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 noun phrases. The examples were sorted out of the core data of the Yahoo! Chiebukuro portion of BCCWJ (2009) by using ChaKi.NET 1.2. The results indicate that 29% of all instances are examples that 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., Opera-ra-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”).

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]
   Fuji TV-gen soap
   “the soap opera by Fuji TV”

   b. [Fuji-no rendora] = \lambda x[soap(x) & AGENTIVE = \exists e[make_act(e) & agent(e) = FujiTV & 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) [AGENTIVE]
   chest-gen front
   “in front of the chest”

   b. sensuikan-no naka (1824) [AGENTIVE]
   submarine-gen inside
   “inside a submarine”

   c. senpuki-no hane-no kazu (1084) [AGENTIVE]
   fan-gen wing-gen number
   “the number of the blade of an electric fan”

   d. roon-no koto (1336) [AGENTIVE]
   loan-gen fact
   “the characteristics of loans”

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*1 The numbers in round parentheses represent sentence IDs of output of ChaKi.
2.3 \( NP_2 \) 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 \( NP_1 \)s 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 \( NP_1 \) is adjectival property of \( NP_2 \)

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.”

2.5 Referential module modification of \( NP_2 \)

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 \( NP_1 \) is a quantifier

(14) a. hotondo-no katei (170)
mmost-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 \( NP_2 \)-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.
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 NP1 is a deverbal noun
(17) osusume-no koen (5380)
recommendation-GEN park
“a recommended park”

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

2.10 NP1 is a theme argument of deverbial noun NP2
(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 NP1
(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 NP1-no NP2 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 NP1-no NP2 Construction

<table>
<thead>
<tr>
<th>Qualia Structure</th>
<th>Frequency</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>selective binding of qualia in NP2</td>
<td>885</td>
<td>0.29240924</td>
</tr>
<tr>
<td>selective binding of qualia in NP2 constitutive</td>
<td>749</td>
<td>0.050165017</td>
</tr>
<tr>
<td>selective binding of qualia in NP2 thematic</td>
<td>445</td>
<td>0.185855856</td>
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<tr>
<td>selective binding of qualia in NP2 thematic</td>
<td>244</td>
<td>0.080528053</td>
</tr>
<tr>
<td>selective binding of qualia in NP2 thematic</td>
<td>244</td>
<td>0.001320132</td>
</tr>
<tr>
<td>selective binding of qualia in NP2 thematic</td>
<td>244</td>
<td>0.010561056</td>
</tr>
<tr>
<td>selective binding of qualia in NP2 thematic</td>
<td>244</td>
<td>0.043234323</td>
</tr>
<tr>
<td>total</td>
<td>1040</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 2: Figure 2. Detailed Classifications

<table>
<thead>
<tr>
<th>Qualia Structure</th>
<th>Frequency</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>selective binding of qualia in NP2</td>
<td>727</td>
<td>0.294539534</td>
</tr>
<tr>
<td>selective binding of qualia in NP2</td>
<td>322</td>
<td>0.05270527</td>
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<td>0.003630363</td>
</tr>
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<td>727</td>
<td>0.294539534</td>
</tr>
<tr>
<td>selective binding of qualia in NP2</td>
<td>1040</td>
<td>1</td>
</tr>
</tbody>
</table>

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 benshin (5589) [TELIC]
evaluation-GEN reply
“reply for evaluation”

b. [reply_for_reply] = λx[reply(x) & TELIC = 3e[communicate(ry.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,” *we* “on/above,” and *shita* “under.”

Nishiyama (2003) discusses what he calls unsaturated nouns (hi-kowa meishi) such as *shugaku* “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,” *kato* “fact” in *room-no kato* “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,” *nanae* “name” in *shujinko-no nanae* “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) a. \[aida = \lambda x \lambda y \lambda z [\text{between}(z)(y)(x)]\]

b. \[hato_haguki - no_aida\] = \[\lambda x [\text{between}(y, \text{gum}(y))(x, \text{tooth}(z))]]

(23) \[nanae = \lambda x \lambda y \lambda z [\text{name-of}(y)(x)]\]

5.2 Extending GL

5.2.1 Limitations of GL

This section proposes formalization of the referential module modification of NP2 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 *Opera-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, *Opera-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) a. \[\text{Phantom}_of_The_Opera \neq \lambda x [\text{phantom}(x) & \text{AGENTIVE} = \lambda x [\text{born}(e) & \text{time}(e) = x & \text{location}(e) = \text{The Opera}]]\]

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

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(EXIT)) has subcategories of TIME, LOC, MAN- NER 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

\[\begin{array}{c}
\text{TYPESTR} = [\text{ARG1} = \text{the type of } \alpha ] \\
\text{ARGSTR} = \lambda \text{other arguments} \in \text{the qualia} \\
\text{EVENTSTR} = \lambda \text{events} \in \text{the qualia} \\
\text{QUALIA} = \lambda \text{const} = \tau - \text{parts of } \alpha \\
\text{TELIC} = \lambda \text{the purpose of } \alpha \\
\text{AGENT} = \lambda \text{how } \alpha \text{ is brought about} \\
\text{LOC} = \lambda \text{in} [x] \\
\text{TIME} = \lambda \text{from} [x] \\
\text{MANNER} = \lambda \text{with} [x]
\end{array}\]

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 NP1-no NP2 construction. For example, *Operaza-no* “of the Opera” specifies the location of the Phantom as the Opera.

(26) a. \[\text{The_Phanom}_of_The_Opera = \lambda x [\text{phantom}(x) & \text{EXT} = \lambda [\text{be-phantom}(e) & \text{theme}(e) = x & \text{location}(e) = \text{The Opera}]]\]

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

c. \[\text{those_on_scooters} = \lambda x [\text{recreational_activity}(e) & \text{time}(e) = \text{midnight}]]\]

6. Conclusion

This study was a quantitative survey of the meaning of the NP1-no NP2 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.

References


