Interpreting Spatial Relational Nouns in Japanese

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Abstract. This paper discusses spatial terms in Japanese. Japanese is a language that uses common nouns such as *ue* "on/over/above" and *naka* "inside" to represent spatial and temporal locations as opposed to languages like English, which uses prepositions such as *on*, *in*, *under* and *between* to express spatial locations. I consider Japanese common nouns for spatial locations to be relational nouns that are two-place predicates, one of whose argument slots is filled with the entity represented by the other NP in the NP_1-*no* NP_2 construction. The corpus data [1] suggests that spatial nouns are often semantically ambiguous among physical, metaphorical and temporal locations. Therefore, the ontological information used in the Generative Lexicon (GL) [5] is useful for spatial term disambiguation.

1 Spatial Relational Nouns

This study considers common nouns representing spatial locations to be relational nouns. While languages like English use prepositions such as *in*, *on*, *under*, or *between* to represent spatial locations, languages such as Chickasaw in North America use relational nouns to express locations [2].

(1) chokka' pakna'
    house   top
    "the top of the house (the house's roof)"

[2, 4]

Pakna' is a relational noun meaning "top," which follows its possessor *chokka'* "house."

1.1 Spatial Relational Nouns in Japanese

Japanese is one such language that expresses locations by using relational nouns like *naka* "inside," *ue* "on/above," and *shita* "under."

(2) a. mune-no   mae-de   tenohira-o awase (4179)
       chest-GEN front-LOC palms-ACC   hold
       "Put your palms together in front of the chest"

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[1] The numbers in round parentheses indicate the sentence IDs of the output of the data in Yahoo! Chiebukuro section of [1] using ChaKi.NET 1.2β.

b. Sensuikan-no nakat-te   kaiteki-desu-ka? (1824)
   submarine-GEN inside-TOP comfortable-HON-Q
   "Is is comfortable inside of the submarine?"

Mae "front" and *naka* "inside" are relational nouns that do not stand alone semantically. *Mae* "front" is semantically unsaturated so that it always means something's front, as *musuko* "son" is always someone's son, e.g., *Bill's son*. *Mune* "chest" is the argument of the relation represented by *mae* "front." Similarly, *sensuikan* "submarine" is the argument of the relational noun *naka* "inside."

1.2   Non-spatial Relational Nouns

Nouns such as *father*, *friend*, and *enemy* are called relational nouns. Because a father is a father of someone, a friend is of someone, and so is enemy, they are considered to represent functions or relations *father-of*, *friend-of*, and *enemy-of*.

[4] 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, wrote or borrowed.

As for Japanese, [3] discusses what he calls *unsaturated nouns* (*hi-howa meishi*) such as *shuyaku* "hero/heroin" of a play, *joshi* "boss" of someone which do not become semantically saturated on their own.

I include what [3] calls unsaturated nouns as relational nouns, e.g., *kazu* "number" in *senpuki-no hane-no kazu* "the number of the blades of a fan," *namae* "name" in (3). Since common nouns are one place holders—a function from individuals to truth values—these relational nouns are two-place holders.

(3) a. $[\![$ *namae "name"* $]\!] = \lambda x \lambda y[\text{name-of}(y)(x)]$
     b. $[\![$ *shujinko − no namae "name of the hero"* $]\!] =$
         $\lambda x[\text{name-of}(x)(\varepsilon y.\text{hero}(y))]$

1.3   Japanese Spatial Language as Relational Nouns

This paper further regards common nouns that represent spacial locations to be relational nouns. For example, *naka* "inside," *ue* "on/above," and *shita* "under" are two-place holders, and nouns such as *aida* "between" which requires another argument are three-place predicates.

(4) a. $[\![$ *ue "on/top"* $]\!] = \lambda x \lambda y[\text{on}(y)(x)]$
     b. $[_{VP} [[_{NP}$ kohi-no ue]-ni] [miruku-o] $[_V$ ireru]]
         coffee-GEN   on-DAT milk-ACC put
         "put milk on (the surface of) coffee"
     c. $[\![$ *kohi − no ue "on coffee"* $]\!] = \lambda x[\text{on}(\varepsilon y.\text{coffee}(y))(x)]$

(5) a. $[\![$ *aida "between"* $]\!] = \lambda x \lambda y \lambda z[\text{between}(z)(y)(x)]$

b. [$_{PP}$[$_{NP}$[$_{NP}$ ha-to haguki]-no aida]-ni]   [$_{vP}$[$_{NP}$ kasu-ga] [$_{VP}$ tamari]] (2908)
   teeth-and   gum-GEN   between-DAT plaques-NOM   accumulate
   "Plaques accumulate between teeth and gum."
c. ⟦*hato_haguki − no_aida_"theplace_between_teeth_and_gum"*⟧ =
   λx[between(εy.gum(y))(εz.tooth(z))(x)]

2 Ambiguity among Physical, Metaphorical and Temporal Locations

Spatial Noun	Translation	Instances	Share	Physical Direction(Share)	Metaphor(Share)	Time(Share)
ho	toward	54	0.338	6(0.111)	48(0.889)	
naka	in	34	0.213	21(0.618)	13(0.382)	
aida	between/among	10	0.063	6(0.273)	1(0.1)	3(0.3)
ue	on	9	0.05	5	1	2
mae	in front of/before	6	0.037	5		1
shita	under	6	0.038	6(1)		
ue-no	top	6	0.038		6(1)	
ato	after	4	0.025			4(1)
chikaku	near	4	0.025	4(1)		
mawari	around	3	0.019	3(1)		
shita-no	under	2	0.013		2(1)	
tonari-no	next to	2	0.013	2(1)		
ura	back	2	0.012	2(1)		
atari	around	1	0.006	1(1)		
ato-no	after	1	0.006			1(1)
chokuzen	immediately before	1	0.006	1(1)		
chuo	center	1	0.006	1(1)		
chushin	center	1	0.006		1(1)	
fuchi	edge	1	0.006	1(1)		
gawa	side	1	0.006	1(1)		
ge	low	1	0.006		1(1)	
hidarigawa	to the left side of	1	0.006	1(1)		
mannaka	in the middle of	1	0.006	1(1)		
moto	under	1	0.006		1(1)	
mukogawa	over	1	0.006	1(1)		
omote	surface	1	0.006	1(1)		
sayu	to the both sides of	1	0.006	1(1)		
soba	beside	1	0.006	1(1)		
soto	outside	1	0.006	1(1)		
uragawa	backside	1	0.006	1(1)		
ushiro	behind	1	0.006	1(1)		
yoko	beside	1	0.006	1(1)		
TOTAL		160	1	75	74	11

Table 1. Distribution of Spatial Nouns among 3083 NP1-no NP2 Occurrences in *Yahoo! Chiebukuro* portion of [1]

Table 1 suggests that Japanese relational nouns are ambiguous between three kinds of readings, namely, locational meaning, metaphorical location, and temporal sequence. For example, the word most frequent *ho* "toward" is mostly used for comparisons and show preferences toward the better one as in (6a), rather than being used for physical directions as in (6b).

(6) a. Chunichi-yori   Hanshin-no   ho-ga   tsuyoi (2219)
      Chunichi Dragons-than Hanshin Tigers-GEN direction-NOM strong
      "Chunichi Dragons is stronger than Hanshin Tigers"
   b. (neko-ga) watashi-no ho-e   ki-masu. (5177)
      cat-NOM me-GEN   direction-GOAL come-HON
      "Cats come toward me."

Mae "front/before," on the other hand, is ambiguous between physical and temporal locations, e.g., *shuppatsu-no mae* "before departure" (4000) and *mune-no mae* "in front of the chest" (4179).

On the contrary, *ue-no* "TOP-GEN" in the *ue-no NP* construction is unambiguously used metaphorically. *Ato* "after" only applies to temporal order while *ushiro* "back" only implies literal location. Similarly, *ue* "top" is used for physical locations in the *NP-no ue* "on NP" construction. However, abstract nouns cannot use *ue* but form noun compounds with a suffix *jo* "on."

(7) a. netto-jo-de   iroiro   mite-tara (3508)
       internet-on-LOC various watch-then
       "While surfing on the internet"
    b. netto-no   ue-de iroiro   mite-tara
       internet-GEN on-LOC various watch-then
       "While surfing on the internet"

(8) a. kohi-no   ue-ni   awadate-ta miruku-o funwari ire-ta   nomimono (6320)
       coffee-GEN on-DAT whip-PAST milk-ACC to float put-PAST drink
       "a drink of coffee with whipped cream floating on it"
    b. *kohi-jo-ni   awadate-ta miruku-o funwari ire-ta   nomimono
       coffee-on-DAT whip-PAST milk-ACC to float put-PAST drink
       "a drink of coffee with whipped cream floating on it"

3   Disambiguation of Spatial Language Using Generative Lexicon

The Generative Lexicon (GL) theory [5] is a powerful tool for disambiguation of spatial terms because it provides richer semantic information to the lexicon. GL incorporates an additional lexical entry to the meaning of words called the qualia structure—constitutive (part-whole relation), formal (ontological categories, shape, color), telic (purpose), and agentive (origin).

The formal quale in GL contains ontological information. For example in (8a), coffee is a drink according to its formal quale, and its higher ontological category is a physical entity, which implies that *ue* "on" is interpreted physically. Furthermore, feature matching between relational nouns the other NP is the key to disambiguation of spatial nouns.

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