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Keiko TAKEHANA

Otemae journal of humanities

volume 5

page range A69-A78

year 2004

URL http://id.nii.ac.jp/1160/00000581/

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A system of spatial categorization represented in the semantic relations between prepositions

TAKEHANA Keiko

Summary:
The investigation of spatial categorization in English, especially the linguistic categorization of spatial concepts, has been devoted to the study of prepositions. Previous literature (Leech 1969; Bennett 1975; Miller & Johnson-Laird 1976, Rule 1989) could not capture the polysemous relations of meanings of each preposition, and Lexical Network Model has been emerged (Brugman 1981; Lakoff 1987; Johnson 1987; Taylor 1990; Tyler & Evans 2003). What these studies lack is the systematic analysis of semantics between prepositions. Spatial categorization can be clarified by investigating not only the polysemous meanings of each preposition, but also the systematic relations of semantics of prepositions. While Lexical Network Models may be feasible for the semantic analysis of each preposition, feature analysis serves better to figure out the systematic relations of prepositions, and I used semantic features to show their relations. English prepositions form systematic categorization in terms of antonymy, synonymy and distinction.

Key words: cognitive semantics, spatial categorization, prepositions.

1. Introduction

The Cognitive investigation of the semantic networks of English prepositions was begun by Lakoff (1987), which analyzed the polysemy of over in terms of image-schema. Related linguistic literature has been devoted on the same line; Tyler & Evans (2001), Kreitzer (1997) and Vandeloise (1990). Experimental psy-
chology, on the other hand, has begun to confirm those linguistic analyses by means of psychological experiments using computer graphics, ex. Kojima & Kusumi (2002). Since cognitive linguistics is based on the psychological reality by nature, its theory should be scrutinized by these kind of experiments.

The aim of this paper is to show a clear semantic analysis of the relation between prepositions. This attempt is important because the relation between spatial concepts and linguistic representations cannot be scrutinized by experiments without reliable linguistic analyses. I analyze the semantic network of English spatial prepositions in terms of the semantic features and show the synonymy, antonymy and other semantic relations. I will adopt the feature analysis to make the relation appear much clearer.

For the purpose of this paper, a cross-linguistic analysis is also essential. The nature of spatial expressions differs from language to language. As Levinson, Meira et al (2003) shows, Languages are placed on a scale according to their abundance of spatial adpositions. English is placed on a high level, and Japanese on a low level. I will examine the spatial expressions of Japanese and show the nature of their system to concatenate the systematic analysis of English prepositions to that of spatial adpositions in general.

In section 2, related psychological experiments are introduced. In section 3, the semantic network of English spatial prepositions is analyzed in terms of the semantic features, showing the synonymy, antonymy and other semantic relations. In section 4, I will show a brief cross-linguistic analysis of spatial expressions.

2. Psychological experiments concerning spatial relations

What sort of experiments do psychologists undergo on the basis of linguistic analyses? The answer to this question may help us linguists to clarify the goal of our investigation. The first experiment examines a cognitive semantic analysis of the preposition *over* in Lakoff (1987), and the second experiment aims to depict the relation between the spatial concept and the value concept of the human mind.

2.1 An examination of a cognitive semantic analysis of the preposition *over*

Kojima & Kusumi (2002) examined the image-schema of *over* as in (1) using the 3 dimensional computer graphics to find out the importance of the feature “Path” in
A system of spatial categorization represented in the semantic relations between prepositions recognition.

(1)  
a. The bird flew over the yard. (eXtended-No Contact)  
b. Sam drove over the bridge. (eXtended-Contact)  
c. The plane flew over the hill. (Vertical-eXtended-No Contact)  
d. Sam walked over the hill. (Vertical-eXtended-Contact)  
e. Sam climbed over the wall. (Vertical-Contact)  
f. The bird flew over the wall. (Vertical-No Contact)  
g. Sausalito is over the bridge. (eXtended-Contact-End point focus)  
h. Sam lives over the hill. (Vertical-eXtended-Contact-End point focus)  

(Lakoff (1987)(2001))

Their results show that the feature “Path” plays a crucial role in the spatial conceptualization of over.

2.2 Integrating spatial and emotional information

Orientational metaphors that associate GOOD with UP and BAD with DOWN suggest that spatial concepts are used to represent positivity and negativity. L. Elizabeth Crawford examined how the association between valence and verticality influences memory and evaluation of spatially distributed, emotionally evocative stimuli. Memories of stimulus locations are systematically biased by stimulus valence, such that positive items are shifted upward relative to negative items. In contrast, there is no evidence that spatial information affects how stimuli are evaluated. The results provide support for a metaphorical mediation of affect, even during non-linguistic tasks, and offer new evidence that stimulus valence biases spatial memory.

3. The semantic network of English spatial prepositions

I analyze the spatial prepositions of English based on the semantic analysis of Bennett (1975) and clarify their semantic network in terms of synonymy, antonymy and other semantic relations. Prepositions: over, under, above, below, up, down, at, on, in, away, off and out, will be analyzed since they have spatial use. I will adopt the feature analysis to make the relation appear much clearer.

3.1 Superior/higher vs. inferior/lower
Let me examine *over, under, above, below, up and down*, which show superior/higher vs. inferior/lower relations.

### 3.1.1 *over* and *under*

The semantic representation of the spatial use of *over* is analyzed as below, Bennett (1975:50). I will use the abbreviations; **G**: goal, **L**: locative, **P**: path and **S**: source.

(2)  

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>My hand is over the table.</td>
</tr>
<tr>
<td></td>
<td>([L \text{ [superior of table] place}])</td>
</tr>
<tr>
<td>b.</td>
<td>I removed the lamp from over the counter.</td>
</tr>
<tr>
<td></td>
<td>([S \text{ [L [superior of counter] place]}]]</td>
</tr>
<tr>
<td>c.</td>
<td>Please put the lamp over the counter (<em>ie. via</em>).</td>
</tr>
<tr>
<td></td>
<td>([P \text{ [L [superior of counter] place]}]]</td>
</tr>
<tr>
<td>d.</td>
<td>Please put the lamp over the counter (<em>ie. to</em>).</td>
</tr>
<tr>
<td></td>
<td>([G \text{ [L [superior of counter] place]}]]</td>
</tr>
<tr>
<td>e.</td>
<td>The post office is over the hill.</td>
</tr>
<tr>
<td></td>
<td>([L \text{ [P [L [superior of hill] place]] place]}]</td>
</tr>
<tr>
<td>f.</td>
<td>A car appeared from over the hill.</td>
</tr>
<tr>
<td></td>
<td>([S \text{ [L [P [L [superior of hill] place]] place]}]]</td>
</tr>
</tbody>
</table>

The common semantic feature of *over* analyzed above is 'locative superior', which is the antipodes of *under* whose common semantic feature is 'locative inferior' as exemplified below. They share the identical semantic feature 'locative' but one can draw a distinction between 'superior' and 'inferior'.

(3)  

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>The dog is under the table.</td>
</tr>
<tr>
<td></td>
<td>([L \text{ [inferior of table] place}])</td>
</tr>
<tr>
<td>b.</td>
<td>The dog emerged from under the table.</td>
</tr>
<tr>
<td></td>
<td>([S \text{ [L [inferior of table] place]}]]</td>
</tr>
<tr>
<td>c.</td>
<td>The dog ran under the table to the door.</td>
</tr>
<tr>
<td></td>
<td>([P \text{ [L [inferior of table] place]}]]</td>
</tr>
<tr>
<td>d.</td>
<td>The dog ran under the table (<em>ie to</em>).</td>
</tr>
<tr>
<td></td>
<td>([G \text{ [L [inferior of table] place]}]]</td>
</tr>
<tr>
<td>e.</td>
<td>The cathedral is under the bridge.</td>
</tr>
<tr>
<td></td>
<td>([L \text{ [P [L [inferior of bridge] place]] place]}]</td>
</tr>
</tbody>
</table>
A system of spatial categorization represented in the semantic relations between prepositions

f. A rabbit appeared from under the hedge.
   \[ [S \:\: [L \:\: [P \:\: [L \:\: \text{inferior of hedge}] \:\: \text{place}]] \:\: \text{place}] \]

3.1.2 above and below

Locative, source and goal use of \textit{above} is exemplified below, Bennett (1975: 57).

(4) a. John's picture is above the shelf.
   \( [L \:\: \text{[higher of shelf]} \:\: \text{place}] \)

b. I've removed John's picture from above the shelf.
   \( [S \:\: [L \:\: \text{[higher of shelf]} \:\: \text{place}]] \)

c. I've put John's picture above the fireplace.
   \( [G \:\: [L \:\: \text{[higher of fireplace]} \:\: \text{place}]] \)

The common semantic feature of \textit{above} analyzed above is 'locative higher', which is the antipodes of \textit{below} whose common semantic feature is 'locative lower' as exemplified below. They share the identical semantic feature 'locative' but one can draw a distinction between 'higher' and 'lower'.

(5) a. The vase is below John's picture.
   \( [L \:\: \text{[lower of picture]} \:\: \text{place}] \)

b. I've removed the vase from below John's picture.
   \( [S \:\: [L \:\: \text{[lower of picture]} \:\: \text{place}]] \)

c. I've put the vase below John's picture.
   \( [G \:\: [L \:\: \text{[lower of picture]} \:\: \text{place}]] \)

3.1.3 \textit{up} and \textit{down}

The spatial use of \textit{up} and \textit{down} are exemplified below, Bennett (1975: 88).

(6) a. Trevor walks up the hill every day.
   \( [G \:\: [L \:\: \text{[higher of hill]} \:\: \text{place}]] \)

b. Gwyneth lives up the hill.
   \( [L \:\: [G \:\: [L \:\: \text{[higher of hill]} \:\: \text{place}]]] \)

(7) a. The dog has just run down the stairs.
   \( [G \:\: [L \:\: \text{[lower of stairs]} \:\: \text{place}]] \)

b. The dog is downstairs.
   \( [L \:\: [G \:\: [L \:\: \text{[lower of stairs]} \:\: \text{place}]]] \)

The common semantic feature of \textit{up} is 'goal locative higher' and that of \textit{down} is 'goal locative lower'. They share the identical semantic feature 'goal locative'
but one can draw a distinction between 'higher' and 'lower'.

3.2 Interior/exterior and attachment

Let me examine at, on, in, away, off and out which show interior/exterior and attachment relations.

3.2.1 at, on, in

Their spatial use is exemplified below, Bennett (1975:66, 67).

(8) a. Gwyneth is at the supermarket.
   [L [supermarket] place]
   b. The book is on the table.
   [L [surface of table] place]
   c. Gwyneth is in the supermarket.
   [L [interior of supermarket] place]

At, on and in has semantic feature 'locative', 'locative surface', and 'locative interior' respectively. Their common semantic feature is 'locative', and one can draw a distinction between 'φ', 'surface', and 'interior'.

3.2.2 away, off, out

Their spatial use is exemplified below, Bennett (1975:72)

(9) a. Trevor is away from home.
   [G [L [some place from home] place]]
   b. The ball is off the grass.
   [G [L [off of grass] place]]
   c. Gwyneth is out of the room.
   [G [L [exterior of room] place]]

Away, off and out has semantic feature 'goal locative some place', 'goal locative off', and 'goal locative exterior' respectively. Their common semantic feature is 'goal locative', and one can draw a distinction between 'some place', 'off' and 'exterior'.

3.3 The semantic network of prepositions

The semantic network of the English prepositions analyzed above is summarized in the tables below. Table 1 shows superior/higher vs. inferior/lower relations analyzed in 3.1. Table 2 shows interior/exterior and attachment relations analyzed
A system of spatial categorization represented in the semantic relations between prepositions in 3.2.

**Table 1. Superior/higher vs. inferior/lower**

<table>
<thead>
<tr>
<th>Prep</th>
<th>feature</th>
<th>Prep</th>
<th>feature</th>
<th>antonymy</th>
</tr>
</thead>
<tbody>
<tr>
<td>at</td>
<td>L</td>
<td>away (from)</td>
<td>G L some place</td>
<td>\phi/G some place</td>
</tr>
<tr>
<td>on</td>
<td>L surface</td>
<td>off</td>
<td>G L off</td>
<td>surface/G off</td>
</tr>
<tr>
<td>in</td>
<td>L interior</td>
<td>out (of)</td>
<td>G L exterior</td>
<td>interior/G exterior</td>
</tr>
<tr>
<td>synonymity</td>
<td>L</td>
<td>GL</td>
<td>some place/off/exterior</td>
<td></td>
</tr>
<tr>
<td>distinction</td>
<td>\phi/surface/interior</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 2. Interior/exterior and attachment**

<table>
<thead>
<tr>
<th>Prep</th>
<th>feature</th>
<th>Prep</th>
<th>feature</th>
<th>antonymy</th>
</tr>
</thead>
<tbody>
<tr>
<td>over</td>
<td>(P) L superior</td>
<td>under</td>
<td>(P) L inferior</td>
<td>superior/inferior</td>
</tr>
<tr>
<td>above</td>
<td>L higher</td>
<td>below</td>
<td>L lower</td>
<td>higher/lower</td>
</tr>
<tr>
<td>up</td>
<td>G L higher</td>
<td>down</td>
<td>G L lower</td>
<td>higher/lower</td>
</tr>
<tr>
<td>synonymity</td>
<td>superior, higher</td>
<td>inferior, lower</td>
<td></td>
<td></td>
</tr>
<tr>
<td>distinction</td>
<td>(P) L/L/\GL</td>
<td>(P) L/L/\GL</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Spatial expressions across languages

Spatial categorization can be clarified by investigating not only the polysemous meanings of each preposition, but also systematic relations of semantics of prepositions. The importance of this point of view could be noticed if we look at the spatial language cross-linguistically. Related literature shows how varied the systems of spatial expressions are from language to language. As the typological study of spatial adpositional systems by Levinson, Meira et al (2003) shows, every language does not necessarily share the rich variety of adpositions or prepositions, illustrated in figure 1 (ibid.: 510)

Figure 1: Implicational scale over adpositional notions.

AT<IN<ON, UNDER<OVER, NEAR<ON-TOP<ATTACHED<INSIDE<SPIKED, HANGING, DISTRIBUTED-OVER

This implicational scale predicsst that any language that has an INSIDE adposition also has an ON-TOP and an OVER, as well as IN. Although some adjustment needs to be made, English enjoys almost the full, rich scale of prepositions, while Japanese
has only the variants of AT, i.e. /de/ and /ni/. For example, in ne ni ‘on’, /ue/ means upper place, while in naka de ‘in’, /naka/ means inside. Thus, in Japanese, spatial nouns + spatial particles serve as spatial terms, except for ‘source’ and ‘goal’ terms like /kara/, /wo/, /made/ and /he/. Table 3 shows the counterpart Japanese expressions for the prepositions in table 1 and table 2.

Table 3. Spatial expressions in English and Japanese

<table>
<thead>
<tr>
<th>Prep</th>
<th>Japanese</th>
<th>Prep</th>
<th>Japanese</th>
</tr>
</thead>
<tbody>
<tr>
<td>at</td>
<td>/ni/</td>
<td>away (from)</td>
<td>/hanare-VERB te/</td>
</tr>
<tr>
<td>on</td>
<td>/ue-NOUN ni/</td>
<td>off</td>
<td>/hanare-VERB te/</td>
</tr>
<tr>
<td>in</td>
<td>/naka-NOUN ni/</td>
<td>out (of)</td>
<td>/soto-NOUN ni/</td>
</tr>
<tr>
<td>over</td>
<td>/ue-NOUN ni/</td>
<td>under</td>
<td>/sita-NOUN ni/</td>
</tr>
<tr>
<td>above</td>
<td>/ue-NOUN ni/</td>
<td>below</td>
<td>/sita-NOUN ni/</td>
</tr>
<tr>
<td>up</td>
<td>/sita-NOUN he/</td>
<td>down</td>
<td>/sita-NOUN he/</td>
</tr>
</tbody>
</table>

In the cases of away and off in table 3, Japanese expresses spatial relations in terms of motion, that is, verbs and connecting particles.

On the usage level, Japanese spatial expressions given in table 3 are sometimes taken to be redundant, and the sentences as a whole illustrate the spatial relations exemplified below, Tanaka (1997: 22).

(10)  a. Taro ha daidokoro ni iru.
    Taro-SUB kitchen at is
    (Taro is in the kitchen.)

    b. Tsukue ni ringo ga aru.
    Table at apple-SUB is
    (There is an apple on the desk.)

    c. Kono kawa ni sakana ga takusann iru.
    This river at fish-SUB plenty is
    (There’s plenty of fish in this river.)

5. Conclusions

I analyzed the semantic network of English spatial prepositions in terms of the
A system of spatial categorization represented in the semantic relations between prepositions semantic features and showed the synonymy, antonymy and other semantic relations, adopting the feature analysis to make the relation appear much clearer. Thus I made the spatial expressions discernible by the related psychological experiments. As the comparison between English and Japanese spatial expressions depict, spatial relations are illustrated not only in terms of adpositions but in related motion verbs. This fact reveals the complexity and the diversity of conceptual space across languages.

Note
1) Other than ‘attachment’, ‘path’ expressions in Japanese have same sort of tendency. ‘Path’ is expressed as motion exemplified below.

i. Kare ha douro wo yokogitta.
   He-SUB road-OBJ went-across-VERB
   (He went across the road.)

ii. Kanojo ha tonneru wo torinuketa.
   She-SUB tunnel-OBJ went-through-VERB
   (She went through the tunnel.)

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