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1. Introduction

Second language (L2) learners have difficulties in acquiring English prepositions (P). This has something to do with the syntax of Ps. As adjuncts, Ps optionally interact with syntactic head, i.e., verbs, to play a dedicated role in semantic composition (Inagaki, 2002; Fujimori, 2015). English has more than 80 Ps (Déchaine, 2005) and they are often analyzed as lexical categories. Their lexical semantics are also complex. For instance, spatial Ps are relevant to semantic properties such as the speaker's viewpoint (Jackendoff, 1996) and the cognitive accessibility of objects (Johnston & Slobin, 1979). With these syntactic and semantic properties, L2 learners often misuse Ps and their errors account for 15% of the total (Matsubara, 1980).

The present study is concerned with the lexical acquisition of spatial Ps in English. We investigate whether Japanese learners of English as a foreign language (EFL) can properly use spatial Ps. We also try to figure out what properties cause difficulty in acquiring Ps. The paper is organized as follows: In section 2 we explain lexical semantic properties of Ps relevant to our discussion. In section 3 we review studies on acquisition of Ps. In section 4 we explain the procedure of our experiment and show its results. In section 5 we discuss the experimental results.

2. Background

2.1. Lexical semantic properties of English Ps

Among spatial Ps in the vertical axis, “over” and “under” are more complex than “above” and “below” in that they denote perpendicularity (Lindstromberg, 2010). Consider the sentences in (1), for example. In (1a), *over* locates a figure *Pepe* directly and perpendicularly up the landmark *table*, while *above* in (1b) can locate *Pepe* somewhere up, out of the perpendicular (i.e., outside the dotted extension lines of the landmark in Figure 1). The difference between the two prepositions is illustrated in Figure 1.

- (1) a. Pepe is **over** the table.
- b. Pepe is **above** the table.
- c. Pepe is **under** the table.
- d. Pepe is **below** the table.

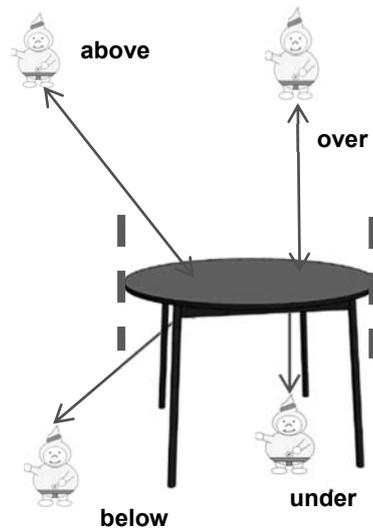


Figure 1: Images of “over”, “above”, “under”, and “below”

“Under” and “below” are a set of vertical Ps in the lower direction. In (1c), *under* locates *Pepe* perpendicularly down the landmark *table*, while *below* in (1d) can locate *Pepe* somewhere down, outside the dotted extension lines of the landmark.

To summarize, the two vertical prepositions “over” and “above” share the upper orientation ([up] henceforth) while they differ in that only “over” is specified in perpendicularity, as in Table 1. Likewise, “under” and “below” share the lower orientation ([down]) while only “under” has the property of perpendicularity.

Table 1: Semantic properties of vertical Ps

Preposition	Orientation	Perpendicularity
over	[up]	[perpendicular]
above		unspecified
under	[down]	[perpendicular]
below		unspecified

Regarding horizontal Ps, “before”, “in front of”, “after”, and “behind” have something in common: The landmark of these Ps is oriented, i.e., having a front or face (Tyler & Evans, 2003). “Before” or “in front of” is used to refer to the anterior orientation of the landmark *car*, as in (2a-b), while “after” or “behind” is used to refer to the posterior orientation, as in (2c-d).

- (2) a. Pepe is running **before** the car.
 b. There is a ball **in front of** the car.
 c. Pepe is running **after** the car.
 d. There is a ball **behind** the car.

The only difference between “before” and “in front of” is that the figure *Pepe* of “before” is also oriented, while the figure of “in front of” is not, as illustrated in Figure 2. Hence, “before”, but not “in front of”, denotes the in tandem alignment where the figure *Pepe* is anterior to the landmark *car*. If both the figure and landmark are in action, the in tandem alignment leads to temporal order. Likewise, “after” and “behind” differ in that only the figure of “after” is oriented. “After”, but not “behind”, denotes the in tandem alignment of the figure *Pepe* posterior to the landmark *car*. The semantic properties of horizontal prepositions are summarized in Table 2.

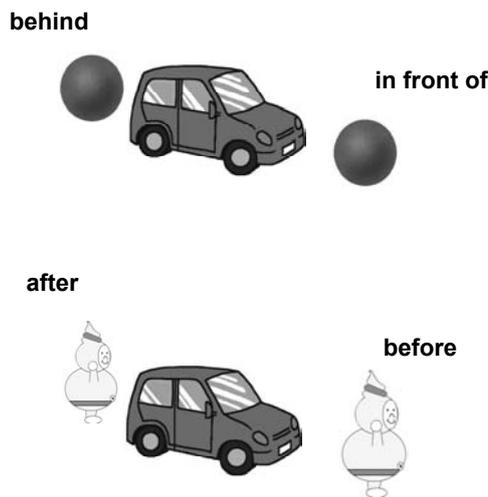


Figure 2: Images of “before”, “in front of”, “after”, and “behind”

Table 2: Semantic properties of horizontal Ps

Ps	Orientation	Landmark’s orientation	Figure’s orientation	Tandem alignment
in front of	[anterior]	[oriented]	unspecified	NO
before		[oriented]	[oriented]	YES
behind	[posterior]	[oriented]	unspecified	NO
after		[oriented]	[oriented]	YES

2.2. Japanese Ps

Japanese has an equivalent expression for each pair of English Ps discussed above. Take the pair *over/above* for instance. The pair corresponds to a Japanese nominal expression *ue* “up” (which is often followed by an accusative case marker *-o* or a locational postposition *-ni* “at”), as shown in (3).

- (3) a. koumori-ga Pepe-no atama-no **ue**-o tondeiru
bat-NOM Pepe-GEN head-GEN up-ACC flying
‘A bat was flying **over** Pepe’s head.’
- b. doroon-ga Pepe-no Atama-no **ue**-o tadayotteiru
bat-NOM Pepe-GEN head-GEN up-ACC floating
‘A drone was floating **above** Pepe’s head.’

The rest of the prepositional pairs each correspond to a Japanese equivalent in the way the pair *over/above* does, as shown in (4) to (6): *Sita* “down” corresponds to *under/below*, *mae* “front” to *before/in front of*, and *usiro* “back” to *after/behind*.

- (4) a. neko-ga isu-no **sita**-ni iru
cat-NOM chair-GEN down-ni be
‘A cat is **under** the chair.’
- b. kaidan-no **sita**-ni ciisana heya-ga aru
stairs-GEN down-ni small room-NOM be
‘There is a small room **below** the stairs.’
- (5) a. kodomotati-ga basutei-de John-no **mae**-ni narandeiru
children-NOM bus.stop-at John-GEN before-ni lined.up
‘The children are lining up **before** John at the bus stop.’
- b. Pepe-ga jitensya-o mise-no **mae**-ni oita
Pepe-NOM bicycle-ACC shop-GEN front-ni parked
‘Pepe parked his bicycle **in front of** the shop.’
- (6) a. Pepe-ga kanban-no **usiro**-ni tatteiru
Pepe-NOM ad-GEN back-ni Pepe-NOM song-ACC sang
‘Pepe is standing **behind** the advertisement.’

- b. Pepe-ga ane-no **usiro**-o otta
Pepe-NOM elder.sister-GEN back-ACC chased
'Pepe ran **after** his elder sister.'

3. Acquisition of Ps

In L1 acquisition, English-speaking children start using spatial Ps such as “in” and “on” prior to others (Tomasello, 1987; Littlefield, 2004). These are categorized as denoting a cognitively simple notion – locating a figure with a landmark in terms of coincidence (coincidental Ps). Other Ps, including “over”, “behind”, and “beside”, denote a relatively complex notion of intrinsic orientation pertaining to vertical and horizontal axes (orientation Ps) (Sinha et al., 1999). Owen (2014) shows in his longitudinal study of child language acquisition that children first uttered “in” and “on” at age 2;0, “under” at 3;0, “next to” at 3;4, and “behind” and “in front of” at 4;0. They still had difficulty with “above” and “below” after 4;0. These findings suggest that the children’s use of English prepositions is affected by their spatial cognition. That is, children can immediately recognize the location of the figure which has a physical contact with the landmark. Once the figure is geographically dislocated from the landmark, however, the location causes troubles in recognition, regardless of vertical and horizontal axes.

In L2 studies, Matsubara (1984) considers the L1 fact that children develop their cognitive perception from unmarked to marked stages. According to Clark (1973), locational Ps are unmarked and they are acquired prior to directional Ps in relation to the direction of motion. Among directional Ps, unmarked are the ones which denote a goal of motion (e.g., “to”) while marked, directional Ps like “from” denotes the source of motion. Matsubara investigated whether the markedness of Ps also causes any difficulties in L2 English. He conducted a Production Task with Japanese EFL learners at a junior high school (JH), high school (HS), and university (UN). The participants were asked to fill in a gap of each test sentence with a preposition which they thought matched a picture. The results show that there were differences among the three types of prepositions, as seen in Table 3. The mean accuracy rate of locational Ps was the highest. Also, the accuracy rate of unmarked, directional Ps was higher than that of marked ones. Based on these results, Matsubara concluded that the markedness of prepositional directionality is one of the factors that cause difficulty in acquiring L2 English prepositions.

Table 3: Mean accuracy rates (%) of producing locational and directional Ps

Group	Locational Ps (<i>at, in, on</i>)	Directional Ps (unmarked) (<i>to, onto, into</i>)	Directional Ps (marked) (<i>from, off, out of</i>)
JH, 2 nd year (<i>n</i> =40)	68.89	33.9	12.5
JH, 3 rd year (<i>n</i> =40)	64.44	35.3	23.3
HS, 1 st year (<i>n</i> =40)	80.56	48.6	39.4
HS, 2 nd year (<i>n</i> =40)	76.94	61.1	48.3
HS, 3 rd year (<i>n</i> =40)	79.17	60.0	51.9
UN (<i>n</i> =40)	84.17	60.0	49.4

Fujimori (2014) examined whether Japanese college EFL learners can properly use vertical orientational Ps, a subcategory of locational Ps. The participants were given a Production Task where they were asked to fill in a gap of each test sentence with a preposition appropriate for a watched video clip. He found differences even among the locational Ps in correct use: In the upward orientation, “on”, “over”, and “above” were arranged in order of increasing difficulty, as seen in Table 4. In the downward orientation, “under” was the easiest, and “below” and “beneath” were barely used.

Table 4. Mean accuracy rates of producing vertical Ps

Upward orientation			Downward orientation		
on	over	above	beneath	under	below
75.0%	61.7%	31.7%	0%	91.7%	1.7%

Fujimori’s study fails to support the complexity hypothesis which claims that the semantic complexity has an impact on the acquisition of orientational Ps in L2 English. Namely, “over” and “under” are more complex than “above” and “below” in the specificity of perpendicularity, as we have seen in Table 4, while “over” and “under” were more appropriately used. If this is correct, the question arises as to whether L2 learners will also easily acquire orientational Ps in horizontal axis which have extra semantic properties. To address this issue, we ran a Production Task with Japanese EFL learners.

4. Experiment

4.1. Subjects

Sixty nine Japanese university students majoring in science (English proficiency at CEFR B1 level) participated in the experiment. The Japanese EFL learners were ideal participants for the experiment in that frequency effects of Ps in question were unpredicted. We surveyed token frequencies of 41 Ps in junior high school textbooks (*New Horizon 1-3* (Tokyo Shoseki)).¹ Figure 3 shows the entire survey results of Ps in relative frequency, where Ps relevant to the present study are in capital letters.

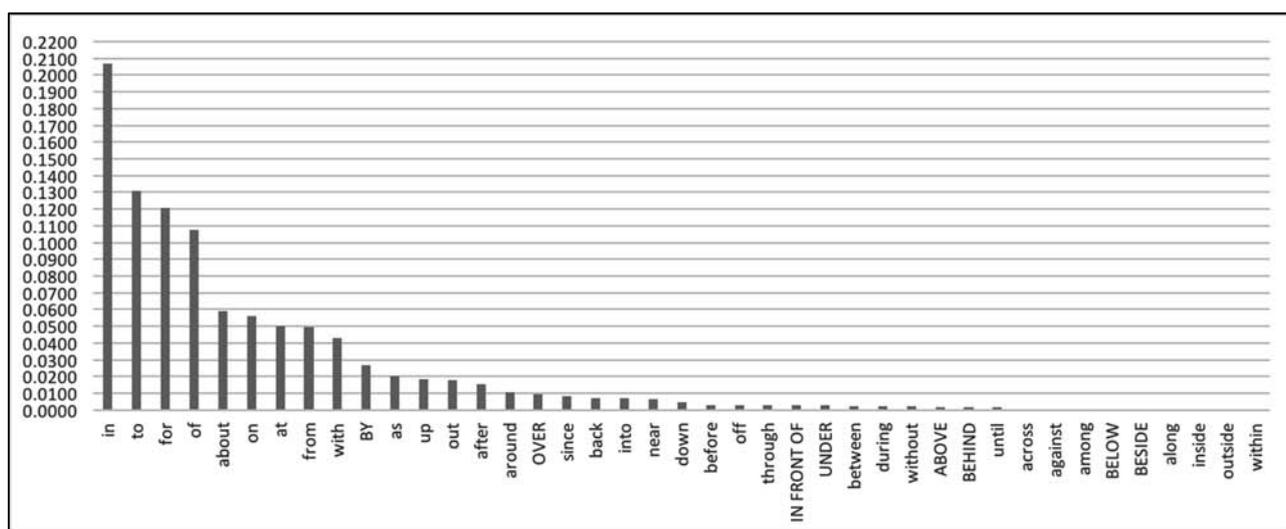


Figure 3: Relative frequencies of Ps in junior high school textbooks

Regarding the four pairs of Ps (*over/above*, *under/below*, *in front of/before*, *behind/after*), *after* is ranked fourteenth whose relative frequency is 1.5%, and the rest of the Ps are below 1% in relative frequency, as shown in Table 5. These are all low frequency items, as opposed to top-ranked high frequency items such as *in* and *to* whose relative frequencies are 21.3% and 10.8%, respectively.

¹ We investigated another junior high school English textbooks *Sunshine 1-3* (Kairyudo) and they showed similar results of Ps in relative frequency.

Table 5: Relative frequencies and ranks of locational Ps

English Ps	Vertical Axis				Horizontal Axes				cf. High frequency	
	over	above	under	below	behind	after	in front of	before	in	to
Relative frequency	.009	.001	.002	.000	.001	.015	.002	.002	.206	.130
Rank	16	30	22	33	30	14	22	22	1	2
Japanese Ps	ue-ni		sita-ni		usiro-ni		mae-ni			

The Japanese EFL learners' L1 was predicted not to affect L2 English, either. Each pair of Ps in Table 5 corresponds to a Japanese equivalent (see Section 2).

4.2. Tasks and tokens

The participants were given a Production task in written form where they were asked to fill in a gap of each sentence with a P which best describes a watched video clip.

Three tokens were given for each preposition of *over*, *above*, *under*, *below*, *behind*, *after*, *in front of*, and *before*, as exemplified in (7) where answers are put in brackets. We confirmed with two native speakers of English that two tokens for each preposition were appropriate. The test tokens were randomized in presentation order.

- (7)
- a. Pepe jumped (over) the fence.
 - b. Pepe saw clouds (above) the mountain.
 - c. There was a cat (under) the chair.
 - d. There was a small room (below) the stairs.
 - e. Pepe ran (after) a chief.
 - f. Pepe was hiding a candy (behind) the TV.
 - g. Pepe stood (in front of) the goal.
 - h. Pepe reached the goal (before) the others.

4.3. Results

A one-way ANOVA shows that the types of Ps had a significant effect on the mean accuracy rates in the Production Task ($F(7,1096)=61.138, p<.001$). Bonferroni's post-hoc tests reveal that there were significant differences between "over" and "above", and between "under" and "below" ($ps<.001$). The mean accuracy rates of "over" and "under" were more than 50%. The results indicate that the participants performed better with the semantically complex Ps "over" and "under" at the

vertical dimension. Regarding the horizontal Ps, the mean accuracy rates of “after” and “before” were at around 50%, although there were no significant differences between “behind” and “after” ($p>.999$), and between “in front of” and “before” ($p>.202$).

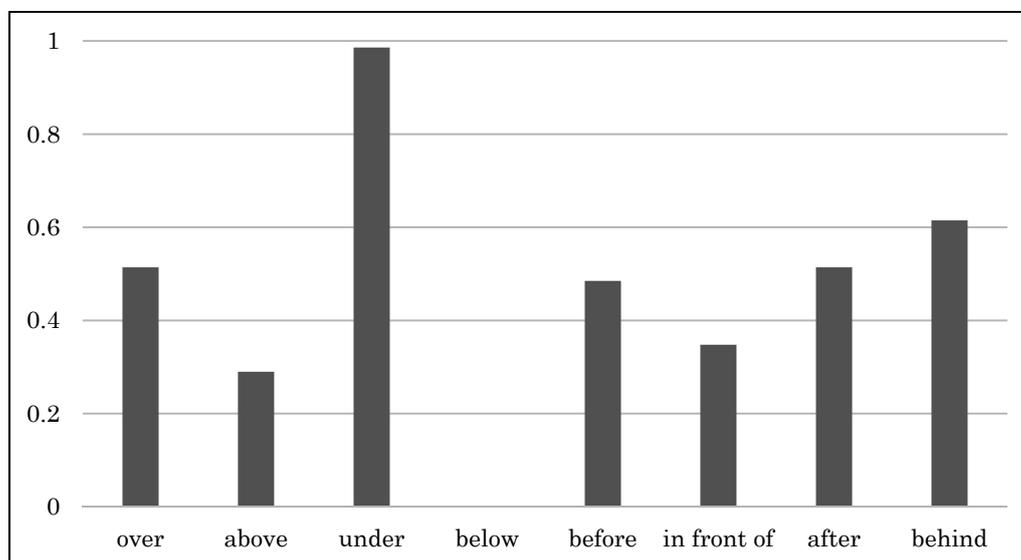


Figure 4: Mean accuracy rates of producing orientational Ps

5. Discussion

The purpose of our experiment was to examine whether the complexity hypothesis holds for orientational Ps with extra semantic properties at any dimension in L2 English. The experimental results fail to support the hypothesis (see also Fujimori 2015). Indeed, the Japanese EFL learners correctly produced the semantically complex vertical Ps “over” and “under”. However, the results of the horizontal Ps do not provide any further evidence for or against the hypothesis. The accuracy rates of the horizontal Ps were all around 50% and there was no significant difference among them.

It remains uncertain why the results of horizontal Ps were obscure. This could be in part attributed to the fact that although “over”, “under”, “after”, and “before” are all complex in semantic properties, the geographical spaces they denote are recognized differently. The vertical Ps “over” and “under” denote limited spaces, compared with “above” and “below”, which L2 learners can easily identify. In contrast, the horizontal Ps “after” and “before” denote both the landmark’s and the figure’s orientations. These orientations give rise to the linear order of the figure and landmark although the Ps denote the same spaces as “behind” and “in front of” do. Therefore, L2 learners cannot distinguish between “after” and “before”, on the one hand, and “behind” and “in front of”, on the other.

Another fact to consider is how the orientational Ps are introduced in textbooks. In *New Horizon* 1-3, “after” and “before” appear 22 times and 4 times, respectively. In all the cases, however, they are used as temporal Ps, as opposed to spatial ones. This might inhibit the spatial use of “before” and

“after”.² To avoid potential effects of temporal Ps, we will soon examine the acquisition of other horizontal Ps such as “beside” and “by” which are primarily used as spatial Ps.

The present study has raised a question about the lexical acquisition of Ps in L2 English and we further need to proceed with syntactic as well as semantic investigations of Ps. In Cinque’s (2010) cartography, prepositional semantics is mapped onto syntax, and directional Ps and locational Ps are in different syntactic heads, as illustrated in (8). With attention to the characteristics of L2 acquisition, we can shed light on what properties cause difficulties in acquiring L2 English Ps.

- (8) a. The dog came out from under the table.
b. [_{dir} from [_{stat} AT [_{Part} under [_P [_{DP} the table]]]]]

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² Owen (2014) points out that temporal Ps such as “in (a week)” are acquired late (at 4;0) in L1 English, compared with spatial ones.

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