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# Monadic Concepts for *Maximalizing Relative* Constructions as Generalized Quantification

**Norio Suzuki** ***Kobe Shinwa Women's University (former professor)***

**Abstract:** This paper gives a description of the relations creating a 'generalized quantification over degrees' configuration between the relative clause and matrix clause in *Maximalizing Relative* (or *amount relative/degree relative*) constructions MRs (in English and Japanese; Cinque 2020, Grosu & Landman 1998, 2017; Grosu & Hoshi 2019; Carlson 1977, Heim 1987; also see Heim 2006 for 'comparative clauses as generalized quantifiers over degrees,' and Suzuki 2019).[1] Hopefully, their description may even count as explanation, given the Darwin's problem compatible nature of Hornstein & Pietroski's (2009) *Minimal syntax-semantics,* in terms of which the relevant description will be given. I emphasize the differential interpretation of the 'relative head' in the two clausal positions, noting specifically what the Sharvy-Link sigma operation as 'maximalization' can do for MR semantics along with the max-operator *sono* and its null counterparts for Japanese and the max-operators *every* and *the* for English (§1, note 3). The semantic interpretation of the examples is couched in Hornstein & Pietroski's (2009) *Minimal Semantic Instructions* framework featuring *monadic concepts* MCs (Pietroski 2011, 2012, 2018a). As for the basic syntactic structure of 'raising restrictive relative clauses,' I follow a 'single, double-Headed, universal structure of Cinque (2020).

## 1. Introduction and Some Preliminary Premises

### *1.1 Some Preliminary Premises*

In addition to the classical semantic typology of relative clauses RCs: ***restrictive*** RCs, which standardly denote sets that combine with the sets denoted by the head through *set intersection,* and ***non-restrictive*** RCs, which simply add information concerning the head whose reference is already established, we recognize and discuss in this paper the third RC type: ***maximalizing (/amount/degree)*** RCs (partly based on Cinque 2020; see also note 1). For the purposes of what Cinque (2020: 5) calls the 'operation of maximalization' (based on Grosu & Landman 1998), I adopt the operation of 'Sharvy-Link sigma,' which "picks out of a set its unique maximal member, if there is one, and is undefined otherwise" (see §1.2, note 3; Grosu & Hoshi 2019, Grosu & Landman 2017, Dayal 2016, Landman 2004, among others). While Japanese has the max-operator *sono* and its null counterparts (Grosu & Hoshi 2019), I take the universal determiner *every* and the definite determiner *the* to serve as max-operators for maximalization purposes in English MR constructions. Note also that these max-operators binds both the overt Head/external Head and the predicate denoted by its associated CP relative clause (note 3).

Let us see the very important phenomenon of **reconstruction** in RCs (see also recent analyses from different frameworks discussed in Krifka & Schenner eds. 2019). ,Roughly, since "One first property of the 'raising' derivation, stemming from the fact that the Head is in a chain with the RC-internal gap, is (obligatory) **'reconstruction'** of the Head inside the RC" (Cinque 2020: 25), the second MR feature (1b) below follows: "MRs, derived by Head raising, are restricted to relatives of the 'raising' restrictive type." Cinque (2020: 25 note 8) goes on to observe: "According to Carlson (1977: §2.1) and Aoun & Li (2003: §4.2.3) reconstruction is only possible if the determiner is of the strong type ('the' 'every', 'all', etc.), which induces maximalization." Aoun & Li (2003: §4.2) further cite Carlson (1977), roughly as follows (with some differences in terminology): "Initially, a distinction between maximalizing relatives and (ordinary) restrictive relatives is made, with the former derived by Head raising/showing reconstruction effects and the latter not necessarily so derived/not exhibiting reconstruction. Further, maximalizing relatives do not allow a *wh*-relative pronoun, such as *which,* leading to Carlson's dichotomy between *wh*-pronouns and *that/Ø* and to maximalizing relatives opting for *that/Ø* (see the third MR feature (2c) below: 'MR complementizers are limited to *that, Ø*')." Then, Aoun & Li (2003: 115) eventually observe: "Since maximalizing relatives do not use *wh*-pronouns, the fact that they allow reconstruction is a subset of a more general observation that non-*wh*-relatives allow reconstruction and can be derived by Head raising."

Roughly, the *syntactically pre-nominal*, 'single, double-Headed, universal structure' of relative clauses of Cinque (2020: 21: '[RC CP … *internal Head* …] *external Head'*) takes the (English) raising option (as opposed to the 'matching' option) to opt for the Head internal to the RC raising to the Spec of the RC CP and licensing the deletion (non-pronunciation) of the external Head, thus ending up being the ***overt*** Head. Internal Heads and external Heads are considered to be a 'dP' (smaller than a DP) which is merged below strong determiners, such as *the, every, all,* and above weak ones (Cinque 2020: 2, 25). (See Cinque 2020: 6 note 4 for some possible antisymmetrical options for *post-nominal* RCs, with some problems pointed out in the literature and some modification proposals which essentially remain within the post-nominal [D CP] analysis plus Head raising for restrictive RCs.) Notice also two types of Japanese RCs: 'internally-headed' and 'externally-headed' RCs for the purposes of maximalizing import (Cinque 2020: 78-82), with finer syntactic/semantic detailes illustrated in the Japanese examples in §2 and note 2 below. See further Grosu & Hoshi (2019) for important similarities and differences between internally-headed RCs and doubly-headed RCs in Japanese. Note that in this paper the term '**double-Headed**' is used to point to the underlying, universal RC structure as in Cinque's (2020) 'a single, double-Headed, universal structure' of RCs, while the term '**doubly-headed**' is employed to denote an overtly manifested, Japanese RC construction, such as *Junya-wa Ayaka-ga ringo-o muita sono ringo-o tabeta* ('Ayaka peeled some apples and Junya ate them'; Grosu & Hoshi 2019: 12).

## *1.2 Maximalization via the* Max-Operator

Generally, a 'maximalization operation' relevant to the analysis of MR constructions (in English and Japanese) is implemented via resources provided by what may usually be called the 'Sharvy-Link sigma operation' featuring the 'sigma' which is a 'presuppositional sum' (Grosu & Landman 2017, Landman 2004, Grosu & Hoshi 2019). And while there are basically two terms, the 'sigma-operator' (Grosu & Hoshi 2019) and the 'operator max' (the 'max-operator' here; Grosu & Landman 2017), for the purpose of carrying out the maximalization operation, I opt for the 'max-operator' for ease of exposition in this paper. Then look at the following important, 'baseline' points concerning 'maximalization' from some relevant references:

(1) a. Grosu & Landman (2017: 24):

"**maximalization**

**max (Δ)** = {**max Δ**} for d(egree)-predicate **Δ** (of type <d, t>)

$$\textbf{max}\ \boldsymbol{\Delta} = \begin{cases} \text{the maximal degree in } \boldsymbol{\Delta} & \text{if } \boldsymbol{\Delta} \text{ contains a maximal degree} \\ \text{undefined} & \text{otherwise} \end{cases}$$

b. Landman (2004: 4):

… presuppositional sum operation, the sigma operation: if the noun *nomen* denotes N, then the definite noun phrase *the nomen* denotes σ (N). And the semantics for σ is specified as follows:

$$\sigma(\mathrm{N}) = \begin{cases} \sqcup\mathrm{N} \text{ if } \sqcup\mathrm{N} \in \mathrm{N} & \\ \perp \quad \text{otherwise} & (\text{where } \perp \text{ stands for undefined}) \end{cases}$$

## 2. *Maximalizing Relative* Examples and Some Assumptions

Some *Maximalizing Relative* MR features/properties are as follows (Cinqe 2020; Grosu & Landman 1998, 2017; Landman 2004; Aoun & Li 2003):

(2) a. MRs, with an operation of (degree) *maximalization*/*Sharvy-Link sigma operation* taking place at the CP-level of the relative clause when the head noun is semantically interpreted CP-internally, create an interpretation of the relative clause as a *singleton predicate,* restricting the set of degrees to the singleton set containing the maximal degree.

b. MRs, derived by Head raising, are restricted to relatives of the 'raising' restrictive type.

c. MR complementizers are limited to *that, Ø.*

d. For MR purposes, only definite and universal determiners are allowed to modify an external head in the matrix clause.

e. MRs do not allow stacking.

Let us see some MR examples (3a, 4a) with the MC containing representations a la Hornstein & Pietroski (2009) in (3b, 4b). For (3a), '*EVERY(Q/ (e×d)/M-OP)*' (with *EVERY(Q/ (e×d)/M-OP)* as the relevant MC) serves as 'head' of the MR taking two arguments, with 'SUE-LIKES-ACTOR' as the Internal Argument of *EVERY(Q/ (e×d)/M-OP)* creating a singleton set of the 'maximalized degree' for ACTOR and 'JACK-MET-ACTOR' as its External Argument allowing of two possibilities: the 'maximalized individual' members corresponding to the Internal Argument singleton set and the 'non-specified,' infinite set of individual members:

(3) a. Jack met every actor Sue likes.

b. *EVERY(Q/ (e×d)/M-OP)* ∧∃[INTERNAL((*e*×) *d* /*Q*/*M-OP,* x)
∧[MAX(*e*×) *d*: SUE-LIKES- ⊔ ACTOR(x)]
∧∃[EXTERNAL(*e* (×*d*) /*M-OP,* x) ∧[MAX*e* (×*d*) -*d* SUE/MAX*e* (×*d*) -∞:
JACK-MET- ⊔ ACTOR(x)]]

(*EVERY(Q/ (e×d)/M-OP)* for *the head of the MR taking two arguments; Q* for *quantifiers; M-OP* for *max-operators; e×d* for *individual-degree pairs; d* for *degree predicates;* ⊔ for *sums; e* for *individual predicates;* (*e*×) *d* for *degrees (initially paired with individuals)*)

(4) a. Did you drink the champagne that was served last night at the party?
(Cinque 2020: 22: "… the more natural interpretation is that we drank *some* of the champagne that was served at the party…")

b. *THE(pdc/ (e×d)/M-OP)*/Force*(PQ)* ∧∃[INTERNAL((*e*×) *d* /*pdc*/*M-OP,* x)

∧[MAX(*e*×) *d*: CHAMPAGNE(x)-WAS-SERVED …]]

∧∃[EXTERNAL(*e*(×*d*)/*M-OP/PQ,* x) ∧[MAX*e*(×*d*)-*d* SERVED-***LESS***/~~MAX*e*(×*d*)-∞~~:

YOU-DRINK-CHAMPAGNE(x)]]

(*THE(pdc/(e×d)/M-OP),* the relevant MC, *as head of the MR taking two arguments; pdc* for *presuppositional definiteness check* (Grosu & Landman 2017: 23-26), with *pdc* checked at the CP-level of the RC, along with *maximalization/Sharvy-Link sigma operation on the part of THE(pdc/(e×d)/M-OP)*; *PQ* for *polar questions,* applying at the matrix CP-level and creating a second label/'reprojection' in the sense of Uriagereka & Hornstein 2002)

In (4), the *polar question* Force may create 'doubt' about the total amount of the served wine you drank, leading to the 'implicature-like' conjecture (with '~~MAX*e*(×*d*)-∞~~') that you may have drunk less than the total amount of the served wine at the party. But it seems possible enough to create a situation where 'you drank something else' on top of '*some* of the champagne that was served at the party,' maintaining the semantic condition (with 'MAX*e*(×*d*)-∞' in place) of 'the External Argument set ⊇ the Internal Argument set' for 'generalized quantification' purposes. More accurately, note first the assumption (Grosu & Hoshi 2019: 21) that max-operators binds both the overt Head/external Head and the predicate denoted by its associated CP relative clause (note 3), and the function of *maximalization* (via the max-operator) at the CP-level of the RC in choosing the default *exactly*-value out of an *exactly*-interpretation and an *at least*-interpretation (Grosu & Landman 2017: 25-26). But the 'implicature-like' situation may be different when it comes to the matrix clause where the max-operator cannot play a relevant role, thus leaving the *at least*-interpretation viable, as noted for (4) above. Then look at the following Japanese 'doubly-headed' relative constructions DHRCs, which Cinque (2020: 81-82) takes to result from one of the two options allowed by the 'externally-headed' RC type:[2]

(5) a. Watasi-wa [[[Taro-ga *aru gaku-o* kaseideru] *sono gaku*]-o
I-TOP Taro-NOM a certain amount-ACC earns that amount-ACC
kasegi-tai.[3]
earn-want
'I want to earn the amount (of money) that Taro earns.'
(Cinque 2020: 82 (80b); *adapted* — *NS*)

b. *SONO((e×d)/(M-OP)* ∧∃[INTERNAL((*e*×) *d* /*M-OP,* x)
∧[MAX(*e*×) *d*: TARO-EARNS- ⊔ AMOUNT(x)]
∧∃[EXTERNAL(*e*(×*d*)/*M-OP,* x) ∧[MAX*e*(×*d*)-*d* TARO/MAX*e*(×*d*)-∞:
I-WANT TO EARN- ⊔ AMOUNT(x)]]

(*M-OP* for *max-operators* for the *Sharvy-Link sigma operation* (Grosu & Hoshi 2019, Landman 2004); *sono* may externally-head ‘doubly-headed’ RCs and its semantics is best representable by the Sharvy-Link sigma operation, which picks out of a set its unique maximal member, if there is one, and is undefined otherwise (note 3))

(6) a. Junya-wa [[Masao-ga [*Ayaka to Yoko*]-o kirattei-ru] *sono hutari-no*
Junya-TOP Masao-NOM Ayaka and Yoko-ACC hate-PRES that two-CL-GEN
*zyosei*]-o aisitei-ru.
woman-ACC love-PRES
‘Masao hates Ayaka and Yoko, and Junya loves those two women.’
( = Grosu & Hoshi 2019: 14 (23a))

b. *SONO((e×d)/(M-OP)* ∧∃[INTERNAL((*e*×) *d* /*M-OP,* x)
∧[MAX(*e*×) *d:* MASAO-HATES-AYAKA ⊔ YOKO (x)]
∧∃[EXTERNAL(*e*(×*d*) /*M-OP,* x) ∧[MAX*e*(×*d*) -*d* MASAO/MAX*e*(×*d*) -∞:
JUNYA-LOVES-TWO WOMEN (x)]]

Given the standard definition of restrictive RCs as denoting sets that combine with the sets denoted by the Head through set intersection (Cinque 2020: 5) and the basic NP types e (referential), <e, t>, (predicative), and <<e, t>, t> (quantificational) (Partee 1987/2002: 357), let us assume that for its interpretation the Japanese ‘doubly-headed’ relative construction (6a) may have to have its RC ‘[Masao-ga [*Ayaka to Yoko*]-o kirattei-ru]’ combine with the set denoted by its external Head ‘(*sono*) *hutari-no zyosei’* along the lines of restrictive RCs. And the two parties taking part in such set intersection have to be predicates, as noted by Grosu & Hoshi 2019: 18: see NP type-shifting cases based on Partee 1987/2002: 362), and the predicate for ‘*hutari-no zyosei/two women’* in (6) is expressed by the lambda notation ‘ λ x.*WOMAN(x) ∧ |x| = 2’ (‘*WOMAN’ for *women*; Landman 2004: 5; Zimmermann & Sternefeld. 2013: 255). In (6), intersection of the relative CP with ‘ λ x.*WOMAN(x) ∧ |x| = 2’ will yield the singleton set whose members are two women just in case the two women denote {AYAKA ⊔ YOKO}, and the null set otherwise (Grosu & Hoshi 2019: 18).

## 3. On More Resources for *Maximalizing Relatives*

### *3.1 Maximalization creates a Singleton Predicate*

MRs/amount relatives, involving an operation of (degree) *maximalization* at the CP-level, produce an interpretation of the relative clause as a *singleton predicate,* restricting the set of degrees to the singleton set containing the maximal degree (if there is one) (Grosu & Landman 1998, 2017). (E.g., ’books that there were _ on the table’ denotes {<4, BOOKS, a ⊔ b ⊔ c ⊔ d>} with the singleton set containing the cardinality ‘4’ of the sum of the books on the table, the sortal predicate BOOKS, and the sum of the books on the table ‘a, b, c, and d.’) The semantics allows a predicate interpretation for the gap derived from a variable over individual-degree pairs, and *the grammar treats this variable on a par with degree variables* (Grosu & Landman 2017). Certain aspects of the interpretation of the external noun may well be contributed both inside and outside the relative (Grosu & Landman 2017). Following Kayne (1994), in "books that there were _ on the table," the syntactic movement operation for the degree phrase 'd-many-books' is assumed to be: [… books$_{e(\times d)3}$ … [d-many-(books$_3$)$_{(e\times)d 2}$ [that … (d-many-books$_{e\times d2}$) …]]] (Grosu & Landman 1998: 130-131). Let us further see how the operation of *maximalization* at the relative CP-level yields an obligatory, 'implicature-like' effect, creating a singleton predicate (also see (4) above; Grosu & Landman 2017: 24-26 ). Given the sentence 'He drank the amount of wine that I drank — of beer' ( = Grosu & Landman 2017 (51)) and faced with the situation in which you have to choose between the ***exactly***-interpretation and the ***at least***-interpretation concerning 'the amount of beer I drank,' *maximalization* forces you to choose the default *exactly*-value out of these two interpretations, creating a singleton set containing 'the amount of beer I drank' (see Chierchia 2004: 59-60 for 'embedded scalar implicature computation, according to which implicatures are processed locally in the order in which their triggers appear').

### *3.2 Deriving the Monadic Concept 'EVERY(Q/ (e×d)/M-OP)' for MR constructions*

The monadic concept MC *EVERY(Q/ (e×d)/M-OP)* applies (in (3b)) to some ordered pairs iff they meet three conditions: each of their 'internal participants IPs' is one of their 'external participants EPs'; their IPs are the actors Sue likes; and their EPs are the actors Jack met. The concept MAX: Φ(_) applies to some things iff they are (all and only) *the* things to which Φ(_) applies (Pietroski 2018). In (3b with MAX$_{e(\times d)\text{-}d\,\mathrm{SUE}}$), a 'contextual definition' (Hornstein & Pietroski 2009) of the MC *EVERY(Q/ (e×d)/M-OP)* is given for both IPs and EPs as they are (all and only) the things to which either '(e×)d-PRED(_)' or 'e(×d)-PRED(_)' applies ('(e×)d-PRED' for *predicates of degrees (initially paired with individuals)*).[4] That is, the External Argument creates a set of individuals ('actors Jack met') of the same number as that of a set of degrees that the Internal Argument creates ('actors Sue likes'). In (3b with MAX$_{e(\times d)\text{-}\infty}$), the External Argument does not specify a set (Hornstein & Pietroski 2009).

## Notes

1 For the purposes of the terminology/terms for what are called *"strange relatives of the third kind"* of Grosu and Landman (1998), there roughly seem to be three major terms in the literature: (i) *'maximalizing relatives'* (adopted by Grosu and Landman 1998, Cinque 2020, & the present paper); (ii) *'amount relatives'* of Carlson 1977 (adopted by Grosu and Landman 2017); and (iii) *'degree relatives'* of Heim 1987. See Grosu and Landman. (2017 sect.1) for some discussion on the terms' origins, motivation, and (intended) range

of coverage.

2 The main properties isolated in the literature on Japanese 'internally headed relative clauses IHRCs' are like the following (Cnque 2020: 78 and other references cited therein; see pp.81-82 also for the Japanese 'externally-headed' RC type, one of whose options may lead to the possibility of 'doubly-headed' RCs):

(i) a. Absence of the indefiniteness restriction.
    b. Impossibility of stacking.
    c. Sensitivity to islands.
    d. Impossibility of non-restrictives (?)

Cinque (2020: 78) observes that the properties (ia-c) point to Japanese IHRCs having maximalizing import with movement taking place within the RC.

3 Grosu & Hoshi (2019) observe that "… only *sono/sore* may externally-head 'doubly-headed' RCs, and in this case, it is not interpretable deictically; rather, its semantics is best representable by the Sharvy-Link sigma, which picks out of a set its unique maximal member, if there is one, and is undefined otherwise" (p.12); "… the sigma operator is phonetically null in IHRCs and overt in DHRCs" (p.13); and "In view of the redundancy of the EH-internal material in the scope of *sono* in DHRCs, *sono* as a sigma-operator in effect binds the predicate denoted by CP, just as the null D that heads IHRCs as a sigma-operator binds the predicate denoted by CP" (p.21). Also one of the most important properties of Japanese DHRCs which is shared with IHRCs is that "*the relative clause ends up as denoting a predicate*, not a proposition" (Grosu & Hoshi 2019:13). Notice the use of the distal demonstrative *that/those* in English constructions, such as *Those (people) who do not learn from history are doomed to repeat it./That which is spoken by a wise man deserves to be taken seriously,* which can be considered to be demonstratives with mere sigma import 'pseudo-demonstratives'" (Grosu & Hoshi 2019:12-13). See Dayal (2016: 44-56) for the Sharvy and Link view that "the domain of discourse includes atomic as well as plural individuals" and Landman (2004: 4) for the 'Sharvy-Link sigma' operation.

4 See Suzuki (2019: 3-5; based on Hornstein & Pietroski 2009 and Pietroski 2018a) for a somewhat detailed, initial exposition of 'contextual definitions CDs' from which lexicalizers *abstract* the associated monadic concepts MCs for the two cases of 'argument structure' (the verb *stab*) and 'quantification' (the quantifier *every*). Note also the very interesting, highly constrained interconnection between a 'dyadic concept' and a 'monadic concept' in the first argument structure case. Moreover for the purposes of Darwin's problem (and hence Plato's problem), Pietroski (2018b: 208) observes: "But permitting limited dyadicity can be viewed as a minimal departure from a fundamentally monadic system whose only mode of semantic combination is the simple operation of M-junction ('two expressions of type <M> can be combined to form a third via "M-junction," a

simple combinatorial operation: ‘Grey (_) ^ Cat (_)’ applies to something if and only if both ‘Grey (_)’ and ‘Cat (_)’ apply to it” (p.205)) … Human languages seem to be a *little* more expressive, in some respects, than purely first-order languages… One can say children naturally acquire languages whose combinatorial operations go beyond those of ‘context-free’ systems, but only in highly constrained ways ….”

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