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Quantifiers in Japanese

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Problems

- The generalized quantifier theory does not apply to Japanese quantifiers since:
  - i) the number of NP argument is unspecified
  - ii) quantities are often expressed by predicative adjectives.
  - iii) the word order changes the interpretation
    e.g., non-split quantifiers correspond to definite NPs while split NPs are indefinites.

Proposals

- Adjectival quantifiers are polymorphic
- Continuation-based combinatory categorial grammar (Shan and Barker 2006) accounts for different meanings between (non)split quantifiers.

Roadmap

1. Limit to Generalized Quantifiers Theory
   - 1.1 Predicative Adjectival Quantifiers
   - 1.2 Unspecified Number of Argument
   - 1.3 Uniqueness Non-Split NP and Indefinite Split NP
2. Flexible Type Approach to Adjectival Quantifiers
3. Uniqueness by Word Order

1. Limit to Generalized Quantifier Theory

- The generalized quantifier theory (Barwise&Cooper 1981) maps the syntactic constituency between a noun and a determiner into a quantifier.

  ex. ||Most people|| = {X ⊆E| X contains most people}

- Such view and even relational view on generalized quantifiers which considers the relation between two sets (Zwarts 1983, van Benthem1986) cannot handle Japanese quantificational words whose number of argument is not necessarily two.

  ex. ||Some|| ||men|| ||coughed||
  =|P∩Q|≠∅ = P =Q

- Moreover, being a determiner-less language, quantities are often expressed by predicates naturally.

1.1 Predicative Adjectival Quantifiers

- English: quantifiers are normally noun phrases
  (1) Many people attended.

- Japanese: Imani (1990): numbers and quantities are more naturally expressed as a predicate.

  (2)a. Oku-no nihonjin-wa A-gata-da.
  many-GEN Japanese-TOP A-type-be
  `Many Japanese are type A'

  b. Nihonjin-wa A-gata-ga oi.
  Japanese-TOP A-type-NOM many
  `There are many Japanese who are type A'

Strong quantifiers

- While weak determiners such as *many*, *few*, and *five* can appear as predicative adjectives, strong determiners like *every* and *most* cannot in English.
- In Japanese, both weak and strong quantifiers appear as predicative adjectives (3b).

(3)a. The number of attendants was {many/few/forty/*most/*every}.

b. Kessekisha-ga {okat/sukunakat/yonju-nin-dat/hotondo-dat/zen-in-dat}-ta.
absentee-NOM many/few/40-CL/most/every-be-PAST
`Many/few/40/most/all people were absent'

What is the type of a quantifier in predicate position?

- Partee (1986): the function BE shifts generalized quantifiers such as *an authority* in type (et, t) into (et) in predicate position

(4) Mary considers John an authority on unicorns

- Problem: Japanese quantificational adjectives predicate more than one argument.

1.2 Unspecified Number of Argument

- Imani (1990): Since quantifiers in Japanese do not correspond to noun phrases as in English, the NP-quantifier universal (Barwise & Cooper 1981) should be rejected.

U1 NP-Quantifier universal:

``Every language has syntactic constituents (called noun-phrases) whose semantic function is to express generalized quantifiers over the domain of discourse."

(Barwise & Cooper 1981:177)

Relational view

Imani (1990): Even though Japanese generalized quantifiers do not correspond to noun phrases, quantification in Japanese is still based on a relation between two predicates.

Ogata (1991): Japanese generalized quantifiers are relational.

(4) a. (Tokyo-wa) (gakusei-ga) oi(E)
Tokyo-TOP student-NOM many
`There are many students in Tokyo'

b. (hitobito-wa) hotondo(E) (kaetteshimatta).
people-TOP most left
`Most people have left'

Phrase structure rule

- This analysis works as far as quantificational words take exactly two arguments.
- However, in arguably non-configurational language Japanese, the number of argument is not specified.
- Hale (1980): generate sentences by means of phrase structure rule:

(5) $X' \rightarrow X'^{*}\ X$

- At sentential level, subject can be null or of any number as far as there is a predicate in a sentence final position.

(6) S -> NP* V
S -> NP* AP

Data

1 argument:

(7) Shussekisha_{NP}-ga $\{\text{sukunakat/okat}\}_{AP}$-ta.
attendants-NOM few/many-PAST
`There were few/many attendants (Lit. The attendants were few/many$^{\prime}$)

2 arguments:

(8) Nihonjin_{NP}-ga A-gata_{NP}-ga oi_{AP}- (koto)
Japanese-NOM A-type-NOM many fact
`Many Japanese are type A$^{\prime}$

3 arguments:

(9) Gakusei_{NP}-ga amerikajin_{NP}-ga josei_{NP}-ga oi_{AP}(koto)
student-NOM American-NOM woman-NOM many fact
`Many students are Americans who have children'

1.3 Uniqueness of Non-Split NP and Indefinite Split NP

- We further observe that word order marks definiteness of the quantifier noun phrase.
- While English floating quantifiers are limited to universals, e.g., all, each (Sportiche 1988), Japanese floating quantifiers have more variety.
- While English floating quantifiers do not allow long distance dependencies, a Japanese numeral quantifier and a modified noun can be split by adverbials under certain restrictions

(10)a The students all came.

b. *The students yesterday all came.

(11)a. Gakusei-ga zen-in/mina/3-nin kita.
student-NOM all-member/all/3-CL came
`All/three students came'

b. Chichioya-wa hotondo/taigai/daitai shiawase-da.
father-TOP most happy-be
`Fathers are mostly happy.'

c. Gakusei-ga rokuwari kuruma-o mot-teiru (koto).
student-NOM 60 percent car-ACC have-PROG fact
`Sixty percent of the students have a car'

Hungarian NP split of the definite superlative (Szabolcsi 1986)

- NP split is allowed only with a comparative indefinite reading, but not with absolute definite reading of the superlative.

(13) [$_{\text{Left disl}}$ zöld ló-val] [$_{\text{FOCUS}}$ itt] találkoztam a legszebb-bel
green horse-with here met-I the prettiest-with
`I met a prettier green horse here than anywhere else'/
`*As for green horses, it was here that I met the prettiest of them, i.e., the prettiest green horse that there is'

Japanese non-split NP is definite

- The use of a non-split quantifier phrase presupposes the unique set of entities, and thus corresponds to definite description.
- On the other hand, the referents of a postnominal quantifier are not presupposed so that split quantifiers correspond to indefinites.

Exhaustivity and maximality

(14)a.# 2-to-no zo-ga hashit-te, hoka-no zo-wa suwat-teiru. [exhaustive]

2-CL-GEN elephant-NOM run-and other-GENelephant-TOP sit-PROG

`The two elephants are running and other elephants are sitting'

b. Zo-ga 2-to hashit-te, hoka-no zo-wa suwat-teiru.[non-exhaustive]

elephant-NOM 2-CL run-and other-GEN elephant-TOP sit-PROG

`Two elephants are running and other elephants are sitting'

Split quantifiers are discourse new

(14)a. Asa-kara 3-nin-no gakusei-to hanashi-ta-ga
morning-since 3-cl-gen student-with speak-PAST-but
nokori-no 3-nin-to-wa hanasa-nakat-ta.
rest-GEN 3-CL-with-TOP speak-NEG-PAST
`I spoke with three students in the morning but I did not speak with the (remaining) other three'

b. #Asa-kara gakusei 3-nin-to hanashi-ta-ga
morning-since student 3-CL-with speak-PAST-but
nokori-no 3-nin-to-wa hanasa-nakat-ta.
rest-GEN 3-CL-with-TOP speak-NEG-PAST
`I spoke with three students in the morning but I did not speak with the (remaining) other three'

- A prenominal quantifier phrase refers to a **unique** set of entities which are **discourse given**.

  3-nin-no gakusei = definite *the three students*

  There is a set of unique students. Even if the total number of students is more than two, the entire set of students is unique.
- A floating (split) quantifier phrase does not presuppose a uniqueness of entities

  gakusei-ga 3-nin = indefinite *three NP*.

(18)a. Definite *three NP*:

$\text{student}'(X) \wedge |X| = 3 \wedge \forall y.[\text{student}'(y) \rightarrow y \leq X] \wedge \text{worked}'(x)]$

b. Indefinite *NP three*:

$\exists X.[\text{student}'(X) \wedge [|X| = 3] \wedge \text{worked}'(x)]$

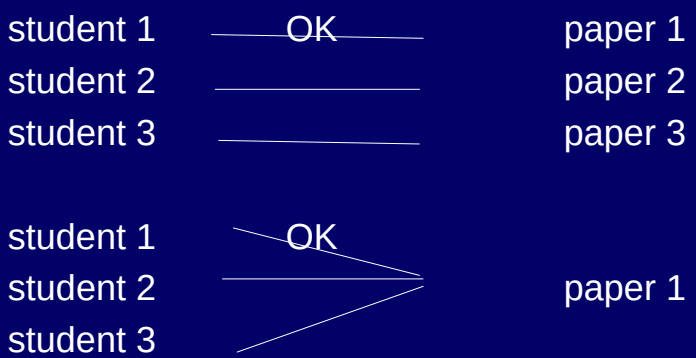
Split NP is wide scope indefinite

- Split NPs are scope insensitive and always take wider scope over a bare noun phrase.
- Split NP allows a distributive reading but not a collective reading (Terada 1990, Nakanishi 2004, among others).

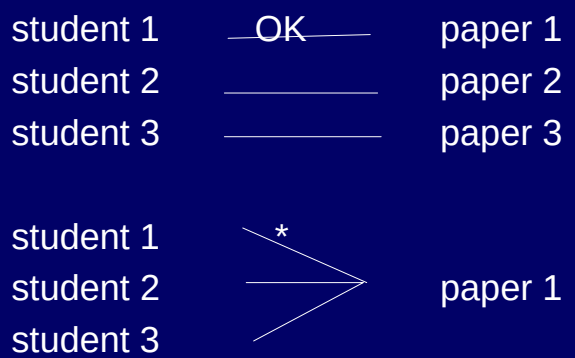
(19)a.3-nin-no gakusei-ga ronbun-o kaita.
3-CL-GEN student-NOM paper-ACC wrote
`The three students wrote a paper'
√collective: a paper > three students
√distributive: three students > a paper

b. Gakusei-ga 3-nin ronbun-o kaita.
student-NOM 3-CL paper-ACC wrote
`Three students wrote a paper'
*collective: a paper > three students
√distributive: three students > a paper

"3-nin-no gakusei (the three students) wrote a paper



"Gakusei 3-nin (student three) wrote a paper"



Zutsu `each'

- In order to force a narrower reading on a split QP, a distributivity marker *zutsu* `each' is necessary (Choe 1987, Kobuchi-Philip 2006)

(21) Neko-ga 3-biki nezumi-o 2-hiki-**zutsu** tabeta.
[*collective, √distributive]
cat-NOM 3-CL rat-ACC 2-CL-each ate
`Three cats ate two rats each'

Are (non)floating quantifiers the same type?

(22) a. non-split QP: definite with uniqueness presuppositions and maximality condition (exhaustive)
b. split QP: indefinites
c. *zutsu* (each) QP: distributive phrase

What is the difference?

(29)a. Gakusei-ga 3-nin kita
students 3-CL came
:et :et→(et→t) :et
b. 3-nin-no gakusei-ga kita.
3-CL-GEN student-NOM came
:et→(et→t) :et :et

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2. Flexible Type Approach to Adjectival Quantifiers

- The unspecified number of arguments suggests a polymorphic type for adjectival quantifiers, (et^n, t), that can be either (et), (et,(et,t)) or ((et,(et,(et))),t).
- Proportional *many*:

(24) $||\text{many}||_{((e \rightarrow t)^n \rightarrow t)}$

$= \lambda P_1,P_2,...,P_n.\ P_1(x) \wedge P_2(x) \wedge,..., \wedge P_n(x) \wedge$

$|P_1 \cap P_2 \cap,..., \cap P_n| \geq |P_n| \circ c$

Addition of *N*-ary Function Application to Combinatory Categorial Grammar (CCG) (Steedman 2000, Szabolcsi 1987)

(25)a. *N*-ary Function Application (Buring 2005):

$|||[_{\chi n} X^o A\ A'\ A"\ldots]||^g =$

$||X^0||^g(||A_n||^g)(||A_{n-1}||^g)...(||A_1||^g)$

where $A_1,A_2,\ldots,A_{n-1},A_n$ are the order of *A, A',* *A"*...on X^0's argument-list

b. *N*-ary Function Application:

A_1: a,...,A_n: z $A_1,...,A_n$ ¥ B: f $\Rightarrow$ B: f((a),...,(z)) ($^n<$)

1 argument

(26) Shussekisha-wa sanju-nin-dat-ta.

attendant-TOP 30-CL-be-PAST

`The number of attendants was thirty'

Shussekisha-wa$_{Lex}$ sanju-nin-dat-ta$_{Lex}$

N : λx.attendant'(x) N¥S : λP.|P|=30 $_<$

S : |attendant'| = 30

2 arguments

(27) Gakusei-wa amerika-jin-ga oi.

student-TOP American-NOM many

`There are many Americans among students'

Gakusei-wa$_{Lex}$ amerikajin-ga$_{Lex}$ oi$_{Lex}$

N:λx:student'(x) N:λy:American'(y) N¥(N¥S):λPλQ.|P ∩ Q|≥|P|◦c$_{n<}$

S: |student' ∩ American'| ≥ |student'| ◦ c

3 arguments

(28) Gakusei-wa amerikajin-ga O-gata-ga oi.
student-TOP American-NOM type O-NOM many
`Many students are Americans who are type O'

Gakusei-wa$_{Lex}$ amerikajin-ga$_{Lex}$ O-gata-ga$_{Lex}$
N:λx.student'(x) N:λy.American'(y) N:λz.type o'(z)

oi ——————————Lex
N¥(N¥(N¥S)):λP,Q,R.|P∩Q∩R|≥|P|◦c$_{n<}$
S: |student'∧American'∧parent'|≥|student'|◦c

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3. Uniqueness by Word Order

- Split NP: indefinite
  Non-split NP: definite
  - word order contributes to meaning.
- The order of evaluation affects interpretation.

What is the difference?

(29)a. Gakusei-ga	3-nin	kita
students	3-CL	came
:et	:et^n →t	:et
b. 3-nin-no	gakusei-ga	kita.
3-CL-GEN	student-NOM	came
:et$_n$→t	:et	:et

Left to right evaluation by continuation-based approach

- Raising rule into a continuized type and its reverse, lowering (Barker 2002).
- Continuation type-raises any type of syntactic categories to obtain higher scope
  - 3 > students
  - students > 3

CCG rules

(29)

a. Functional Application

A/B: f B: a ⇒ A: f(a) (>)

A: a A¥B: f ⇒ B: f(a) (<)

b. Functional Composition

A/B: f B/C: g ⇒ A/C: λx. f(g(x)) (B)

A¥B: f B¥C: g ⇒ A¥C: λx.f(g(x)) (B)

c. Type Raising

A: a ⇒ S/(A¥S): λf.f(a) (T)

d. Type Raising into a Continuatized Type

A: a ⇒ R/(R/A): λk.k(a) (T)

e. Lowering

(R/(R/A): λk.k(a) ⇒ A: a (LOWER)

Left argument raises to higher order

(30)

gakusei–ga$_{Lex}$

N: λx.∃x.student'(x)$_T$ 3-nin$_{Lex}$ kita$_{Lex}$

S/(S/N): λk.k(λx.∃x.student'(x)) NP¥S:λX.|X|=3 NP¥S: y.came'(y)$_∃$

S/S: λt.t=[∃X.student'(X)∧|X| = 3] S: ∃y.came'(y)$_>$

S: ∃X.student'(X) ∧ |X| =3 ∧ came'(X)

(31)

3-nin-no$_{Lex}$

NP¥S: λX.|X| = 3$_T$ gakusei-ga$_{Lex}$ kita$_{Lex}$

S/(S/(NP¥S)): λk.k(λX.|X|=3) N: λx∃x.student'(x)

S/S: λt.t=[|X| = 3 ∧ ∀y.student'(y)→X≥y] NP¥S: λy: came'(y)

$_∃$

S: ∃y.came'(y)$_>$

S : [|X| = 3 ∧ ∀y.student'(y)→X≥y]

Definiteness by word order

- The left category takes wider scope over the one on the right by definition.
- When an indefinite continuized bare noun *students* composes with *three* on the right, the whole quantifier phrase is interpreted to be indefinite.
- When *five* in the continuized type takes wider scope over students, the whole quantifier phrase receives exhaustivity and definiteness.

4. Conclusion

- Quantities are expressed by predicative adjectives and split and non-split quantifiers in Japanese.
- Since the number of arguments is unspecified, we need a polymorphic type for adjectival quantifiers.
- The word order differentiates the definiteness of quantifiers, which is explainable by left to right evaluation of a bare noun and a numeral phrase in the continuized type.