Semantic Ambiguity of Spatial Relational Nouns in Japanese

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Abstract. This paper discusses spatial terms in Japanese. Common nouns such as ue "on/over/above" and naka "inside" are used in Japanese to represent spatial and temporal locations, as front in in front of, or center in in the center of in English. I consider Japanese common nouns that represent spatial locations to be relational nouns that are two-place predicates, one of whose argument slots is filled by the entity represented by the other NP in the NP_1 -no NP_2 construction. Since the corpus data [1] suggest that spatial nouns are often semantically ambiguous among physical, metaphorical, and temporal locations, the unified semantic entry in the Generative Lexicon (GL) [2] proves to be useful for handling the semantic ambiguity.

1 Spatial Relational Nouns

Languages such as Chickasaw in North America use relational nouns to express locations [3], rather than prepositions such as *in*, *on*, *under*, or *between* as in English. In (1a), *pakna*' "top" is a relational noun, that follows its possessor *chokka*' "house." Japanese is another language that expresses locations using relational nouns such as *naka* "inside," *ue* "on/above," and *shita* "under" as in (1b).

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

[3, 4]

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

Mae "front" is a relational noun that does not stand alone semantically; therefore, it always means "the front of something," for example, musuko which means "son" always stands for "someone's son" (e.g., "Bill's son"). Naka "inside," ue "on/above," and shita "under" are two-place holders, and nouns such as aida "between" that require another argument are three-place predicates.

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

- (2) a. $[ue"on/top"] = \lambda x \lambda y [on(y)(x)]$
 - 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. $[kohi no_ue"on_coffee"] = \lambda x[on(\varepsilon y.coffee(y))(x)]$

2 Ambiguity among Physical, Metaphorical and Temporal Locations

Table 1 indicates that Japanese relational nouns are ambiguous among three types of readings—physical location, metaphorical location, and temporal sequence. For example, the most frequent relational word *ho* "toward" is generally used for comparisons and indicates preference as in (3a). Such meaning is a metaphorical extension of literal physical directions as in (3b). On the other hand, *mae* "front/before" is ambiguous between physical and temporal locations; for example, *shuppatsu-no mae* "before departure" (4000) and *mune-no mae* "in front of the chest" (4179).

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)		
TOTAL		160	1	75	74	11

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

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

3 Modeling Lexical Ambiguity of Spatial Language

3.1 Formal Semantics

This section formalizes the spatial terms in Japanese. Most of them are two-place holders except *aida* "between" which is a three-place predicate.

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(4) a. [mae] = \lambda x, y[in-front-of(x)(y)]
     b. [mae] = \lambda t, t'[before(t)(t')]
(5) a. [mune - no\_mae"in\_front\_of\_the\_chest"] = \lambda y.in-front-of(\varepsilon x.chest(x))(y)
     b. [shuppatsu-no\_mae"before\_departure"]
        = \lambda e'.\exists e[before(time(e))(time(e'))\&departure(e)]
(6) a. \llbracket ho \rrbracket = \lambda x, y[toward(x)(y)]
     b. [ho] = \lambda x, y[to(x)(y)]
(7) a. [(physical)naka] = \lambda x, y.in(x)(y)
     b. [(metaphorical)naka] = \lambda x, y.among(x)(y)
(8) a. [nabe - no\_naka"inside\_the\_pot"] = \lambda y.in(\varepsilon x.pot(x))(y)
     b. [reshipi - no\_naka``amongrecipes''] = \lambda y.among(\varepsilon x.recipe(x))(y)
  (9) a. [aida] = \lambda x, y, z[between(x)(y)(z)]
       b. [aida] = \lambda x, y, z[among(x)(y)(z)]
       c. [aida] = \lambda t, t'[t' = during(t)]
(10) a. Ha-to
                                                             chairoku naru-no-desu-ka. (2906)
                      ha-no
                                   aida
                                             atari-ga
           tooth-and tooth-GEN between vicinity-NOM brown become-GEN-HON-Q
           "Have the gaps between your teeth turned brown?"
       b. Geinojin-no
                             aida-de
                                           hayat-teiru
                                                            daietto-shokuhin (427)
           entertainer-GEN among-LOC popular-PROG diet-food
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3.2 Lexical Ambiguity in the Generative Lexicon

this a few months-GEN period "during these few months"

c. Koko sukagetsu-no

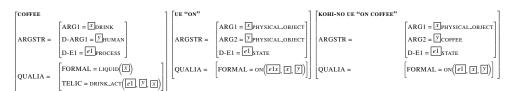
"The diet food popular among TV entertainers"

Contrary to the previous section which listed two-way or three-way ambiguous lexical entries, the GL [2] has the means to provide unified lexical entries for a single spatial term, due to its elaborate lexical semantic information. In particular, the Lexical Conceptual Paradigm (LCP) [4, 2] is a powerful tool for resolving semantic ambiguity.

aida (3201)

The formal quale in GL contains ontological information. In (11), *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. The unification profess is described in the following manner:

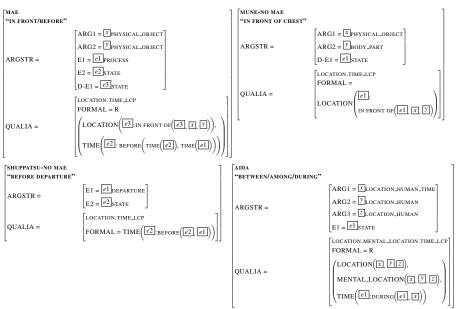
(11)



Mae "in front/before" is lexically ambiguous between physical and temporal locations. Lexical ambiguity calls for a meta-entry, that is, the LCP, which is a Cartesian product of the different concepts represented by a single lexical item [2, 5] as in (12). For example, book is a Cartesian product of a physical entity and the information contained within it, thus, (13a,b) are both grammatically correct.

- (12) mae.lcp = {location.time, location, time }
- (13) a. The book is on the table.
 - b. That book was right. An earthquake did happen as it had predicted.

(14)



Argument structure also needs to have metaentries since mae "front/before" and aida "between/among/during" combine with different types of semantic arguments.

Conclusion

In this paper, spatial language in the form of "NP₁-GEN NP₂" constructions in Japanese was taken from [1] and classified into literal, temporal, and metaphorical meanings. Spatial terms are semantically ambiguous relational nouns. Lexical meta-entries in the GL effectively handle the semantic ambiguity of the most common spatial nouns.

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