

Semantic Disambiguation of “NP₁-no NP₂” Construction by Extended GL

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This paper proposes an elaboration of the Generative Lexicon (GL) in Pustejovsky (1995) based on a survey of BCCWJ (2009). I manually classified the Japanese NP₁-no NP₂ “NP₁’s NP₂” construction into the following patterns: (i) qualia structure modification in the sense of Pustejovsky (1995) (ii) relational nouns (iii) adjectival modification (iv) event nominals (v) extensional module modification, a term used by me, and others. The result indicates the need for the expansion of GL for computing the meaning by incorporating an extensional module that predicates temporary location, time, and manner of the referent. For example, in *ima-no nihon* “the present Japan,” *ima-no* modifies the time of the event argument in the extensional module.

1. Introduction

I have manually classified the 3030 examples containing the NP₁-no NP₂ “NP₁-GEN NP₂” construction in Japanese in accordance with the semantic relations between the two nouns phrases. The examples were sorted out of the core data of the *Yahoo! Chiebukuro* portion of BCCWJ (2009) by using ChaKi.NET 1.2β. The results indicate that 29% of all instances are examples that NP₁ *selectively binds*, or modifies the inherent property, that is, the qualia structure of the lexical meaning of the NP₂ (e.g., *Fuji-no rendora* “a soap opera by Fuji TV”) (Pustejovsky, 1995). Moreover, I adopt a broader view for the definition of relational nouns, which share 25% of all instances—NP₂ is a relational noun in a broader sense, and NP₁ represents their arguments (e.g., *mune-no mae* “in front of the chest.”). I further argue that GL needs to be expanded to include not only inherent properties but also referential descriptions, because 8% of the data involved the modification of the temporary elements, such as location, time, and manner of the referent of NP₂ (e.g., *Operaza-no Kaijin* “Phantom of the Opera”). In addition, 14% of the data were pairs of derived event nouns (NP₂) and event arguments (e.g., *shacho-no kitai* “expectations of the CEO”). From the data, 3% consist of the adjectival modification of NP₂ (*aruchu-no haiyu* “an alcoholic actor”). Lastly, 5% had quantifiers for NP₁ (*hotondo-no katei* “most families”).

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2. Patterns

2.1 Selective binding of qualia in NP₂

GL incorporates an additional lexical entry to the meaning of words called the qualia structure—CONSTITUTIVE (part-whole relation), FORMAL (ontological categories, shape, color, and so on), TELIC (purpose), and AGENTIVE (origin). The most frequent pattern consists of NP₁’s modification of one of the qualia roles contained in NP₂’s lexical entry.

- (1) a. Fuji-no rendora (447) [AGENTIVE] *1
Fuji TV-GEN soap
“the soap opera by Fuji TV”

- b. $[[Fuji - no_rendora]] = \lambda x[\text{soap}(x) \ \& \ \text{AGENTIVE}]$
 $= \exists e[\text{make_act}(e) \ \& \ \text{agent}(e) = \text{FujiTV} \ \& \ \text{theme}(e) = x]$

- (2) Docomo-no FOMA (1157) [AGENTIVE]
Docomo-GEN FOMA
“FOMA service by Docomo (mobile communications)”

Since Fuji TV and Docomo are the producers of the soap and service, they modify the AGENTIVE roles of *rendora* “soap” and FOMA respectively.

- (3) senpuki-no hane (1084) [CONSTITUTIVE]
fan-GEN blade
“the blades of a fan”

As *hane* “blades” is a part of *senpuki* “a fan,” it modifies the CONST quale of a fan.

2.2 NP₂ is a relational noun

- (4) a. mune-no mae (4179)
chest-GEN front
“in front of the chest”
b. sensuikan-no naka (1824)
submarine-GEN inside
“inside a submarine”
c. senpuki-no hane-no kazu (1084)
fan-GEN wing-GEN number
“the number of the blade of an electric fan”
d. roon-no koto (1336)
loan-GEN fact
“the characteristics of loans”

*1 The numbers in round parentheses represent sentence IDs of output of ChaKi.

- e. Daiei-no Nakauchi-san-no baka-musuko (1394)
Daiei-GEN Nakauchi-san-GEN stupid son
“(The Supermarket) Daiei’s (CEO) Mr Nakauchi’s
stupid son”

Mae “front,” *naka* “inside,” *kazu* “number,” *koto* “fact,” and *musuko* “son” are relational nouns that do not stand alone semantically. For example, the word *mae* “front” is semantically unsaturated so that it always means something is in front, as *musuko* “son” is always someone’s son, e.g., *Bill’s son*. *Mune* “chest,” *sensuikan* “submarine,” *senpuki-no hane* “blades of a fan,” *roon* “loan,” and *Daiei-no Nakauchi-san* “Mr Nakauchi (CEO) of Daiei Supermarket” are arguments of the relational nouns.

2.3 NP₂ is a deverbal noun

- (5) a. shacho-no kitai (4069)
CEO-GEN expectation
“the CEO’s expectations”
b. Shacho-ga kitai-suru.
CEO-NOM expect
“The CEO expects.”
- (6) a. doramu-breeki-no sabi-no shori (1910)
drumbrake-GEN rust-GEN process
“cleaning rust off a drum brake”
b. doramu-breeki-no sabi-o shori-suru
drum-brake-GEN rust-ACC process
“clean rust off a drum brake”

The NP₁s *kitai* “expectation” and *shori* “processing” both have event arguments, since they derive *do*-verbs *kitai-suru* “expect” and *shori-suru* “process.” *Shacho* “CEO” plays an agentive role in the expecting event, and *doramu-breeki-no sabi* “rust of a drum brake” is the theme argument of the processing event.

2.4 NP₁ is adjectival property of NP₂

Attributive adjectives can be postposed in a predicative position (7–8), while other patterns do not allow postposition (9).

- (7) a. aruchu-no haiyu (462)
alcoholic actor
“an alcoholic actor”
b. haiyu-wa aruchu-da
actor-TOP alcoholic
“The actor is alcoholic.”
- (8) a. muryo-no kyanpu-jo (2078)
free of charge-GEN camping site
“a camping site free of charge”
b. kyanpu-jo-wa muryo-da.
camping-site-TOP free-be
“The camping site is free of charge.”

- (9) a. senpuki-no hane (1084)
fan-GEN blade
“blades of a fan”

- b. *Hane-wa senpuki-da.
blades-TOP fan
“The blades are a fan.”

*2

2.5 Referential module modification of NP₂

Kinjo-no “in the neighborhood” in (12) and *mayonaka-no* “midnight” in (13) represent the temporary location and time of the referents of *seikeigeka* “orthopedic clinic” and *kaigan* “beach.” This paper proposes the addition of a referential module to the lexical meaning in GL, for incorporating temporary location, time, manner and others of referents, in addition to the qualia structure. *Kinjo-no* “in the neighborhood” in (12) and *mayonaka-no* “midnight” in (13) modify the referential modules of *seikeigeka* “orthopedic clinic” and *kaigan* “beach.”

- (12) kinjo-no seikeigeka (3379) [LOCATION]
neighborhood-GEN orthopedic
“an orthopedic clinic in neighborhood”

- (13) mayonaka-no kaigan (3633) [TIME]
midnight-GEN beach
“midnight beach”

2.6 NP₁ is a quantifier

- (14) a. hotondo-no katei (170)
most-GEN family
“most families”
b. hoka-no hito (4012)
other-GEN person
“other people”
c. kanari-no hito (3875)
considerably many-GEN person
“considerably many people”

*2 According to Kuno (1973,25), *no* “of/’s” in quantifiers such as *is-satsu-no* “one-CL” and in *NP-no* as in *gakusei-no* “student’s” is not the genitive particle but the attributive form of the copula *da* “be,” because they can be postposed as predicative adjectives. If Kuno is correct, *no* in attributive adjectives is also the copula.

- (10) a. is-satsu-no hon
1-CL-GEN book
“one book”
b. hon-wa is-satsu-da.
book-TOP 1-CL-be
“There is one book. Lit. The book is one in number.”
- (11) a. gakusei-no Tanaka
student-GEN Tanaka
“the student Tanaka”
b. Tanaka-wa gakusei-da.
Tanaka-TOP student-be
“Tanaka is a student.”

2.7 Possession

- (15) a. aite-no keitai (5709)
addressee-GEN mobile phone
“the addressee’s mobile phone”
- b. jibun-no PC (883)
self-GEN PC
“your PC”

2.8 Demonstratives

- (16) a. sorera-no taiya (2066)
those-GEN tire
“those tires”
- b. doko-no chiiki (4713)
where-GEN area
“which area”

2.9 NP_1 is a deverbal noun

- (17) osusume-no koen (5380)
recommendation-GEN park
“a recommended park”

Osusume “recommendation” is the noun form of the verb *osusumeru* “recommend”; therefore, it contains an event whose theme argument is *koen* “koen.”

2.10 NP_1 is a theme argument of deadjectival noun NP_2

- (18) tabi-no tanoshisa (5395)
trip-GEN pleasure
“the pleasure of trips”

Tanoshisa “pleasure” is a noun form of an adjective *tanoshii* “pleasant” whose theme is *tabi* “trip.”

2.11 Adverbs

- (19) tada-no manuke (5874)
mere-GEN fool
“mere fool”

2.12 Selective binding of qualia in NP_1

- (20) zenzen chigau gakko-no onna-no ko (3835) [TELIC]
at all different school-GEN female-GEN child
“a girl from a totally different school”

Gakko “school” is a place for study, and *onna-no-ko* “a girl” is an agent of studying.

3. Results

3.1 Statistical output

The statistical data of semantic classification is shown below. Figure 1 classifies the NP_1 -no NP_2 construction without caring about different qualia roles or different roles in the referential module that they modify. Figure 2 further classifies which of the four qualia roles—FORMAL, CONSTITUTIVE, TELIC, or AGENTIVE—is modified, or which role of the referential module—TIME, LOCATION, or MANNER—is modified and presents each frequency.

Table 1: Figure 1: Distribution of Semantic Patterns of NP_1 -no NP_2 Construction

selective binding of qualia in NP_2	886	0.292409241
NP_2 is a relational noun	777	0.256435644
NP_2 is a deverbal noun	445	0.146864686
NP_1 is adjectival property	395	0.130363036
referential module modification of NP_2	244	0.080528053
NP_1 is a quantifiers	152	0.050165017
possession	45	0.014851485
demonstratives	32	0.010561056
NP_1 is a deverbal nouns	24	0.007590759
NP_1 is theme of deadjectival NP_2	23	0.007306226
adverb	6	0.001980198
selective binding of qualia in NP_1	1	0.000330033
total	3030	1

Table 2: Figure 2. Detailed Classifications

NP_2 is a relational noun		777	0.256435644
NP_1 is adjectival property		395	0.130363036
selective binding of qualia in NP_2	constitutive	322	0.106270627
selective binding of qualia in NP_2	telic	294	0.097029703
NP_2 is a deverbal noun	theme	244	0.080528053
selective binding of qualia in NP_2	agentive	220	0.072607261
NP_1 is a quantifier		152	0.050165017
NP_2 is a deverbal noun	agent	146	0.048184818
referential module modification of NP_2	location	131	0.043234323
referential module modification of NP_2	time	112	0.036963696
selective binding of qualia in NP_2	formal	50	0.016501650
possession		45	0.014851485
demonstratives		32	0.010561056
NP_1 is theme of deadjectival NP_2		23	0.007590759
NP_2 is a deverbal noun	time	18	0.005940594
NP_1 is a deverbal noun	theme	17	0.005610561
NP_2 is a deverbal noun	goal	12	0.003960396
NP_2 is a deverbal noun	location	11	0.003630363
NP_2 is a deverbal noun	source	9	0.002970297
NP_1 is a deverbal noun	agent	7	0.002310231
adverbs		6	0.001980198
NP_2 is a deverbal noun	manner	4	0.001320132
NP_2 is a deverbal noun	instrument	1	0.000330033
referential module modification of NP_2	manner	1	0.000330033
selective binding of qualia in NP_1	telic	1	0.000330033
total		3030	1

4. Observations

4.1 Frequent qualia structure modification

The most frequent occurrences are the modifications of qualia structure, which represents the inherent properties of lexical meaning.

- (21) a. hyoka-no henshin (5589) [TELIC]
evaluation-GEN reply
“reply for evaluation”

$$b. [\textit{reply_for_evaluation}] = \lambda x[\textit{reply}(x) \ \& \ \textit{TELIC} = \exists e[\textit{communicate}(\epsilon y.\textit{evaluation}(y))]]$$

5. Proposal

5.1 A broader definition of relational nouns

Nouns like *father*, *friend*, and *enemy* are called relational nouns. Because a father is someone’s father, a friend someone’s friend, and an enemy someone’s enemy, they are considered to represent the functions or relations of *father-of*, *friend-of*, and *enemy-of*. Partee (1997) points out that it is the relation expressed by the relational noun *brother* in *John’s brother* that the relation between John and his brother inherits, unlike *John’s book* in which *book* is a common noun, so that the relation between John and his book is not specified. It can mean the book that John owns, has written, borrowed, or a book about John and others.

Further, this study considers common nouns representing spatial locations to be relational nouns. While languages like English use prepositions such as *in*, *on*, *under*, or *be-*

tween, languages such as Tlacolula Valley Zapotec in Mexico and Chickasaw in North America use relational nouns to express locations (Lillehaugen and Munro, 2006). Japanese is one such language that expresses locations by using relational nouns like *naka* “inside,” *ue* “on/above,” and *shita* “under.”

Nishiyama (2003) discusses what he calls *unsaturated nouns* (*hi-howa meishi*) such as *shuyaku* “hero/heroine” of a play and *joshi* “boss” of someone, which require their *parameters* such as (hero of) Macbeth or (a boss of) Taro to be saturated.

The present study includes what Nishiyama (2003) calls unsaturated nouns as relational nouns: *kazu* “number” in *senpuki-no hane-no kazu* “the number of the blades of a fan,” *koto* “fact” in *roon-no koto* “the fact about loans,” *ho* “side/direction” in *hikoki-no ho* “airplanes,” *nenmatsu* “the end of the year” in *kotoshi-no nenmatsu* “the end of this year,” *namae* “name” in *shujinko-no namae* “the name of the hero.” Since common nouns are one place holders—a function from individuals to truth values—these relational nouns are two-place holders, and nouns such as *aida* “between” which requires another argument are three-place predicates.

$$(22) \text{ a. } \llbracket aida \rrbracket = \lambda x \lambda y \lambda z [\text{between}(z)(y)(x)]$$

$$\text{ b. } \llbracket hato_haguki - no_aida \rrbracket = \lambda x [\text{between}(ey.gum(y))(ez.tooth(z))]$$

$$(23) \llbracket namae \rrbracket = \lambda x \lambda y [\text{name-of}(y)(x)]$$

5.2 Extending GL

5.2.1 Limitations of GL

This section proposes formalization of the referential module modification of NP_2 which shares 8 % of all instances. (24) suggests that qualia structure in GL does not provide means to compute modification of temporary nature—e.g., temporary location at the time of utterance as in *Operaza-no Kaijin* “Phantom of the Opera,” time as in *mayonaka-no kaigan* “midnight beach,” temporarily used vehicles, outfit and accessories as in *baiku-no karera* “those riding scooters.” The phantom who currently resides in the Opera was not born there; therefore, *Operaza-no* “of The Opera” does not modify the AGENTIVE role of *kaijin* “phantom.” *Mayonaka-no kaigan* “midnight beach” is not made for playing at midnight only (TELIC role modification). The current GL theory does not have the means to compute such meaning.

$$(24) \text{ a. } \llbracket Phantom_of_The_Opera \rrbracket \neq \lambda x [\text{phantom}(x) \ \& \ \text{AGENTIVE} = \exists e [\text{born}(e) \ \& \ \text{theme}(e) = x \ \& \ \text{location}(e) = \text{The Opera}]]]$$

$$\text{ b. } \llbracket midnight_beach \rrbracket \neq \lambda x [\text{beach}(x) \ \& \ \text{TELIC} = \exists e [\text{recreational_activity}(e) \ \& \ \text{time}(e) = \text{midnight}]]]$$

5.2.2 Extended GL

Even though Pustejovsky’s four qualia express inherent properties of referents, I propose supplementing lexical semantics with information about the referents. Besides

type, argument, event, and qualia structures in GL (cf. Johnston and Busa, 1996,79), the referential module (EXTENSION(EXT)) has subcategories of TIME, LOC, MANNER roles and others. For example, *Operaza-no* “of The Opera” in *operaza-no kaijin* “the Phantom of the Opera” and *mayonaka-no* “midnight” modify extensional modules of the Phantom and the beach. In *baiku-no karera* “those on scooters,” scooter-riding is one of the temporary properties of the referents, so that it is a MANNER role modification.

(25) Template for Extended GL

$$\left[\begin{array}{l} \alpha \\ \text{TYPESTR} = [\text{ARG1} = \text{THE TYPE OF } \alpha] \\ \text{ARGSTR} = [\text{D-ARG1} = \text{OTHER ARGUMENTS IN THE QUALIA}] \\ \text{EVENTSTR} = [\text{E1} = \text{EVENTS IN THE QUALIA}] \\ \text{QUALIA} = \left[\begin{array}{l} \text{FORMAL} = \text{ISA-RELATION} \\ \text{CONST} = \text{PARTS OF } \alpha \\ \text{TELIC} = \text{PURPOSE OF } \alpha \\ \text{AGENT} = \text{HOW } \alpha \text{ IS BROUGHT ABOUT} \end{array} \right] \\ \text{EXT} = \left[\begin{array}{l} \text{LOC} = \text{in}(\boxed{e2}, \boxed{x}, \boxed{t}) \\ \text{TIME} = \text{at}(\boxed{e2}, \boxed{x}, \boxed{t}) \\ \text{MANNER} = \text{with}(\boxed{e2}, \boxed{x}, \boxed{y}) \end{array} \right] \end{array} \right]$$

As a result, selective binding not only applies to qualia structure but also to a referential module, which enables the computation of the meaning of the NP_1 -no NP_2 construction. For example, *Operaza-no* “of the Opera” specifies the location of the Phantom as the Opera.

$$(26) \text{ a. } \llbracket The_Phantom_of_the_Opera \rrbracket = \lambda x [\text{phantom}(x) \ \& \ \text{EXT} = \exists e [\text{be-phantom}(e) \ \& \ \text{theme}(e) = x \ \& \ \text{location}(e) = \text{The Opera}]]]$$

$$\text{ b. } \llbracket midnight_beach \rrbracket = \lambda x [\text{beach}(x) \ \& \ \text{EXT} = \exists e [\text{be-beach}(e) \ \& \ \text{theme}(e) = x \ \& \ \text{time}(e) = \text{midnight}]]]$$

$$\text{ c. } \llbracket those_on_scooters \rrbracket^g = \lambda x [g(1) = x \ \& \ \text{EXT} = \exists e [\text{born}(e) \ \& \ \text{manner}(e) = \text{with-scooter}]]]$$

6. Conclusion

This study was a quantitative survey of the meaning of the NP_1 -no NP_2 construction in Japanese. While many examples were of the qualia structure modification in GL and relational nouns in a broader sense, the data called for the expansion of the GL for the computation of the meaning.

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