Internally Headed Relative Clauses in Japanese

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1 Introduction

■ Externally headed (EHRC) vs. internally headed relative clauses (IHRCs), e.g. in Japanese:[1]

(1) Taro-wa [**[**Yoko-ga reezooko-ni irete-oita $_{RC}$**] hotondo-no kukkii-o**] paatii-ni
Taro-Top [**[**Yoko-Nom refrigerator-Loc put-Aux $_{RC}$**] most cookie-Acc**] party-to
motte-itta. EHRC
brought

'Taro brought to the party most cookies that Yoko had put in the refrigerator .'

(2) Taro-wa [**[**Yoko-ga reezooko-ni **hotondo-no kukkii-o** irete-oita $_{RC}$**]** -no]-o
Taro-Top [**[**Yoko-Nom refrigerator-Loc **most cookie-Acc** put-Aux $_{RC}$**]** -NM]-Acc
paatii-ni motte-itta. IHRC
party-to brought

'Yoko put most cookies in the refrigerator and Taro brought them (= all the cookies Yoko had put in the refrigerator) to the party.'

(3) Scenario: (Shimoyama, 1999)
Yoko put 10 cookies in the refrigerator and Taro brought 7 of them to the party.
↦ EHRC (1) is TRUE
↦ IHRC (2) is FALSE

(4) Taro-wa [**[**Yoko-ga reezooko-ni irete-oita $_{RC}$**] ooku-no kukkii-o**] paatii-ni
Taro-Top [**[**Yoko-Nom refrigerator-Loc put-Aux $_{RC}$**] many-NM cookie-Acc**] party-to
motte-itta. EHRC
brought

'Taro brought to the party many cookies that Yoko had put in the refrigerator .'

(5) Taro-wa [**[**Yoko-ga reezooko-ni **ooku-no kukkii-o** irete-oita $_{RC}$**]** -no]-o paatii-ni
Taro-Top [**[**Yoko-Nom refrigerator-Loc **many-NM cookie-Acc** put-Aux $_{RC}$**]** -NM]-Acc party-to
motte-itta. IHRC
brought

'Yoko put many cookies in the refrigerator and Taro brought them (= all the cookies Yoko had put in the refrigerator) to the party.'

(6) Scenario:
Yoko put 10 cookies in the refrigerator and Taro brought 6 of them to the party.
↦ EHRC (4) is TRUE
↦ IHRC (5) is FALSE

[1] Crosslinguistically, IHRCs do not pattern alike in all languages. Grosu (2012) presents an overview distinguishing two main types: restrictive IHRCs and maximalizing IHRCs. Japanese IHRCs belong to the latter type.

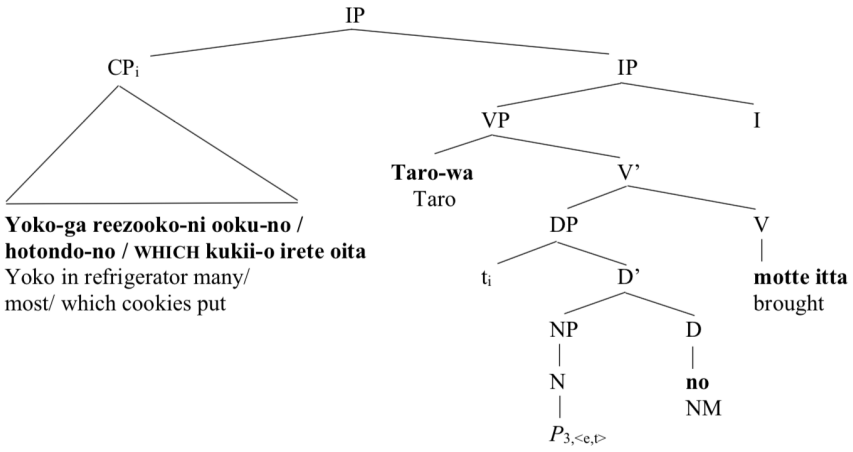
(7) Taro-wa [[**[**Yoko-ga turete-kita $_{RC}$**]** **dono neko**]-ga nigedasita ka] siritagatte-iru. EHRC
Taro-Top [[**[**Yoko-Nom brought-along $_{RC}$**]** **which cat**]-Nom ran.away Q] want.to.know
'Taro wonders which cat that Yoko brought along run away.'
↦ It implies that Yoko brought more than one cat and that at least one of those cats –say, x– ran away.
↦ It asks what cat x that is.

(8) Taro-wa [[**[**Yoko-ga **dono neko-o** turete-kita $_{RC}$**]** -no]-ga nigedasita ka]
Taro-Top [[**[**Yoko-Nom **which-NM cat-Acc** brought-along $_{RC}$**]** -NM]-Nom ran.away Q]
siritagatte-iru. IHRC
want.to.know
'Taro wonders which cat Yoko brought along and that the cat that Yoko brought along ran away.'
↦ It implies that Yoko brought exactly one cat and that all the cats that Yoko brought (which are just one) ran away.
↦ It asks what cat x that is.

■ Current analysis of Japanese IHRCs (Shimoyama (1999) building on Hoshi (1995)):[2]

- The IHRC is adjoined to IP at LF, and it will interpreted as a separate sentence.
- The N position in the DP that the IHRC has been extracted from is occupied by a free (phonologically null) proform $P_{<e,t>}$, to which **no** 'NM' (≈ definite article) applies: The DP as a whole functions as an E-type pronoun.

(9) Taro-wa [**[**Yoko-ga reezooko-ni **ooku-no** / **hotondo-no** / WHICH **kukkii-o** irete-oita
Taro-Top [**[**Yoko-Nom refrigerator-Loc **many-NM** / **most-NM** / WHICH **cookie-Acc** put-Aux
$_{RC}$**]** -no]-o motte-itta.
$_{RC}$**]** -NM]-Acc brought



■ Determiner-like vs. adjective-live uses of *many*, e.g. in English:

(10) **Many** students that attended the meeting has fun.

(11) The **many** students that attended the meeting had fun.
≈ 'The students that attended the meeting, which were many students, had fun.'

[2]For an alternative analysis, see Grosu & Landman (2012).

■ IDEA:[3]

> *[Qu N]* functioning as internal heads of relative clauses in Japanese have parallel truth conditions to *[the $Qu_{adj\text{-}use}$ N]* in English.

(12) IHRC (5):
Translation: 'Yoko put many cookies in the refrigerator and Taro brought them (= all the cookies Yoko had put in the refrigerator) to the party.'
Our paraphrase: 'Taro brought to the party the many cookies that Yoko had put in the refrigerator.'[4]
≈ 'Taro brought to the party the cookies that Yoko had put in the refrigerator, which were many cookies.'

(13) IHRC (2):
Translation: 'Yoko put most cookies in the refrigerator and Taro brought them (= all the cookies Yoko had put in the refrigerator) to the party.'
Our paraphrase: ≈ 'Taro brought to the party the cookies that Yoko had put in the refrigerator, which were most of the cookies.'

(14) IHRC (8):
Translation: 'Taro wonders which cat Yoko brought along and that the cat that Yoko brought along ran away.'
Our paraphrase: ≈'Taro wonders for which x: the cat that Yoko brought along, which was x, ran away.'

■ Parallel ambiguity exists between reconstructed N' containing superlatives in (15) (Bhatt, 2002; Hulsey & Sauerland, 2006) and reconstructed N' containing adjectival *many/few* in (16)-(17) (Romero, 2018):

(15) The longest book that John (ever) said Tolstoy had (ever) written is on the shelf.
a. High reading: 'the x that is the longest book about which John said that Tolstoy had written it'
b. Low reading: 'the x such that John said that the longest book that Tolstoy had written was x'

(16) The many women that Mary said John had dated were standing over there.
a. High reading: 'the x that is a numerous women sum and about which Mary said that John had dated it'
b. Low reading: 'the x such that Mary said [that John had dated the women sum x and that x is many]'

(17) The few women that Mary (ever) said John had (ever) dated were standing over there.

■ GOAL:
To provide a unified analysis of English adjectival uses of *many* like (11) and Japanese IHRCs like (5) that is as close as possible to that of reconstructed superlatives.

■ Roadmap

§2 Background on determiner-like uses of *many* (Solt, 2009) and *which* (Rullmann & Beck, 1998)
§3 Background on reconstruction into relative clauses (Bhatt, 2002; Hulsey & Sauerland, 2006)
§4 Proposal on English adjective-like uses of *many*
§5 Proposal on Japanese IHRC
§6 Outlook

[3] In fact, see (Solt, 2015, 257) for an analysis of adjectival-like uses of *many* in English that, building on an idea by Hackl (2000), involves reconstructing *many N* inside the relative clause and using Shimoyama's (1999) E-type anaphora, as in (i):

(1) a. The many/few students who attended enjoyed the lecture. (Solt, 2015, 257)
b. LF: [[$_{NP}$ The pro$_{<e,t>}$ [$_{CP}$ *that there were* many students who attended]] enjoyed the lecture]
c. $[\![pro_{<e,t>}]\!]$ = λx_e. *student(x) ∧ attend(x)

[4] So far checked with one speaker!

2 Background

2.1 Background on determiner-like uses of *many*

■ A family of degree operators: STEM + *-er* / *-est* / *POS*

(18) $[\![\text{-}er]\!] = \lambda Q_{<d,t>}.\lambda P_{<d,t>}.\ Q \subset P$

(19) a. (Greta is 1,26m). Lucía is taller (than that).
b. $\lambda d.\text{tall}(\text{greta}, d) \ \subset \ \lambda d.\text{tall}(\text{lucia}, d)$

(20) $[\![\text{-}est]\!] = \lambda \boldsymbol{Q}_{<dt,t>}.\lambda P_{<d,t>}.\ \forall Q \in \boldsymbol{Q}[Q \neq P \rightarrow Q \subset P]$

(21) a. Lucía is tallest (among the girls in her class).
b. $\forall Q \in \{\lambda d.\text{tall}(\text{greta}, d), \lambda d.\text{tall}(\text{sarah}, d), \lambda d.\text{tall}(\text{lucia}, d), \lambda d.\text{tall}(\text{liv}, d), \ldots\}$
$[Q \neq \lambda d.\text{tall}(\text{lucia}, d) \ \rightarrow \ Q \subset \lambda d.\text{tall}(\text{lucia}, d)]$

(22) $[\![POS]\!] = \lambda \boldsymbol{Q}_{<dt,t>}.\lambda P_{<d,t>}.\ L_{<<dt,t>,<dt>>}(\boldsymbol{Q}) \subseteq P$

(23) |- - - - - - - - - - - - - - - - - -[/////////]- - - - - - - - - - - - - - - - - - - ∞

(24) a. Lucía is tall (for an 8-year old).
b. $L(\{\lambda d.\text{tall}(\text{valentin}, d), \lambda d.\text{tall}(\text{jonah}, d), \lambda d.\text{tall}(\text{lucia}, d), \ldots\}) \ \subseteq \ \lambda d.\text{tall}(\text{lucia}, d)$

■ Ordinary adjectives in superlative form:
Ambiguity: absolute reading vs. relative relative reading with several association possibilities (Heim, 1999; Szabolcsi, 1986):

(25) John climbed the highest mountain.
a. Absolute: 'John climbed a mountain higher than any other mountain.'
b. Relative: 'John climbed a higher mountain than anybody else climbed.'

(26) a. John wrote the longest letter to $\text{Mary}_{\mathbf{F}}$. ↦ compares *recipients* of John's letters
b. $\text{John}_{\mathbf{F}}$ wrote the longest letter to Mary. ↦ compares *senders* of letters to Mary

■ Ordinary adjectives in positive form
Ambiguity: absolute reading vs. relative reading with several "association" possibilities (Schwarz, 2010)

(27) Mia has an expensive hat.
a. Absolute: 'Mia has a hat that is expensive for a hat'
b. Relative: 'Mia has a hat that is expensive for somebody like Mia to have (e.g., for a 3-year old)'.

(28) a. Paul_{ALT} gave Mia an expensive hat.
↦ a hat that is expensive for somebody like Paul (e.g. unemployed people) to give
b. Paul gave Mia_{ALT} an expensive hat.
↦ a hat that is expensive for somebody like Mia (e.g. a 3-year old) to get

■ Determiner-like uses of *many* in positive form

- Ambiguity: absolute reading Penka (2016) vs. relative reading with several "association" possibilities (Romero, 2015; Solt, 2009):

(29) Ada ate many cookies.
a. Absolute: 'Of the cookies, Ada ate a cookie sum x that is large compared to the remaining cookie sums.'
b. Relative: 'Ada ate a sum of cookies that is large for somebody like Ada (e.g., a diabetic) to eat.'

(30) a. Many parents visited the $\text{Linguistics}_{\text{ALT}}$ table this year.
↦ many visitors in comparison to those of other tables this year
b. Many parents visited the Linguistics table $[\text{this year}]_{\text{ALT}}$.
↦ many visitors in comparison to those of the Ling table other years

- Analysis of the relative reading, adapted from Solt (2009):

(31) $[\![POS]\!] = \lambda \boldsymbol{Q}_{<dt,t>}.\lambda P_{<d,t>}.\ L_{<<dt,t>,<dt>>}(\boldsymbol{Q}) \subseteq P$ (=(22))

(32) $[\![\text{MANY}_{\text{card}}]\!] = \lambda d_d.\lambda x_e.|x| \geq d$

(33) Many parents visited the Linguistics$_{\mathbf{ALT}}$ table this year.
  a. LF: [**[POS C]** [1[[$_{\text{NP}}$ A t_1-MANY parents visited the Linguistics$_{\mathbf{ALT}}$ table this year]]] $\sim$ C]
  b. $[\![C]\!] \subseteq$ $\{\lambda d'.\exists x[$*parent$(x) \wedge |x| \geq d' \wedge$ visit$(x,$ the.**ling**.table, this.year$)]$,
  $\lambda d'.\exists x[$*parent$(x) \wedge |x| \geq d' \wedge$ visit$(x,$ the.**psych**.table, this.year$)]$,
  $\lambda d'.\exists x[$*parent$(x) \wedge |x| \geq d' \wedge$ visit$(x,$ the.**bio**.table, this.year$)], \ldots\}$
  c. $L([\![C]\!]) \subseteq \lambda d.\exists x[$*parent$(x) \wedge |x| \geq d \wedge$ visit$(x,$ the.ling.table, this.year$)]$

(34) Many parents visited the Linguistics table [this year]$_{\mathbf{ALT}}$.
  a. LF: [**[POS C]** [1[[$_{\text{NP}}$ A t_1-MANY parents visited the Linguistics table [this year]$_{\mathbf{ALT}}$]]] $\sim$ C]
  b. $[\![C]\!] \subseteq$ $\{\lambda d'.\exists x[$*parent$(x) \wedge |x| \geq d' \wedge$ visit$(x,$ the.ling.table, **this.year**$)]$,
  $\lambda d'.\exists x[$*parent$(x) \wedge |x| \geq d' \wedge$ visit$(x,$ the.ling.table, **2018**$)]$,
  $\lambda d'.\exists x[$*parent$(x) \wedge |x| \geq d' \wedge$ visit$(x,$ the.ling.table, **2017**$)], \ldots\}$
  c. $L([\![C]\!]) \subseteq \lambda d.\exists x[$*parent$(x) \wedge |x| \geq d \wedge$ visit$(x,$ the.ling.table, this.year$)]$

2.2 Background on *which* phrases

- *Which*-phrases and presupposition projection (Rullmann & Beck, 1998):

(35) A: Which unicorn did Bill want to catch?
B: Bill wanted to catch the unicorn Isabella.
B': Bill wanted to catch the blue unicorn.
$\mapsto$ Bill believes that there is a (unique) unicorn Isabella / blue unicorn.
$\mapsto$ Speaker B/B' does not need to believe so.

- *Which*-phrases as definite descriptions (Rullmann & Beck, 1998):
As in (36), leading to answers like (35B), or as in (37), leading to answers like (35B) or (35B'):

(36) which$_i$ unicorn $\mapsto$ the (λy[unicorn$_w$(y) $\wedge$ y=x$_i$])

(37) which$_i$ unicorn $\mapsto$ the (λy[P$_i$(y)(w) $\wedge$ unicorn$_w$(y)])

3 Background on reconstruction into relative clauses

3.1 Low reading of ADJ+*est*

- Recall the low reading of example (15), repeated here as (38):

(38) The longest book that John said Tolstoy had written is on the shelf.
  a. Low reading: 'the x such that John said that the longest book that Tolstoy had written was x'

- Syntactic structure (Bhatt, 2002; Hulsey & Sauerland, 2006):
  - Head raising structure of the Relative Clauses and Copy Theory of movement
  - Trace conversion (Fox, 2000)
  - Scoping out the degree phrase *[est C]* and adding $\sim C$

(39) Trace Conversion Rule (Fox, 2000):

a. Variable insertion: (Det) Pred_i $\Rightarrow$ (Det) [Pred λy.y=pro_i]

b. Determiner Replacement: (Det) [Pred λy.y=g(i)] $\Rightarrow$ the [Pred λy.y=pro_i]

(40) a. Copies at LF:
The longest book$_1$ that [$_{CP1}$ Op longest book$_1$ that John said [$_{CP2}$ Op longest book$_1$ that Tolstoy had written Op longest book$_1$]]

b. Copy deletion:
The ~~longest book$_1$~~ λ1 that [$_{CP1}$ ~~Op longest book$_1$~~ that John said [$_{CP2}$ ~~Op longest book$_1$~~ that Tolstoy had written **Op longest book$_1$**]]

c. Trace conversion:
The ~~longest book$_1$~~ λ1 that [$_{CP1}$ ~~Op longest book$_1$~~ that John said [$_{CP2}$ ~~Op longest book$_1$~~ that Tolstoy had written **the longest book λy.y=pro$_1$**]]

d. *-est* movement and marking of the focus associate:
The ~~longest book$_1$~~ λ1 that [$_{CP1}$ ~~Op longest book$_1$~~ that John said [$_{CP2}$ ~~Op longest book$_1$~~ that **[-est C]** λ2[Tolstoy had written **the t$_2$-long book λy.y=pro$_{1,F}$**]~C]]

■ Semantic derivation:

- Intensional version of *-est*: (41)
- The comparison class C is relativized to the relevant evaluation world w': (42)

(41) $[\![\text{-}est]\!] = \lambda \boldsymbol{Q}_{<<d,st>,t>}.\lambda P_{<d,st>}.\lambda w.\ \forall\ \text{Q} \in \boldsymbol{Q}[\text{Q} \neq P \rightarrow Q_w \subset P_w]$

(42) $[\![\phi \sim C_{w'}]\!]$ is defined only if $[\![C_{w'}]\!] \subseteq [\![\phi]\!]^f$ and $\forall D_{<d,st>} \in [\![C_{w'}]\!] : \exists d[D(d)(w')]$;
$= [\![\phi]\!]$ if defined.

(43) a. [The 1 [$_{CP1}$ that John said [$_{CP2}$ $\lambda w'$ that w' **[-est C$_{w'}$]** 2[Tolstoy had written the t$_2$-long book λy.y=pro$_{1,F}$]~C$_{w'}$]] is on the shelf]

b. [$\![$ $\lambda 2$ *[Tolstoy had written the t_2-long book $\lambda y.y$=pro$_1$]* $]\!]$ =
$\lambda d.\lambda w''$. Tolstoy wrote$_{w''}$ ιy[y is d-long$_{w''}$ book$_{w''}$ $\wedge$ y=g(1)]

c. $[\![C_{w'}]\!]$ = { $\lambda d.\lambda w''$. Tolstoy wrote$_{w''}$ ιy[y is d-long$_{w''}$ book$_{w''}$ $\wedge$ y=**a**],
$\lambda d.\lambda w''$. Tolstoy wrote$_{w''}$ ιy[y is d-long$_{w''}$ book$_{w''}$ $\wedge$ y=**b**],
$\lambda d.\lambda w''$. Tolstoy wrote$_{w''}$ ιy[y is d-long$_{w''}$ book$_{w''}$ $\wedge$ y=**c**], ... }

d. $[\![\text{CP}_2]\!]$ = $\lambda w'$. $\forall$Q $\in$ $[\![C_{w'}]\!]$
[Q $\neq$ $\lambda d.\lambda w''$. Tolstoy wrote$_{w''}$ ιy[y is d-long$_{w''}$ book$_{w''}$ $\wedge$ y=g(1)] $\rightarrow$
Q$_{w'}$ $\subset$ λd. Tolstoy wrote$_{w'}$ ιy[y is d-long$_{w'}$ book$_{w'}$ $\wedge$ y=g(1)]]

e. $[\![$(43a)$]\!]$ = λw. ιx_e [John said$_w$: $\lambda w'$. $\forall$Q $\in$ $[\![C_{w'}]\!]$
[Q $\neq$ $\lambda d.\lambda w''$. Tolstoy wrote$_{w''}$ ιy[y is d-long$_{w''}$ book$_{w''}$ $\wedge$ y=x] $\rightarrow$
Q$_{w'}$ $\subset$ λd. Tolstoy wrote$_{w'}$ ιy[y is d-long$_{w'}$ book$_{w'}$ $\wedge$ y=x]]]
is$_w$ on the shelf

3.2 Low reading of ADJ+*POS*

■ Consider scenario (44) and example (45), modified from Hulsey & Sauerland (2006):

(44) Scenario: Siouxsie said, pointing at a book on the table: "Lydia has written this book. For a 9-year old, this is a long book to write."

(45) The long book that Siouxsie said that (for a 9-year old) Lydia had written was on the table.

a. Low relative reading: 'the x of which Siouxsie said that Lydia wrote the book x and that x was a long book for somebody like Lydia (e.g., a 9 year old) to write'

■ We parsimoniously extend the analysis in §3.1 to adjectives in the positive form:

- Intensional version of *-POS*: (46)
- The comparison class C is, again, relativized to the relevant evaluation world w'
- To derive the relative reading comparing each 9-yr old and her books with the other 9-yr olds and their books, we need two elements in the sentence to be ALT-marked: *Lydia* and pro_1, as in (47a).

(46) $[\![\text{POS}]\!] = \lambda \boldsymbol{Q}_{<<d,st>,t>}.\lambda P_{<d,st>}.\lambda w.\ L_w(\boldsymbol{Q}) \subseteq P_w$

(47) a. LF: [The 1 that $[_{CP1}$ that S said $[_{CP2}$ $\lambda w'$ that w' **[POS $C_{w'}$]** 2[Lydia$_{\textbf{ALT}}$ wrote [the t_2-long book λy.y=pro$_{1,\textbf{ALT}}$]]$\sim$ $C_{w'}$]] was on the table]

b. $[\![$*2 [Lydia$_{\textbf{ALT}}$ wrote the t_2-long book $\lambda y.y$=pro$_{1,\textbf{ALT}}$/*$]\!]$
$= \lambda d.\lambda w''$.Lydia wrote $\iota y[y$ is a d-long$_{w''}$ book$_{w''} \wedge y$=g(1)$]$

c. $[\![C_{w'}]\!]$ = { $\lambda d.\lambda w''$. **Lydia** wrote$_{w''}$ $\iota y[y$ is d-long$_{w''}$ book$_{w''} \wedge y$=**a**$]$,
$\lambda d.\lambda w''$. **Amy** wrote$_{w''}$ $\iota y[y$ is d-long$_{w''}$ book$_{w''} \wedge y$=**b**$]$,
$\lambda d.\lambda w''$. **Gina** wrote$_{w''}$ $\iota y[y$ is d-long$_{w''}$ book$_{w''} \wedge y$=**c**$]$, ... }

d. $[\![\text{CP}_2]\!] = \lambda w'.\ L_{w'}([\![C_{w'}]\!]) \subseteq \lambda d.$ Lydia wrote$_{w'}$ $\iota y[y$ is d-long$_{w'}$ book$_{w'} \wedge y$=g(1)$]$

e. $[\![$(47a)$]\!]$ =
$\lambda w.\iota x_e$[Siouxsie said$_w$:
$\lambda w'.L_{w'}([\![C_{w'}]\!]) \subseteq \lambda d.$ Lydia wrote$_{w'}$ $\iota y[y$ is d-long$_{w'}$ book$_{w'} \wedge y$=$x]]$
was$_w$ on the table.

(48) Rough paraphrase:
"Consider the x of which Siouxsie said that: Lydia wrote the book x and x is long compared to books that 9 yr-olds have written. That x was on the table."

4 Proposal on English adjective-like uses of *many*

■ We are ready to tackle the low reading of *many* in examples like (50) (=(16)) and, by extension, general adjective-like uses of *many* like (52) (parallel to (11)): [5]

(49) Scenario: Mary said, pointing at a group of women nearby: "The women John has dated are standing over there. For an 18-year old, these are many women to have dated."

(50) The many women that Mary said John had dated were standing over there.

a. Low reading: 'the x such that: Mary said [that John had dated the women sum x and that x is many for somebody like John (e.g., an 18-year old) to have dated]'

(51) Scenario: For an 18-year old, John had dated many women.

(52) The many women that John had dated were standing over there.

a. 'the x such that: John had dated the women sum x and that x is many for somebody like John (e.g., an 18-year old) to have dated'

■ The analysis will be presented in several steps:

- FIRST attempt, which will fail. ↦ This section
- SECOND attempt adding an Exhaustivity operator, INFORMALLY. ↦ This section
- SECOND attempt adding an Exhaustivity operator, FORMALLY ↦ Romero (2018)

[5] The low reading that we are targeting is a de re reading about an individual x_e. For de re readings about an intensional object –e.g., an individual concept–, one could incorporate insights from Grosu & Krifka (2007) into the present analysis

4.1 First attempt

■ Syntactic structure: We transpose the LF structure used for ADJ+*POS* to MANY+*POS*:

- *[POS C]* and the converted copy *[the t_2-MANY women $\lambda y.y = pro_1$]* are embedded under the intentional verb *say* –hence the low reading.
- Both *John* and pro_1 function as *POS*' ALT-associates –hence the relative reading comparing John and his dates to other people like John and their dates

(53) The many women that Mary said John had dated were standing over there.

(54) LF: [The 1 [$_{CP1}$ that M said [$_{CP2}$ that **[POS C]** 2[$_{IP}$John$_{\mathbf{ALT}}$ had dated [the t_2-MANY women λy.y=pro$_{1,\mathbf{ALT}}$]]~ C]] were nearby]

■ Semantic derivation:
Assume for simplicity that, for any world w' compatible with Mary's utterance, the following holds: the set of 18-year olds in w' contains only John, Bill and Herbert, the women John dated in w' are a+b+c, the women Bill dated in w' are d+e, and the women Herbert dated in w' are f+g. This means that, for that world w', the comparison class $[\![C_{w'}]\!]$ will be as in (56).[6]

(55) $[\![2[John_{\mathbf{ALT}}$ *had dated the* t_2-MANY *women* $\lambda y.y{=}pro_{1,\mathbf{ALT}}]]\!]$
$= \lambda d.\lambda w''.$John dated$_{w''}$ σy[*woman$_{w''}(y) \wedge |y| \geq d \wedge y = g(1)]$

(56) $[\![C_{w'}]\!]$ = { $\lambda d.\lambda w''.$**John** dated$_{w''}$ σy[*woman$_{w''}(y) \wedge |y| \geq d \wedge y{=}$**a+b+c**],
$\lambda d.\lambda w''.$**John** dated$_{w''}$ σy[*woman$_{w''}(y) \wedge |y| \geq d \wedge y{=}$**a+b**],
$\lambda d.\lambda w''.$**John** dated$_{w''}$ σy[*woman$_{w''}(y) \wedge |y| \geq d \wedge y{=}$**b+c**],
$\lambda d.\lambda w''.$**John** dated$_{w''}$ σy[*woman$_{w''}(y) \wedge |y| \geq d \wedge y{=}$**a+c**],
$\lambda d.\lambda w''.$**John** dated$_{w''}$ σy[*woman$_{w''}(y) \wedge |y| \geq d \wedge y{=}$**a**],
$\lambda d.\lambda w''.$**John** dated$_{w''}$ σy[*woman$_{w''}(y) \wedge |y| \geq d \wedge y{=}$**b**],
$\lambda d.\lambda w''.$**John** dated$_{w''}$ σy[*woman$_{w''}(y) \wedge |y| \geq d \wedge y{=}$**c**],

$\lambda d.\lambda w''.$**Bill** dated$_{w''}$ σy[*woman$_{w''}(y) \wedge |y| \geq d \wedge y{=}$**d+e**],
$\lambda d.\lambda w''.$**Bill** dated$_{w''}$ σy[*woman$_{w''}(y) \wedge |y| \geq d \wedge y{=}$**d**],
$\lambda d.\lambda w''.$**Bill** dated$_{w''}$ σy[*woman$_{w''}(y) \wedge |y| \geq d \wedge y{=}$**e**],

$\lambda d.\lambda w''.$**Herbert** dated$_{w''}$ σy[*woman$_{w''}(y) \wedge |y| \geq d \wedge y{=}$**f+g**],
$\lambda d.\lambda w''.$**Herbert** dated$_{w''}$ σy[*woman$_{w''}(y) \wedge |y| \geq d \wedge y{=}$**f**],
$\lambda d.\lambda w''.$**Herbert** dated$_{w''}$ σy[*woman$_{w''}(y) \wedge |y| \geq d \wedge y{=}$**g**] }

(57) $[\![\text{CP}_2]\!]$ =
$\lambda w'.L_{w'}([\![C_{w'}]\!]) \subseteq \lambda d.$John dated$_{w'}$ σy[*woman$_{w'}(y) \wedge |y| \geq d \wedge y{=}$g(1)]

(58) $[\![(54)]\!]$ =
$\lambda w.\sigma x$[Mary said$_w$:
$\lambda w'.\ L_{w'}([\![C_{w'}]\!]) \subseteq \lambda d.$John dated$_{w'}$ σy[*woman$_{w'}(y) \wedge |y| \geq d \wedge y = x$]
were$_w$ nearby.

■ Problem!!!:

- Function L will combine with the set of degree properties (56) and, for each of these properties, it will extract its extension at w'. This leads to the multi-set of degree sets –depicted as intervals– in (59), where each 18-year old contributes not one but several degree intervals. If function L calculates the neutral segment based on this multi-set, we will end up with a wrong neutral segment skewed towards low numbers (as if many 18-year olds had dated exactly one woman).

[6] If, additionally, there is an 18-year old –e.g. Al– who has not dated any woman in w', we would need a degree property like (i), where $\top$ is a dummy individual whose cardinality is 0 and of which any combination of (other) non-contradictory properties is true at w'. We will ignore this complication in the remainder of this paper.

(1) $\lambda d.\lambda w''.$Al dated$_{w''}$ σy[*woman$_{w''}(y) \wedge |y| \geq d \wedge y{=}\top$]

- What we need is the multi-set (60), where each 18-year old contributes exactly one interval, namely, their maximal interval:

(59) { [1,3], [1,2], [1,2], [1,2], [1], [1], [1], ↦ John's intervals
[1,2], [1], [1], ↦ Bill's intervals
[1,2], [1], [1] } ↦ Herbert's intervals

(60) { [1,3], ↦ John's maximal interval
[1,2], ↦ Bill's maximal interval
[1,2] } ↦ Herbert's maximal interval

4.2 Second attempt, informally

■ Adding an exhaustivity operator *Exh*:

- We just saw that, for each alternative x to John, we want as the alternative to pro_1 the *maximal, exhaustive* sum of women that x dated.
- We propose to secure this maximality by adding the exhaustivity operator *Exh* in (61) to the LF (cf. Chierchia et al. (2012)) and associating it with pro_1 via F-marking (cf. Nicolae (2013)): (62).
- This means that we have nested ALT/F-marking on pro_1 in (62).

(61) $[\![Exh]\!] = \quad \lambda C_{<st,t>}.\lambda p_{<s,t>}.\lambda w.\ p(w)=1 \ \wedge\ \forall q \in C\ [q(w)=1 \ \rightarrow\ p \subseteq q]$

(62) LF: The 1 [$_{CP1}$ that M said [$_{CP2}$ that **POS** $\mathbf{C_{j,m}}$ 2[$_{IP1}$ **Exh** $\mathbf{D_i}$ [$_{IP2}$ $\mathbf{John_{ALTj}}$ dated the t_2-MANY women λy.y=$\mathbf{[[pro_1]_{ALTm}]_{Fi}}$]$\sim D_i$]$\sim C_{j,m}$]] were nearby.

■ Example of nested foci from the literature and informal derivation (Rooth, 1992; Wold, 1996):

(63) A: John once only drank WIne.
B: John also once only drank WAter.

(64) LF: [$_{IP1}$ [Also C_m] once [[only D_i] [$_{IP2}$ John drank [water$_{Fm}$]$_{Fi}$] $\sim$ D_i] $\sim$ C_m]

(65) a. $[\![D_i]\!]$ = { $\lambda w'$. John drank$_{w'}$ water,
$\lambda w'$. John drank$_{w'}$ wine,
$\lambda w'$. John drank$_{w'}$ beer, ... }

b. $[\![[only\ D_i]\ IP_2]\!] = \lambda w'$. John drank$_{w'}$ water and nothing else

c. $[\![C_m]\!]$ = { $\lambda w'$. John once drank$_{w'}$ water and nothing else,
$\lambda w'$. John once drank$_{w'}$ wine and nothing else,
$\lambda w'$. John once drank$_{w'}$ beer and nothing else, ... }

d. $[\![IP_1]\!]$ =
λw : $\exists p \in C_m[p \neq [\lambda w'$. John once drank$_{w'}$ water and nothing else] and $p(w) = 1]$. John once drank$_w$ water and nothing else

■ Parallel informal derivation of our example:

(66) The many women that Mary said John had dated were standing over there.

(67) LF: The 1 [$_{CP1}$ that M said [$_{CP2}$ that **POS** $\mathbf{C_{j,m}}$ 2[$_{IP1}$ **Exh** $\mathbf{D_i}$ [$_{IP2}$ $\mathbf{John_{ALTj}}$ dated the t_2-MANY women λy.y=$\mathbf{[[pro_1]_{ALTm}]_{Fi}}$]$\sim D_i$]$\sim C_{j,m}$]] were nearby. =(62)

(68) a. $[\![D_i]\!]$ = { $\lambda w''$.John dated$_{w''}$ σy[*woman$_{w''}(y) \wedge |y| \geq g(2) \wedge y$=a+b+c],
$\lambda w''$.John dated$_{w''}$ σy[*woman$_{w''}(y) \wedge |y| \geq g(2) \wedge y$=a+b],
$\lambda w''$.John dated$_{w''}$ σy[*woman$_{w''}(y) \wedge |y| \geq g(2) \wedge y$=b+c],
$\lambda w''$.John dated$_{w''}$ σy[*woman$_{w''}(y) \wedge |y| \geq g(2) \wedge y$=a+c],
$\lambda w''$.John dated$_{w''}$ σy[*woman$_{w''}(y) \wedge |y| \geq g(2) \wedge y$=a],
$\lambda w''$.John dated$_{w''}$ σy[*woman$_{w''}(y) \wedge |y| \geq g(2) \wedge y$=b],
$\lambda w''$.John dated$_{w''}$ σy[*woman$_{w''}(y) \wedge |y| \geq g(2) \wedge y$=c] }

b. $[\![2[Exh\ D_i]\ IP_2]\!]$
$= \lambda d.\lambda w''.$John dated$_{w''}$ σy[*woman$_{w''}(y) \wedge |y| \geq$ d $\wedge\ y$=a+b+c] and
$\forall p \in D_{\text{i}}\ [p(w'') = 1 \rightarrow$
$[\lambda w'''.$John dated$_{w'''}$ σy[*woman$_{w'''}(y) \wedge |y| \geq$ d $\wedge\ y$=a+b+c]] $\subseteq p]$
$= \lambda d.\lambda w''.$John dated$_{w''}$ σy[*woman$_{w''}(y) \wedge |y| \geq$ d $\wedge\ y$=a+b+c] and no other woman$_{w''}$

c. $[\![C_{\text{m,j}}]\!] = \{$ $\lambda d.\lambda w''.$John dated$_{w''}$ σy[*woman$_{w''}(y) \wedge |y| \geq$ d $\wedge\ y$=a+b+c] and no other woman$_{w''}$,
$\lambda d.\lambda w''.$Bill dated$_{w''}$ σy[*woman$_{w''}(y) \wedge |y| \geq$ d $\wedge\ y$=d+e] and no other woman$_{w''}$,
$\lambda d.\lambda w''.$Herbert dated$_{w''}$ σy[*woman$_{w''}(y) \wedge |y| \geq$ d $\wedge\ y$=f+g] and no other woman$_{w''}$ $\}$

d. $[\![CP_2]\!] = \lambda w'.L_{w'}([\![C_{m,j}]\!]) \subseteq$
$\lambda d.$John dated$_{w'}$ σy[*woman$_{w'}(y) \wedge |y| \geq$ d $\wedge\ y$=a+b+c] and no other woman$_{w'}$

- For a formal compositional derivation using Wold's (1996) framework for nested foci, see Appendix.

- To sum up section §4:

> Adjective-like uses / reconstructed readings of *many* have been derived using:
> i. LF structures motivated for reconstruction of N' heads of relative clauses in general and
> ii. an additional exhaustive operator *Exh* maximizing the value of pro_1.

5 Proposal on Japanese IHRCs

- Back to Japanese IHRCs with *[many N]* (and *[most N]*):

(69) Taro-wa [**[**Yoko-ga reezooko-ni **ooku-no** (/ **hotondo-no**) **kukkii-o** irete-oita $_{\text{RC}}$**]**
Taro-Top [**[**Yoko-Nom refrigerator-Loc **many-NM** (/ **most**) **cookie-Acc** put-Aux $_{\text{RC}}$**]**
-no]-o paatii-ni motte-itta. = IHRC (5)(/(2))
-NM]-Acc party-to brought
'Taro brought to the party the cookies that Yoko had put in the refrigerator, which were many(/most of the) cookies.'

- On (69) with internal head *ooku-no/hotondo-no kukkii-o* 'many/most cookies':
Analysis exactly as in §4, with:

  i. adjectival version of *ooku-no* 'many' and *hotondo-no* 'most'

  ii. lowest copy / internal head *[Op many/most cookies$_1$]* converted via Fox's (2000) Trace Conversion: *[the* MANY *cookies* $\lambda y.y$=pro_1*]*

  iii. *Exh* associates with pro_1 within converted copy / internal head

- Back to Japanese IHRC with *[which N]*:

(70) Taro-wa [[**[**Yoko-ga **dono** **neko-o** turete-kita $_{\text{RC}}$**]** -no]-ga nigedasita ka]
Taro-Top [[**[**Yoko-Nom **which-NM** **cat-Acc** brought-along $_{\text{RC}}$**]** -NM]-Nom ran.away Q]
siritagatte-iru. = IHRC (8)
want.to.know
'Taro wonders which cat Yoko brought along and that the cat that Yoko brought along ran away.'
≈ 'Taro wonders for which x: the cat the Yoko brought along, which was x, ran away.'

- On (70) with internal head *dono neko-o* 'which cat':
Analysis as close as possible to that in §4, with:

  i. adjectival version of *dono* 'which':

(71) which$_2$ unicorn $\mapsto$ λy[P$_2$(y)(w) $\wedge$ unicorn$_w$(y)] $\approx$(37)
which$_2$ unicorn $\mapsto$ λy[y=pro$_2$ $\wedge$ unicorn$_w$(y)]

ii. lowest copy / internal head */Op which$_2$ cat$_1$/* converted via Fox's (2000) Trace Conversion:

(72) [the which$_2$ cat λy.y=pro$_1$]
[the λy.y=pro$_2$ cat λy.y=pro$_1$]

iii. Need of Exh? If so, associating with what?

- The analysis of (70) will be presented in two steps:
  - First attempt, which will fail.
  - Second attempt adding an Exhaustivity operator.

5.1 First attempt

- The embedded interrogative at stake:

(73) ... [[**[**Yoko-ga **dono neko-o** turete-kita $_{\text{RC}}$**]** -no]-ga nigedasita ka] ...
... [[**[**Yoko-Nom **which-NM cat-Acc** brought-along $_{\text{RC}}$**]** -NM]-Nom ran.away Q] ...
'For which x: the cat the Yoko brought along, which was x, ran away.'
$\mapsto$ It implies that Yoko brought exactly one cat and that all the cats that Yoko brought (which are just one) ran away.
$\mapsto$ It asks what cat x that is.

- Syntactic structure and semantic interpretation:

(74) LF: [Q$_2$ [The 1 [$_{CP}$ Yoko brought [the which$_2$ cat λy.y=pro$_1$]]] ran away]

(75) { λw.ιu[Yoko brought$_w$ ιx[x=z $\wedge$ cat$_w$(x) $\wedge$ x=u] ran-away$_w$ | z $\in$ D$_e$ }

- Problem!!!:
No guarantee that Yoko brought exactly one cat, but just guarantee that Yoko brought exactly one cat that equals z –which is (far more) trivial.

5.2 Second attempt

- Adding the exhaustivity operator *Exh* to the LF and associating it with...
  - F-marking on *pro$_2$* and
  - F-marking in *which$_2$*

(76) LF: [Q$_2$ [The 1 [$_{CP}$ **Exh C** [$_{IP}$ Yoko brought [the which$_{2,\mathbf{F}}$ cat λy.y=pro$_{1,\mathbf{F}}$]]$\sim$ C]] ran away]

- Semantic interpretation:

(77) $[\![$C$]\!]$ = { λw. Yoko brought$_w$ ιx[x=z $\wedge$ cat$_w$(x) $\wedge$ x=u] | z,u $\in$ D$_e$ }
= { λw. Yoko brought$_w$ ιx[x=**a** $\wedge$ cat$_w$(x) $\wedge$ x=**a**],
λw. Yoko brought$_w$ ιx[x=**b** $\wedge$ cat$_w$(x) $\wedge$ x=**b**],
λw. Yoko brought$_w$ ιx[x=**c** $\wedge$ cat$_w$(x) $\wedge$ x=**c**],
~~λw. Yoko brought$_w$ ιx[x=**a** $\wedge$ cat$_w$(x) $\wedge$ x=**b**]~~,
... }

(78) { λw. ιu[Yoko brought$_w$ ιx[x=z $\wedge$ cat$_w$(x) $\wedge$ x=u] $\wedge$
$\forall$p $\in$ C [p(w)=1 $\rightarrow$
λw'. Yoko brought$_{w'}$ ιx[x=z $\wedge$ cat$_{w'}$(x) $\wedge$ x=u] $\subseteq$ p]]
ran-away$_w$ | z $\in$ D$_e$ }

- To sum up section §5:

> The correct reading of Japanese IHRCs containing *many/most* and *which* has been derived using:
> i. LF structures motivated for reconstruction of N' heads of relative clauses in general and
> ii. an additional exhaustive operator *Exh* maximizing the value of *pro$_1$* and *which$_1$*.

6 Outlook

- A unified analysis of reconstructed Relative Clause heads (in English) and internal Relative Clause heads (in Japanese) has been proposed that derives the correct truth conditions using:
  - independently motivated LF structures (for reconstruction of superlatives, as in Bhatt (2002); Hulsey & Sauerland (2006)) and,
  - crucially, an exhaustivity operator *Exh* associating with part(s) of the reconstructed/internal head.
- Some open issues:
  - What principle of the grammar enforces the insertion of this *Exh*?
  - Why can we have reconstructed adjectival uses of *many* in English but not of *most* and *which*?

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