noting here that, in general, some semantically available readings are pragmatically hard to obtain. For instance, to obtain (iii), *them* has to get the indices of *Alex* and *Dan*, which is, I believe, already odd. Even in a more semantically simple sentence, e.g., *Alex saw Bill, and Chris saw Dan. They talked to them*, hardly allows the reading where *they* is anteceded by *Alex* and *Dan*. The near unavailability is not governed by semantics, however. Semantics allows such indexation, but the indexation is not felicitous pragmatically. I claim the same reasoning goes for readings (iii)–(v).

Consider the Japanese sentence in (42) to confirm this point. Japanese has scrambling and scrambling changes pragmatic saliency. In (42), *dotira* quantifies over (i.e., is anteceded by) *Alex* and *Bill*, where the former is the subject of the first conjunct, and the latter is the object of the second conjunct. This reading is in principle available without scrambling but is facilitated by scrambling.

(42) a. *Alex-wa saru-o mi-ta. Bill-o, roba-ga t keritobasi-ta.*
Alex-TOP monkey-ACC see-PAST Bill-ACC donkey-NOM *t* kick-PAST
'Alex saw a monkey, and a donkey kicked Bill.'
b. *Dotira-mo sore-o tsukamae-ta.*
Each-all it-ACC catch-PAST
'Each caught it.'

2.3. Formalizing the Proposal

Following Champollion (2016a, b), I take the domain of events (D_v) to contain plural events. Plural events are the sum of two or more events. The plural event pronoun E above thus should be defined as (43).

(43) $E_{\varepsilon_1,\varepsilon_2} \rightsquigarrow \lambda f_s.\ \varepsilon_1(f) \oplus \varepsilon_2(f)$

I adopt the Neo-Davidsonian event semantics (Parsons 1990: a.o.) and follow Champollion (2015) in that verbs existentially quantify over events. In the current dynamic framework, it means that verbs introduce a new event discourse referent. The definitions below makes use of *continuation* as done by Champollion (2015). The simple sentence *a man sleeps* has the following derivation.

(44) a. $sleeps^{\varepsilon} \rightsquigarrow \lambda u_{\mathbf{e}}.\lambda V_{\mathbf{vt}}.\ [\varepsilon]\,;[\texttt{sleep}\{\varepsilon\}]\,;[\texttt{subject}\{\varepsilon,u\}]\,;V(\varepsilon)$

b. $man \rightsquigarrow \lambda u_{\mathbf{e}}.[\texttt{man}\{u\}]$

c. $a^{u} \rightsquigarrow \lambda P_{\mathbf{et}}.\lambda \mathbb{Q}_{\langle \mathbf{e}\langle \mathbf{vt},\mathbf{t}\rangle\rangle}.\lambda V_{\mathbf{vt}}.\ [u]\,;P(u)\,;\mathbb{Q}(u)(V)$

(45) a. $a^{u}\ man \rightsquigarrow \lambda \mathbb{Q}_{\langle \mathbf{e}\langle \mathbf{vt},\mathbf{t}\rangle\rangle}.\lambda V_{\mathbf{vt}}.\ [u]\,;[\texttt{man}\{u\}]\,;\mathbb{Q}(u)(V)$

b. $a^{u}\ man\ sleeps^{\varepsilon} \rightsquigarrow \lambda V_{\mathbf{vt}}.\ [u]\,;[\texttt{man}\{u\}]\,;[\varepsilon]\,;[\texttt{sleep}\{\varepsilon\}]\,;[\texttt{subject}\{\varepsilon,u\}]\,;V(\varepsilon)$

The (dynamicized) closure saturates the remaining variable **true**, which is true of any event.

(46) $\mathbf{true} \rightsquigarrow \lambda \varepsilon_{\mathbf{v}}.[\texttt{true}\{\varepsilon\}]$

(47) **true** a^{u} *man sleeps*$^{\varepsilon}$

$\rightsquigarrow [u]\,;[\texttt{man}\{u\}]\,;[\varepsilon]\,;[\texttt{sleep}\{\varepsilon\}]\,;[\texttt{subject}\{\varepsilon,u\}]\,;[\texttt{true}\{\varepsilon\}]$

$\rightsquigarrow [u]\,;[\texttt{man}\{u\}]\,;[\varepsilon]\,;[\texttt{sleep}\{\varepsilon\}]\,;[\texttt{subject}\{\varepsilon,u\}]$

$\rightsquigarrow [u,\ \varepsilon \mid \texttt{man}\{u\},\ \texttt{sleep}\{\varepsilon\},\ \texttt{subject}\{\varepsilon,u\}]$

Now I define *each* with two restrictors as follows. The thematic-relation condition is stated using two-place predicate θ, which I define as (49). It is true of a pair of an event and an individual iff there is some two-place predicate of an event and an individual (e.g., `subject`, `object`, and `time`) that is true of the pair.

(48) *each*

$\rightsquigarrow \lambda u'_{\mathbf{e}}.\lambda \varepsilon'_{\mathbf{v}}.\lambda \mathbb{Q}_{\langle \mathbf{e}\langle \mathbf{vt},\mathbf{t}\rangle\rangle}.\lambda V_{\mathbf{v}}.([u]\,;[\varepsilon]\,;[u <_{A} u']\,;[\varepsilon <_{A} \varepsilon'];[\theta(u,\varepsilon)])$

$\Rightarrow ([\delta_1,...,\delta_n]\,;[\theta\{\varepsilon,\delta_1\},...,\theta\{\varepsilon,\delta_n\}]\,;\mathbb{Q}(u)(V))$

(49) $\forall e_v \forall x_e\ [\theta(e,x)=1 \leftrightarrow \exists P_{v,et}[P(e,x)=1]]$

The above definition straightforwardly accounts for the sentence interpretation in question by implementing the event distribution outlined above. Notice that in the derivation below, u_6 is introduced in the scope as an instance of the arbitrary introduction $[\delta_1,...,\delta_n]$.

(50) a. Alex^{u_1} saw$^{\varepsilon_1}$ a^{u_2} monkey, and Bill^{u_3} saw$^{\varepsilon_2}$ a^{u_4} donkey.

b. Each of [them$_{u_1,\ u_3}$ E$_{\varepsilon_1,\ \varepsilon_2}$] caught$^{\varepsilon_4}$ it$_{u_6}$.

(51) a. $caught^{\varepsilon_4}\ it_{u_6} \rightsquigarrow \lambda u_{\mathbf{e}}.\lambda V_{\mathbf{vt}}.\ [\varepsilon_4]\,;[\texttt{caught}\{\varepsilon_4\}]\,;[\texttt{subject}\{\varepsilon_4,u\}]\,;[\texttt{object}\{\varepsilon_4,u_6\}]$

b. *Each of* [$them_{u_1,\ u_3}\ E_{\varepsilon_1,\ \varepsilon_2}$]

$\rightsquigarrow \lambda \mathbb{Q}_{\langle \mathbf{e}\langle \mathbf{vt},\mathbf{t}\rangle\rangle}.\lambda V_{\mathbf{v}}.\ ([u]\,;[\varepsilon]\,;[u <_{A} u_1 \oplus u_3]\,;[\varepsilon <_{A} \varepsilon_1 \oplus \varepsilon_2]\,;[\theta\{u,\varepsilon\}])$

$\Rightarrow ([\delta_1,...,\delta_n]\,;[\theta\{\varepsilon,\delta_1\},...,\theta\{\varepsilon,\delta_n\}]\,;\mathbb{Q}(u)(V))$

c. *Each of* [*them*$_{u_1,\ u_3}$ $E_{\varepsilon_1,\ \varepsilon_2}$] *caught*$^{\varepsilon_4}$ *it*$_{u_6}$
$\rightsquigarrow\ \lambda V_{\mathbf{v}}.\ ([u]\,;[\varepsilon]\,;[u <_A u_1 \oplus u_3]\,;[\varepsilon <_A \varepsilon_1 \oplus \varepsilon_2]\,;[\theta\{u,\varepsilon\}])$
$\Rightarrow ([u_6]\,;[\theta\{\varepsilon,u_6\}]\,;[\varepsilon_4]\,;[\mathtt{caught}\{\varepsilon_4\}]\,;[\mathtt{subject}\{\varepsilon_4,u\}]\,;[\mathtt{object}\{\varepsilon_4,u_6\}]\,;V(\varepsilon))$

d. **true** *Each of* [*them*$_{u_1,\ u_3}$ $E_{\varepsilon_1,\ \varepsilon_2}$] *caught*$^{\varepsilon_4}$ *it*$_{u_6}$
$\rightsquigarrow\ ([u]\,;[\varepsilon]\,;[u <_A u_1 \oplus u_3]\,;[\varepsilon <_A \varepsilon_1 \oplus \varepsilon_2]\,;[\theta\{u,\varepsilon\}])$
$\Rightarrow ([u_6]\,;[\theta\{\varepsilon,u_6\}]\,;[\varepsilon_4]\,;[\mathtt{caught}\{\varepsilon_4\}]\,;[\mathtt{subject}\{\varepsilon_4,u\}]\,;[\mathtt{object}\{\varepsilon_4,u_6\}]\,;V(\varepsilon))$
$\rightsquigarrow\ [u,\ \varepsilon \mid u <_A u_1 \oplus u_3, \varepsilon <_A \varepsilon_1 \oplus \varepsilon_2, \theta(u,\varepsilon)]$
$\Rightarrow [u_6,\ \varepsilon_4 \mid \theta\{\varepsilon,u_6\},\ \mathtt{caught}\{\varepsilon_4\},\ \mathtt{subject}\{\varepsilon_4,u\},\ \mathtt{object}\{\varepsilon_4,u_6\}]$

The proposal can easily be extended to temporal and other domains. Consider, for instance, the definition of temporal adverbs and pronouns below.

(52) a. *at five*$^{\tau}$ $\rightsquigarrow\ \lambda \mathbb{Q}_{\langle \mathbf{e}\langle \mathbf{ev},\mathbf{t}\rangle\rangle}.\lambda u_{\mathbf{e}}.\lambda V_{\mathbf{vt}}.\ [\tau]\,;[\mathtt{at\_five}(\tau)]\,;\mathbb{Q}(u,\lambda\varepsilon.[\mathtt{time}\{\varepsilon,\tau\}]\,;V)$
b. *then*$_{\tau}$ $\rightsquigarrow\ \lambda \mathbb{Q}_{\langle \mathbf{e}\langle \mathbf{ev},\mathbf{t}\rangle\rangle}.\lambda u_{\mathbf{e}}.\lambda V_{\mathbf{vt}}.\ \mathbb{Q}(u,\lambda\varepsilon.[\mathtt{time}\{\varepsilon,\tau\}]\,;V)$

This definition yields (53), for instance, where the temporal adverbs introduce a temporal dref, and the temporal pronoun picks the referent up.

(53) a. *was in a park at five*
$\rightsquigarrow\ \lambda u_{\mathbf{e}}.\lambda V_{\mathbf{vt}}.[\tau]\,;[\mathtt{at\_five}(\tau)]\,;[\varepsilon]\,;[\mathtt{in\_park}\{\varepsilon\}]\,;[\mathtt{subject}\{\varepsilon,u\}]\,;[\mathtt{time}\{\varepsilon,\tau\}]\,;V$
b. *got*$^{\varepsilon}$ *a phone call then*$_{\tau}$
$\rightsquigarrow\ \lambda u_{\mathbf{e}}.\lambda V_{\mathbf{vt}}.[\mathtt{got\_phone\_call}\{\varepsilon\}]\,;[\mathtt{subject}\{\varepsilon,u\}]\,;[\mathtt{time}\{\varepsilon,\tau\}]\,;V$

The sentence with the temporal pronoun in (8) is worked out as (54). Notice that *each* introduces τ_3 where it introduced u_6 in a previous example. This is possible because the definition of *each* does not specify the type (or number) of drefs it introduces in processing the scope. Still, the value of the dref introduced is constrained by the thematic-relation condition. The value is either *at five* or *at six*, depending on the value of ε. The analysis can be extended for the examples with temporal and event pronouns in (9)/(10) in an obvious way.

(54) a. Alex^{u_1} was$^{\varepsilon_1}$ in the station at 5^{τ_1}, and Bill^{u_1} was$^{\varepsilon_2}$ in the park at 6^{τ_2}.
b. Each [of them$_{u_1,\ u_2}$, $E_{\varepsilon_1,\ \varepsilon_2}$] got a phone call then$_{\tau_3}$.

(55) *each of them got a phone call then*
$\rightsquigarrow\ [u,\ \varepsilon \mid u <_A u_1 \oplus u_2,\ \varepsilon <_A \varepsilon_1 \oplus \varepsilon_2,\ \theta(u,\varepsilon)]$
$\Rightarrow [\tau_3,\ \varepsilon_3 \mid \theta\{\varepsilon,\tau_3\},\ \mathtt{got\_phone\_call}\{\varepsilon_3\},\ \mathtt{subject}\{\varepsilon_3,u\},\ \mathtt{time}\{\varepsilon_3,\tau_3\}]$

Intuitively, what the event distribution does is to ‘collect’ the participants, times, and relevant components of a particular event. This is made possible by combining the thematic-relation condition and the arbitrary dref introduction $\delta_1,...,\delta_n$. Since a quantifier causes the event distributivity, the degradation of the reading without a quantifier is also accounted for.

Summarizing this section, I proposed that *each* (dynamically) quantifies over individuals and events. The proposal explains the interpretation of (2), for which previous theories do not have an account.

3. Comparisons and Remaining Issues

3.1. Comparison 1: Pluralized CDRT

As pointed out in the introduction, a similar sentence to (1)/(2) has been discussed in the literature, with a disjunction. The sentence in (11a), repeated here, is an example. With a Pluralized Compositional DRT (PCDRT), Brasoveanu (2007) successfully analyzes this sentence with the indexation shown in (11), where the two indefinites in the disjuncts bear the same index, u_2. In this section, I demonstrate that the analysis of (11a) in PCDRT cannot be extended to (1)/(2). Since the technical detail of PCDRT is quite involved, I will only carry out the discussion informally. The version of PCDRT used for illustration below is the one in Brasoveanu (2007), but the same problem arises for different versions and for other systems like *slicing* of Beaver (1994) and the *distributive operator* of Nouwen (2003).

(11) a. If Alex sees a monkey or a donkey, he waves to it.
b. If Alex^{u_1} sees a^{u_2} monkey or a^{u_2} donkey, he$_{u_1}$ waves to it$_{u_2}$.

PCDRT is a pluralized CDRT based on the plural dynamic predicate logic proposed by van den Berg (1996). It works with *a set* of assignments (called an *information state*). Thus, sentences denote a binary relation between sets of assignments, $\langle F, G\rangle$. As in non-pluralized dynamic systems, the input F is tested or updated into G according to conditions imposed by a sentence. An introduction of new drefs and tests are performed according to the following definition, where new drefs are introduced for each $f \in F$. The second conjunct in (56a) ensures that the process does not add arbitrary new assignments to the output G. Tests are also performed individually. Conditions C_i typically have the form of an n-place predicate P as in (56b). It tests if each $f \in F$ passes the test. For instance, the update by (57a) can be visualized as (57b).

(56) $[u_1, ..., u_n \mid C_1, ..., C_m]$
a. $[u] := \lambda F_{st}.\lambda G_{st}.\ \forall f \in F(\exists g \in G(f \rightarrow_u g)) \wedge \forall g \in G(\exists f \in F(f \rightarrow_u g))$
b. $P\{u_1, ..., u_n\} := \lambda F_{st}.\ F \neq \varnothing \wedge \forall f \in F : P(u_1(f), ..., u_n(f))$

(57) a. $[u_1,\ u_2 \mid \mathtt{dog}\{u_1\},\ \mathtt{cat}\{u_2\}, \mathtt{chased}\{u_1, u_2\}]$

b.

G	u_1	u_2	...	
g_1	$\mathtt{d}_1$	$\mathtt{c}_1$	...	($\mathtt{d}_1$ is a dog, $\mathtt{c}_1$ is a cat, $\mathtt{d}_1$ chased $\mathtt{c}_1$)
g_2	$\mathtt{d}_2$	$\mathtt{c}_2$	...	($\mathtt{d}_2$ is a dog, $\mathtt{c}_2$ is a cat, $\mathtt{d}_2$ chased $\mathtt{c}_2$)
g_3	$\mathtt{d}_3$	$\mathtt{c}_3$	...	($\mathtt{d}_3$ is a dog, $\mathtt{c}_3$ is a cat, $\mathtt{d}_3$ chased $\mathtt{c}_3$)
...	....	...	...	

To see how PCDRT accounts for (11), it is necessary to discuss disjunctions and conditionals. Simplifying somewhat, disjunction in PCDRT sumps up the outputs of each disjunct. That is, the update by $D_1 \vee D_2$ produces G such that $G = K \cup H$ where $D(F)(K) = 1$ and $D(F)(H) = 1$ for some input F. Thus, the disjunction in (58a) produces (58b). For simplicity, I take every disjunction as a sentential disjunction.

(58) a. Alex^{u_1} sees a^{u_2} monkey or (Alex sees) a^{u_2} donkey.

b.

G	u_1	u_2	
g_1	$\mathtt{a}$	$\mathtt{d}$	($\mathtt{a}$ is Alex, $\mathtt{d}$ is donkey, $\mathtt{a}$ sees $\mathtt{d}$)
g_2	$\mathtt{a}$	$\mathtt{m}$	($\mathtt{a}$ is Alex, $\mathtt{m}$ is monkey, $\mathtt{a}$ sees $\mathtt{m}$)

Notice that the definition of disjunction is internally static: D_2 does not take the output of D_1 as an input. This is why in (58a), the reuse of the index u_2 does not cause any issues. If it were internally dynamic, either the second occurrence of u_2 would overwrite the referential information stored by the first one, or the reuse leads to a violation of some condition such as the Novelty Condition (Heim 1982b), resulting in infelicity.

The PCDRT treatment of conditionals $D_1 \Rightarrow D_2$ is similar to CDRT as long as irrelevant complexities are ignored. It calls for a test whether for any G such that $D_1(F)(G)$ holds for some input F, there is K such that $D_2(G)(K)$ holds.

The split antecedence case in (11) is analyzed as follows. The antecedent of the conditional creates G in (59) as an output. Then for each $g \in G$, it is tested if g satisfies the conditions of the consequent. Since the test is performed distributively over the assignments in G, the pronoun it_{u_2} refers to `d` and `m` at the same time, resulting in the intended interpretation.

(59) a. If Alex^{u_1} sees a^{u_2} monkey or (Alex sees) a^{u_2} donkey, he$_{u_1}$ waves to it$_{u_2}$.

b.

G	u_1	u_2	
g_1	a	d	(a waves to d)
g_2	a	m	(a waves to m)

It is easy to see that the account hinges on the internal staticity of the disjunction. One may wonder at this point then if we can postulate an internally dynamic conjunction by which the anaphora in (1)/(2) is resolved in the same way PCDRT resolves the split antecedent in disjunction. Although this is in principle possible, it does not offer us a fully general solution for (1)/(2). This is because the same anaphoric relation is obtained even when internal dynamicity is forced in the antecedent conjunction, as in (60).

(60) a. A man saw a monkey, and his brother saw a donkey.
b. Each of them caught it.

An analysis with an internally static conjunction would face difficulty in analyzing this sentence. Thus, this datapoint further justifies t justifies the introduction of the event distributivity.

3.2. Comparison 2: *d*-type theory

E-type / *d*-type theory (Cooper 1979; Heim 1990; Elbourne 2001, 2005; a.o.) is an option competing with a dynamic system in accounting for anaphoric relations. I argue that these theories do not make correct predictions because of the problem of indistinguishable participants.

The theory subsumes two assumptions. Firstly, pronouns are syntactically complex. They are decomposed into [D [P s]] at LF, where D is a covert definite determiner, P is a contextually-supplemented description, and s is a situation variable. Secondly, quantifiers quantify over pairs of an individual and a (minimal) situation.

Suppose under this theory that propositions are predicates of situations of type *st* (where s is a type for situations). Then a simple and informal version of the theory defines *every* as follows.

(61) *every P Q*
$\rightsquigarrow$ for every $\langle x, s\rangle$ where x is an individual and s is a minimal situation in which $P(x)(s) = 1$, there is an extended situation s' of s such that $Q(x)(s') = 1$.

Suppose further the following translations of English phrases. In (62b), *it* is decomposed at LF, and the predicate *donkey* is filled in by the context. (See Elbourne (2001) for a more principled way of filling in the description part. He argues that the description overtly appears in syntax and undergoes ellipsis.) The definite determiner there is supposed to induce the uniqueness presupposition. Thus, it is a predicate true of a pair $\langle x, s\rangle$ iff x beats the unique donkey in s.

(62) a. *man who owns a donkey*
$\rightsquigarrow$ $\lambda s.\lambda x.\exists y\, [\texttt{man}(x,\ s) \wedge \texttt{donkey}(y,\ s) \wedge \texttt{own}(x,\ y,\ s)]$
b. *beats it* (LF: *beats* [*D* [*donkey s*]])
$\rightsquigarrow$ $\lambda s.\lambda x.\texttt{beats}(x, \iota y[\texttt{donkey}(y, s)], s)$

Combining the definition of *every* above, the canonical donkey sentence is analyzed as in (63). Since s and s' are minimal situations, they contain only one donkey. The uniqueness presupposition is satisfied in each such situation. The analysis results in the reading where each donkey owner beats the donkey(s) s/he owns.

(63) *every man who owns a donkey beats it*
$\rightsquigarrow$ For every $\langle x, s\rangle$ where x is an individual and s is a minimal situation in which
$\exists y\, [\texttt{man}(x,\ s) \wedge \texttt{donkey}(y,\ s) \wedge \texttt{own}(x,\ y,\ s)]$
is true, there is an extended situation s' of s such that
$\texttt{beats}(x, \iota y[\texttt{donkey}(y, s')], s')$.
is true.

Now consider our sentence (2). Following Elbourne (2001, 2008), suppose that the description part of the decomposed *it* has a predicate *donkey-or-monkey*. Suppose further *each* quantifies over individuals and situations. The domain of the individual quantification is provided by the overt restrictor *of them*. The domain of situation quantification is provided contextually. Here, the covert restrictor C contains situations where either Alex saw a monkey or Bill saw a donkey. I define *each* as (64). The condition $\texttt{exists}(x, s)$ works as a situation counterpart of the thematic-relation condition. It is true iff x exists in s. Now (65a) is analyzed as shown.

(64) *each* [*of them*, *C*] *P*
$\rightsquigarrow$ For all $\langle x, s\rangle$ where s is a minimal situation such that $s \in C$, $x <_A$ *them*, and $\texttt{exists}(x, s)$, there is an extended situation s' such that $P(x, s') = 1$.

(65) a. Alex saw a monkey, Bill saw a donkey.
b. Each [of them, *C*] caught it. (LF: ... caught [*D* [monkey-or-donkey *s*]]) $\rightsquigarrow$
For all $\langle x, s\rangle$ where s is a minimal situation such that
s is a situation where either Alex saw a monkey or Bill saw a donkey, and
x is an atomic part of $\texttt{Alex} \oplus \texttt{Bill}$, and
$\texttt{exists}(x, s) = 1$,
There is an extended situation s' of s such that
x caught the unique donkey or monkey in s'

Since s is a minimal situation and is subject to the condition $\texttt{exist}$, it contains either Alex and one monkey, or Bill and one donkey. The situation s' is an extended situation of s such that the uniqueness presupposition is satisfied. Thus, *it* correctly picks up an animal in the relevant situation.

However, this theory cannot handle cases like (66) and (67), which raises the problem of indistinguishable participants.

(66) a. *Roba-ga* *betsu-no* *roba-ni,* *saru-ga* *betsu-no* *saru-ni*
donkey-NOM another-GEN donkey-DAT monkey-NOM another-GEN monkey-DAT
sooguu-sita.
encounter-PAST
'A donkey encountered another donkey, and a monkey encountered another monkey.'

b. *Dotiramo* *sore-ni* *kamitsui-ta.*
each it-DAT bite-PAST
'Each bit it.'

(67) a. A donkey saw another donkey. A monkey saw another monkey.
b. Each of them bit it.

If analyzed similarly, the quantifiers here quantify over situations containing two donkeys or two monkeys. The uniqueness presupposition in the pronoun thus fails to be satisfied. The problem of indistinguishable participants is now replicated with the new data, and it is unclear how the theory overcomes it.

Notice that the dynamic analysis does not face this problem because the uniqueness presupposition does not exist there. The proposal works similarly as illustrated in section 2.

3.3. Remaining Issues

Finally, I lay out three remaining empirical issues. Firstly, not all quantifiers allow the reading for which we needed the event distribution. Though the reading is obtained with equal acceptability with *neither* and *both*, it is degraded with *all*, *every*, *none*, and *most*. This is the case for Japanese counterparts of these quantifiers as well. We can differentiate these quantifiers by defining them differently, by encoding the event distributivity only into the former group. However, it is unclear why the quantifiers are divided in this way.

Secondly, the reading in question is not obtained in sentences where a quantifier does not take surface scope over a pronoun, as shown in (68). Given that the quantifier can take scope over the pronoun at LF via quantifier raising, the sentence should also have the intended reading. This is reminiscent of Weak Crossover – the reference of *it* 'depends' on the quantifier crossing over it in a loose sense, in that the reference of *it* is only defined with the event distributivity induced by a quantifier. It is interesting to see if Chierchia's (2020) dynamic account of Weak Crossover can be extended to handle this degradation.

(68) a. Alex saw a monkey, and Bill saw a donkey.
b. #It was caught by each of them.

Thirdly, there are cases where the anaphoric relation in question is obtained with violating the thematic-relation requirements. In (69a), a monkey and a donkey are not participants of the meeting events. Thus, letting *each* be anaphoric to these events does not help obtain the anaphoric relation. The same goes for (70). There, the relevant individuals and the animals are participants of different events – *Alex* and *Bill* are participants of the asking events, and a monkey and a donkey are of the catching events. To deal with these cases, we may need to replace *events* in the proposal with *situations*. (Note that even with situations, the dynamic system makes a different and better prediction regarding the indistinguishable participant case.) See Tancredi (2001) for justification to introduce dynamic situations to a non-pluralized dynamic system.

(69) a. Alex met a monkey's owner, and Bill met a donkey's owner.
 b. Each of them wanted to buy it.

(70) a. Alex asked Mary to catch a monkey, and Bill asked her to catch a donkey.
 b. Each of them wanted to pet it.

Another empirical question regards the analysis of (71), which contains a quantifier in each conjunct.[6]

(71) (This camp is about fostering a sense of responsibility.)
 a. This year, every boy was assigned a cat, and every girl was assigned a rabbit.
 b. Each of them had to take care of it on a daily basis.

The problem is that the relevant event drefs for assigning events are introduced under the scope of *every*, which is standardly assumed to be external static. Thus, the drefs are not accessible from *each*. The problem is avoided by adopting a pluralized dynamic system, which makes drefs introduced under the scope of a universal quantifier available for future discourse.

4. Conclusion

In this study, I proposed a new treatment of distributivity within dynamic semantics. Novel data was pointed out, to which the proposed operation of the event distributivity offers an analysis. The present proposal is compared with a pluralized dynamic system and *d*-type analysis. It is shown that the event distributivity is still necessary because the alternatives do not offer an analysis of the data.

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