Qualia-Based Lexical Knowledge for the Disambiguation of the Japanese Postposition No

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1 Introduction

This paper proposes the elaboration of the qualia structure of the Generative Lexicon in [5] and the Extended Generative Lexicon theory [3]. My proposal is based on the Japanese genitive postposition no. The Japanese “NP$_1$-no NP$_2$” construction expresses a wider range of relations between two entities than does the English possessive “NP$_1$’s NP$_2$,” such that the Pustejovskian qualia roles encoded in NP$_2$ do not supply the necessary relations between two entities, which [7] succeeded to certain degree. Possessive relation disambiguation requires enriching lexical entries by incorporating the HAVE relation into the CONSTITUTIVE role and listing other qualia such as the ACTIVITY and the SPATIO-TEMPORAL role with the subcategories of LOCATION and TIME.

2 Various Relations and Argument Reversal

The Japanese genitive marker is semantically very ambiguous. ‘NP1-GEN NP2’ expresses not only possession as in John’s pen and a part-whole relation as in John’s leg, but also location, accompaniment, property, quantity, etc., as shown in Table 1.

| Relation | Japanese Possessive | English Possessive | English Compound | English PP |
|----------|---------------------|--------------------|-----------------|-----------|
| I possession | Tanaka-no kaban | Tanaka’s bag | *Tanaka bag | a bag of Tanaka |
| II part-whole | Tanaka-no kao | Tanaka’s face | *Tanaka face | the face of Tanaka |
| III location | Tokyo-no shinseki | *Tokyo’s relative | Tokyo relatives | in Tokyo |
| IV time | 3-ji-no koen | *3 o’clock’s park | *3 o’clock park | park at 3 o’clock |
Table 1:

|        | Accompaniment | VI Trade | VII Activity | VIII Property | IX Weight | X Quantity | XI Intensional Property |
|--------|---------------|----------|--------------|---------------|-----------|------------|------------------------|
|        | kaban-no hito | kaban-no | maruboro-no  | chisee-no     | 1-kiro-no | 3-bon-no   | nise-no fukahire        |
|        | *bag’s man    | Sanpei  | kuni         | hito          | pasokon   | *three’s   | *fake’s shark fin       |
|        | the bag man   | Bags     | *the beer’s  | *male’s tiger | computer  | pen        | *fake’s shark fin fin   |
|        | the man       | Sanpei   | country      | man           |           |            | fake shark fin police   |
|        | with a bag    |          | *the beer    | a man of      |           |            | fake police             |
|        | the lady with a hat | | city | intelligence |           |            |            |
|        |               |          | country      | man           |           |            |                         |
|        |               |          | *the city of | a tiger of    |           |            |                         |
|        |               |          | Marlboro     | male kind     |           |            |                         |
|        |               |          | country      | the doll      |           |            |                         |
|        |               |          |              | with blue eyes|           |            |                         |
|        |               |          |              |               |           |            |                         |

Note the reversal of the possessor argument between (I) and (V–VI). The possessor argument is NP₁ in (I), as in English Tanaka’s bag whose possessor argument is Tanaka. On the contrary in (V), the possessor of the bag is NP₂ hito “man” and there is no English equivalent big bag’s person. In (VI) Kaban-no Sanpei “Bags Sanpei,” Sanpei is a bag store, and therefore the possessor of a bag. The controller-controller relation is also reversed, for example, in Tanaka-no kuruma “Tanaka’s car” (type I), Tanaka is the controller of the car, i.e., NP₂ the car is at Tanaka’s disposal as in English the girl’s car [7]. On the contrary, in boshi-no fujin “the lady with a hat,” NP₁ boshi is at the person’s disposal. Aoi-me-no ningyo “the doll with blue eyes,” literally, “blue eyes’ doll” in (VIII) even expresses the part-whole relation in the reverse direction, compared with ningyo-no me “the doll’s eyes.” Such non-canonical relations, i.e., other than those expressing possession or a part-whole relation, are more likely expressed in noun compounds such as magic land or prepositional phrases using of, in, or with in English.

3 Problems with Deriving Various Possessive Relations from NP₂

Possessive relations are ambiguous in both English and Japanese. For example, there is more than one interpretation for Tanaka-no hon “Tanaka’s book.” Tanaka’s book may refer to the book that Tanaka owns or the book
that Tanaka wrote [1,87]. In view of such ambiguity, [4] assumes two syntactic types for John’s depending on whether or not the following noun is inherently relational. If the following noun is a non-relational common noun (CN) such as car, John’s composes with car which is regular (et) type, and the relation between John and car is contextually supplied (1a). On the contrary, when John is followed by inherently relational nouns such as brother, employee and enemy, which are (e,et) type with an extra argument slot, the relation between John and his brother in John’s brother inherits kinship from the two-place predicate brother (1b). (2) exemplifies the computation related to another relational noun, friend.

(1) a. Free R type:

Syntax: [John’s]NP/CN
Semantics: \(\lambda Q \lambda P [NP'(\lambda z [\exists x [\forall y ([Q (y) \land R (y) (z)] \iff y = x] \land P (x)])] \)

b. Inherent relation type:

Syntax: [John’s]NP/TCN (TCN: transitive common noun)
Semantics: \(\lambda R \lambda P [NP'(\lambda z [\exists x [\forall y [R (z) (y) \iff y = x] \land P (x)])]] \)

(2) Syntax: [[John’s]NP/TCN[friend]TCN]NP

Semantics: \(\lambda R \lambda P [John'(\lambda z. [\exists x [\forall y [R (z) (y) \iff y = x] \land P (x)]])(friend - of') = \lambda P [John’s(\lambda z. [\exists x [\forall y [friend - of' (z) (y) \iff y = x] \land P (x)])] \)

If we apply Partee’s theory to Japanese examples, most of the possessive relations are unpredictable, and the contextually supplied relation R remains largely ambiguous. Possession relation (I) is prototypical, and part-whole relation (II) can be derived lexically from a possessive te “hand” [1]. However, other possessee nominals are not necessarily relational. In order to reduce the cost of pragmatics, [7] apply the Qualia Structure [5] of the possessee noun and type-shift even non-inherently relational NP_2 into a relational noun. For example, even though poem is not a relational noun, John’s poem can be interpreted as the poem that John composed because the internal semantic structure of poem contains an author-of relation as AGENTIVE role. The meaning shifting operator QA raises a one-place holder poem in (3a) into a two-place holder in (3b). The type-shifted NP_2 can now combine with the possessive NP, which has a uniformly type ((e,et),(et,t)) so that the authorship relation is inherited from NP_2 poem, and R is no longer a free variable.
However, even [7]'s method is not sufficient to systematically compute the meaning of the Japanese ‘NP₁-no NP₂’ construction. For example, in terms of location (III), *tomodachi* “friend” and *shinseki* “relative” in *Tokyo-no tomodachi* “a friend in Tokyo” and *Kyoto-no shinseki* “Kyoto relative” are relational nouns, i.e., *friend-of x/relative-of x*, but the relation between NP₁ and NP₂ is not *friend-of or relative of* but of location, namely, NP₂ is in NP₁. We also encounter a problem with *boshi-no fujin* “the lady with a hat.” Since wearing a hat is not part of the qualia roles, that are AGENTIVE (origin), TELIC (purpose), CONSTITUTIVE (part-whole) and FORMAL (isa) roles, of the non-inherently relational noun *fujin* “lady,” even Vikner and Jensen’s system is unable to supply the binder for R.

4 Enriching the Qualia Structure

In order to reduce the weight of pragmatics, I propose encoding more information into the lexicon elaborating the qualia structure. Specifically, I suggest adding two qualia into the already existing four qualia roles:

- **CONSTITUTIVE** = SIZE, WEIGHT, HAVE, COLOR
- **TELIC** = TRADE
- **SPATIO-TEMPO** = IN, AT
- **ACTIVITY** = MAKE_ACT, DRINK_ACT

HAVE, which is a two-place predicate with possessor and posseesee arguments, is added to subcategories of the extended CONST quole. LOCATION and TIME are subcategories of the new SPATIO-TEMPO role. These are added to the qualia roles of nominals because all physical objects usually occupy some space and time [6]. In addition to WEIGHT, which is included into the CONST quale in [5], we add SIZE, which is related to dimensionality, and COLOR. TRADE is incorporated into the TELIC role.

SIZE and COLOR are part of the CONST role of clothing artifacts such as *boshi* “hat”; therefore, *aka-no boshi* “the red hat” can be computed compositionally. The TIME, the LOCATION and the HAVE roles of location terms such as *koen* “park” are used to interpret *haru-no koen* meaning “the park in spring,” *chicaku-no koen* meaning “a nearby park,” and *tsutsuji-no koen* meaning “a park with azaleas,” respectively. TRADE role in the TELIC of proper nouns is observed in *Supa-no Marutsu* “Marutsu Supermarket” and *Kaban-no Sanpei* “Sanpei for bags.” Such expanded qualia roles can substitute R through type-shifting NP₂.
The $\epsilon$ operator and the $\iota$ operator lower the types of CN into (e). The use of the $\epsilon$ operator follows its use for Japanese nouns in [2].

(4) boshi “hat”: $\epsilon x.\text{hat'}(x)$: some x satisfying hat'(x), if there is one

hito “person”: $\iota y.\text{person'}(y)$: the unique x satisfying person'(x), if there is such a thing

no: $\lambda X.\lambda Y.\iota y.\left[\text{person'}(y) \land R - Y(\epsilon x.\text{hat'}(x))(y)\right]$

boshi-no hito “the hat person”: $\iota y.\left[\text{person'}(y) \land \text{HAVE}(\epsilon x.\text{hat'}(x))(y)\right]$

The SPATIO-TEMPO role of nouns enables the interpretations for Tokyo-no shinseki “Tokyo relative” and 3-ji no koen “the park at three o’clock,” by supplying location and temporal relations.

koe “park”

The ACTIVITY roles in Maarumoro-no kuni “the Marlboro Country,” and biiru-no machi, or “the city of beer” account for the interpretations.
5 Conclusion

Japanese genitive postpositions cannot be disambiguated in terms of the existing qualia of the possessee nominals. We need to enrich the lexical input by expanding the subcategories of FORMAL and CONSTITUTIVE roles, and by supplementing them with new roles – SPATIO-TEMPO and ACTIVITY. As [7] did not propose any method for restricting the quale to be used for type-shifting, the present analysis does not provide any suggestions for identifying the quale to be used for the interpretation of the possessive noun phrases. However, it provides the enriched lexical entry which enables access to the sense of NP₂ and determines the semantic relation expressed by Japanese genitive postpositions.

References

[1] Chris Barker. Possessive Descriptions. CSLI Publications, Stanford, 1995.

[2] Ronnie Cann, Ruth Kempson, and Lutz Marten. The Dynamics of Language: an Introduction, volume 35 of Syntax and Semantics. Academic Press, Amsterdam, San Diego, 2005.

[3] Alessandro Lenci, Nuria Bel, Federica Busa, Nicoletta Calzolari, Elisabetta Gola, Monica Monachini, Antoine Ogonowski, Ivonne Peters, Wim Peters, Nilda Ruimy, Marta Villegas, and Antonio Zampollo. Simple: A general framework for the development of multilingual lexicons. International Journal of Lexicography, 13:4:249–263, 2000.

[4] Barbara H. Partee. Genitives - a case study. appendix to theo m.v.janssen, "compositionality". In Handbook of Logic and Language, pages 464–470. Elsevier Science Publishers, Amsterdam, 1983, 1997.

[5] James Pustejovsky. The Generative Lexicon. MIT Press, Cambridge, 1995.

[6] John F. Sowa. Knowledge Representation: Logical, Philosophical, and Computational Foundations. Course Technology, 1999.

[7] Carl Vikner and Per Anker Jensen. A semantic analysis of the english genitive. interaction of lexical and formal semantics. Studia Linguistica, 56:191–226, 2002.