

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”

¹

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. $[[ue\text{“}on/top\text{”}]] = \lambda x \lambda y [on(y)(x)]$
 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. $[[kohi - no_ue\text{“}on_coffee\text{”}]] = \lambda x [on(\epsilon y.coffee(y))(x)]$

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.

- (4) a. $\llbracket mae \rrbracket = \lambda x,y[\text{in-front-of}(x)(y)]$
 b. $\llbracket mae \rrbracket = \lambda t,t'[\text{before}(t)(t')]$
- (5) a. $\llbracket mune - no_mae \text{“in_front_of_the_chest”} \rrbracket = \lambda y.\text{in-front-of}(\epsilon x.\text{chest}(x))(y)$
 b. $\llbracket shuppatsu - no_mae \text{“before_departure”} \rrbracket = \lambda e'.\exists e[\text{before}(\text{time}(e))(\text{time}(e')) \& \text{departure}(e)]$
- (6) a. $\llbracket ho \rrbracket = \lambda x,y[\text{toward}(x)(y)]$
 b. $\llbracket ho \rrbracket = \lambda x,y[\text{to}(x)(y)]$
- (7) a. $\llbracket (\text{physical})naka \rrbracket = \lambda x,y.\text{in}(x)(y)$
 b. $\llbracket (\text{metaphorical})naka \rrbracket = \lambda x,y.\text{among}(x)(y)$
- (8) a. $\llbracket nabe - no_naka \text{“inside_the_pot”} \rrbracket = \lambda y.\text{in}(\epsilon x.\text{pot}(x))(y)$
 b. $\llbracket reshipi - no_naka \text{“among_recipes”} \rrbracket = \lambda y.\text{among}(\epsilon x.\text{recipe}(x))(y)$
- (9) a. $\llbracket aida \rrbracket = \lambda x,y,z[\text{between}(x)(y)(z)]$
 b. $\llbracket aida \rrbracket = \lambda x,y,z[\text{among}(x)(y)(z)]$
 c. $\llbracket aida \rrbracket = \lambda t,t' [t' = \text{during}(t)]$
- (10) a. Ha-to ha-no aida atari-ga chairoku naru-no-desu-ka. (2906)
 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
 “The diet food popular among TV entertainers”
 c. Koko sukagetsu-no aida (3201)
 this a few months-GEN period
 “during these few months”

3.2 Lexical Ambiguity in the Generative Lexicon

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.

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 process is described in the following manner:

(11)

$$\left[\begin{array}{l} \text{COFFEE} \\ \text{ARGSTR} = \left[\begin{array}{l} \text{ARG1} = \boxed{x} \text{DRINK} \\ \text{D-ARG1} = \boxed{y} \text{HUMAN} \\ \text{D-E1} = \boxed{e1} \text{PROCESS} \end{array} \right] \\ \text{QUALIA} = \left[\begin{array}{l} \text{FORMAL} = \text{LIQUID}(\boxed{x}) \\ \text{TELIC} = \text{DRINK_ACT}(\boxed{e1} \boxed{y} \boxed{x}) \end{array} \right] \end{array} \right] \left[\begin{array}{l} \text{UE “ON”} \\ \text{ARGSTR} = \left[\begin{array}{l} \text{ARG1} = \boxed{x} \text{PHYSICAL_OBJECT} \\ \text{ARG2} = \boxed{y} \text{PHYSICAL_OBJECT} \\ \text{D-E1} = \boxed{e1} \text{STATE} \end{array} \right] \\ \text{QUALIA} = \left[\begin{array}{l} \text{FORMAL} = \text{ON}(\boxed{e1x} \boxed{y} \boxed{y}) \end{array} \right] \end{array} \right] \left[\begin{array}{l} \text{KOHI-NO UE “ON COFFEE”} \\ \text{ARGSTR} = \left[\begin{array}{l} \text{ARG1} = \boxed{x} \text{PHYSICAL_OBJECT} \\ \text{ARG2} = \boxed{y} \text{COFFEE} \\ \text{D-E1} = \boxed{e1} \text{STATE} \end{array} \right] \\ \text{QUALIA} = \left[\begin{array}{l} \text{FORMAL} = \text{ON}(\boxed{e1} \boxed{y} \boxed{y}) \end{array} \right] \end{array} \right]$$

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)

<p>[MAE “IN FRONT/BEFORE”</p> <p>ARGSTR =</p> $\begin{bmatrix} ARG1 = [x]_{PHYSICAL_OBJECT} \\ ARG2 = [y]_{PHYSICAL_OBJECT} \\ E1 = [e1]_{PROCESS} \\ E2 = [e2]_{STATE} \\ D-E1 = [e3]_{STATE} \end{bmatrix}$ <p>QUALIA =</p> $\begin{bmatrix} LOCATION_TIME_LCP \\ FORMAL = R \\ \left(LOCATION([e3]_{IN\ FRONT\ OF}([x], [y])). \right) \\ \left(TIME([e2]_{BEFORE}(TIME([e2]), TIME([e1]))) \right) \end{bmatrix}$	<p>[MUNE-NO MAE “IN FRONT OF CHEST”</p> <p>ARGSTR =</p> $\begin{bmatrix} ARG1 = [x]_{PHYSICAL_OBJECT} \\ ARG2 = [y]_{BODY_PART} \\ D-E1 = [e1]_{STATE} \end{bmatrix}$ <p>QUALIA =</p> $\begin{bmatrix} LOCATION_TIME_LCP \\ FORMAL = \\ \left(LOCATION([e1]_{IN\ FRONT\ OF}([x], [y])) \right) \end{bmatrix}$
<p>[SHUPPATSU-NO MAE “BEFORE DEPARTURE”</p> <p>ARGSTR =</p> $\begin{bmatrix} E1 = [e1]_{DEPARTURE} \\ E2 = [e2]_{STATE} \end{bmatrix}$ <p>QUALIA =</p> $\begin{bmatrix} LOCATION_TIME_LCP \\ FORMAL = TIME([e2]_{BEFORE}([e2], [e1])) \end{bmatrix}$	<p>[AIDA “BETWEEN/AMONG/DURING”</p> <p>ARGSTR =</p> $\begin{bmatrix} ARG1 = [x]_{LOCATION_HUMAN_TIME} \\ ARG2 = [y]_{LOCATION_HUMAN} \\ ARG3 = [z]_{LOCATION_HUMAN} \\ E1 = [e1]_{STATE} \end{bmatrix}$ <p>QUALIA =</p> $\begin{bmatrix} LOCATION_MENTAL_LOCATION_TIME_LCP \\ FORMAL = R \\ \left(LOCATION([x], [y], [z]). \right) \\ \left(MENTAL_LOCATION([x], [y], [z]). \right) \\ \left(TIME([e1]_{DURING}([e1], [x])) \right) \end{bmatrix}$

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

4 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.

References

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