Singularity and plurality of discourse reference to worlds*

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Abstract The referential analysis of conditionals has recently been put forth as an alternative of the Kratzer-style restrictor analysis (Schein 2001, Schlenker 2004, among others). Under this analysis, conditional antecedents are definite descriptions of worlds/situations. This paper explores a widely accepted assumption of the referential analysis, namely that conditional antecedents refer to *plural* objects. I show that the singularity/plurality of conditional antecedents can correlate with whether the conditional expresses modal or adverbial quantification. I use this correlation to motivate an analysis where conditional antecedents are *numberneutral* by default, but can be forced to denote *singular* referents. This idea is formally implemented within the dynamic framework by Brasoveanu (2010).

Keywords: Japanese, discourse reference, plurality, modality, adverbs of quantification

1 Introduction

In formal semantics, conditionals are standardly treated as quantificational constructions, with a quantificational operator being restricted by the antecedent (Lewis 1975, Kratzer 1986). However, the recent literature has put forth an alternative analysis, namely the referential analysis of conditionals (Schein 2001, Schlenker 2004, among others; see also Stalnaker 1968 for an early predecessor). The hallmark of this analysis is that conditional antecedents are definite descriptions of possible worlds or situations. To illustrate, consider the conditional in (1). Under the referential analysis, the antecedent of (1) refers to the world(s) where Mary comes, in the same way that *the*-phrases refer to individuals; the consequent ascribes to this referent that John is coming at some future point.

(1)   If Mary comes, John will come, too.

This paper explores a widely accepted assumption of the referential analysis, namely that conditional antecedents refer to *plural* objects (argued explicitly by Schein 2001 and Schlenker 2004; adopted later by Brasoveanu 2010, Ebert, Ebert & Hinterwimmer 2014, among others). As noted by Schlenker (2004), plurality is needed to capture adverbs of quantification (henceforth Q-adverbs) in conditionals.[1] The reasoning is as follows.[2] As shown by de Swart (1995), Q-adverbs cannot be restricted by *when*-clauses that describe unique events. This can be illustrated by the contrast between (2a) and (2b):

(2)   a.   *When Anil died, his wife usually killed herself.
        b.   When an Indian died, his wife usually killed herself.

(de Swart 1995: 178 (22))

Crucially, the verb *die* describes a non-repeatable event. Hence, when *die* applies to an individual, as in (2a), the *when*-clause describes a unique event, i.e. that of Anil dying. In contrast, when *die* applies to an indefinite subject, as in (2b), the *when*-clause describes multiple events, each involving an Indian dying. The contrast in the acceptability of (2a) and (2b) thus indicates that the Q-adverb *usually* must be restricted by *when*-clauses that describe multiple events. This can be taken to indicate the constraint that Q-adverbs require non-singleton restrictors.

In addition, it is well-known that the restrictors of Q-adverbs can also be provided by English *if*-clauses (Lewis 1975). For instance, in (3), *usually* quantifies over the situations described by the *if*-clause, as shown by the paraphrase provided below:

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1 For an additional argument of plurality, Schlenker cites Schein's (2001) observations about conditionals with iterated *if*-clauses, such as (ia). Schein notes that (ia) is interpreted similarly to (ib), whose antecedent expresses the conjunction of S_1 and S_2. He argues that we can easily derive the interpretation of (ia) by analyzing conditional antecedents as *plural* definite descriptions: S_1 refers to a plural situation such that all of its atomic parts verify the property of having a vaccinated donkey, and that situation gets restricted further by S_2, i.e. by the property that the donkey has vitamin deficiency. The resulting interpretation of iterated *if*-clauses is equivalent with that of (ia), which refers to a plural situation that verifies the property of having a donkey that is vaccinated and has a vitamin deficiency.

(i)   a.   [$_{S1}$ If a donkey is vaccinated], then [$_{S2}$ if it has a vitamin deficiency], it usually faints.

(Barker 1997: 202 (12), cited in Schein 2001: 408 (18))

       b.   If a donkey is vaccinated *and* has a vitamin deficiency, it usually faints.

However, in languages with multiple forms of conditional connectives, the judgments of conditionals with iterated antecedents are extremely subtle; I will thus leave the examination of Schein's argument to future research. See also fn. 3 for an argument of plurality by Lewis (1973) from counterfactuals.

2 Note that Schlenker himself does not provide a detailed argumentation of the plural view. Hence, what I outline below is a stepwise rendition of Schlenker's point, which strikes me as necessary in order to conduct an in-depth evaluation of the plural view.

(3)   If Mary comes, John usually comes, too.

       Roughly: Most situations where M comes are situations where J comes.

Since we have shown in (2) that *usually* requires non-singleton restrictors, it is plausible to conclude that the *if*-clause of (3) describes multiple events, too.[3]

However, the standard assumption of the referential analysis of conditionals goes one step further—it is assumed that *if*-clauses *always* refer to pluralities. Under this assumption, *if*-clauses refer to plural objects not only in conditionals that express adverbial quantification, such as (3) (henceforth Q-adverbial conditionals); they are also assumed to refer to pluralities in conditionals that express modal quantification (henceforth modal conditionals). (4) provides an example of modal conditionals, which contains the modal auxiliary *might*. Under the standard assumption of the referential analysis, the *if*-clause of (4) refers to a plural object, just like that of (3). (4) If Mary comes, John might come, too.

In this paper, I present a paradigm of Japanese conditionals where the conditional marker *moshi* is compatible with modal conditionals, but not Q-adverbial conditionals. I show that the split between Q-adverbial and modal conditionals made by *moshi* challenges the assumption that both types of conditionals have antecedents that refer to pluralities. To solve this problem, I argue that conditional antecedents can refer to singular objects, and that this singularity can be overtly marked.

The rest of this paper is structured as follows. Sec 2 presents the key data. Sec 3 introduces an independent assumption about the difference between Q-adverbial and modal conditionals. Sec 4 spells out my formal proposal. Sec 5 concludes the paper.

2   Data

2.1   Basic profile of Japanese conditionals

Japanese conditionals are obligatorily marked by connectives that appear as verbal suffixes (e.g. *-(re)ba*, *-tara*) or enclitics (e.g. *to*, *nara*) in antecedent-final position:

3 An even earlier argument of the plural view comes from Lewis's (1973) discussion of the Bizet/Verdi counterfactuals (in response to Stalnaker 1968):

(i) a. If Bizet and Verdi had been compatriots, Bizet would have been Italian.
     b. If Bizet and Verdi had been compatriots, Verdi would have been French.

Based on his intuition that (ia) and (ib) are false, Lewis argues that the antecedents of the two conditionals pick out multiple closest worlds: one where Bizet and Verdi were Italian, and one where they were French. I leave it to future work to examine how the semantics of conditionals developed in this paper fares with counterfactuals, and in particular, with the Bizet/Verdi cases.

(5)   *Mary-ga {ku-reba / ki-tara   / kuru to / kuru nara}, John-mo kuru.* M-NOM   come-REBA   come-TARA   come TO come NARA   J-ADD   come

       'If Mary comes, John also comes.'

Conditional antecedents can sometimes also be accompanied by the adverb *moshi*, which normally appears in antecedent-initial position, as in (6):

(6)   *{moshi / ∅} Mary-ga ku-reba,   John-mo kuru.* MOSHI   M-NOM   come-REBA J-ADD   come

       'If Mary comes, John will also come.'

The rest of this section examines the distribution of *moshi* in Q-adverbial and modal conditionals. Note that apart from *moshi*, some of the verbal suffixes and enclitics in conditional antecedents (cf. (5)) also show sensitivity to whether they appear in a Q-adverbial or a modal conditional. To avoid such confounds, I use -*(re)ba* in the following, as this connective has been observed to be compatible with both types of conditionals (e.g. Masuoka 1993, 2006).

2.2   Distribution of *moshi*

The key observation is that *moshi* exhibits sensitivity to the type of conditionals where it appears: it is compatible with modal conditionals, but resists Q-adverbial conditionals. I provide four diagnostics to establish this observation.

Interaction with Q-adverbs and modals Similarly to English (3), Japanese conditionals with the Q-adverb *taitei* 'usually' in the consequent are interpreted as Q-adverbial conditionals, as shown in (7):[1]

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[1] Intuitively, *taitei* 'usually' in (7) quantifies over plane rides, rather than the intervals where I'm on a plane. Hence, the sentence is true just in case, say, at least sixty percent of my plane rides are such that I feel sick, regardless of the duration of each plane ride under consideration.

(7)   *hikouki-ni nor-eba,   taitei kibun-ga waruku naru.*

   plane-DAT get.on-REBA usually feeling-NOM bad become 'If I get on
   a plane, I usually feel sick.'

   Roughly: Most situations where I get on a plane are sit. where I feel sick.

However, as noted by Kaufmann (2017) (credited to Ikumi Imani, p.c.), Q-adverbial conditionals become unacceptable when *moshi* is present. Compare (8) with (7):

(8)   ??*moshi hikouki-ni nor-eba, taitei kibun-ga waruku naru.* MOSHI

   plane-DAT get.on-REBA usually feeling-NOM bad become

   Intended: 'If I get on a plane, I usually feel sick.'

In contrast, modal operators are compatible with *moshi*, be they modal auxiliaries (e.g. *kamoshirenai* 'might' in (9)) or modal adverbials (e.g. *tabun* 'maybe' in (10)):

(9)   *{moshi / Ø} Mary-ga ku-reba,   John-mo kuru kamoshirenai.*

   MOSHI   M-NOM   come-REBA J-ADD   come might

   'If Mary shows up, John might show up, too.'

(10)   *{moshi / Ø} Mary-ga ku-reba,   tabun John-mo kuru.*

   MOSHI   M-NOM   come-REBA maybe J-ADD   come

   'If Mary shows up, maybe John will show up, too.'

Generic conditionals We can further confirm the contrast between (8) vs. (9)/(10) by examining the distribution of *moshi* in conditionals that contain covert quantificational operators. One such case are generic conditionals. Generic conditionals are standardly assumed to contain a covert generic operator, which gets directly restricted by the antecedent clause and interpreted similarly to the Q-adverb *usually* (Farkas & Sugioka 1983, among many others). Kaufmann (2017) observes that *moshi* is unacceptable in generic conditionals, as shown in (11). This provides another instantiation of the incompatibility between *moshi* and Q-adverbial conditionals observed in (8).

(11)   *{#moshi / Ø} taiyou-ga shizum-eba, yoru-ni naru.* MOSHI   sun-NOM

   sink-REBA   night-DAT become

   As a description of natural laws: 'It becomes night if the sun goes down.'

   (Adapted from Kaufmann 2017: 12 (53), credited to Ikumi Imani, p.c.)

Ambiguity between covert *always* and covert *must* (12) provides another conditional that does not contain explicit quantificational operators. It is ambiguous between the readings paraphrased in (12a) and (12b).

(12)   *Mary-ga ku-reba,   John-mo kuru.*
     M-NOM   come-REBA J-ADD   come
'If Mary comes, John comes, too.'

    a.   All situations where Mary comes are situations where John comes.
    b.   If Mary comes (e.g. tomorrow), it must be the case that John will come.

Under the reading in (12a), the sentence expresses universal quantification over the situations described by the antecedent. I assume with Lewis (1975) that this reading can be derived with a covert Q-adverb *always*. In contrast, under the reading in (12b), the speaker draws on her knowledge and describes what is likely to happen in case Mary comes; in other words, under this reading, the sentence gets interpreted as a modal conditional. I assume with Kratzer (1986) that this interpretation can be derived with a covert epistemic *must*. Now, observe that when *moshi* is added, the Q-adverbial reading becomes unavailable, as in (13):

(13)   *moshi Mary-ga ku-reba,   John-mo kuru.* MOSHI M-NOM   come-REBA
J-ADD   come
'If Mary comes, John comes, too.'

    a.   7 All situations where Mary comes are situations where John comes.
    b.   If Mary comes (e.g. tomorrow), it must be the case that John will come.

I take the contrast between (12) and (13) to be another instantiation of the observation that *moshi* is compatible with modals conditionals, but not Q-adverbial conditionals.

Q-adverbs that allow narrow-scope readings At this point, the reader may wonder whether conditionals containing Q-adverbs also allow modal interpretations in addition to their Q-adverbial readings. For instance, one might expect (7) to be acceptable under the following interpretation: 'if I get on a plane (e.g. tomorrow), it must be the case that I'll feel sick many times during that flight'. This would be a reading where the Q-adverb *taitei* 'usually' takes narrow scope within the consequent, quantifying over the *intervals* of my stay on a plane. However, this reading is unavailable for (7) (and hence for its counterpart with *moshi* in (8), too), which I take to indicate that in conditionals, *taitei* 'usually' must be restricted by conditional antecedents. For a systematic investigation of the Q-adverbs that resist the narrow-scope reading, see de Swart (1993: §5).

However, not all Q-adverbs behave like *taitei*.[2] For instance, Q-adverbs like *yoku*

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[2] See Nitta (2002) for a systematic classification of Japanese frequency adverbs.

'often' and *tokidoki* 'sometimes' can, but do not have to, be restricted by conditional antecedents, as shown by the two readings of the sentence in (14):[3]

(14) *hikouki-ni nor-eba,   {yoku / tokidoki} kibun-ga   waruku naru.*
   plane-DAT   get.on-REBA often   sometimes feeling-NOM bad   become
   'If I get on a plane, I often/sometimes feel sick.'
   a. Many/Some situations where I get on a plane are sit. where I feel sick.
   b. If I get on a plane (e.g. tomorrow), I'll feel sick many times/on and off during that flight.

Note that similarly to the modal reading of (12), I assume that the reading in (14b) is derived from a covert epistemic *must* that scopes over *yoku* 'often' and *tokidoki* 'sometimes'. Now, observe that the effect of *moshi* in (14) is similar to that in (12), i.e. its presence blocks the Q-adverbial reading, as shown in (15):

(15) *moshi hikouki-ni nor-eba, {yoku / tokidoki} kibun-ga waruku naru.* MOSHI
   plane-DAT get.on-REBA often sometimes feeling-NOM bad become
   'If I get on a plane, I often/sometimes feel sick.'
   a. ⁊ Many/Some sit. where I get on a plane are sit. where I feel sick.
   b. If I get on a plane (e.g. tomorrow), I'll feel sick many times/on and off during that flight.

The unavailability of the reading in (15a) is consistent with our observation so far, i.e. *moshi* is compatible with modal conditionals, but not Q-adverbial conditionals.

2.3 Interim summary

What we have seen is the following. As noted in the introduction, Q-adverbial conditionals in English were used to motivate the assumption that conditional antecedents denote plural objects. In this section, we have observed that conditionals containing *moshi* lack Q-adverbial interpretations. It thus seems plausible to conclude that conditional antecedents containing *moshi* do *not* denote plural referents.

However, it still remains unexplained why *moshi* is allowed in modal conditionals. Put differently, what is the difference between Q-adverbial and modal conditionals such that *moshi* is allowed in the latter, but not in the former?

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[3] Geurts (2004) discusses English *usually* vs. *often/sometimes* as displaying a similar contrast in terms of whether narrow scope in the consequent clause is available; de Swart (1993: §5) discusses these two types of Q-adverbs as "strong" and "weak" frequency adverbs more generally.

The next section tackles this question by presenting an independent argument regarding the difference between the two types of conditionals from the literature.

3   Q-adverbial vs. modal quantification in conditionals

For concreteness, let us first take a step back and consider how Q-adverbial and modal conditionals are captured by Kratzer's restrictor analysis. Under the restrictor analysis, both Q-adverbs and modals are restricted by conditional antecedents, as exemplified by the construals of the Q-adverbial conditional in (16) and the modal conditional in (17):

(16)   If Mary comes, John sometimes comes, too.

$$\exists s[\text{MARY-COME}(s)][\text{JOHN-COME}(s)]$$

(17)   If Mary comes, John might come, too.

$$\exists w[w_@ R^{epi} w \ \& \ \text{MARY-COME}(w)][\text{JOHN-COME}(w)]$$

In words, (16) expresses existential quantification over the situations where Mary comes. Likewise, (17) expresses existential quantification over the worlds that (i) are epistemically accessible from the actual world $w_@$ and (ii) verify Mary's coming.

However, converging evidence from various independent sources has shown that the Kratzer-style construal for modal conditionals exemplified in (17) is incorrect (Frank 1996, Zvolenszky 2002, von Fintel & Iatridou 2005, Schwager 2006, among many others). Here, I present one piece of evidence from deontic conditionals found by Frank (1996). (18) provides a slightly modified version of her example:[4]

(18)   If the new laws for opening hours pass, salespeople have to work longer.

Under the restrictor analysis, (18) would be construed as in (19); that is, it would be analyzed as universal quantification over the worlds that can be deontically accessed from $w_@$ and verify the passing of the new laws:

(19) $\forall w[w_@ R^{deo} w \ \& \ \text{NEW-LAWS-PASS}(w)][\text{SALESPPL-WORK-LONGER}(w)]$

Frank points out that this construal makes wrong predictions for (18). Suppose that at $w_@$, the actual laws do not require salespeople to work longer, and that the new laws would require them to do so, but those laws have not gone through. Intuitively, the sentence is true in this scenario, but the construal in (19) predicts

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[4] (18) is a minimal modification of Frank's original *If the new laws for opening hours pass, salespeople will have to work longer* (Frank 1996: 199), suggested by Magdalena Kaufmann (p.c.) in response to complications with *will* pointed out to her by Dan Lassiter [at *Conditionals 2*, Paris, June 2022].

the sentence to be false. The reasoning is as follows. According to (19), the necessity of salespeople's working longer gets evaluated with respect to the *actual* laws; this is so in virtue of the conjunct $w_@ R^{deo} w$ in the restrictive clause, that is, only the worlds that are compatible with the laws at $w_@$ will be in the quantificational domain. Since salespeople do not need to work longer at $w_@$ (and presumably, it would be deontically optimal that salespeople do not work longer than they are supposed to), this means that all worlds in the quantificational domain are such that salespeople do not work longer. As a result, the construal in (19) comes out as false in this scenario.

More generally, what goes wrong with the construal in (19) is that the criteria that are used to evaluate the deontic modal are independent of the content of the antecedent, namely the passing of the new laws. Intuitively, what we need is a construal where the criteria can reflect the change of laws described by the antecedent, instead of being "fixed" to the laws of the actual world. A number of solutions have been proposed to implement this intuition (Frank 1996, Kaufmann & Schwager 2009, Condoravdi & Lauer 2016, among others; see an overview in Kaufmann & Kaufmann 2015: 258–261). Here, I adopt a common idea that underlies all those proposals, namely that modals can be evaluated pointwise at antecedent worlds. For (18), this means that *have to* need not be restricted by the antecedent clause, but rather can be evaluated at each world where the new laws have passed. This idea, once properly implemented, will ensure that the necessity of salespeople's working longer gets evaluated with respect to the new laws, rather than the actual laws.

To sum up, we have seen that Q-adverbs and modals in conditionals differ in that Q-adverbs are directly restricted by conditional antecedents (*à la* Kratzer), whereas modals can be interpreted pointwise at antecedent-worlds. This idea will be formalized in Sec 4 within a dynamic framework.

4   Analysis

4.1   Basic set-up of the framework

My analysis is couched in Intensional Plural Compositional Discourse Representation Theory (Intensional PCDRT), a dynamic-semantic framework developed by Brasoveanu (2010). This framework is equipped with the apparatus for dealing with plurality and definite descriptions of worlds, both of which are necessary for analyzing our phenomena of interest. This subsection introduces the basic ingredients of this framework; Sec 4.2 provides a simple illustration of them put to work.

First, there are four types in the version of Intensional PCDRT that I adopt: *t* (truth values), *e* (individuals), *s* (variable assignments) and *ω* (situations). For simplicity, I assume that maximal situations are possible worlds (Kratzer 1989).
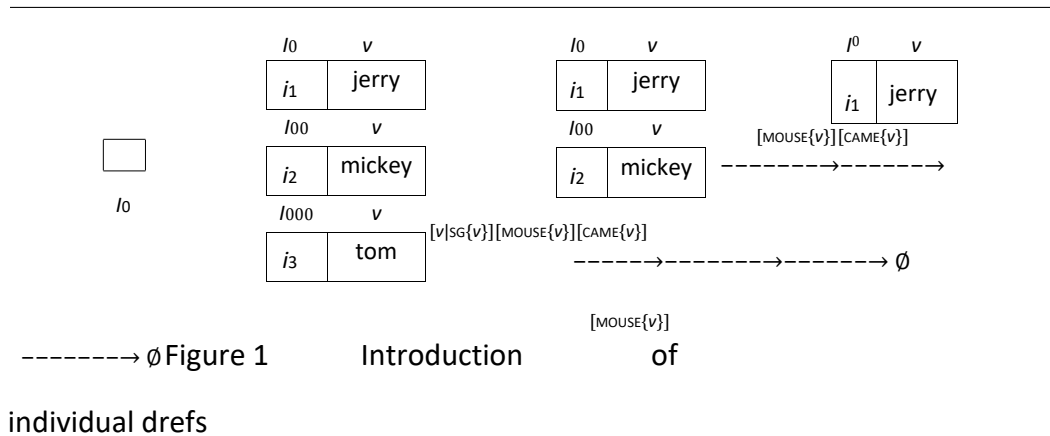
Second, information available at each point in a discourse is represented as a set of information states (henceforth info states). Differently from traditional dynamic-semantic frameworks (e.g. Dynamic Predicate Logic, Groenendijk, Stokhof & Veltman 1996), info state are modeled as *sets of* variable assignments (hence, type h*s,t*i), rather than as variable assignments (cf. van den Berg 1996).

Third, this framework facilitates two types of anaphora, anaphora to individuals and to situations. Specifically, there are two types of discourse referents (drefs) that can be referred back to, namely individual drefs and situation drefs. The former are functions from variable assignments to individuals (type h*s,e*i), and the latter from variable assignments to situations (type h*s,ω*i).

Fourth, sentences denote relations between info states. They are thus of type h*st,*h*st,t*ii, which I abbreviate as type *T*. Formally, sentences are translated as discourse representation structures (DRSs), written as [*newdrefs|conditions*]:[5]

(20)   [*newdrefs|conditions*] := $\lambda I_{hs,ti}.\lambda J_{hs,ti}.I[newdrefs]J \wedge conditionsJ$

(20) says that a DRS relates an input info state *I* with an output info state *J* such that (i) with respect to drefs, *I* and *J* differ only in terms of the newly introduced ones specified by *newdrefs*, and (ii) all *conditions* are satisfied in *J*. In the main text, I

Figure 1   Introduction   of individual drefs

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leave the idea of dref introduction and condition satisfaction at an intuitive level (see Sec 4.2 for an illustration); their formal definitions are provided in Appendix.

Finally, a sentence is true with respect to an info state just in case there is at least one way of successfully updating the info state with the DRS it denotes.

4.2   Simple illustration: Introduction of individual drefs

Let us use the mini-discourse in (21) to see how the system works. By common convention, subscripts indicate that a dref is newly introduced, subscripts indicate anphoric reference; semi-colons stand for dynamic conjunction (see Appendix for the translations of the lexical items).[6]
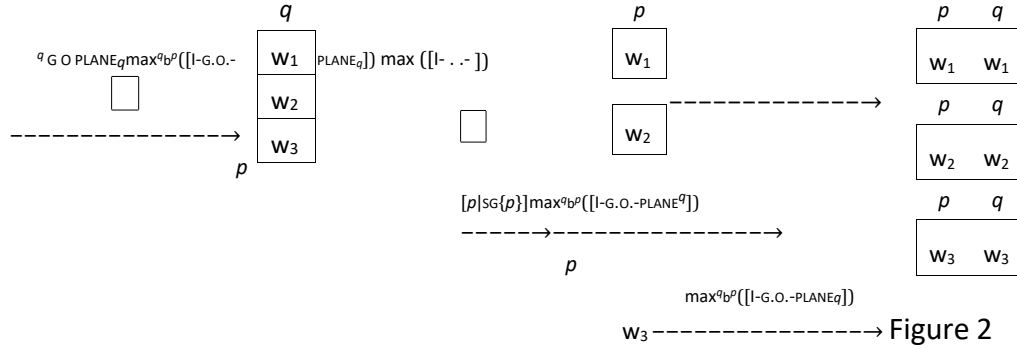
(21)   a. A^v mouse came. $[v|\text{SG}\{v\}];[\text{MOUSE}\{v\}];[\text{CAME}\{v\}]$

   b. It_v laughed. $[\text{LAUGHED}\{v\}]$

Suppose a model with three individuals: jerry, who is a mouse that came and laughed, mickey, who is a mouse but didn't come and didn't laugh, and tom, who is a cat that came and laughed. And suppose that our input info state does not yet contain any information. Fig. 1 visualizes the interpretation of (21a) in this model.[7]

In the sequence of updates depicted in Fig. 1, the first DRS $[v|\text{SG}\{v\}]$ is contributed by the indefinite determiner; it specifies the introduction of a new dref v and a singularity condition imposed on v. Specifically, it asks us to randomly store at v

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[6] For the sake of illustration, I translate the sentences in (21) into extensional, rather than intensional terms. Intensional translations of, say, (21b) would appear as $\lambda q_{\text{hs},\omega}i.[\text{LAUGHED}_q\{v\}]$; see Appendix for relevant details of the intensional system. Throughout, curly braces indicate application to the value of the dref at a particular variable assignment; SMALLCAPS stand for expressions in the translation language, and boldface stands for entities and situations in the model.

[7] Technically, the discourse-initial info state I_0 should be the singleton set of a dummy assignment $i_?$, which assigns to all drefs a dummy value $?$ that falsifies all lexical relations (cf. Brasoveanu 2010: 455–456). For instance, when MOUSE$\{v\}$ is applied to the discourse-initial info state $\{i_?\}$, the only assignment in this info state, $i_?$, does not store a v-individual that satisfies the property of being a mouse; hence, the discourse-initial info state cannot be updated by the DRS [MOUSE$\{v\}$]. This captures the fact that anaphors cannot be used in discourse-initial utterances, e.g. It_v *is a mouse*.

q

^{q} G O PLANE$_q$max$^q b^p$([I-G.O.-

PLANE$_q$]) max ([I- . .-])

w_1
w_2
w_3

p

p

w_1
w_2

$[p|$SG$\{p\}]$max$^q b^p$([I-G.O.-PLANE^q])

p

p q

w_1	w_1

p q

w_2	w_2

p q

w_3	w_3

max$^q b^p$([I-G.O.-PLANE$_q$])

w_3 ----------------→ Figure 2

Introducing situation drefs (left: number-neutral; right: singular)

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all individuals in our model, but to also ensure that v stores exactly one value in each info state. As a result, $[v|$SG$\{v\}]$ gives rise to a distributive effect: the discourse, which originally consists of only one info state (i.e. I_0), gets split into a *set of* info states (i.e. I^0, I^{00}, I^{000}), each storing exactly one individual at v. Next, the output of $[v|$SG$\{v\}]$ gets updated first with $[$MOUSE$\{v\}]$, and then with $[$CAME$\{v\}]$. This requires us to check whether the individuals stored at v satisfy the property of being a mouse and having come. Since tom is not a mouse, the info state I^{000} is eliminated by $[$MOUSE$\{v\}]$. Since mickey did not come, I^{00} is eliminated by $[$CAME$\{v\}]$. In contrast, the v-individual stored in I^0, jerry, is a mouse that came; hence, I^0 can be successfully updated by the DRS sequence in (21a). Despite not being depicted in the figure, it is easy to see that I^0 will also pass the test expressed by (21b). Overall, since truth is defined by the existence of output info states, we correctly predict the mini-discourse in (21) to be true in the given model.

4.3 Introduction of situation drefs

Following Brasoveanu, I assume that English *if* introduces a new dref that stores the situations verifying the antecedent proposition, as in (22a). For Japanese, I propose that it is the verbal suffixes/enclitics in the antecedents that do this, as in (22b). The translation of (22a-b) is given in (22c). The maximization operator max ensures that q stores *all* situations that verify the antecedent proposition (see the appendix).

(22)　　a.　If^q I get on a plane, …　c. max^q([I-GET-ON-A-PLANE$_q$])

　　　　b.　　*hikouki-ni nor-eba^q, …*
　　　　　　plane-DAT　　get.on-REBA

For instance, in a model where I get on a plane in w_1, w_2 and w_3, the update in (21c) is visualized on the left of Fig. 2. For simplicity, henceforth I will leave out the variables for info states (e.g. *I*) and assignments (e.g. i_1) in the figures. Note that the translation in (21c) is essentially a dynamic implementation of the idea that conditional antecedents are definite descriptions of situations. In addition, while Brasoveanu assumes that conditional connectives store *plural* referents (see Brasoveanu 2010: 500–501), I propose that by default, they store *number-neutral* referents. It is also worth mentioning that the definite descriptions denoted by (21a) and (21b) are *non-anaphoric*, since *if* and *-(re)ba* establish new drefs, instead of anaphorically retrieving existing drefs. Anaphoric instances of conditional connectives will become relevant in Sec 4.4.

I propose that situation drefs can be singular; in particular, *moshi* is an overt marker of the singularity of situation drefs. Specifically, *moshi* introduces a singular situation dref (similarly to the singular indefinite determiner *a*; see (21)), and the verbal suffixes/enclitics (e.g. *-(re)ba*) are anaphoric to it.[8] To illustrate, consider (23a); see the indices on *moshi* and *-(re)ba* for the relevant drefs. See (23b) for the translation of (23a); the corresponding update is visualized on the right of Fig. 2. (23b) says that *moshi* introduces a singular dref *p*, thereby storing exactly one situation in each info state. As for *-(re)ba*, it is anaphoric to *p* and introduces a new dref *q* that is a structured subset (b) of *p*.[9]

(23)　　a.　*moshi^p hikouki-ni nor-eba$^q_p{}^{bp}$, …*
　　　　　　　MOSHI　　plane-DAT　　get.on-REBA
　　　　　　'If I get on a plane, …'

---

[8] I leave it open *why* the verbal suffixes/enclitics have to be anaphoric to the dref introduced by *moshi*. One possibility is that it is forced by the local binding of situation variables argued by Percus (2000).

[9] Informally, structured subset helps us preserve the dependencies between individuals; see the appendix for its definition. Brasoveanu (2010: §2.4) argues that a stronger notion of structured subset is needed in order to capture the strong reading of donkey anaphora. Since the issue is orthogonal to our current concern, this paper adopts the simpler definition.

b. $[p|\text{SG}\{p\}];\max^q{}_b{}^p([\text{I-GET-ON-A-PLANE}_q])$

As a consequence of the singularity of p and the structured subset relation between p and q, each info state ends up storing exactly one value not only at p, but also at q. In other words, the singularity introduced by *moshi* is inherited by the dref that stores the antecedent situations. This effect will become crucial in my explanation of the oddness of *moshi* in Q-adverbial conditionals.

4.4 Analysis of Q-adverbial conditionals

I follow Brasoveanu and assume that Q-adverbs relate two drefs that store the situations satisfying the restrictor and the nuclear scope, respectively. As indicated in (24), the restrictor dref p is obtained via anaphora (e.g. from the context, a subordinate clause or a common noun phrase; cf. von Fintel 1994), whereas the nuclear-scope dref q is freshly established by the Q-adverb itself (irrelevant individual drefs are
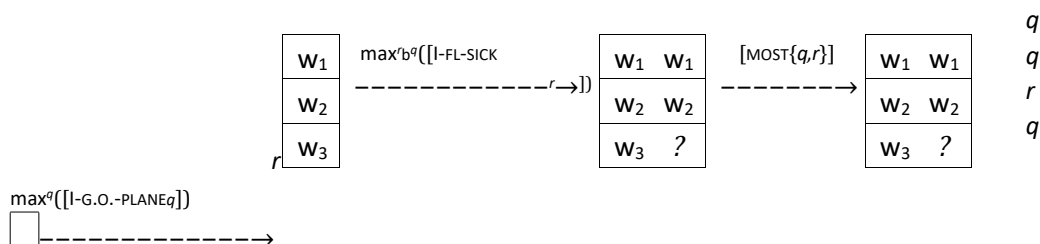

Figure 3 Interpretation of Q-adverbial conditionals (cf. (25))

omitted in (24)). Due to the conservativity of natural language quantifiers, the nucelar-scope dref is assumed to be a structured subset of the restrictor dref (i.e. q b p). Overall, Q-adverbs express a set relation between the two drefs; for instance, *usually* tests whether the p-situations and the q-situations stand in a MOST-relation.

(24)   Usually$_{q_p b p}$, I'm happy. $\max^q{}_b{}^p([\text{I'M-HAPPY}_q]);[\text{MOST}\{p,q\}]$

14

In Q-adverbial conditionals, the restrictor dref of Q-adverbs is provided by the antecedent via anaphora. (25) provides the example from (7) and its translation.

(25)   a. *hikouki-ni nor-reba^q, taitei$^r{}_q{}^{bq}$ kibun-ga   waruku naru.*
             plane-DAT   get.on-REBA usually   feeling-NOM bad   become
             'If I get on a plane, I usually feel sick.'

       b. $\text{max}^q([\text{I-G.O.-PLANE}_q]);\text{max}^r\text{b}^q([\text{I-FL-SICK}_r]);[\text{MOST}\{q,r\}]$

Suppose that I get on a plane in w_1, w_2 and w_3, and feel sick in w_1 and w_2. The interpretation of (25a) in such a model is depicted in Fig. 3. In the first two updates, we store at q all situations where I get on a plane, and at r all situations where I feel sick. Note that the dummy situation *?* assigned to r at the third assignment reflects the fact in this model that I do not feel sick at w_3 (see footnote 10 for the dummy value). Next, we perform the test [MOST$\{q,r\}$] on the resulting info state by checking whether most q-situations are also r-situations. Since this is indeed the case, the info state passes the update. We thus correctly predict (25a) to be true in this model.

Together with my proposal for *moshi* introduced in Sec 4.3, this analysis of Q-adverbial conditionals explains the oddness of *moshi* in Q-adverbial conditionals. (26a) repeats the relevant example from (8). Compare the indices in (25a) and (26a), and also the translations in (25b) and (26b).

(26)   a. ??*moshi ^{p} hikouki-ni nor-reba$^q{}_p{}^{bp}$, taitei$_q{}^{rbq}$ kibun-ga   waruku naru.*
          MOSHI   plane-DAT   get.on-REBA   usually   feeling-NOM bad become 'If I get on a plane, I usually feel sick.'

       b. $[p|\text{SG}\{p\}];\text{max}^q\text{b}^p([\text{I-G.O.-PLANE}_q]);\text{max}^r\text{b}^q([\text{I-FL-SICK}_r]);[\text{MOST}\{q,r\}]$

p

w_1 $\max^q b^p([\text{I-G.O.-}$

w_2

w_3

p q

w_1 w_1 $\text{PL}_q])\max^r b^q([\text{FL-}$

p q

w_2 w_2

p q

w_3 w_3

p q r

w_1 w_1 w_1 $\text{SICK}r])[\text{MOST}\{q,r\}]$

p q r

w_2 w_2 w_2

p q r

w_3 w_3 $?$

$\dashrightarrow \dashrightarrow \dashrightarrow \emptyset$

p

$[p|\text{SG}\{p\}]\max^q b^p([\text{I-G.O.-PL}^{q]})\max^r b^q([\text{FL-SICK}r])[\text{MOST}\{q,r\}]$

$\square \dashrightarrow \quad \dashrightarrow \quad \dashrightarrow \quad \dashrightarrow \emptyset$

p

$\max^q b^p([\text{I-G.O.-PL}_q])\max^r b^q([\text{FL-SICK}r])[\text{MOST}\{q,r\}]$

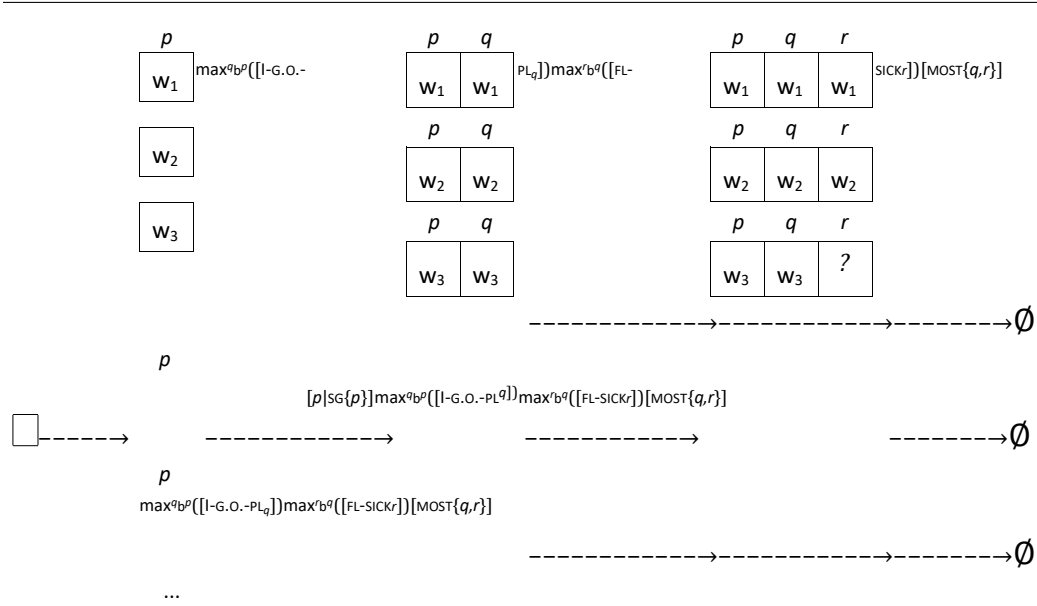$\dashrightarrow \dashrightarrow \dashrightarrow \emptyset$

…

Figure 4 Interpretation of Q-adverbial conditionals in presence of *moshi* (cf. (26))

Assuming the same model as before, the interpretation of (26) is depicted in Fig. 4. As shown in the figure, in addition to the singular dref p introduced by *moshi*, the restrictor dref q and the nuclear-scope dref r also turn out to store singular referents. As noted in Sec 4.3, this effect arises from the singularity condition imposed by *moshi*, in combination with the structured subset relation between p and q and between q and r. I propose that it is the singularity of the restrictor dref q that leads to the unacceptability of (26a); specifically, the singularity of q causes trouble for the last update, $[\text{MOST}\{q,r\}]$. Recall that in Sec 1, we have established the general constraint that Q-adverbs require non-singleton restrictors. I implement this constraint as the presupposition of the two-place lexical relations that quantifiers are associated with, exemplified using MOST below:

(27)   MOST$\{u,u^0\}$ is defined relative to $I_{\text{hs},t}i$ only if $|\{u(i) : i_s \in I_{u6=?}\}| > 1$, where $I_{u6=?}$ is the set of assignments $i \in I$ that store a non-dummy value at u.

It is now easy to see what goes wrong with the interpretation depicted in Fig. 4. In all input info states of $[\text{MOST}\{q,r\}]$, q stores a singular referent, thus failing to satisfy the presupposition in (27); as a result, none of the input info states can be updated

successfully. Since truth is defined in this framework in terms of the existence of output info states, (26a) comes out necessarily false. I argue that this necessary falsity explains the unacceptability of *moshi* in Q-adverbial conditionals.[10]

4.5   Analysis of modal conditionals

In Sec 3, I have argued for independent reasons that, unlike Q-adverbs, modals in conditionals do not need to be restricted by the antecedents. Therefore, deviating from Brasoveanu, I propose the following difference between Q-adverbs and modals: while Q-adverbs are anaphoric to the antecedent dref for their restrictor (e.g. *q* in
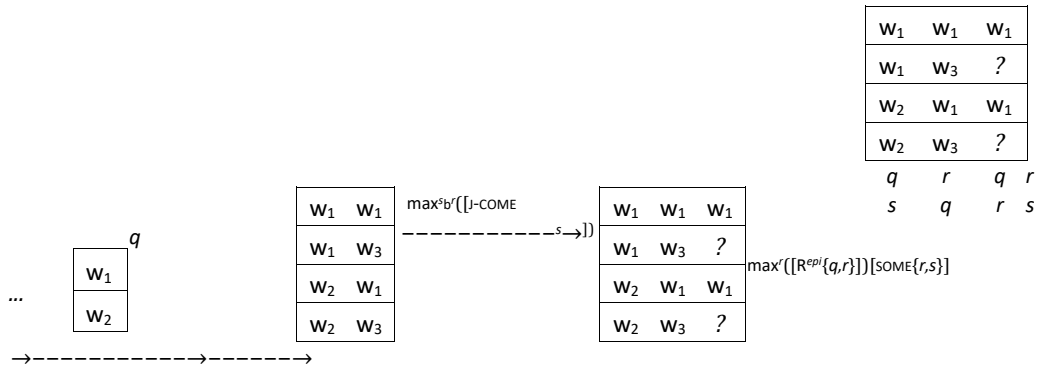(25)), modals establish restrictor drefs on their own.

Figure 5   Interpretation of modal conditionals (cf. (29))

As exemplified in (28), I propose that modals are associated with three drefs: an anaphorically retrieved dref that stores the evaluation situation (*p*), a newly established restrictor dref (*q*), and a newly established neclear-scope dref (*r*). Overall, modals express a set relation between restrictor and nuclear-scope drefs.

(28)   I might^q_p,^{rbq} be late. $\max^q([R^{epi}\{p,q\}]);\max^r b^q([\text{I'M-LATE}_r]);[\text{SOME}\{q,r\}]$

---

[10] See Gajewski (2002, 2009) for an account of ungrammaticality based on semantic triviality.

In the translation above, R^{epi} is a two-place lexical relation between situations, which models the epistemic accessibility relation associated with *might*.[11] Hence, the update $\max^q([R^{epi}\{p,q\}])$ introduces a new dref q that stores all situations that are epistemically accessible from the evaluation situation stored in p. The rest of the interpretation proceeds as usual: we store in r all situations that satisfy the prejacent of *might*, and check whether the q- and the r-situations stand in a SOME-relation.

I propose that in conditionals, it is the evaluation dref of modals that is provided by the antecedent. Using the example discussed in (9), this is illustrated by the indices in (29a) and the translation in (29b).

(29)   a.   *Mary-ga ku-reba^q, John-mo kuru kamoshirenai$_q^{r,sbr}$.* M-NOM   come-REBA

J-NOM   come might

'If Mary comes, John might also come.'

b. $\max^q([\text{M-COME}_q]);\max^r([R^{epi}\{q,r\}]);\max^s{}_b{}^r([\text{J-COME}_s]);[\text{SOME}\{r,s\}]$

To see how this idea works, assume that the following holds: (i) Mary comes in w_1 and w_2, (ii) John comes in w_1, and (iii) from both w_1 and w_2, we can epistemically access w_1 and w_3. The translation in (29b) is depicted in Fig. 5 (the step of applying $\max^q([\text{M-COME}_q])$ to the initial info state is omitted). It is easy to see that R^{epi} has an "expansion" effect on its input info state in the sense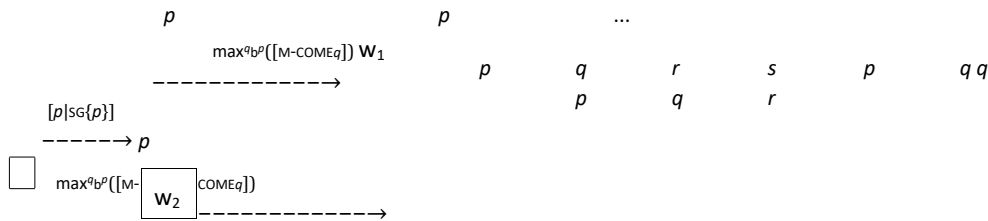 that its DRS yields an output info state that consists of four assignments, rather than just two. This is so because from each situation stored in q, namely w_1 and w_2, there are two situations are epistemically accessible. The reader can verify using Fig. 5 that the translation in (29b) predicts correctly that (29a) is true in this model.

w_1	w_1	w_3
p	q	r
w_2	w_2	w_1
w_2	w_2	w_3

$\max^r([R^{epi}\{q,r\}])$

$----------\rightarrow\max_{sbr}([\text{J-COME}_s])$

$----------\max_r([R_{epi}\{q,r\}\rightarrow])--------$

$--\max_{sbr}([\text{J-COME}_s\rightarrow])$ r s $----------\rightarrow$

| w_1 | w_1 | w_1 | w_1 | $[\text{SOME}\{r,s\}]$ | | w_1 | w_1 | w_1 | w_1 |
| w_1 | w_1 | w_3 | $?$ | $------\rightarrow$ | | w_1 | w_1 | w_3 | $?$ |

p q r s

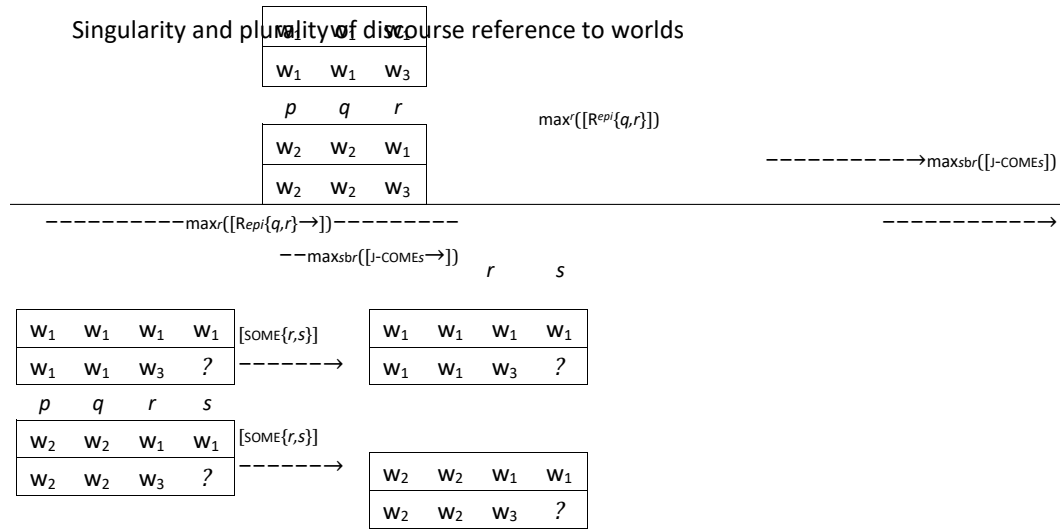| w_2 | w_2 | w_1 | w_1 | $[\text{SOME}\{r,s\}]$ | | w_2 | w_2 | w_1 | w_1 |
| w_2 | w_2 | w_3 | $?$ | $------\rightarrow$ | | w_2 | w_2 | w_1 | w_1 |
| | | | | | | w_2 | w_2 | w_3 | $?$ |

Figure 6   Interpretation of   modal conditionals in presence of *moshi* (cf. (31))

Before examining the effect of *moshi* in modal conditionals, it is worth emphasizing again that the main feature of the current semantics of modal conditionals—that modals are anaphoric to the antecedent dref for their situation dref, rather than for their restrictor dref—is not itself a new idea. Rather, it is an implementation of the existing idea that modals in conditionals can be evaluated pointwise at antecedent worlds (cf. Sec 3). Consider again deontic conditionals whose antecedents describe a change of laws; (30) provides a shortened version of the example in (18):

(30)   If^q the new laws pass, salespeople have-to$^r_q{}^{sbr}$ work longer.

The indices indicate that under the current analysis, the deontic modal *have to* is evaluated with respect to the situations where the new laws have passed. This allows us to obtain a set of deontically accessible situations (stored at r) from the law-passing situations, rather than from the actual situation. As a result, the change of laws described by the antecedent will feed into the criteria for evaluating *have to*.

As noted in Sec 3, this is exactly what we need to capture the interpretation of (30). We are now ready to explain why *moshi* is acceptable in modal conditionals. Consider (31a) and its translation in (31b); the update is visualized in Fig. 6.

(31)   a.   *moshi ^{p} Mary-ga ku-reba$^q_p{}^{bp}$, John-mo kuru kamoshirenai$_q{}^{r,sbr}$.* MOSHI
            M-NOM   come-REBA   J-NOM   come might 'If Mary comes, John might also come.'

        b. $[p|\text{SG}\{p\}];\max^q{}_b{}^p([\text{M-COME}_q]);\max^r([R^{epi}\{q,r\}]);\max^s{}_b{}^r([\text{J-COME}_s]); [\text{SOME}\{r,s\}]$

The key to explaining *moshi*'s acceptability in (31a) lies in the accessibility relation that the modal is associated with. As shown in Fig. 6, the steps up to the update performed by $\max^q \mathrm{b}^p([\text{M-COME}_q])$ proceed the same as in Q-adverbial conditionals

that contain *moshi*, cf. (26). Their difference comes in when the restrictor dref of (31a), *r*, gets introduced by the DRS $\max^r([R^{epi}\{q,r\}])$. This update stores at *r* the (possibly non-unique) situations that are epistemically accessible from each situation stored in *q*. Hence, unlike the restrictor dref of (26) (in that example, *q*), *r* in (31a) does *not* inherit the singularity effect induced by *moshi*. As a consequence, the last update [SOME$\{r,s\}$] operates on info states that store non-singular referents at the restrictor dref *r*. These info states thus satisfy the presupposition that the first argument of the lexical relation SOME be non-singular (cf. (27)). The interpretation can thus proceed without running into the problem that besieged its Q-adverbial counterpart (26).

5 Conclusion

In this paper, I have explored a widely accepted assumption of the referential analysis of conditionals, namely that conditional antecedents refer to plural objects. While this assumption was made for conditionals that express both Q-adverbial and modal quantification, it is challenged by Japanese *moshi*, which is compatible with modal conditionals but not Q-adverbial conditionals. To capture the observed paradigm, I have proposed that conditional antecedents are by default number-neutral, but can be forced to denote singular referents by *moshi*.[12] In Q-adverbial conditionals, the singularity enforced by *moshi* gets inherited by the restrictors of Q-adverbs, which is in conflict with the requirement that the restrictors of Q-adverbs be non-singleton sets; this explains the oddness of *moshi* in Q-adverbial conditionals. As for modal conditionals, I have adduced an independent argument from the literature that modals need not be restricted by conditional antecedents; hence, modals are insensitive to the singularity/plurality of conditional antecedents, which explains the acceptability of *moshi* in modal conditionals.

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[12] The reader might wonder whether the paradigm can be explained by a type restriction, i.e. by assuming that *moshi* can apply to expressions referring to *situations*, but not those referring to *worlds* (thanks to Jon Gajewski and Ezra Keshet for pointer). While I do not have direct evidence to rule out this possibility, I would like to point out that *moshi* has been shown to display type-flexibility between worlds and individuals based on its use in topic constructions (Yang 2022). I leave it to future work to develop the diagnostics for teasing apart reference to situations and reference to worlds.

Appendix: Definitions and translations of lexical entries in Intensional PCDRT

Definitions

(32)   Truth: A DRS D_T is true with respect to an info state $I_{hs,ti}$ iff $\exists J_{hs,ti}(DIJ)$.

(33)   Non-dummy substates: $I_{u6=?} := \{i_s \in I : u(i) 6= ?\}$

(34)   Dynamic conjunction: $D_T;D$ ▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮ I . J . H
        $(DIH \wedge D^0HJ)$

(35)   Dref introduction: $[v] := \lambda I_{hs,ti}.\lambda J_{hs,ti}.\forall i_s \in I(\exists j_s(i[v]j)) \wedge \forall j_s(\exists i_s \in I(i[v]j))$

(36)   Tests (example): $[\text{MOUSE}_q\{v\}] := \lambda I_{hs,ti}.\lambda J_{hs,ti}.I = J \wedge \text{MOUSE}_q\{v\}J$

(37)   Dynamic conditions (examples):[13]

    a. $\text{MOUSE}_q\{v\} := \lambda^J_{hs,ti}.J_{q6=?,v6=?} 6= \emptyset \wedge \forall j_s \in J_{q6=?,v6=?}(^{\text{MOUSE}}q(j)(v(j)))$

    b. $\text{SG}\{u\} := \lambda I_{hs,ti}.|\{u(i) : i \in I_{u6=?}\}| = 1$

    c. $\text{MOST}\{u,u^0\} := \lambda I_{hs,ti}.\text{MOST}(\{u(i) : i \in I_{u=6?}\},\{u^0(i) : i \in I_{u6=?}\})$, defined
          only if $|\{u(i) : i \in I_{u6=?}\}| > 1$.

(38)   Structured subsets: $u \text{ b } u^0 := \lambda I_{hs,ti}.\forall i_s \in I(u(i) = u^0(i) \vee u(i) = ?)$

(39)   Maximization: $\max^q(D) := \lambda I_{hs,ti}.J_{hs,ti}.([q];D)IJ \wedge \neg \exists K(([q];D)IK \wedge J \subset K)$

Translations of lexical items

(40) a^v ▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮

(41)   *mouse* $\lambda v_{hs,ei}.\lambda q_{hs,\omega i}.[\text{MOUSE}_q\{v\}]$

---

[13] SG and MOST are originally defined relative to a situation dref, just like MOUSE. This is needed to deal with cases where the singularity of drefs or the most-relation between drefs covaries with situations. For instance, when interpreting A^u *thief might come in*, the intuition is that each epistemic possibility can be paired with a different thief; hence, we need to ensure that u is singular with respect to each situation stored by the modal. Since I have glossed over the interpretation of determiners in modalized sentences and conditionals, I provide the simpler, extensional definitions of SG and MOST.

(42) $if^{\,q}$ / $reba^{q}$ $\lambda P_{h_{s\omega},\tau i}.\max^{q}(P(q))$[14]

(43) $moshi^{p}$ $\lambda R_{hh_{s\omega},\tau i,\tau i}.\lambda P_{h_{s\omega},\tau i}.[p|\text{SG}\{p\}];R(P)$

(44) $usually_{r_{q}bq}$ / $taitei_{r_{q}bq}$ $\lambda P_{h_{s\omega},\tau i}.\max^{r}{}_{b}{}^{q}(P(r));[\text{MOST}\{q,r\}]$

(45) $might_{qp,rbq}$ / $kamoshirenai$ ■ q

   $\lambda P_{h_{s\omega},\tau i}.\max^{q}([R^{epi}\{p,q\}]);\max^{r}{}_{b}{}^{q}([P(r)]);[\text{SOME}\{q,r\}]$

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[14] In PCDRT, the max-operator always scopes over a distributive operator. This is needed to deal with cases where a singularity test occurs inside the restrictor or the nuclear scope of the quantifier. For instance, in *Every boy has a^{u} book*, the singularity of u needs to be satisfied with respect to each boy who has a book, rather than throughout the whole info state. Since I have glossed over the interpretation of drefs in such environments, I leave out the distributive operator in (44) and (45).

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