Pre-head Processing Cost of Theme/location Alternations: An Experimental Study

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Chapter 1.   Introduction

Alternation phenomena are known as cognitive phenomena where an observer can switch multiple perspectives within a framework. Such a switching can be often explained in terms of Figure and Ground: Figure is something in the foreground while Ground is one in the background. The observer generally focuses on either of Figure or Ground. For example, in Figure/Ground reversals such as Rubin's *vase* (Rubin 1915), *Necker cubes* (Necker 1832), and *duck-rabbit* figure (Jastrow 1900), the observer can see the two different kinds of object within the same illustration since there are two ways to focus on one part or the other. In a linguistic context, such a switching effect of perception may correspond to an argument structure alternation I deal with in this thesis. The linguistic alternation means the switching between multiple types of variants, which have almost the same interpretations, as shown in (1):

(1)   a.   John gave a dish to Sam.

       b.   John gave Sam a dish.

(Pinker 1989: 7)

The sentence in (1a) is called ditransitive construction where *a dish* appears as the direct object of *gave* and a recipient *Sam* appears as a prepositional phrase with *to*. On the other hand, the sentence in (1b) is called double object construction where the recipient *Sam* appears as the direct object position and the theme *a dish* appears in the second object position. It should be noted that the thematic roles are kept constant between (1a-b) although there is a syntactic difference. Furthermore each construction focuses on the different aspect of the same event in (1): the example in (1a) denotes an event where John

causes a dish to move to Sam while the one in (1b) denotes an event where Sam possesses a dish by means of John's giving manner. The linguistic alternation corresponds to such a pair of two (or more) expressions as shown in (1a-b), which has reversals of constructions depending on the highlighted event. The alternation in (1) is called *dative alternation,* and Pinker (1989) described the following generalization of dative alternation:

(2)   NP$_1$ [V] NP$_2$ *to* - NP$_3$ → NP$_1$ [V] NP$_3$ NP$_2$

(Pinker 1989: 7)

This generalization shows the cross-mapping of each argument between the dative construction in the left of the arrow in (2) and the double-object construction in the right side. However, this is not always the case for any types of verb even when the verb seems to include the similar types of semantics to *give*:

(3)   a.   John donated a painting to the museum.

  b.   *John donated the museum a painting.

(4)   a.   John reported the accident to the police.

  b.   *John reported the police the accident.

Here the example in (3) includes *donated*, which means an event of giving something for the purpose of contribution. Similarly, the example in (4) includes *reported*, which means an event of giving information. However, the double object variants in (3b) and (4b) are not allowed while the dative construction variants are acceptable in (3a) and (4a). These examples indicate that the verb semantics does not exclusively determine the possibility of the alternation.

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The similar kinds of the symmetric behavior can be observed in other types of alternation. Take the examples of *locative alternation*, one of well-known argument structure alternations (Anderson 1971, Fraser 1971, Kageyama 1980, Okutsu 1981, Salkoff 1983, Jefferis & Willis 1984, Rappaport & Levin 1985, Fukui, Miyagawa & Tenny 1985, Pinker 1989, Jackendoff 1990, Goldberg 1995, Maruta 1997, Kishimoto 2001, Iwata 2008, etc):

(5) a.   John smeared paint onto the wall. (T-type construction)

    b.   John smeared the wall with paint. (L-type construction)

In locative alternation, two object nouns alternates between the two types of constructions. In the first type as in (5a), the theme object *paint* appears as the direct object of the main verb *smeared* while the location object *the wall* is accompanied by the dative preposition *to*. On the other hand the second type in (5b), the location object appears as the direct object of while the theme object is accompanied with the oblique preposition *with*. The first type is sometimes called 'Theme-object type', 'Content object frame', and so on while the second one is called 'Location-object type', 'Container object frame' and so on (Pinker 1989, Levin 1993, Iwata 2008, etc). Although the naming varies among previous studies, I call these two constructions *T(heme object)-type* construction and *L(ocation object)-type* construction henceforth.

In the case of Japanese, locative alternation sentences are represented as in (6):

(6) a.   *kabe-<u>ni</u>   penki-<u>o</u>   nut-ta.*   (T-type construction)

          wall-dat   paint-acc smear-past

b. *kabe-o   penki-de nut-ta.*   (L-type construction)

wall-acc paint-obl smear-past

In Japanese locative alternation, case marking alternates between *-ni/-o* (dative/accusative) and *-o/-de* (accusative/oblique). In (6a), *kabe* 'the wall' is marked with the dative *-ni* as the location and *penki* 'paint' is marked with the accusative *-o* as the theme object, so this frame corresponds to the T-type construction. On the other hand, in (6b), *kabe* 'the wall' appears as the accusative object with the marker *-o,* and *penki* 'paint' appears as the theme with the marker *-de* 'with', corresponding to the L-type construction.

As discussed above, locative alternation consists of the T-type construction and the L-type one. However, these two constructions are not symmetry around the verb. It is pointed out by Anderson (1971) that these two constructions evoke different interpretations. The following examples show the contrast regarding the affectedness of the location object *the wall*:

(7) a. John smeared <u>paint on the wall</u>, but most of the wall didn't get any paint on it.

  b. *John smeared <u>the wall with paint</u>, but most of the wall didn't get any paint on it.

(Anderson 1971)

The example in (7a) is categorized to the T-type construction variant and (7b) is to the L-type construction one. The second clause indicates that the entire wall is not affected. The T-type variant in (7a) is not contradictory with the second clause because the movement of paint to the wall does not necessarily make the wall covered with paint. It is possible that most region of the wall is not covered with paint. By contrast, the example in (7b) shows a contradiction, that is, it is inferred from the first clause that the entire wall is

affected while the second clause attempts to cancel the preceding event. From this contrast, it has been argued that the location object in the L-type variant is totally affected by causation event with the theme object. Such an interpretation inferred from the L-type variant is usually called *holistic interpretation.* Such a contrast in terms of holistic interpretation is a piece of evidence that each variant of the alternation is not always identical with respect to the interpretation denoted by an event. However, holistic interpretation is not a common property of the L-type construction, as illustrated below:

(8)   The vandal sprayed the sculpture with paint.

<div align="right">(Pinker 1989: 78)</div>

According to Pinker, a holistic effect in the L-type variant is an epiphenomenon of a change-of-state. In (8), the location (goal) object, *the sculpture*, is assumed to have a kind of aesthetic property. Spraying paint can spoil the property of the sculpture even if it is partially sprayed with paint. Thus it follows that covering over the location is not necessary. This exception also reveals that the verb does not exclusively determine the interpretations in locative alternation.

The aim of this thesis is to investigate the non-verbal factors in processing the theme/location alternations in Japanese, i.e., locative alternation and *bump* alternation. I defend the hypothesis that there is a preverbal structural preference for the theme/location alternation in Japanese, even before the language users encounter the verb, which is regarded as a central role on deciding the possibility of the alternation. In detail, in the case of locative alternation there is a structural preference for the T-type construction before the verb appears, even if the verb to follow is the L-oriented one (e.g., *mitasu* 'fill', which is compatible only with the L-type construction). I argue that such a preference is triggered by

each case-marking pattern: the case-marking pattern facilitates anticipation for specific types of events, resulting in a difference of processing cost. That is, the dative case marker included in the T-type construction is likely to be related with the movement event when it is accompanied with the accusative-marked NP. In contrast, the oblique marker included in the L-type is so ambiguous that the event type is not specified by the combination of the case-marking pattern and the object NP until the verb is encountered, resulting in more processing cost than the T-type before the verb appears. In addition, the event type evoked by the combination of the case marking and the object NPs is not unique information used for processing the alternation. I reveal that causation types are also computed by properties of the object NPs in *bump* alternation, which is similar to locative alternation in Japanese.

I carry out 4 acceptability judgment and 5 self-paced reading studies in order to address these problems. I explore how the participants process the preverbal regions by using a self-paced reading method. These studies were conducted on Lancers and Ibex Farm. Lancers is a Japanese crowdsourcing website where it is possible to recruit participants and pay compensation for each participation. Ibex Farm is a hosting website for various linguistic experiments, developed by Alex Drummond. The participants were recruited via Lancers, then they were asked to participate in the tasks on Ibex experiment pages.

This thesis is organized as follows: in Chapter 2 I review previous studies on locative alternation. The first three sections are dedicated to previous theoretical studies: Lexical rule approach (Pinker 1989), construction grammar approach (Goldberg 1995, 2002, 2006), and lexical-constructional approach (Iwata 2008). These theoretical approaches suppose that the verb semantics determines the possibility of the locative alternation, that is, the alternation is allowed if the verb included in a sentence is an alternating one. Then in the other section, classifications on alternating verbs are shown based on the examples in English from Levin (1993) and the ones in Japanese. Here disagreements over the

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alternating verbs are also shown.

In Chapter 3 previous experimental studies are reviewed. This section consists of the judgment study in English by Carlson & Tanenhaus (1988), the forced-choice and elicitation study in English by Gropen, Pinker, Hollander & Goldberg (1991), the fMRI study in Danish by Christensen & Wallentin (2011), and the corpus study in Spanish and Polish by Wojciench (2014). From the results of the judgment and the reaction time, Carlson & Tanenhaus showed that each construction in locative alternation is associated with thematic ambiguity, not but lexical ambiguity. The forced-choice and elicitation study revealed that there is a correlation between acquisitions of verb semantics and its syntactic appearance: if there is a misunderstanding of the semantic component of container-verb such as *fill*, it is applied to the T-type construction although it is compatible with the T-type. Christensen & Wallentin revealed from fMRI study that there is an asymmetry between two constructions in the locative alternation in such a way that the T-type construction is easier to process, at least in SVO languages. Wojciench showed that the T-type construction variants are produced in the satellite-framed language more than the verb-framed language. On the other hand, in both languages, the T-type construction variants are produced more than the L-type ones when verbs with abstract manner are used.

In Chapter 4 I address the issues in Japanese by conducting two acceptability judgments on the two constructions. On the basis of these judgments, the verbs were classified into three classes: alternating verbs, T-oriented verbs, and L-oriented verbs. Then I conducted three self-paced reading studies using the attested verbs in the acceptability judgment to address the questions of (i) whether there is a structural preference in locative alternation in SVO language such as Japanese and (ii) how the word-order affects processing of locative alternation. These studies revealed that processing cost for the variants was not symmetric even before the verb appeared.

In Chapter 5, I expand the idea in Chapter 4 to *bump* alternation in Japanese that the verb does not exclusively determine the possibility of the alternation. Through two acceptability judgments and two self-paced reading studies I argue that the preverbal processing is the case for *bump* alternation in such a way that a causation type (Talmy 2004) is computed by a combination of the object NPs.

Chapter 2.   Previous Theoretical Studies

In the present chapter, I review the literature adopting theoretical approaches. Section 2.1 is dedicated to the lexical-rule approach by Pinker (1989). In section 2.2 I discuss the construction grammar approach by Goldberg (1995, 2002, 2006), and in section 2.3 I deal with the lexical-constructional approach by Iwata (2008). Finally in section 2.4 I compare the classifications of the English locative alternating verbs in English with those of Japanese. Then the questions arise as to whether the alternating verbs always show the alternation and whether the acceptability judgments the literatures showed are empirically attested.

2.1. Lexical rule approach: Pinker (1989)

Lexical rule approach, mainly discussed by Pinker (1989), assumes that (i) the verb with the two constructions includes two distinct lexical senses whose semantic structures are also distinct, and that (ii) one of the forms is more basic while the other is derived from an application of a lexical rule. In the case of locative alternation, if a verb includes a semantic structure (in Pinker's terminology, *thematic cores*) such that "X causes Y (theme-object) to move *into/onto* Z (location-object)", which represents a caused motion, then the semantic structure can be converted into another structure such that "X causes Z (location-object) to change state by means of moving Y (theme-object) *into/onto* it" which represents a change-of-state by the lexical rule. A criterion for a verb to allow the locative alternation is that it includes both a caused motion and a change-of-state component. The examples in (9)–(11) show the examples of the alternation using *spray* and the ones using non-alternating verbs *pour* and *fill*:

(9) a.   Bob sprayed paint onto the wall. (T-type construction)

     b.   Bob sprayed the wall with paint. (L-type construction)

<div align="right">(Pinker 1989: 228)</div>

(10) a.   I poured water into the glass. (T-type construction)

     b.   *I poured the glass with water. (L-type construction)

<div align="right">(Pinker 1989: 97)</div>

(11) a.   *I filled water into the glass. (T-type construction)

     b.   I filled the glass with water. (L-type construction)

<div align="right">(Pinker 1989: 66)</div>

The pair of sentences with *spray* in (9) is an example of the alternation while the examples in (10) with *pour* and (11) with *fill* are non-alternating ones. First, the event denoted by the sentences in (9) is that liquid object *paint* is turned into a mist state and then moved to the location. This motion of paint is specified in the semantics of *spray*, resulting in the T-type construction as in (9a). As a result of such an action, the surface of the wall gets paint and its state is changed. The change of state of the wall is also specified in *spray* and the L-type construction in (9b) is allowed. However, the examples in (10)–(11) lack either a motion or a change-of-state in their verb meanings. In the case of *pour in* (10), it specifies a manner of motion but a change-of-state of *the glass* is not specified in the verb meaning: the glass can be filled with water after water is poured into the glass, or it can be still half empty. Thus the example in (10) is acceptable while (10) is not allowed. Conversely, *fill* specifies only a change-of-state such that something is full, but it does not specify any manner of motion of water: water can be moved by a pouring activity, by turning on a faucet, and so on. So *fill* can take the container object, like *the glass*, as its direct object in (11) while it cannot take *water* as its direct object in (11).

Figure 1 represents a general idea for the derivation of locative alternation:

Argument structures: V NP into/onto NP   V NP with NP

Thematic cores: [Move substance in a particular manner to an object]   [Affect object in a particular way by adding substance]

Verbs: ['pour': substance moves in a stream] ['spray^1': substance moves in a mist] $\longleftrightarrow$ ['spray^2': surface is covered with drops by moving mist] ['fill': interior is occupied]
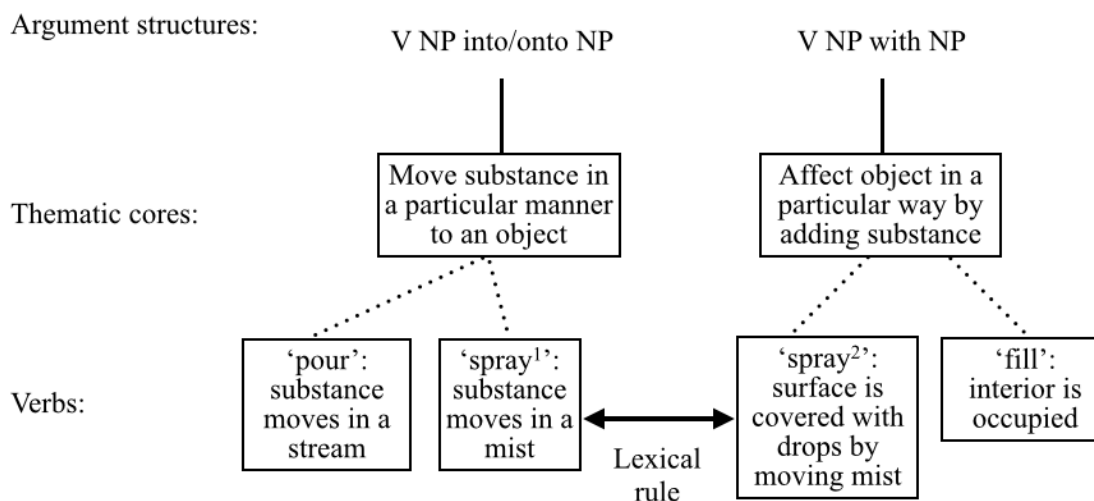
        Lexical rule

Figure 1. The lexical rule approach (Pinker 1989: 80)

These three layers show a linking among the verb semantics, thematic cores, and argument structures (i.e., syntactic frames). A thematic core, as mentioned in the middle layer in Figure 1, specifies the relation between event participants denoted by a class of verbs, i.e., the relation between the moving object and its goal. Furthermore the thematic core is tied with argument structures by a linking rule, represented by each solid line in the top of the layers in Figure 1. Through this linking, each variant is syntactically instantiated. In the left side of Figure 1, *pour* and *spray*^{1} denote the movement of a substance in a certain manner, and thus they also specify thematic cores such that the agent moves the substance to the object. Finally the thematic cores are associated with the syntactic frame [V NP into/onto NP], resulting in *I poured water into the glass,* and *I smeared paint onto the wall*. In the same way, *spray*^{2} and *fill* denote the covering or occupying of the location, and thus they are associated with the thematic core such that the object is affected by the substances, and in turn they are associated with the syntactic frame [V NP with NP]. The examples such as

I sprayed the wall with paint and *I filled the glass with water* are the instantiations of this syntactic frame.

In the case of the alternating verb *spray*, lexical rule can be directly applied to its semantic structure as shown in the bottom of Figure 1, and it triggers the locative alternation: *spray*[1] is linked with one variant, and then *spray*[2], the other variant is derived through lexical rule. In the former variant with *spray*[1], the moving object is regarded as the theme, so it is linked to the direct object following the linking rule. In turn, in another variant with *spray*[2], the location is regarded as the object undergoing a change-of-state, and hence it is linked to the direct object. The remaining argument, which is not linked to the object, appears as the oblique object like *to*-PP or *with*-PP. In sum, the verb such as *spray* can participate in the alternation since it includes the movement of liquid and the change-of-state triggered by the movement.

2.2. Construction grammar approach: Goldberg (1995, 2002, 2006)

In the construction grammar approach developed by Goldberg (1995, 2002, 2006), it is assumed that the interpretation of a sentence results from the fusing of a constructional meaning with the verb's specific meaning. For example, consider the following examples shown below:

(12)   a.   They laughed the poor guy out of the room.

        b.   Frank sneezed that tissue off the table.

        c.   Mary urged Bill into the house.

        d.   Sue let the water out of the bathtub.

        e.   Sam helped him into the car.

        f.   They sprayed the paint onto the wall.   (Goldberg 1995: 152)

According to her, the common frame [S V O PP] in (12a–f), drives the common interpretation of the causative movement. The central idea of the construction grammar is that frame-specific meanings (e.g., the causative movement) exist independently of verbs. The following figures are used for the representations of constructions and their specific meanings:
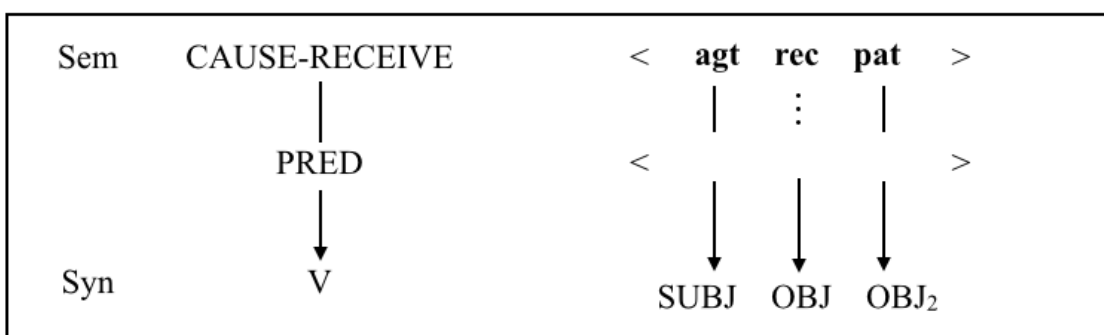
Figure 2. Ditransitive construction (Goldberg 1995: 50)
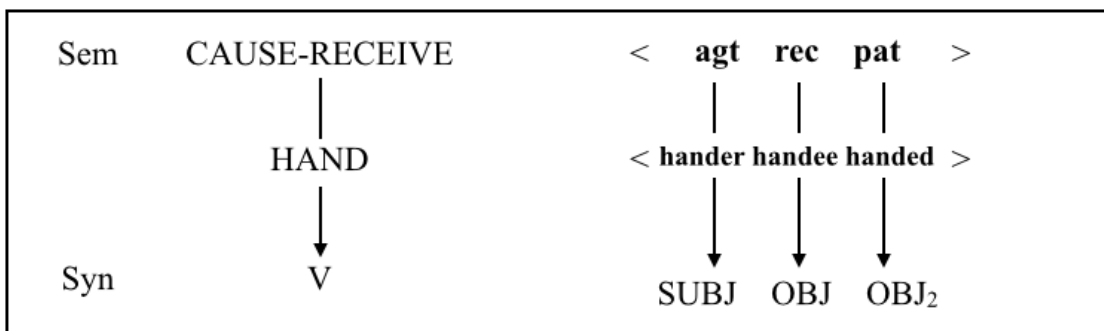
Figure 3. Fused structure: Ditransitive + *hand* (Goldberg 1995: 51)

First, the construction specifies the argument roles such as <**agt rec pat**>, which means the agent, the patient, and the theme as listed on the top of Figure 2. Here the bold font indicates that the role must be represented in a surface structure (in Goldberg's terminology, the role is *profiled*). Additionally, the construction specifies which argument role is

associated with a grammatical role such as the subject, the object and the second object. The middle row in Figure 2 is a slot for the verb specific participant role, which is a participant in an event denoted by the verb. Once the middle variable is fulfilled with a verb as in Figure 3 with *hand*, the argument role and the participant role are fused if they are semantically compatible. In the case of *hand* in ditransitive construction in Figure 3, the participant roles which *hand* requires are <**hander handee handed**>. Then *hander* is associated with the agent, *handee* is the recipient, and *handed* is the patient. Then each appears as the subject, the object, and the second object indicated in the bottom of Figure 3, resulting in the sentence such as *she handed him the ball* (Goldberg 1995: 80).

Such a fusion can account for the two constructions in locative alternation in (13):

(13)   a.   Pat loaded the hay onto the wagon. (caused-motion (= T-type))

          b.   Pat loaded the wagon with the hay. (causative + *with* (= L-type))

(Goldberg 2006: 34)

The sentence in (13a) is interpreted as a caused-motion construction while the one in (13b) is as a causative construction accompanied by an adjunct *with*. The verb *load* specifies its participant roles as <**loader**, **loaded-theme**, **container**>. The structures in (14)–(15) below indicate the two instantiations of the fusing of the constructional argument roles with the participant roles:

(14) Caused motion construction of *load*

CAUSE-MOVE	(**cause**	**theme**	path/location)
|	|	|	|
Load	(**loader**	**loaded-theme**	**container**)

(15) Causative + *with* construction of *load*

```
CAUSE   (cause    patient) + INTERMEDIARY (instrument)
  |        |         |                         |
Load    (loader container             loaded-theme)
```
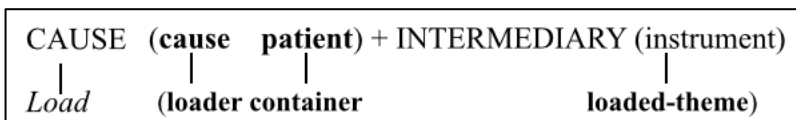
Both structures in (14)–(15) show that the participant roles of *load* are kept constant between the two constructions, but the matching between the participant roles and the argument roles is different from each other. When the event is construed as a caused-motion event as shown in (14), each participant role is connected to the argument roles profiled by caused-motion construction, where **loader** can be associated with **cause**, **loaded-theme** with **theme**, and **container** with path/location. By contrast, when the event is construed as a causative construction with intermediary instrument as shown in (15), **container** can be associated with **patient** in that the location object can be regarded as the affected object. Thus *load* can be associated with the two constructions, resulting in the alternation.

2.3. Lexical-constructional Approach: Iwata (2008)

First, Iwata (2008) supports the construction grammar approach as in Goldberg (1995) because it is preferable to the lexical approach in that there is no necessity to consider a direction of derivation of the two constructions. Two main points of his ideas are as follows: (i) verb meanings should be taken into more consideration, and (ii) in accordance with the verb meanings, lower-level constructions should be added to the model proposed by Goldberg.

2.3.1. Verb meanings

As noted above, Iwata proposes that the verb meanings should be reflected in the

constructional model because the label of a change-of-state, as used in Pinker and Goldberg, sounds too general in the location-as-object variant (i.e., L-type construction). In detail, a change-of-state meaning should be substituted for *cover/fill* semantics. According to him, one of the reasons for this is that change-of-state verbs like *break* necessarily require a transition from an old state to a new one: when something is broken, an unbroken thing turns into the broken thing, which essentially occurs and such a new state does not go on once the thing is broken. Unlike change-of-state verbs, the location-as-object variant does not have to denote such a transition of state:

(16) Linda sprayed the plants with water.

(Iwata 2008: 24)

The example in (16) can be used even in the situation where the plants are still wet. Additionally the new state can go on even once it is attained:

(17) Bill sprayed/smeared/dabbed/splashed the wall with paint (for ten minutes), but it still wasn't covered.

(Jackendoff 1996: 346)

As Jackendoff pointed out, the location-as-object variant evokes the covered/filled reading, but it does not have to be attained. This property is also different from the change-of-state verbs.

From these points Iwata proposed that the location-as-object variant is defined as *cover/fill* semantics on the basis of the verb meanings, not but a change-of-state. In the case of a class of verbs like *spray*, *smear*, and *scatter*, the location-as-object variant is

characterized as the construction with "cover" semantics. On the other hand, in the case of a class of verbs like *load* or *cram*, it is characterized as the construction with "fill" semantics.

2.3.2. Multiple hierarchical organization of constructions

Iwata adopts the usage-based model: constructions are generalized from individual occurrences, and there is a hierarchy including multiple levels of abstraction. As for the hierarchy of the construction, Iwata assumed the following levels under the higher-level general construction (i.e., Caused-motion construction), following Croft (2001, 2003): *verb-class-specific construction*, and *verb-specific construction*. The hierarchies are instantiated in Figure 4:
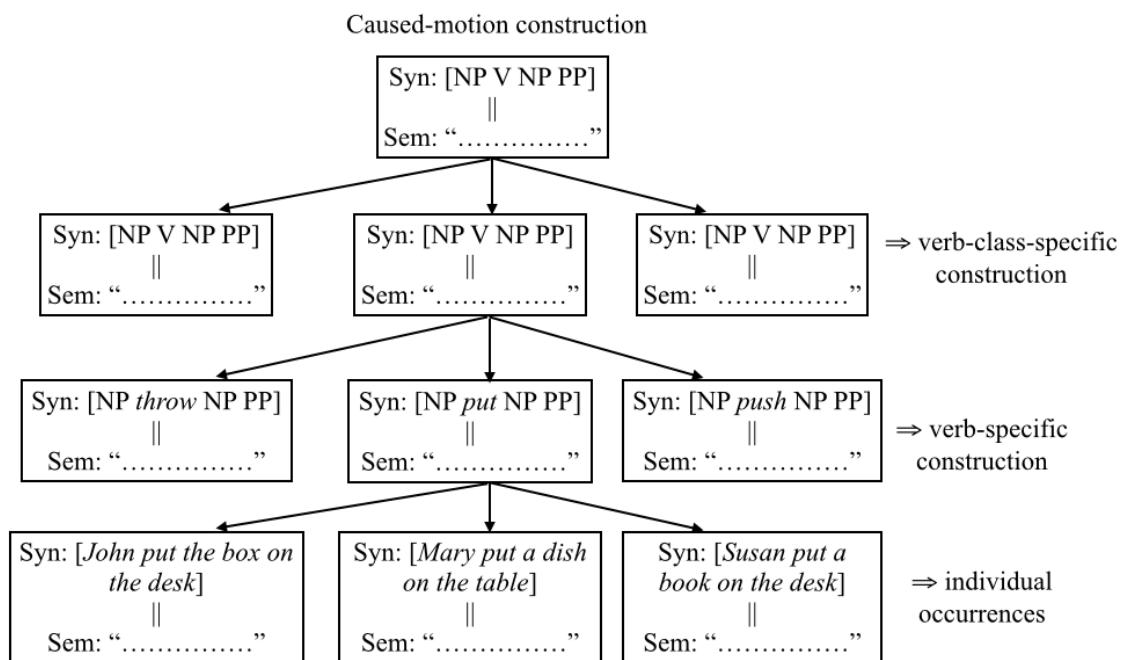
Figure 4. The hierarchical organization of constructions (Iwata 2008: 37)

For example, take *put* as an instance. The verb *put* always appears in a syntactic frame [NP V NP PP], as in (18):

(18)   a.   John put the box on the desk.

           b.   Mary put a dish on the table.

           c.   Susan put a book on the desk.

<div align="right">(Iwata 2008: 36)</div>

In the examples in (18), the object NPs varies on each example, corresponding to individual occurrences in Figure 4. Each example is abstracted to the syntactic frame [NP *put* NP PP] at the level of verb-specific construction because all the individual occurrences with *put* share this syntactic frame. In the same way, *throw* or *move* allow the same syntactic frames as [NP V NP PP], as shown in (19):

(19)   a.   John threw a ball into center field.

           b.   John moved the piano into the bedroom.

<div align="right">(Iwata 2008: 36)</div>

With respect to the common frames [NP V NP PP], the verbs in (18)–(19) share, these verb-specific constructions can be abstracted to a verb-class-specific construction. It can be said that verb-class-specific construction of *put*, *throw*, or *move* is [NP V NP PP] as shown in the second layer in Figure 4. Moreover, by abstracting over the verb-class-specific construction, the caused-motion constructions in the top of the hierarchy can be acquired.

    The locative alternation can be handled in such a way that the alternation variants are associated with two constructions following this type of hierarchy. The instantiations of two constructions associated with *spray* are in (20b) and (21b), compared with the other instantiations of the same verb-class-specific constructions in (20a) and (21a), and their

representations of the hierarchical organizations are shown in Figure 5 and Figure 6:

(20)   a.   She put the box on the desk.

         b.   He sprayed paint onto the wall.

(21)   a.   She covered the floor with a rug.

         b.   He sprayed the wall with paint.

(Iwata 2008: 39-40)
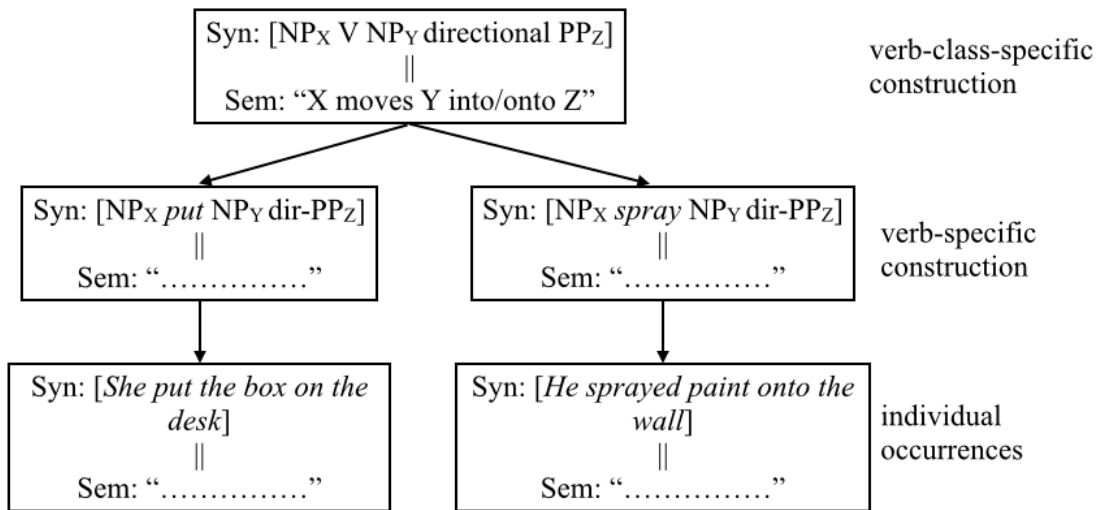
Figure 5. How the content-object variant of spray is sanctioned (Iwata 2008:39)
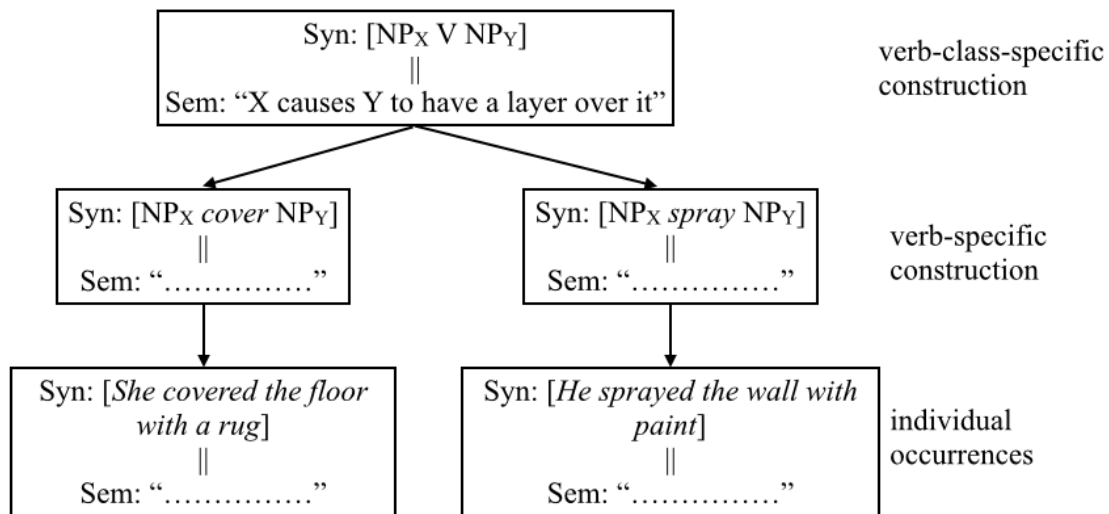
Figure 6. How the container-object variant of spray is sanctioned (Iwata 2008: 39)

As shown in Figure 5, a verb-class-specific construction which includes the syntactic frame [NP V NP PP] with the semantics "X moves Y into/onto Z" sanctions a verb-specific construction of [NP *spray* NP PP], along with [NP *pour* NP PP], and then each individual occurrence appears. In the same way, as shown in Figure 6, a verb-class-specific construction which includes the syntactic frame [NP V NP] with "X causes Y to have a layer over it" sanctions a verb-specific construction of [NP *spray* NP], and each individual occurrence appears. In this way, the two variants with *spray* as in (20b) and (21b) are sanctioned by the two types of verb-class-specific constructions, resulting in the locative alternation.

2.4. Verb classifications

Many researchers attempted to classify verbs into alternating ones or non-alternating ones across languages (Okutsu 1981, Fukui, Miyagawa & Tenny 1985, Pinker 1989, Levin 1993, Kishimoto 2001, Iwata 2008, Takami & Kuno 2014, among others). This section

focuses on the classification of the locative verbs, including alternating and non-alternating ones, in English and Japanese. To do so, I first review the classification of the locative verbs in English. As for the English locative verbs, one of the studies with an exhaustive classification is Levin (1993). Next, the classifications of Japanese locative verbs are compared with English verbs. Finally, I show that some examples categorized as alternating, including the representative alternating verb like *smear*, are not always acceptable in both frames.

2.4.1. English locative verbs: Levin (1993)

Levin (1993) classifies the English locative verbs following their semantic properties into the following five classes: *spray/load*-class, *clear* (transitive)-class, *wipe*-class, *swarm*-class, and *clear* (intransitive)-class. In the next subsections, verbs included in the five classes and their acceptability judgments in locative variants (i.e., T-type construction) and *with* variants (i.e., L-type construction) are presented.

2.4.1.1. *spray/load*-class

The verbs included in this class appear in the transitive form as in (23a-b), and they are semantically associated with putting and covering.

(22)   Alternating verbs:

　　brush, cram, smear, splash, spray, spread, etc.

(23)　　a.　Jack sprayed paint on the wall. (locative variant)

　　　　b.　Jack sprayed the wall with paint. (*with* variant)

(Levin 1993: 51)

Here *paint* is treated as the locatum, which is also called *locatum* from Clark & Clark's (1979) terminology and corresponds to the object moving to a goal. Its syntactic position varies depending on two constructions: it appears in the direct object position in (23a) while in the prepositional phrase in (23b). On the other hand, *the wall* is treated as a location. It appears as the prepositional phrase in (23a) while as the direct object in (23b).

Within this class of verbs, there are non-alternating verbs as follows:

(24) Non-Alternating *with* Only

       block, cover, decorate, fill, etc.

(25)   a.   *June covered the blanket over the baby.

        b.   June covered the baby with a blanket.

<div align="right">(Levin 1993: 51)</div>

These non-alternating verbs do not allow the locative variant like in (25a) where the locaum appears as the direct object of *fill*. In contrast, the following types of non-alternating *spray/load* verbs show the opposite behavior:

(26) Non-Alternating Locative Preposition Only:

       arrange, put, suspend, shovel, pour, coil, wind, etc.

(27)   a.   Tamara poured water into the bowl.

        b.   *Tamara poured the bowl with water.

<div align="right">(Levin 1993: 51)</div>

The non-alternating locative verb *pour* does not allow the *with* variant in (27b) where the location *the bowl* occupies the direct object position.

2.4.1.2. *clear* (transitive)-class

It is pointed out that this class of verbs in (28) is semantically opposite to *spray*/*load*-class in that the locatum is removed from the location. A PP in a locative variant is *from*-PP in (29a), while a PP in an *of* variant is *of*-PP, which corresponds to an abstrument preposition in (29b).

(28) Alternating Verbs

     clear, clean, drain, empty

(29)   a.   Henry cleared dishes from the table. (locative variant)

       b.   Henry cleared the table of dishes. (*of* variant)

In (29a), the locatum *dishes* appears as the direct object, which is removed from the location *the table.* The location object is marked with *from.* In (29b), conversely, *the table* appears as the direct object and *dishes* is marked with *of.*

As the examples of (31) shows, *steal* is a non-alternating verb which only allows the locative variant while it does not allow the *of* variant with the location taken as the direct object.

(30) Non-Alternating *from* Only:

     abstract, *banish, steal*, etc.

(31)   a.   The thief stole the painting from the museum.

       b.   *The thief stole the museum of the painting.

The following examples exemplify another non-alternating class which only allows the *of* variant:

(32) Non-Alternating *of* Only:

      cure, *drain*, *rob*, etc.

(33)   a.   *The doctor cured pneumonia from Pat.

          b.   The doctor cured Pat of pneumonia.

<div align="right">(Levin 1993: 52)</div>

Cure can take *Pat* as the location and *pneumonia* as the removed locatum marked with *of* in (33b), but it does not allow the locative variant in (33a), where *pneumonia* appears as the direct object.

2.4.1.3. *wipe*-class

This class of verbs as in (34) is also opposite to *spray/load*-class, along with *clear*-class, because they denote a removal event. However, the main difference from the *clear*-class verbs is that in the *wipe*-class, the *of*-PP is not obligatory in the location object variant as in (35).

(34) Alternating Verbs

      wipe, *brush*, *shovel*, etc.

(35)   a.   Helen wiped the fingerprints off the wall. (locative PP variant)

          b.   Helen wiped the wall (*of fingerprints). (locative object variant)

<div align="right">(Levin 1993: 53)</div>

Here the locatum is *the fingerprints* while the location is *the wall*. The locative PP variant consists of the direct object and the prepositional phrase marked with *off* in (35a). The

locative object variant in (35b) takes the locational direct object but it rejects the locatum object marked with *of*, unlike the *clear*-class in (33b).

2.4.1.4. *swarm*-class

Swarm-class verbs consist of intransitive verbs as in (36). The *swarm*-class is semantically parallel to *spray/load* class in that the locatum occupies the location. A locative variant of the *swarm*-class verb takes the locatum as the subject, and takes the location as the prepositional object marked with *in* as in (37a) while a *with* variant takes the location as the subject, and takes the locatum as the oblique object marked with *with* as in (37b).

(36)　　Alternating Verbs

　　　　blink, *splash*, *drip*, *echo*, *bloom*, *dance*, *swarm*, etc.

(37)　　a.　Bees are swarming in the garden. (locative variant)

　　　　b.　The garden is swarming with bees. (*with* variant)

(Levin 1993: 53-54)

As for the non-alternating verbs in this class, there are two types of behavior: a pattern which allows *with* variant only, as in (38)–(39), or a pattern which allows locative variant only, as in (40)–(41):

(38)　　Non-Alternating *with* Only

　　　　bristle, *bulge*, *seethe*

(39)　　a.　*People are seething in the square.

　　　　b.　The square is seething with people.

(40)   Non-Alternating Locative Preposition Only

    cluster, *collect*, *herd*, etc.

(41)   a.   The cattle are herding in the pasture.

    b.   *The pasture is herding with cattle.

(Levin 1993: 54)

2.4.1.5. *clear* (intransitive)-class

Clear-class verbs correspond to the intransitive counterpart of *clear*-class verbs as listed in 2.4.1.2. The locatum and the location alternate between the subject position and the object marked with a preposition although they always appear as the objects in the transitive counterpart. Interestingly, the *of* variant seems to be degraded when the location marked with *of* overtly appears in (43b) while both the locatum and the location overtly appear as the subject and the prepositional object in (43a).

(42)   Alternating Verbs

    clear, drain, empty

(43)   a.   Clouds cleared from the sky. (locative variants)

    b.   The sky cleared (?of clouds). (*of* variant)   (Levin 1993: 55)

2.4.2. Japanese locative verbs

This subsection is dedicated to Japanese locative verbs and their variants.

2.4.2.1. Alternating verbs which have a movement component and "cover/fill" semantics

The Japanese locative verbs show the similar syntactic behaviors and semantic

classifications to the English locative verbs. Iwata (2008) argues that there are 30 alternating verbs in Japanese on the basis of Fukui, Miyagawa, & Tenny (1985), as shown in the following four classes of verbs:

(44) Alternating verbs, parallel to English counterparts

        a.   *nuru* 'smear', *haru* 'stretch', *maku* 'wind'

        b.   *chiribameru* 'inlay', *mabusu* 'coat'

        c.   *tsumeru* 'stuff', *umeru* 'bury'

        d.   *moritsukeru* 'dish up', *yamamori-ni suru* 'heap up', *yamazumi-ni suru* 'pile up'

(45)   Complex verbs

        a.   *maki-tsukusu* 'sprinkle-exhaust', *hari-tsukusu* 'put up-exhaust'

        b.   *hatte-iku* 'go-putting up'

(46) Alternating verbs which English counterparts do not alternate

        a.   *mitasu* 'fill', *ippai-ni suru* 'make full', *tsumarasu* 'stick'

        b.   *kazaru* 'decorate'

        c.   *chirakasu* 'clutter'

(47) Syntactically alternating verbs without the "cover/fill" semantics

        a.   *kukuru* 'tie up', *shibaru* 'bind', *tomeru* 'fasten', *utsu* 'drive'

        b.   *karameru* 'entwine', *aeru* 'dress', *mazeru* 'mix'

        c.   *sasu* 'pick', *tsukisasu* 'stick'

        d.   *iru* 'shoot', *ateru* 'hit', *butsukeru* 'throw'

(Iwata 2008: 204)

The examples in each class of verbs are reviewed in the following subsection.

Alternating verbs, parallel to English counterparts

    Iwata pointed out that the verbs listed in (44) are parallel to the counterparts in English in that they appear in two variants; a locatum-object or a location-object.

(48)   a.   *kabe-ni   penki-o   nuru*   (locatum-object)

            wall-dat   paint-acc smear

            'smear paint on the wall'

        b.   *kabe-o   penki-de   nuru*   (location-objet)

            wall-acc   paint with   smear

            'smear the wall with paint'

(49)   a.   *kabe-ni   kabegami-o   haru*

            wall-dat   wall.paper-acc stretch

            'spread wall-paper on the wall'

        b.   *kabe-o   kabegami-de   haru*

            wall-acc   wall.paper-acc stretch

            'spread the wall with wall-paper'

(50)   a.   *ude-ni   houtai-o   maku*

            arm-dat   bandage-acc   wind

            'wind a bandage around the arm'

        b.   *ude-o   houtai-de   maku*

            arm-acc   bandage with   wind

            'wind the arm with a bandage'

(Iwata 2008: 176-184)

The case of (48) is the examples of *nuru* 'smear', (49) is the ones of *haru* 'stretch', and (50) is the ones of *maku* 'wind'. In these examples, the variants in (48)–(50) are both acceptable

and they are parallel to English *spray*/*load*-class in that they denote the putting action and the addition of substance to the location.

Complex verbs

The verbs in (45) are suffixed with *-tsukusu* 'up' and *-te iku* '-ing go', resulting in the complex verbs. It can be observed that such suffixation contributes to the productivity of Japanese locative verbs (Fukui, Miyagawa, & Tenny 1985, Kishimoto 2001, 2006, 2012 etc.). For example, *maku* 'sprinkle' can show the alternations when suffixing *-tsukusu* 'up' to the verb:

(51) a. *mizu-o   hodou-ni   maku*

water-acc sidewalk-dat   sprinkle

'sprinkle water on the sidewalk'

b. **hodou-o   mizu-de   maku*

sidewalk-acc   water-with   sprinkle

'sprinkle the sidewalk with water'

c. *hodou-o   mizu-de   maki-tsukusu*

sidewalk-acc   water-with   sprinkle-exhaust

'sprinkle the sidewalk completely with water'

(Iwata 2008: 188)

The example in (51c) suffixed with *-tsukusu* allows the location-object variant although the original verb *maku* 'sprinkle' does not allow the location-object variant. It is argued that the suffixes such as *-tsukusu* trigger the holistic interpretation necessary for the container-object variant.

29

Alternating verbs whose English counterparts do not alternate

The cases of (46) are not parallel to English cases in that their corresponding verbs in English do not show the alternation. One of the sharpest contrasts is the case of *full* in English and *mitasu* in Japanese:

(52)   *fill* in English

      a.   *Bill filled water into the tank.

      b.   Bill filled the tank (with water).

(53)   *mitasu* in Japanese

      a.   *gurasu-ni   mizu-o   mitasu*

           glass-dat   water-acc fill

           '(lit.) fill water into the glass'

      b.   *gurasu-o mizu-de   mitasu*

           glass-acc water with   fill

           'fill the glass with water'

The English verb *fill* cannot appear in the locatum-object variant as shown in (52a) while the corresponding Japanese verb *mitasu* can appear in both the locatum-object and the location-object frame as in (53a–b). This contrast is accounted for by the behaviors of the adjective counterpart *full* in (54) and the intransitive counterpart *michiru* 'be full' in (55):

(54)   a.   *The water is full (in the glass).

      b.   The glass is full (of water).

(55) a. *gurasu-ga michi-te-iru.*

glass-nom fill-STATE

'The glass is full.'

b. *mizu-ga michi-te-iru*

water-nom fill-STATE

'(lit). The water is full.'

(Iwata 2008: 196)

In (54b), *fill* can be predicated of the location object *the glass*, not but the locatum *the water*. The behaviors in (52) with the transitive verb *fill* show parallel behavior to these ones. This is because *fill* derives from its adjective *full*, which means 'to cause to become full', so the property of selectional restriction is inherited from the adjective *full* to the transitive verb *fill*. On the other hand, *mitasu* in Japanese is etymologically related to its intransitive form *michiru*, which takes both the container and the content as its direct object as in (55). It follows from this contrast that the differences between the possibilities of alternation in English/Japanese are due to the differences in such derivational point.

Syntactically alternating verbs without the "*cover/fill*" semantics

Iwata points out that there is a class, which superficially shows the alternation but does not involve the "*cover/fill*" semantics. Then he argues that verbs of such a class are not strictly regarded as the case of locative alternation.

(56) *kukuru* 'tie up'

a. *ki-ni   nawa-o   kukuru*

tree-dat   rope-acc tie up

'tie rope around the tree'

31

b. *ki-o   nawa-de kukuru*

　　tree-acc   rope with tie up

　　'tie the tree with rope'

Kukuru 'tie' denotes attaching action of the locatum to the location, resulting in a functional unity between the objects although the rope attached does not cover the entire of the tree.

(57) *karameru* 'entwine'

　　a. *soosu-o   nikudango-ni   karameru*

　　　　sauce-acc meatball-dat   entwine

　　　　'entwine sauce around a meatball'

　　b. *nikudango-o   soosu-de   karameru*

　　　　meatball-acc   sauce with   entwine

　　　　'entwine a meatball with sauce'

This type of verb like *karameru* 'entwine' is unlike *kukuru* 'tie' in that the unity of the locatum and the location is so strong that they are inseparable.

(58) *sasu* 'prick'

　　a. *hari-o   ude-ni   sasu*

　　　　needle-acc   arm-dat   prick

　　　　'prick a needle in one's arm'

b. *ude-o   hari-de   sasu*

   arm-acc   needle with   prick

   'prick one's arm with a needle'

(59) *iru* 'shoot'

a. *ya-o   mato-ni   iru*

   arrow-acc   target-dat shoot

   'shoot an arrow at a target'

b. *mato-o   ya-de   iru*

   target-acc   arrow with   shoot

   'shoot a target with an arrow'

<div align="right">(Iwata 2008: 200-203)</div>

These classes of verbs denote an action in sticking manner in (58) and a hitting manner in (59), resulting in damage to the location. Both actually include a change-of-state, but it does not correspond to "cover/fill". Iwata defines this "cover/fill" semantics as an essential component in the alternation as discussed in section 2.3, so he does not regard the examples like (58) and (59) as the cases of the alternation.

2.4.2.2. Alternating verbs which denote a removal event

Unlike the locative verbs listed in Levin (1993), the removal verbs such as *wipe-* or *clear*-class are not included in Iwata (2008). Some removal verbs are treated as alternating ones in Fukui, Miyagawa & Tenny (1985) and Kishimoto (2001, 2012, 2015) although the case-marking pattern is different from Japanese *spray*/*load* class.

(60) *katazukeru*

    a.   *teeburu-kara   sara-o   katazukeru*

          table-from   dishes-acc   clear

          'clear dishes from the table'

    b.   **teeburu-o   sara-de   katazukeru*

           table-acc   dishes-of clear

          'clear the table of dishes'

    c.   *teeburu-o katazukeru*

          table-acc clear

          'clear the table'

(Fukui, Miyagawa & Tenny 1985: 62, Kishimoto 2001: 104)

The locatum-object example in (60a) takes the locatum as the accusative-marked object and the location as the prepositional object which has *-kara* 'from'. The location-object example in (60b) does not allow a realization of the locatum unlike the English counterpart takes it as the abstrument-marked object, and thus the variant without the locatum in (60c) is allowed. This is because Japanese lacks an abstrument marker corresponding to *of*, precluding the variant with the accusative location and the abstrument locatum such as *clear the table of dishes*.

2.4.2.3. Examples of unacceptable alternations with alternating verbs

So far the comparison/contrast between locative verbs in English and Japanese has been reviewed. As shown above, the alternating verbs show the instantiations of two variants, but it should be noted that some cases are unacceptable even if alternating verbs are used. The following examples show unacceptable examples in the location-object frame with

nuru 'spread', *haru* 'put up', and *maku* 'wind', listed as the alternating verbs in Japanese:

(61) *nuru* 'spread'

    a.   *pan-ni*   *bataa-o*   *nuru*

        bread-dat butter-acc   smear

         'spread butter on the bread'

    b.   ?*pan-o*   *bataa-de*   *nuru*

        bread-acc butter with   smear

         'spread the bread with butter'

(62) *haru* 'put up'

    a.   *kabe-ni*   *kabegami-o*   *haru*

        wall-dat   wall.paper-acc put

         'put up the wall-paper on the wall'

    b.   ?**kabe-o *kabegami-de*   *haru*

        wall-acc wall.paper with   put

         'put up the wall with wall-paper'

(63) *maku* 'wind'

    a.   *yubi-ni*   *ito-o*   *maku*

        finger-dat   thread-acc   wind

         'wind thread around a finger'

    b.   ??*yubi-o*   *ito-de*   *maku*

        finger-acc   thread with   wind

         'wind a finger round about with thread'

2.4.2.4. Disagreements in acceptability judgments

As for the alternating/non-alternating judgments, there are disagreements among the researchers. For example, Takami & Kuno (2014) suggest that the location-object variant in (51c) with *maki-tsukusu* 'sprinkle up', repeated here as (64b), is unacceptable, contrary to the judgments given by Iwata (2008):

(64)   a.   *mizu-o   hodou-ni   maki-tsukusu*

                water-acc sidewalk-dat   sprinkle-exhaust

                'sprinkle water on the sidewalk'

          b.   *hodou-o mizu-de maki-tsukusu* (Iwata: acceptable / Takami &Kuno: *)

                sidewalk-acc water-with   sprinkle-exhaust

                'sprinkle the sidewalk completely with water'

                                      (Iwata 2008: 188, Takami & Kuno 2014: 158)

The root verb *maki-* corresponds to the English alternating verb *sprinkle* and it should involve a movement of substance to the location and a change of state, but the example in (64b) is regarded as unacceptable according to the judgments provided by Takami & Kuno.

Furthermore, another case may cast doubt on the definition of the alternation. Takami & Kuno point out that the example such as *aeru* 'dress' does not show the alternation:

(65) *aeru* 'dress'

          a.   *goma-o   kyuuri-ni   aeru*

                sesame-acc   cucumber-dat dress

                'dress sesame into pieces of cucumber'

b. *kyuuri-o   goma-de   aeru*

cucumber-acc sesame with   dress

'dress pieces of cucumber with sesame'

By contrast to Iwata's judgment, Takami & Kuno argue that their judgment is due to an unclear distinction between the locatum and the location. In (65) *kyuuri* 'cucumber' appears as the location while *goma* 'sesame' appears as the locatum with respect to the syntactic position. Takami & Kuno argue that the location object works together with the locatum one as mixed ingredients, so this location object does not play a role as a pure location. This is the case for other similar verbs, such as *mabusu* 'coat', *karameru* 'entwine', *mazeru* 'mix', which are often used in a cooking context.

2.5. Summary

In this chapter, I outlined the previous theoretical approaches to locative alternation. Three main approaches discussed here were as follows: the lexical rule approach, the construction grammar approach, and the lexical-constructional approach. Lexical approach takes the verb meaning as an important factor governing the alternation. If the verb involves a movement, the verb meaning is tied with a thematic core associated with a syntactic frame [NP V NP to NP]. On the other hand, if the verb involves a change-of-state of the location, the verb meaning is tied with a thematic core associated with the other syntactic frame [NP V NP]. These two patterns of syntactic realization are mediated through a lexical rule, resulting in the alternation. In the construction grammar approach, the fuse of the constructional meaning and verb's specific meaning leads to the alternation: there are two ways to associate the event participant roles, which is specified by a verb,

with the argument roles, which is specified by a construction. Locative alternation occurs when the participant roles of the verb are associated with a caused-motion construction and a causative construction followed by *with* construction. The Lexical constructional approach by Iwata (2008) is based on the construction grammar approach. This approach is characterized by incorporating (i) a detailed verb meaning and (ii) the lower-level constructions into a model of sanction of the construction. The alternation is attributed to two verb-specific constructions in which the verb appears.

Finally, I compared the classifications of the locative alternation verbs in English and Japanese. There is an overlap of the alternating verbs between two languages, where Japanese alternating verbs include the class like *spray/load* and the removal class, just like English ones. Furthermore, what is special to the Japanese alternating verbs is that a suffix *-tsukusu* 'up' may promote the non-alternating verbs to the alternating ones. Additionally, the acceptability judgments on each case depend on the choice of the object NPs, so there are disagreements over the classification of the alternating verbs.

However, two questions arise. First, can the theoretical approaches account for an online processing of the alternation? In particular, it is doubtful that the theoretical approaches can account for the locative alternation in SOV languages such as Japanese. The three approaches as reviewed above are associated with the idea that two meanings are somehow built around an alternating verb, i.e., a head-driven idea. These approaches seem to be definitely compatible with SVO languages such as English because the preceding verb approves the frames to follow. On the other hand, the verb in SOV languages such as Japanese follows the objects, so the speakers cannot make use of the verb meaning to decide the possibility of the alternation until the verb appears. Second, because there are disagreements regarding the judgments on the alternation data, a better-controlled examination of the acceptability judgments for the alternating/non-alternating verbs is

necessary. In connection with these questions, I will further show previous experimental studies on the alternation, including the corpus studies and behavioral data.

Chapter 3.   Previous Experimental Studies

This chapter is dedicated to a review of previous experimental studies on the locative alternation. In section 3.1, I review Carlson & Tanenhaus's (1988) processing study in English about a lexical ambiguity and a thematic ambiguity. Section 3.2 discusses Gropen, Pinker, Hollander & Goldberg's (1991) study regarding children's acquisition of the locative verbs through a forced-choice task and elicitation. Section 3.3 describes a fMRI study by Christensen & Wallentin (2011) dealing with a difference in a syntactic processing and a brain activation between the two variants of the alternation in Danish. In section 3.4, I review a corpus study by Wojciench (2014) in Spanish and Polish locative alternation.

3.1. Judgment study: Carlson & Tanenhaus (1988)

In Carlson & Tanenhaus (1988), constructional approach is supported by the difference in the grammatical judgments and its reaction time between lexically ambiguous sentences and locative alternation sentences. First, they distinguished sense ambiguities from thematic ambiguities. Sense ambiguities are exemplified in *set*, which has two different sense "to place" and "adjust (as a clock)". An example of thematic ambiguities like *load the truck* can be interpreted in such a way that (i) *the truck* is a place to be loaded, or (ii) *the truck* is loaded to somewhere, although the core meaning of *load* in both cases are kept constant. In their prediction, lexical access would activate multiple senses and sets of thematic roles. As for the multiple senses, the appropriate (or most frequent) sense would remain active on the basis of the context while the others become inactivate. On the other hand, as for a thematic ambiguity, the provisional thematic roles would be assigned to each argument incrementally, and the other inappropriate roles would be inactivated while they

were still available in the discourse model. These predictions would lead to the following consequences: if readers try to resolve the sense of ambiguous word based on the context, such a reanalysis (which is called *reprocessing*, in Carlson & Tanenhaus) should be costly. However, when readers try to resolve the thematic ambiguity, reassignment cost of the thematic roles would be relatively less than that of sense ambiguities because (i) the core meaning of the verb is constant between the alternatives of the thematic assignment, so they would not retrieve the lexical sense from the verb senses, and (ii) these alternative thematic roles are kept activate. In order to examine these predictions, the authors conducted a judgment study and examined the reaction time. They included the items in their material examples as shown in (66) and (67). The sets in (66) show the items for sense ambiguity, and the ones in (67) shows the items for thematic ambiguity:

(66) sense ambiguity

    a.   Bill set the alarm clock for six in the morning.   (Preferred sense / item)

    b.   Bill reset the alarm clock for six in the morning. (Preferred sense / control)

    c.   Bill set the alarm clock onto the shelf.   (Less-preferred sense / item)

    d.   Bill put the alarm clock onto the shelf.   (Less-preferred sense/ control)

(67)   thematic ambiguity

    a.   Bill loaded the truck with bricks.   (Preferred sense / item)

    b.   Bill filled the truck with bricks.   (Preferred sense / control)

    c.   Bill loaded the truck onto the ship.   (Less-preferred / item)

    d.   Bill drove the truck onto the ship.   (Less-preferred / control)

According to the authors, the examples in (66a,c) both include *set* as the main verb, but each *set* denotes the different action: *set* in (66a) means an action of adjusting the alarm in

such a way that it goes off at a certain time while *set* in (66c) means putting action on the alarm. Thus, it can be said that *set* has two possible meaning, i.e., lexical ambiguity. The examples of *reset* in (66b) and *put* in (66d) are the unambiguous counterparts to (66a) and (66c). On the other hand, the examples in (67a, c) show thematic ambiguity in such a way that *load* in (67a, c) has two possible assignments of thematic roles to *the truck*: the first candidate is to assign location role to *the truck* as in (67a), which corresponds to the location-object sentence in (67b) with *fill*. In this interpretation, *the truck* is regarded as a container onto which *bricks* are loaded. The second candidate is to assign the theme role to *the truck* as in (67c), which corresponds to the assignment in (67d). In these interpretations, *the truck* is interpreted as a content to be loaded. So *the truck* can be as the location or the theme object in the examples in (67). The author's assumption was that lexical ambiguity as shown in (66a, c) incurred larger reanalysis cost when an unambiguous context followed to the target word than the case of the thematic ambiguity as shown in (67a, c). The participants were exposed to the material sentences on a computer screen, and were asked to judge if the sentence made sense as fast as possible. The judgments and the reaction times for them were measured.

First, the sense ambiguity items as in (66a, c) took longer to comprehend than the sense controls as in (66b, d). In addition, the rate of the judgments of 'make sense' in the sense-ambiguous items were less than their controls (items: 77%, controls: 94%). By contrast, the reaction time for the thematic-ambiguous items as in (67a, c) were not significantly greater than the thematic controls as in (67b, d), as well as their judgments (items: 92%, controls: 93%).

Within the less-preferred sense-ambiguity condition as in (66c-d), it took longer to comprehend the items than the controls. On the other hand, in the case of the less-preferred thematic ambiguities as in (67c–d), the reaction time for the items was slightly greater than

the controls, although it was not as long as the reaction time for the sense ambiguity condition.

From these results, it was concluded that there was a difference in the processing cost between sense ambiguity and thematic one, and it was easier to reanalyze the thematic ambiguity than the lexical one although the authors showed just raw reaction times and the percentage. The results of this experiment supports the construction approach in that the uses of the different type of the constructions are not due to the sense ambiguity, and the meanings of the alternating verb is kept constant even in the different constructions. Also, this conclusion would lead to the assumption that the processing difficulties between the two constructions in locative alternation would be reduced to the property of the constructions.

3.2. Forced-choice and Elicitation: Gropen, Pinker, Hollander & Goldberg (1991)

Gropen, Pinker, Hollander & Goldberg (1991) examined children's acquisition of semantic interpretation of locative verbs such as *fill/pour* and the production in the appropriate syntactic frames. As for the acquisition of the uses of locative verbs, it is known that children have more difficulty acquiring the semantics of change-of-state than that of change-of-location, and the misuse of the container-verb in the content-form, e.g., *fill water into a glass*, is more frequent than the content-verb in the container-form, e.g., *pour a glass with water* (Bowerman 1982, Pinker 1989, Gentner 1975, 1982). The authors suggest that such errors are due to the misinterpretation of the verb meaning, i.e., the semantic component about which object is directly affected and is mapped to the direct object. This linking rule is called the *affectedness linking rule* by them, and it is treated as a universal linking rule. Provided that the affectedness linking rule is acquired by children

and is applied to a production of locative alternation, there might be a correlation between the semantic interpretation of the locative verbs and their appropriate use: if they acquire the appropriate semantics of the locative verbs, they could produce the sentence with the adequate direct object. An elicitation task and a forced-choice task were conducted in order to address the following questions: (i) whether the error of the container-verb in the content-form like *fill water into a glass* was produced more than the other type of errors in the elicitation task, (ii) whether they misinterpreted the verb semantics in the forced-choice task where the children were asked to select the picture representing locative events, and (iii) whether there was a relation between the syntactic error and the semantic error. In particular, they attempted to examine whether the children who misinterpreted the semantics of *fill* would produce the sentence with *fill* in the content-form.

In the forced-choice part, the participants were exposed to a picture, which consisted of one panel of the manner component and the other panel of the result state component as shown in Figure 7–9. In each picture, the manner part was displayed on the left while the result was on the right within the picture. For example, Figure 7 shows the 'pouring-spilling' component in such a way that in the first panel a woman trying to pour water of a pitcher to a glass was drawn, and in turn, in the second one there was an empty glass in a sink, indicating that she spilled the water. As the other pattern, Figure 8 shows 'dripping-filling' component, where a woman turning on a tap was drawn in the first panel indicating a manner of dripping while the glass in a sink is full in the second panel. The experimenters started with introducing an ambiguous picture as in Figure 9 with pouring/filling component to the participants. Here they explained the conventions of the pictures, which include the manner part in the right while the result part in the left, and made the participants familiarize with the verb meaning. After that, the experimenters asked children and adults to select which of two pictures was more adequate to a given verb

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meaning. For example, in the case of *fill*, it specifies a change-of-location and thus Figure 8 would be preferred over Figure 7.

Figure 7. A picture of 'pouring-spilling'

Figure 8. A picture of 'dripping-filling'
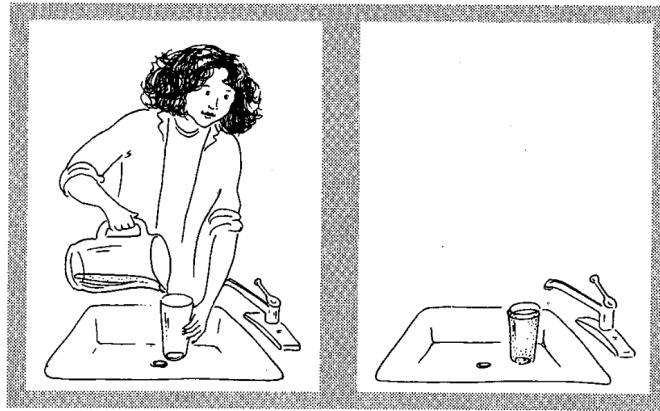
Figure 9. A picture of 'pouring-filling'

(Gropen *et al* 1991: 123-124)

The results showed that children interpreted that a pouring manner was necessary. A significant number of the youngest and mid-aged children were likely to show the bias towards a pouring manner interpretation as the most important component even for the container-verb (e.g., *fill*).

In the elicitation task, the participants were asked to describe the scene pictures used in the forced-choice task. As for the child participants, the experimenters explicitly to the appropriate form by suggesting which argument should be the direct object in production.

The results revealed that the children who showed the bias toward pouring as the important component of *fill* produced more content-object sentences with *fill* than the children who showed no bias toward pouring manner.

From these results in the two types of experiments, the authors assumed that children were likely to make syntactic errors if they misinterpreted the meaning of the locative verbs. The authors attributed these findings to the sensitivity to manner-of-motion more than change-of-state, as reported by Gentner (1978), and the overapplication of the manner-of-motion construction where the content is regarded as the affected object and it appears as the direct object. Through the affectedness linking rule, children are prone to

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misinterpret that the affected object is the content even in the case of the verbs like *fill*, so they also tend to misinterpret that the content-object form is acceptable.

This conclusion indicates that the verb semantics closely correlates with the productivity of the construction and the verb semantics is an essential factor. On the other hand, there is a preference of the overapplication to manner-of-motion. So this means that there exists an asymmetry between the motion and the change-of-state in the production data.

3.3. fMRI study: Christensen & Wallentin (2011)

Christensen & Wallentin (2011) examined that a syntactic difference in the constructions in Danish locative alternation showed the different activation for the processing cost in LIFG (left inferior frontal gyrus) through fMRI study. LIFG activation is known to be associated with a syntactic complexity such as word-order difference and semantic anomalous. In particular, LIFG activation is assumed to result from an interaction of the word-order and thematic hierarchy. A thematic hierarchy is a hierarchy of thematic role's saliency, where the agent is more salient than the experiencer, and so on. Furthermore, such a thematic hierarchy is projected to the syntactic relation, e.g., the agent appears as the subject. In locative alternation in SVO languages, there is a crossed mapping of a linear-word order and the thematic saliency. For example, a Content-locative such as *Jack sprayed paint on the wall* includes the order of Agent > Theme > Goal while a Container-locative such as *Jack sprayed the wall with paint* includes the order of Agent > Goal > Theme. On the basis of the thematic hierarchy where the agent ranks over the theme and in turn the theme ranks over the goal, the container-locative sentence shows the crossed mapping in that goal precede theme shown in (68), unlike the order of the Content-Locative sentence.

(68) Crossed mapping between the thematic hierarchy and each construction

Content-Locative: *Jack sprayed* [NP1 *paint*] *on* [NP2 *the wall*]

Thematic Hierarchy: Agent > THEME > GOAL

Container-Locative: *Jack sprayed* [NP2 *the wall*] *with* [NP1 *paint*]
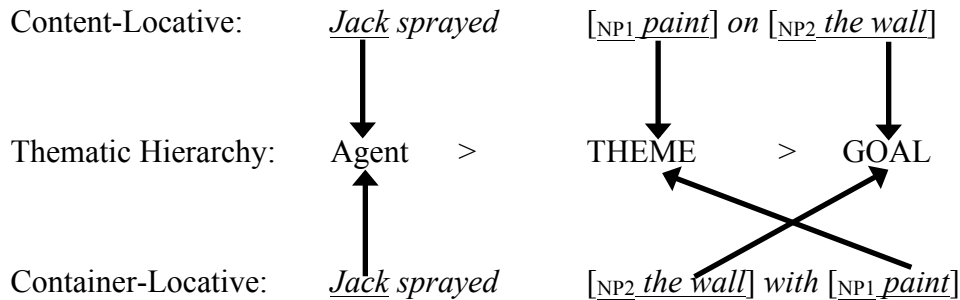
(Christensen&Wallentin 2011: 1623)

They hypothesized that these contrasts of the construction might trigger the different LIFG activation.

In their fMRI study, participants were asked to judge whether the sentences made sense or not, while their brain activation was also measured. The material sentences in Danish consisted of the Content-Locative construction and the Container-Locative construction with (i) the alternating verbs, e.g., *spray/load* in English (type A), (ii) the verbs which show the compatibility with the Content-Locative only, e.g., *pour* in English (type B), and (iii) the verbs which show the compatibility with the Container-Locative only, e.g., *cover* in English (type C).

As for an analysis of acceptability judgment data, the results showed that there was a significant main effect of the verb type and a significant interaction between the verb type and the Construction type. This is because the verb of type A showed a larger acceptability ratings than the other two types, where type A allows both types of constructions whereas one of the two constructions in type B and C is unacceptable. The interaction between verb type and construction type was also caused by such asymmetries among the properties of the three verb types: type B does not appear in the Container-Locative construction and

type C does not appear in the Content-Locative one.

By contrast, in an analysis of the reaction time, there was a significant main effect in the construction type in such a way that the response time for the Container-Locative was significantly longer than the other construction. This main effect was significant within type A where there were no significant differences in the acceptability judgments.

Finally, fMRI results showed that there was a main effect of construction in such a way that Container-Locative construction triggered more activation in LIFG, and a significant interaction between construction type and verb type. From these results, the authors concluded that the syntactic processing due to the thematic hierarchy mapping and the semantic anomalous are reflected on the acceptability judgment and the increased activation in LIFG. This study suggests that there is an asymmetric processing behavior between the two constructions in locative alternation, at least in SVO language. Again, the asymmetric behavior would be reduced to the constructional property like the different type of thematic hierarchy mapping.

3.4. Corpus study: Wojciench (2014)

Wojciench (2014) examined whether there is a difference in behavior in corpus data between Polish and Spanish. The author showed the examples of Spanish in (69) and Polish in (70), and it was striking that there was a difference in behavior of a preposition in the change-of-location constructions (T-type constructions) between Spanish and Polish:

(69) Spanish

   a. (...) *cargó*   *sus libros en varias cajas de cartón* (...). (change-of-location)

       loaded-3.SG   his books in several cardboard.boxes

       '(...) he loaded his books into several cardboard boxes (...).'

b.   *Juan cargó el carro con heno*. (change-of-state)

John loaded the cart with hay

'John loaded the cart with hay.'

(70)   Polish

a.   *Jan władował   siano   na wóz.* (change-of-location)

John W-loaded-pfv hay-acc   on cart-acc

'John loaded the hay onto the cart.'

b.   *Jan załadował   wóz   sianem.* (change-of-state)

John ZA-loaded-pfv cart-acc hay-ins

'John loaded the cart with hay.'

In the Spanish variants in (69a), the change-of-location construction takes *en* 'in' as their locational preposition, although a directional preposition like *to* cannot appear. On the other hand, Polish examples show the corresponding behavior to English change-of-location pattern: in (70a), the change-of-location sentence takes the accusative-marked object *siano* 'hay-acc' and the other accusative-marked location object *wóz* 'cart-acc', accompanied with a directional PP *na* 'on'. However, in both change-of-state examples, the locatum NPs are accompanied with *con* 'with' in (69b) and the instrument marker in (70b). Wojciech assumed that such a difference is derived from a typological difference, i.e., a verb-framed language and a satellite-framed language. The

verb-framed language, Spanish, encodes path in a verb and a manner is conflated with the motion verb while the satellite-framed one, Polish, encodes the manner in the verb and the path component is encoded in a satellite, i.e., a particle, prefix, and so on. As for the change-of-location construction, the satellite-framed languages are more accessible to the construction than the verb-framed ones because they are compatible with the directional PP as the satellite constituents.

The predictions in this study were as follows: (i) Polish alternating verbs would not show the frequency differences between the change-of-location and the change-of-location construction patterns. On the other hand, as for Spanish alternating verbs, there would be less frequency in the change-of-location than the other pattern. That is, Spanish would show an asymmetric distribution for the types of the constructions. However, (ii) there would be an exception for *cargar* 'load', one of Spanish alternating verbs. This verb denotes more abstract manner by means of a three-dimensional location unlike other types of alternating verbs, therefore this verb would frequently appear in the change-of-location construction more than the other verbs. In order to test these predictions, the author examined the Corpus de Referencia del Español Actual and the National Corpus of Polish.

The results revealed that the number of frequency of the change-of-location construction in Spanish was significantly lower than Polish, due to the difference between the verb-framed and the satellite-framed language. Additionally, the difference of the specificity of an encoded manner evoked the difference in the frequencies between the two constructions: the change-of-location sentences with *cargar* in Spanish showed the higher frequency than the change-of-state sentences although the other verb classes showed strong frequency for the change-of-state sentences. In the same way, in Polish, the verbs with more abstract manner, like *ładować* 'load', showed the higher frequency in the change-of-location construction than the verbs with more specific manner. To sum up,

there was a tendency that a satellite-framed language, Polish, could approve the change-of-location constructions more than a verb-framed language, Spanish, although the distributional relation between the two constructions was common: the change-of-state pattern more frequently appeared in both languages. Nevertheless, the verb class with more abstract manner frequently appeared in the change-of-location more than the other class both in Spanish and Polish.

3.5. Summary

In the present chapter, I have reviewed the experimental studies about the locative alternation. First, the processing study by Carlson & Tanenhaus (1988) in section 3.1 revealed that there was a difference in reaction time between a lexical ambiguity like *set* and a thematic ambiguity included in the locative verb, supporting the idea in that locative alternation is not due to the different sense of the locative verb but the different thematic assignment. The thematic relation is reanalyzed when the less-referred assignment is encountered, resulting much processing cost. Gropen *et al* (1991) in section 3.2 conducted a forced-choice and an elicitation task for child participants, showing that there was an interaction between acquisition of semantics of the locative verbs and its syntactic use, in such a way that the container-object verb like *fill* was likely to be produced in the content-object frame when the children misinterpreted the meaning of *fill* as the verb requiring the manner of motion. Section 3.3 was dedicated to the fMRI study in Christensen & Wallentin (2011). The authors found that a syntactic difference in the alternation variants in Danish triggered the different activation for processing cost in LIFG because the container-object variant includes a crossed mapping of the thematic hierarchy, and it triggered stronger activation in LIFG and its reaction time were longer than the content-object variant. Finally, corpus study for Polish and Spanish in Wojciench (2014)

was introduced in section 3.4. This study dealt with the satellite-framed language such as Polish and the verb-framed language such as Spanish. From the corpus data, it revealed that Polish allowed more change-of-location constructions than Spanish. This was due to the difference in the language structure, i.e., the satellite-framed language takes advantage of the directional component as a preposition.

The experimental studies using the various methods introduced in the present chapter suggest that the two variants in the locative alternation are not symmetric with respect to production and comprehension, unlike the ideas proposed by theoretical approaches that the variants are switchable through a linking rule. In particular, the T-type construction (might be called as locatum-object, or change-of-location) variants were easier to process than the other variant. As discussed in chapter 2, the change-of-location specified by the T-type variant is regarded as an initial event in an event denoted by locative verbs. Actually, in the semantic structures or LCS proposed by many previous studies (Pinker 1989, Kageyama 1997, Levin & Rappaport 1998, etc.), the component of change-of-location precedes the one of change-of-state, although in the structure of the container-object variant, the component of a change-of-location is deeply embedded. So it is natural that the T-type variants are easier to process because speakers are easily accessible to the shallow-embedded change-of-location meaning, which is an initial event component denoted by the locative sentence.

Conversely, it could be pointed out that the L-type construction (might be called as location-object, or change-of-state) variant was more restricted. As analyzed above, the semantic structure of the L-type variant is more complex than the one of the content-object because it specified an initial change-of-location component in the deeper level, resulting in much processing cost.

The question arises as to whether such differences in experimental data of the SVO

languages between the two variants are observed in SOV languages such as Japanese. As mentioned in chapter 2, provided that the verb meaning is exclusively centered on the possibility of the alternation, the SOV speakers cannot judge the validity of the constructions until the verb appears in the sentence. If so, their processing behavior would be the same even when the preverbal objects appear in the different constructions. On the other hand, if the speakers show the different processing behavior for each construction, it could be said that they take advantage of the preverbal components to decide the validity of the constructions.

In order to address these problems, I conducted four acceptability judgments and five self-paced reading studies on two types of the theme/location alternation in Japanese, locative alternation and *bump* alternation. Through the online and offline experiments, I attempted to empirically examine whether there is an asymmetric behavior between the two constructions even before head information is available, and what factor interacts with the acceptability judgments and processing cost. The next chapter is dedicated to the locative alternation: the locative verbs as mentioned in the literature were classified into three classes: a class of alternating verbs and two classes of non-alternating verb. Based on these classifications, the self-paced reading studies were conducted using the attested verbs.

Chapter 4.   Experiments

In the previous chapters, I have reviewed both theoretical approaches and experimental approaches to the locative alternation across languages. Some previous theoretical studies examine what kind of verbs allows the alternation, providing a list of alternating verbs and their acceptability judgments in the two constructions. As pointed out in section 2.4, the locative verbs in such a list, however, vary among the studies. Furthermore, most of the experimental studies, at least the ones reviewed in Chapter 3, do not pay close attention to the classification of the verbs. For example, Christensen & Wallentin (2011) examined the differences in processing each variant of the locative alternation in Danish via fMRI study (see section 3.3). Their study included both alternating and non-alternating verbs like *smear*, *pour*, and *fill* while they did not show the criteria for the classification of the verbs. That is, the fundamental problem in the experimental study on locative alternation is that there are few studies examining what verbs are alternating. Therefore, in the current thesis, I start with examining which verbs are allowed in which constructions. So the first research question is as follows:

(i)   Which verbs are alternating and which ones are non-alternating, i.e., which verbs can appear in the T-type construction or the L-type construction, or both?

In order to address these problems, I first conducted norming studies to examine the acceptability judgments on the locative alternation, using the verbs previously categorized as alternating or non-alternating, as well as the marginal ones. If both variants were judged equally acceptable for a certain verb, it would be regarded as alternating. The verb would be classified into a class of *T-oriented verb* if the T-type variant were significantly more

acceptable than the L-type variant. On the other hand, the verb would be classified into *L-oriented verb* if the L-type variant were significantly more acceptable than the T-type variant. Here 'T' in T-oriented stands for Theme, which is the direct object in the T-type construction, and 'L' stands for Location, which is the direct object in the L-type construction.

The next research question would be as follows:

(ii)   Is the possibility of the alternation exclusively determined by the verb semantics, even in the case of the SOV languages such as Japanese? In particular, is the decision on the alternation delayed until the verb appears in Japanese?

As for the online sentence comprehension, Pritchett (1992) argues for a head-driven account in head-final languages including Japanese. In this account, the assignment of theta-role to each argument is left underspecified until the verb appears. If this is on the right track, then the difference between the constructions would not affect sentence processing load until the verb is encountered. However, there is much evidence that pre-head parsing works in SOV language such as Japanese (Kamide & Mitchell 1999, Kamide *et al* 2003, Miyamoto 2002, Aoshima *et al* 2004, Nakatani & Gibson 2010, etc). I argue that the pre-head parser works in the processing of locative alternation.

The following sections are dedicated to the experimental studies that deal with the questions raised above. In section 4.1, I briefly review previous studies on head-driven parser and pre-head parser in sentence processing. Then in section 4.2 I contrast the traditional offline method in linguistic survey like acceptability judgments with the methods I adopted throughout the current study, i.e., a questionnaire and a self-paced reading through an experimental platform website *Ibex Farm* and a Japanese

crowdsourcing website *Lancers*. Then I introduce the merits of using crowdsourcing in a linguistic experiment. In section 4.3, I report the results of two norming studies on the classification of the verbs. Three SPR studies were conducted using the attested verbs. These experiments are discussed in section 4.4 through 4.6[1].

4.1. Processing of arguments in a head-final languages

In this section, I review previous studies including Pritchett (1992), and Kamide & Mitchell (1999) to contrast head-driven processing with pre-head processing. Then I argue that pre-head processing is applied to the case of locative alternation in Japanese. Section 4.1.2 is dedicated to literature review on how a difference between word-order patterns affects sentence processing. I hypothesize that the preference for acc-2nd order is applied to both constructions in locative alternation, following Koizumi & Tamaoka (2004).

4.1.1. Head-driven vs. pre-head processing

As for the application of head-driven view to the examples in Japanese, Pritchett argues that there would be no attachment of the dative-marked NP to the structure in the sentences in (71a-b) until the verb appears, and that this view is supported by the fact that neither sentence induces a garden-path effect:

(71) a. Dative *-ni*

      Rex-ni   John-ga   hanasi-ta.

      Rex-dat John-nom   speak-past

      'John spoke to Rex.'

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[1] Earlier versions of some parts of this chapter have been presented at *Linguistics Beyond and Within 2017* (Aoki 2017), *the Tenth International Conference on Construction Grammar* (Aoki 2018a), and *the 34th meeting of Konan English Literary Society* (Aoki 2018b).

b.   Subject *-ni*

John-ni   nihongo-ga   wakaru.

John-dat Japanese-nom understand

'John understands Japanese.'

(Pritchett 1992: 151)

As shown in (71a-b), there are two interpretations of *-ni* '-dat' in Japanese: the dative-marked NP *Rex-ni* in (71a) serves as a recipient to whom John spoke while the dative-marked *John-ni* in (71b) serves as an experiencer subject. Following Pritchett's head-driven idea, the attachments cannot be made until the verb appears so the interpretation of the dative-marked NP is not specified, which does not yield processing difficulties. The structure is built and the ambiguity of the dative-marked NP is solved when the verb licenses the dative-marked NP. If such a head-driven parser were applied to the case of locative alternation, there would be no structural processing differences between the T-type construction and the L-type construction before the verb appears, because both patterns of the case-marked NPs in the constructions are not attached to the structure before the verb.

However, some studies have revealed that structural processing starts before the verb is encountered in a head-final language such as Japanese. Kamide & Mitchell (1999) argued that the dative marked NP was likely to be attached to a main clause when the sentence had an initial segments of three NPs marked with *-ga -ni -ga* '-nom -dat -nom' in this order even before the verbs appear. According to them, the dative marked NP in (72a) has two possible interpretations:

(72) a.   Globally Ambiguous (GA) condition

Kyooju-ga   /   *gakusee-ni*   /   *toshokansisho-ga*   /   *kas-ita*   /

Professor-nom   student-dat   librarian-nom   lend-past

mezurasii komonjo-o   /   *mise-ta.*

unusual ancient manuscript-acc   show-past

'The professor showed [HA: the student] the unusual ancient manuscript which the librarian had lent [LA: the student].'

b.   High Attachment (HA) condition

Kyooju-ga   /   *gakusee-ni*   /   *toshokansisho-ga*   /   *yabut-ta* /

Professor-nom   student-dat   librarian-nom   tear-past

mezurasii komonjo-o   /   *mise-ta.*

unusual ancient manuscript-acc   show-past

'The professor showed [HA: the student] the unusual ancient manuscript which the librarian had lent [LA: the student].'

c.   Low Attachment (LA) condition

Kyooju-ga   /   *gakusee-ni*   /   *toshokansisho-ga*   /   *kasi-ta*   /

Professor-nom   student-dat   librarian-nom   lend-past

mezurasii komonjo-o   /   *yabut-ta.*

unusual ancient manuscript-acc   tear-past

'The professor showed [HA: the student] the unusual ancient manuscript which the librarian had lent [LA: the student].'

(Kamide & Mitchell 1999: 646)

The first interpretation is that the dative marked NP is attached to the first *kasita* 'lent' in which case it is regarded as the goal in the embedded clause. The second possibility is that the dative marked NP is regarded as the goal of the matrix verb *miseta* 'showed'. They call each interpretation Low Attachment and High Attachment. Following the head-driven view, there would be no structural preference in these interpretations because the parser delays all attachment decisions until the verb appears. On the other hand, the incremental pre-head parser may prefer the High Attachment where the dative marked NP is attached to the matrix verb *miseta* 'showed', because the pre-head parser may temporarily construct a generic sentence-structure frame even before the head is encountered. It is supposed that the pre-head parser retains a link of the first potential argument (i.e., the dative marked NP) to the main verb to follow, making use of such a tentative generic structure, so the High attachment may be preferred. They conducted a self-paced reading study in order to examine how different the reading times would be between the three conditions in (72a-c) at the two critical verb regions.

The results showed that a main effect of the condition was found at the matrix verb region in such a way that the RTs for the LA condition were significantly higher than the other two conditions while there was no difference between of the RTs for the GA condition and the HA one. This indicates that the participants attempted to attach the dative-marked NP to a structure associated with the matrix verb to follow. That is, the participants preferred the high-attachment even before the matrix verb appeared. Therefore, processing was more difficult when it turned out that the matrix verb could not be linked to

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the dative marked NP, which cannot be explained in terms of a head-driven parser.

Pre-head processing also evokes an anticipation of a specific type of events. Kamide, Altmann & Haywood (2003) reported that the motion event was easier to anticipate when the case-marking pattern of dative/accusative markers was presented. They conducted eye-tracking studies using a Visual-World Paradigm to examine whether participants were likely to look at the potential theme object after a nominative-marked subject and dative-marked object were encountered. The material audio sentences were as follows:

(73)　　a.　*Weitoresu-ga kyaku-ni　　tanosigeni　　hanbaagaa-o hakobu.*
　　　　　　waitress-nom　customer-dat　merrily　　　　hamburger-accbring
　　　　　　'The waitress will merrily bring the hamburger to the customer.'

　　　　b.　*Weitoresu-ga kyaku-o tanosigeni karakau.*
　　　　　　waitress-nom customer-acc merrily tease
　　　　　　'The waitress will merrily tease the customer.'

(Kamide, Altmann & Haywood 2003: 147)

They found that anticipatory eye-movement to the potential theme 'hamburger' started when participants heard the dative object. This is because the dative-marked NP is interpreted as the recipient after the nominative-marked NP appears. In turn, such an interpretation triggers eye-movement to the potential theme, which participates in the motion event.

The same mechanism might apply to the T-type construction in the locative alternation. That is, a motion event in the T-type construction may be anticipated in advance because a combination of the dative and the accusative leads to a movement event.

I would also like to point out that the case markers in the L-type construction involve semantic ambiguities that are not found in the T-type variant. There are at least two possibilities for the interpretation of the oblique marked object in the L-type sentence: theme object or instrumental. For instance, the interpretations of *with* in (74a) and in (74b) seem to be different: the former corresponds to the theme while the latter corresponds to the instrument:

(74)　　a.　Pat loaded the wagon with hay.

　　　　b.　Pat broke the window with a hammer.

<div align="right">(Goldberg 2002: 14)</div>

However, Goldberg (2002, 2006) points out that it is difficult to divide the uses of *with* into either instrumental or non-instrumental. In other cases, there is an overlap between the property of moved entity and the independent tool in (75a-d):

(75)　　a.　He wrapped the present with tin foil.

　　　　b.　She broke the fever with cool washcloths.

　　　　c.　She warmed the child with a blanket.

　　　　d.　She loosened the cap with hot water.

<div align="right">(Goldberg 2002: 340)</div>

The theme object in (75a–d) are manipulated as the independent instrument and as the stuff moved to the other object simultaneously, so it is difficult to classify these uses of the *with* NP into the theme or the instrument. She proposed that the theme and the instrument commonly serve as the *intermediary* in the causal chain because these oblique NPs are

manipulated by the subjects and play a role in the change of state denoted by the event. As discussed in section 2.2, she argued that the intermediary is not essential to an argument structure. If this view is adopted, the L-type construction of locative alternation is considered to consist of a causative construction and an optional intermediary. This optionality is contrasted to the dative object in the T-type construction (i.e., the caused-motion construction in Goldberg's approach) because the dative object is included in its argument structure. Thus I assume that the combination of the accusative-marked NP and the -*de* NP 'with NP*'* in Japanese triggers some processing difficulty of the L-type construction.

My working hypothesis is that the processing differences between the constructions of locative alternation would be found if the participants actually start expecting the verb to follow using the NPs and the case markers, in a similar way to the findings of Kamide & Mitchell (1999) and Kamide *et al.* (2003). In particular, the T-type construction would be read faster than the L-type construction with respect to the combination of case marking if the processing difficulty is reflected on the reading times. The case-marking patterns in the two constructions share the accusative case, so their processing difference, if any, would be due to the difference between -*ni* '-dat' in the T-type construction and -*de* '-with' in the L-type construction: it is easier to specify the event type when the combination of case-marking in the T-type is encountered than the L-type marking. Specifying the event type facilitates anticipation for a verb to follow.

To sum up, the proposal for the first question of whether there is a processing asymmetry between the constructions in locative alternation in Japanese is that they are processed differently in such a way that the T-type construction is processed easier. Such a processing asymmetry would be also reflected on the reading times in self-paced reading studies.

4.1.2. Word-order differences

The canonical word-order in Japanese locative alternation remains an open question. Some examples mentioned in the previous studies were represented in the order of the accusative-oblique marked NPs, others were in the order of the oblique-accusative marked ones. There are no studies about the canonical word-order of Japanese locative alternation as far as I am aware, and it may be the case that the disagreement of judgments on the alternating verbs might be due to the differences in the word-order. In order to consider the effect of word-order of in locative alternation, I briefly review the previous studies about the word-order in general and its processing cost.

Japanese is a language allowing flexible word-order in a sentence as long as the verb is clause-final, although it has been reported that the scrambled order triggers an increase of processing cost. As for the increase of processing cost for scrambled sentences, the following two assumptions are proposed: some previous studies (Chujo 1983, Miyamoto & Takahashi 2002, Muraoka, Tamaoka, and Miyaoka 2004) propose that a scrambled sentence requires more processing cost because the parser must look for a gap. Mazuka, Itoh & Kondo (2002) propose that scrambled sentences must require more S-nodes to process than its counterpart in canonical order, triggering processing cost.

With respect to the word-order difference and its processing cost, ditransitive sentence is well studied. The examples of ditransitive sentence are as follows:

(76)   a.   *John-ga <u>Mary-ni</u> <u>sono hon-o</u> mise-ta.*

John-nom Mary-dat that book-acc show-past

'John showed that book to Mary.'

b.   *John-ga sono hon-o Mary-ni mise-ta*.

John-nom that book-acc Mary-dat show-past

(Koizumi & Tamaoka 2004: 174)

In the examples of (76), the sentence consists of *miseta* 'showed' with its accusative marked object (*sono hon-o* 'that book') and the dative marked object (*Mary-ni*). As shown above, there are two possible orders. The default word-order of a ditransitive sentence has been controversial. The disagreement on this matter may stem from (i) the disagreement in the method, or (ii) the types of verbs included in each experiment.

Koizumi & Tamaoka (2004) conducted an experiment to examine whether native speakers of Japanese take longer time to process ditransitive sentences in the acc-dat order than those in the dat-acc order by using *show*-type verbs and *pass*-type verbs. It has been argued that these verbs are different depending on which object NP promotes to the subject position in the inchoative variants. In the case of the *pass*-type verbs, the dative marked object in the transitive promotes to the object position when it takes the inchoative corresponding example. On the other hand, the *show*-type verbs in the inchoative make the accusative-marked NP promotes to the subject position. In Koizumi & Tamaoka's study, the participants were instructed to judge the plausibility of the Japanese ditransitive sentence by pressing a Yes/No button. The reaction times for the judgments were measured to examine whether there was a difference in reaction times in accordance with the word-order of dative/accusative and the verb type {pass-type/show-type}. Their results revealed that the RTs for the acc-second order sentences were significantly shorter than the acc-first ones regardless of the type of the verbs. So they argue that the acc-second order in Japanese ditransitive sentences is canonical while the acc-first is derived from the acc-second one, regardless of the verb type. Therefore, they conclude that the acc-second

order is canonical in Japanese ditransitive sentences.

As for the word-order of *with*-phrase, there is a suggestion that the *with*-phrase in locative alternation has the optional status, rather than the argument. Iwata referred to the example in (77a) from Goldberg (1995), and compared it with (77b). In (77a) *with hay* follows the resultative sentence *Joe loaded the wagon full*. The example in (77b), where the *with hay* precedes the resultative *full*, is unacceptable.

(77)   a.   Joe loaded the wagon full with hay.

(Goldberg 1995: 82)

         b.   *Joe loaded the wagon with hay full.

(Iwata 2008: 47)

The resultative construction is treated as a construction consisting of <agent, theme, resultative> in Goldberg (1995). Thus it can be assumed that the example in (77a) consists of the resultative construction and the intermediary *with*, in the same way that the L-type construction consists of the causative construction and the intermediary *with*.

From these behaviors of the *with* phrase, I agree with the idea of Goldberg (2002, 2006) that the intermediary *with*-phrase is not essentially included in the argument structure but regarded as an optional element accompanied with the causative construction, whether the *with* phrase in locative alternation is instrumental or not. Therefore an intervention of the *-de* 'with'   might trigger processing difficulty in the L-type construction if *-de* 'with' also has the optional status. On the other hand, in the case of the T-type construction, *-ni* '-dat' is related to eventive structure building because the dative marking is part of the argument structure (Takezawa 1987, Sadakane & Koizumi 1995). So the effect of the intervention of the dative-marked NP might not be stronger in the T-type construction than the case of the

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L-type.

Here our second research question is whether the word-order contributes to processing difficulty in locative alternation including the ditransitive form. As for the effect of the word-order on processing of the T-type construction, my working hypothesis is following Koizumi & Tamaoka (2004): if the preference for the acc-2nd order applies to the locative alternation, then the RTs for the acc-2nd order would be shorter than the acc-1st. On the other hand, the effect of the acc-1st on the L-type construction would be found in such a way that the acc-1st would trigger processing difficulty before the verb is encountered: this is due to the combination of the accusative-marked NP and *-de* NP 'with NP'. The accusative-marked NP should be expected to be adjacent to the verb, so it would take more processing load when the adjunct *-de* intervenes between the accusative-marked NP and the verb. This is compatible with Goldberg's argument structure as discussed in section 2.2, where the L-type construction is treated as a causative construction and an optional *with*-phrase.

In order to examine these problems, three self-paced reading studies were conducted using (i) the alternating verbs, (ii) the T-oriented verbs, and (iii) the L-oriented verbs attested in two norming studies. In the norming studies and the SPR studies, I adopted a web-based method using a crowdsourcing website and an experimental hosting website. The next section is dedicated to an introduction of such a web-based method.

4.2. Experimental Method

Before the experiment sections, I will briefly describe the comparison of web-based methods with traditional offline methods. Through this dissertation I adopt the web-based method using Lancers and Ibex Farm because the web-based method is advantageous in time-effectiveness and cost-effectiveness compared with the offline methods.

4.2.1. Offline Methods

Linguistic survey such as acceptability judgments is often conducted on a paper-based way. In fact, the paper-based method does not require any special tools other than paper and pencils. However, a lot of problems are also pointed out in the literature (Behrend, Sharek, Meade & Wiebe 2011, Gibson, Piantadosi & Fedorenko 2011, Kohita & Miyamoto 2014, etc). From now on, I review some of the problems about traditional offline methods. After that, I will move on to the experiment using an online method.

One problem is that a paper-based survey must be printed out. The more participants the experimenter tries to distribute the survey to, the more time it would take. Additionally, the answers from the surveys must be converted electronically into data points by hand, and this procedure is also time-consuming, and error-inducing.

Reliability problem arises regarding the participant pools: Behrend *et al* (2011) point out that sampling may be heavily biased because many researchers attempt to recruit undergraduates or graduates as participants. That is, it is doubtful that such student participants are truly random sampled from the language users.

Furthermore, in a paper-based survey, missing answers on their survey sheets frequently occur, but it is difficult to avoid such a problem because it is conducted on a paper and there is no way to alert it to them.

4.2.2. Online Methods: Crowdsourcing

The web-based method with crowdsourcing, however, can solve the problems shown above. Crowdsourcing is a form that refers to the outsourcing to an open network (Howe 2006). The workers in such a network are recruited via Internet. Some tasks are handled by multiple workers (e.g., a survey task) while others are done by a single worker (e.g., a logo-design task). In the following studies, I used *Lancers*, one of the most popular

crowdsourcing websites in Japan with a large pool of participants. We can rapidly collect big data in a shorter time and in a cost-effective way by making use of such a platform (Gibson *et al* 2011, Kohita & Miyamoto 2014).

Lancers is the first crowdsourcing website in Japan, which was established in 2008. Users can recruit participants for a variety of tasks such as copywriting, design, and translation etc. Lancers is implemented with various templates for tasks and users can construct the introduction page on Lancers without any special tools. For example, in the case of a survey, we can put the material sentences on the template form and set a Likert scale below each sentence. However, it is impossible to shuffle material sentences with a Latin square design using Lancers' built-in system. So it is better to use Ibex Farm together with Lancers.

Ibex Farm is a linguistic experiment hosting website developed by Alex Drummond. It uses JavaScript, which allows us to flexibly construct various types of experiments by editing codes. Ibex can present materials in a Latin square design, so we do not have to distribute sentences into multiple item lists like we have to when conducting paper-and-pencil acceptability judgment questionnaires or surveys on Internet services without a Latin-square function such as Lancers and Google Form.

In order to conduct an online experiment, I adopted the following flow: First, recruiting participants was done on Lancers. Participants were asked to access the Ibex Farm experiment page through a link given in the task page on Lancers. Then they participated in the actual experiment tasks on the Ibex Farm, and were presented with a certification code at the end of the experiment. This certification hash code was used to finalize the Lancers' task page so that we could process the payment in Lancers. Compensation was paid for each of the participants after the experimenter clicks "approve". The experimenter could refer to results on the Ibex mypage, and download CSV files of the results.

In the next section, I report the results from two norming studies for SPR experiments.

4.3. Norming studies: Acceptability judgments on locative alternation

In order to classify the verbs according to the possibility of locative alternation, two acceptability judgment questionnaires were conducted. The first experiment included 20 verbs and the second one included 16 verbs.

4.3.1. Experiment 1a: Norming Study 1

In Experiment 1a, I tested 20 verbs mentioned in the previous studies (Ito 2014, 2015, Iwata 2008, Kawano 1997, 2009, 2011, Kishimoto 2001, 2006, 2012, 2015, Kuroda 2004, Okutsu 1981, Takami & Kuno 2014).

4.3.1.1. Materials

The current experiment had 1 factor with 2 levels, namely the Construction factor {T-type/L-type}. The list of the 20 verbs is shown below:

(78)   *nuru* 'smear', *oou* 'cover', *sosogu* 'pour', *mitasu* 'fill', *maku* 'wind', *tsumeru* 'stuff', *kazaru* 'decorate', *tsumaraseru* 'stick', *chiribameru* 'inlay', *sasu* 'prick', *haru* 'put up', *umeru* 'bury', *tsumiageru* 'pile up', *tsumu* 'pile', *tsumekomu* 'cram', *fukitsukeru* 'spray', *maku* 'sprinkle', *mabusu* 'coat', *moritsukeru* 'dish up', *chirakasu* 'clutter'

Material sentences each consisted of a verb, the subject, and two object NPs (theme/location), as shown in (79):

(79)   a. T-type variant

Syokunin-wa penki-o kabe-ni nut-ta

Craftsman-nom paint-acc wall-dat smear-past

'The craftsman smeared paint onto the wall.'

b. L-type variant

Syokunin-wa kabe-o penki-de nut-ta

Craftsman-nom wall-acc paint-obl smear-past

'The craftsman smeared the wall with paint.'

In the T-type variant in (79a), the theme-object was suffixed with accusative case marker *-o* while the location-object was suffixed with the dative case marker *-ni*, and the verb followed these nouns. In the L-type variant as shown in (79b), the location-object was suffixed with accusative marker while the theme-object is suffixed with oblique marker *-de*. The order of the objects was kept constant in such a way that the acc-object NP preceded the other object NP. The choices of the objects were mostly based on the examples in the previous studies with slight modification. All the item sentences are shown in Appendix 1.

4.3.1.2. Participants and Procedure

Participants were 102 native speakers of Japanese, who were recruited via Lancers and their mean of age was 43.1. 84 JPY was paid each for their participation. The participants could access the questionnaire webpage through the link pasted in the description page in Lancers after they applied to the current task. They started with an introduction, consisting of a brief description of this study, a form to report the username and the age, and two checkboxes to ask whether their native language is Japanese and whether they agree with

the purpose of the study. Before the main questionnaire part, they were instructed to rate each item quickly following their intuitions in the practice part. They were asked to judge the naturalness of each sentence on a 7-point scale shown below the material sentence, by clicking a box or pressing the key corresponding to each scale, where '1' corresponded to 'unnatural' and '7' to 'the most natural'. After the questionnaire was completed, a certification code was presented on the screen for the proof of completion. They had to report their code in Lancers at the end of the task. Once all the participants' codes were submitted to Lancers and the experiencer approved them, the participants could receive their compensation.

A total of 20x2 target sentences were evenly spaced using a Latin square design. Each list also included 40 filler sentences, among which 12 sentences were unacceptable, 12 were acceptable, and 16 were from another experiment. A total of 60 sentences were pseudo-randomly presented to each participant.

4.3.1.3. Results

Prior to the analyses, 5 participants were excluded from the data because their mean ratings were two SDs away from the mean ratings of the acceptable fillers or the unacceptable fillers. The participants might be unreliable if they answered the clearly acceptable/unacceptable sentences in a significantly different way from other participants. Therefore, the SD of the mean ratings for the filler sentences was used as trimming criteria. A one-way ANOVA was conducted to compare the effect of the Construction type on the mean ratings for each verb. The grand mean rating was 5.29, the mean rating of the T-type construction was 6.15, and the mean rating of the L-type construction was 4.43. On the basis of the result, the target verbs included in the materials were then sorted into the following three categories: (i) the alternating class, which did not show the statistical

significant differences between the acceptability for the T-type and the L-type frame, (ii) the T-oriented class, whose T-type variant showed a higher acceptability than the L-type, and (iii) the L-oriented class, whose L-type variant showed a higher acceptability than the T-type. The overall results are summarized in Table 1. The label "A", "T", "L" in Class stand for (i) alternating class, (ii) T-oriented class, and (iii) L-oriented class.

Table 1. The mean ratings in Experiment 1a

Verb	T-type	L-type	Significance	Class
nuru 'smear'	6.74	6.55	ns	A
sosogu 'pour'	6.58	1.49	***	T
oou 'cover'	3.70	6.48	***	L
mitasu 'fill'	4.83	6.49	***	L
maku 'wind'	6.57	5.63	**	T
tsumeru 'stuff'	6.80	2.98	***	T
kazaru 'decorate'	6.74	6.33	.	T?
tsumaraseru 'stick'	5.60	5.57	ns	A
chiribameru 'inlay'	6.38	5.35	**	T
sasu 'prick'	5.55	5.08	ns	A
haru 'put up'	6.45	3.73	***	T
umeru 'bury'	6.45	5.83	*	T
tsumiageru 'pile up'	6.38	1.90	***	T
tsumu 'pile'	5.93	1.43	***	T
tsumekomu 'cram'	5.74	3.38	***	T
fukitsukeru 'spray'	6.33	3.51	***	T

maku 'sprinkle'	6.66	2.13	***	T
mabusu 'coat'	6.78	6.00	*	T
moritsukeru 'dish up'	6.62	3.20	***	T
chirakasu 'clutter'	6.08	5.66	ns	A

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 'ns'

4.3.2. Experiment 1b: Norming Study 2

In Experiment 1b, I tested 16 verbs mentioned in the previous studies (Ito 2014, 2015, Iwata 2008, Kawano 1997, 2009, 2011, Kishimoto 2001, 2006, 2012, 2015, Kuroda 2004, Okutsu 1981, Takami & Kuno 2014).

4.3.2.1. Materials

Again, the experiment had 1 factor with 2 levels, namely the Construction factor {T-type/L-type}. The list of the 16 verbs is shown below:

(80)   *yamamorini-suru* 'heap up', *yamazumini-suru* 'pile up', *mazeru* 'mix', *makitsukusu* 'sprinkle up', *haritsukusu* 'put up', *tomeru* 'fasten', *tsukisasu* 'stick', *shibaru* 'bind', *kukuru* 'tie up', *karameru* 'entwine', *utsu* 'hit', *iru* 'shoot', *ippaini-suru* 'make full', *aeru* 'dress', *someru* 'dye', *shikitsumeru* 'spread all over'

Material sentences each consisted of a verb, the subject, and two object NPs (theme/location), as in Experiment 1a. All the item sentences are shown in Appendix 2.

4.3.2.2. Participants and Procedure

Participants were 100 native speakers of Japanese, who were recruited via Lancers and

their mean age was 41.9. 84 JPY was paid each for the participation.

A total of 16x2 target sentences were evenly spaced using a Latin-square design. Additionally, 40 filler sentences, which were the same as in the first norming study, were added. The items were pseudo-randomly presented to the participants.

4.3.2.3. Results

Prior to the analyses, 10 participants were excluded from the data because their mean ratings were two SDs away from the mean ratings of the acceptable fillers or the unacceptable fillers. A one-way ANOVA was conducted to compare the effect of the Construction type on the mean ratings for each verb. Among these verbs, the verbs regarded as alternating verbs, which did not show significant differences between the T-type variant and L-type variant, are shown in Table 2. The other verbs are classified into either T-oriented verbs or L-oriented verbs: the verbs were regarded as T-oriented verbs if their T-type variant's acceptability ratings were significantly higher than the L-type one while the verbs were regarded as L-oriented ones if their L-type variants' acceptability ratings were higher than the T-type ones.

Table 2. The mean ratings in Experiment 1b

Verb	T-type	L-type	Significance	Class
yamamorini suru 'heap up'	6.38	5.42	**	T
yamazumini suru 'pile up'	5.82	4.69	**	T
mazeru 'mix'	5.83	4.74	**	T
makitsukusu 'sprinkle up'	5.53	3.85	***	T

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haritsukusu 'put up'	5.67	4.18	***	T
tomeru 'fasten'	3.92	6.63	***	L
tsukisasu 'stick'	6.23	5.16	***	T
shibaru 'bind'	4.61	6.88	***	L
kukuru 'tie up'	6.17	5.66	ns	A
karameru 'entwine'	6.11	5.92	ns	A
utsu 'hit'	6.46	3.82	***	T
iru 'shoot'	4.84	6.37	***	L
ippaini suru 'make full'	5.06	5.66	ns	A
aeru 'dress'	3.87	3.38	ns	A
someru 'dye'	3.40	6.55	***	L
shikitsumeru 'spread all over'	6.58	6.29	ns	A

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 'ns'

In the next section, the SPR studies are conducted using the verbs attested above. SPR1 in 4.4 includes the alternating verbs in their material, SPR2 in 4.5 includes the T-oriented verbs, and SPR3 include the L-oriented verbs.

4.4. Experiment 2: A self-paced reading study with alternating verbs

The purpose of Experiment 2 was to examine how the construction types interact with the word-order types when the participants process the locative alternation sentences with the alternating verbs attested in Experiment 1a and 1b.

4.4.1. Materials

The experiment had a 2x2 factorial design crossing the Construction factor

(T-type/L-type) and the Word-order factor (acc-first/acc-second order). Material sentences consisted of two clauses: the main clause included the subject, two object NPs (theme/location), and the main verb suffixed with a conjunction such as *-node* 'because'. The matrix clause followed the embedded clause to avoid sentence wrap-up effects for the regions of interest. The verbs used in this experiment were the alternating ones attested in Experiment 1a–b: *nuru* 'smear', *sasu* 'prick', *chirakasu* 'clutter', *kukuru* 'tie up', *karameru* 'entwine', *ippai-ni suru* 'make full'. Some sample material sentences are shown below, with slashes indicating region boundaries:

(81)　　a.　T-type variant ✕ Accusative-first

Syokunin-ga　　　/　*penki-o*　/　*kabe-ni*　/　*nut-ta*　　*node*
Craftsman-nom　　/　paint-acc /　wall-dat　/　smear-past　because

yogore-wa　　/　*sukoshi*　/　*usuku nat-ta.*
spot-top　　　/　slightly　/　be.light-past

　　　　b.　T-type variant ✕ Accusative-second

Syokunin-ga　　　/　*kabe-ni*　/　*penki-o*　/　*nut-ta*　　*node*
Craftsman-nom　　/　wall-dat　/　paint-acc /　smear-past　because

yogore-wa　　/　*sukoshi*　/　*usuku nat-ta.*
spot-top　　　/　slightly　/　be.light-past

'The craftsman smeared paint onto the wall, so the spot on the wall was slightly lighter.'

c. L-type variant ✕ Accusative-first

Syokunin-ga / *kabe-o* / *penki-de* / *nut-ta* *node*/
Craftsman-nom / wall-acc/ paint-obl / smear-past because /

yogore-wa / *sukoshi* / *usuku nat-ta.*
spot-top / slightly / be.light-past.

d. L-type variant ✕ Accusative-second

Syokunin-ga / *penki-de* / *kabe-o* / *nut-ta* *node*/
Craftsman-nom / paint-obl / wall-acc / smear-past because/

yogore-wa / *sukoshi* / *usuku nat-ta.*
spot-top / slightly / be.light-past

'The craftsman smeared the wall with paint, so the spot on the wall was slightly lighter.'

A total of 24x4 target sentences were prepared and distributed over four lists using a Latin-square design. They were spaced among the other 16 sentences from another experiment, 16 acceptable and 16 unacceptable filler sentences. A total of 72 sentences were pseudo-randomly presented to the participants.

If the pre-head parser works when the participants process the locative alternation sentences, the processing asymmetry would be found in such a way that the T-type construction is read faster than the L-type one before the verb appears. On the other hand, at the verb region, the participants encounter the verb and compute a compatibility of the

preceding argument structure and the verb meaning. So there would be no main effects of the Construction type because the alternating verbs allow in both constructions. A second prediction was that the effect of Word-order would be found only in the L-type construction: the acc-1st in the L-type construction triggers processing difficulty because the adjunct *-de* '-with' intervenes between the accusative-marked object and the verb. This would lead to an interaction between the Construction factor and the Word-order factor.

4.4.2. Participants and Procedure

111 participants were recruited via Lancers, who were native speakers of Japanese and their mean age was 39.5. 108 JPY was paid for each for participation. They were asked to do the task by accessing the webpage on Ibex Farm via the link pasted in Lancers.

Sentences were presented region by region, non-cumulatively in a moving-window manner, on Ibex Farm. A yes-or-no comprehension question followed each sentence.

4.4.3. Results

Prior to the analyses, 2 participants were excluded because their overall accuracy rates of the comprehension questions were less than 70%, and 2 were excluded because their z-scores of the overall mean RTs were higher than 3. In addition, the data of the RTs shorter than 150ms and longer than 5000ms were removed from the analyses. The data for all regions were summarized in Figure 10.
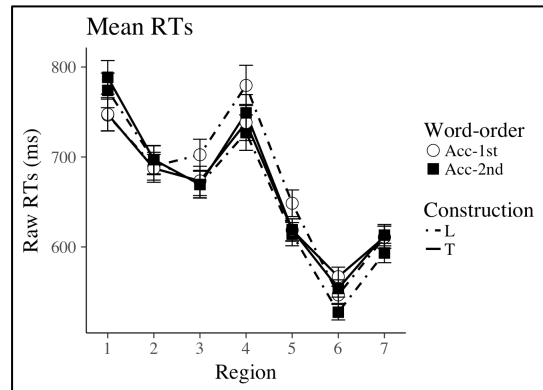
Figure 10. The mean raw RTs in Experiment 2

The regions of interest were the following regions: Region 3 was the object NP region preceding the verb. In this experiment, the same pair of the object NPs was used for each item, but the words in the R3 were not lexically constant across the construction types and Word-order types. So it was not appropriate to analyze R3 alone because the differences in RTs might be due to the lexical inconsistency at the preceding regions if any effect were found at R3. In order to resolve this issue, the regions of the first object (R2) and the second one (R3) were put together as one preverbal region by summing these raw RTs before the data analyses. If the readers started processing the structure by making use of the information regarding the case-markers and the word-order, the first processing difference might be found at the preverbal region. By contrast, if the head-driven account were on the right track, there might be no effects; in particular, there might be no differences between the T-type construction and the L-type construction because the verb does not appear at the preverbal region.

Figure 11 and Figure 12 show the results of the preverbal region (R2/R3) and the verb region. As for the analyses, linear mixed-effects models were fitted with subject and item as random intercepts, predicting reading time of the regions from the Construction factor

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and the Word-order factor. In the preverbal region shown in Figure 11, there was a trend for the effect of the Construction type (t = -1.91, p = .06) in such a way that the T-type construction was read faster. There was no main effect of the Word-order factor (t = -0.03, p = .98). Furthermore, there was no interaction between these two factors (t = -1.01, p = 0.31).
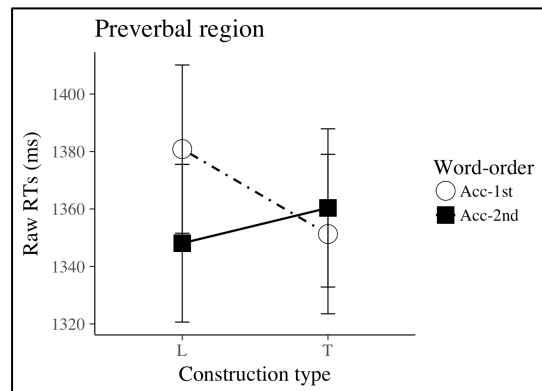
Figure 11. The mean raw RTs at the preverbal region in Experiment 2

The second region of interest was Region 4; this region was the critical verb region where the matching between each case marking for the preceding NPs and the verb would be completed. At the verb region shown in Figure 12, there were no main effects of the construction factor (t = -1.36, p = .17) or the Word-order factor (t = 0.89, p = .37). However, there was a significant interaction between the Construction factor and the Word-order factor (t = -2.17, p <.05): Planned paired comparison revealed that the acc-2nd condition was significantly read faster than the acc-1st within the L-type condition (t = -2.24, p = 0.03) and the T-type construction was significantly read faster than the L-type one in the case of the acc-1st condition (t = -2.37, p = 0.02). No other differences were found (T-type x Acc-1st vs. T-type x Acc-2nd: t = 0.51, p = 0.61, T-type x Acc-2nd vs. L-type x Acc-2nd: t = 0.38, p = 0.70).

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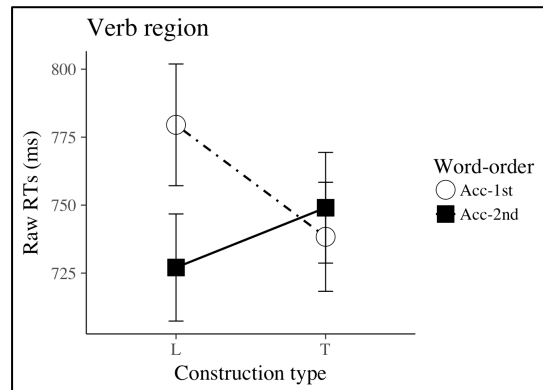
Figure 12. The mean raw RTs at the verb region in Experiment 2

4.4.4. Discussion

The findings at the preverbal region in the current study were compatible with the previous study's arguments (Christensen & Wallentin 2011), that is, the T-type frame was processed differently from the L-type although the effect was marginal: the T-type frame tended to be read faster than the L-type even before the verb appeared. It is assumed that the difference of processing cost is due to the anticipation for the event type: the case-marking pattern in the T-type construction is easier to specify the event type than the L-type construction. This result also casted doubt on the head-driven view of locative alternation because the difference in RTs between the two constructions was found before the head appeared.

The effect of Word-order was not observed at the preverbal region. This result does not confirm to the expectation that the acc-2nd order condition would be processed faster than the acc-1st order condition as reported in Koizumi & Tamaoka (2004).

As predicted, the interaction between the Construction and the Word-order was found at the verb region: The acc-2nd condition was significantly read faster than the acc-1st within

the L-type conditions, and the T-type construction was significantly read faster than the L-type one in the case of the acc-1st condition. A possible account provided for the effect of Word-order on the L-type is that the optional -*de* '-with' intervenes between the accusative-marked object and the main verb: as discussed in Goldberg (1995, 2002, 2006) and Iwata (2008), *with*-NP in the locative alternation can be treated as the optional element following a causative construction consisting of the verb and the accusative NP. If the speakers of Japanese regard the L-type construction as a unit consisting the accusative NP and the verb followed by the optional -*de* 'with' NP, they should have expected the verb to follow the accusative object. For this reason, the acc-2nd was easier to process than the acc-1st in the L-type construction. The effect of the T-type on the acc-1st can be explained by the similar account: Unlike the NP-*de* 'NP-with' in the L-type construction, the accusative-marked NP in the T-type construction is treated as an argument. So the intervention of the dative-marked NP between the accusative and the verb does not affect processing the T-type. On the other hand, the L-type essentially requires a sequence of the accusative-marked NP and the verb in order to be interpreted to avoid the intervention of the optional element.

4.5. Experiment 3: A self-paced reading study with T-oriented verbs

The purpose of SPR2 was to examine how the Construction types interact with the Word-order types when the participants process the locative alternation sentences with the T-oriented verbs attested in Experiment 1a and 1b.

4.5.1. Materials

Again, the experiment had a 2x2 factorial design crossing the Construction factor

(T-type/L-type) and the Word-order factor (acc-first/acc-second order). Material sentences included the T-oriented verbs attested in Experiment 1a and 1b. They consisted of an embedded clause with the verbs and the two object NPs, and the matrix clause so that a wrap-up effects would be avoided. The verbs used in this experiment were the T-oriented ones attested in Experiment 1a–b: *sosogu* 'pour', *tsumeru* 'stuff', *haru* 'put up', *tsumu* 'pile', *maku* 'sprinkle', *maku* 'wind'. Some sample material sentences are shown below, with slashes indicating region boundaries:

(82)   a.   T-type variant ✕ accusative-first order

Rinjin-ga /	*mizu-o* /	*hodoo-ni* /	*mai-ta*	*node*/
Neighbor-nom/	water-acc/	pavement-dat /	splash-past	because/

gogo-wa /	*suzushiku*/	*sugose-ta.*
Afternoon-top /	coolly /	spend-past

b.   T-type variant ✕ accusative-second order

Rinjin-ga /	*hodoo-ni* /	*mizu-o* /	*mai-ta*	*node*/
Neighbor-nom/	pavement-dat /	water-acc/	splash-past	because/

gogo-wa /	*suzushiku*/	*sugose-ta.*
Afternoon-top /	cooly /	spend-past

'I could stay cool afternoon because my neighbor splashed water to the pavement.'

c.   L-type variant $\times$ accusative-first order

Rinjin-ga / *hodoo-o* / *mizu-de* / *mai-ta node*/

Neighbor-nom/   pavement-acc /   water-obl /   splash-past   because/

gogo-wa / *suzushiku*/ *sugose-ta*.

Afternoon-top /   cooly   /   spend-past

d.   L-type variant $\times$ accusative-second order

Rinjin-ga / *mizu-de* / *hodoo-o* / *mai-ta node*

Neighbor-nom/   water-obl   /   pavement-acc /   splash-past because/

gogo-wa / *suzushiku*/ *sugose-ta*.

Afternoon-top /   cooly   /   spend-past

'I could stay cool afternoon because my neighbor splashed the pavement with water.'

A total of 24x4 target sentences were prepared again and distributed over four lists using a Latin-square design. The experiment also included 16 sentences from another experiment, 16 acceptable and 16 unacceptable filler sentences. A total of 72 sentences were pseudo-randomly presented to the participants.

As for predictions, at the preverbal region, a main effect of the Construction type should be found in such a way that the T-type construction is easier to process. Again, the same tendency would be observed at the verb region because the verbs used in this experiment were the T-oriented verbs, which were compatible with the T-type construction only. The effect of the Word-order type might be found in such a way that the acc-2nd order conditions would be read faster at both regions of interest. Furthermore, the acc-1st

might trigger processing difficulty of the L-type construction because the oblique *-de* NP intervenes between the accusative-marked NP and the verb, and *-de* NP was incompatible with the T-oriented verb which was included in this experiment. These might lead to an interaction.

4.5.2. Participants and Procedures

110 participants were recruited via Lancers, who were native speakers of Japanese their mean age was 40.7. and 108 JPY were paid each for their participation. As in the previous experiments, they did their task on Ibex Farm, directed from Lancers.

4.5.3. Results

Prior to the analyses, two participants were excluded because their mean RTs were greater than the grand mean of the mean RTs by more than 3 SDs. In addition, the data of the RTs shorter than 150ms and longer than 5000ms were removed from the analyses. Overall mean RTs are shown in Figure 13:
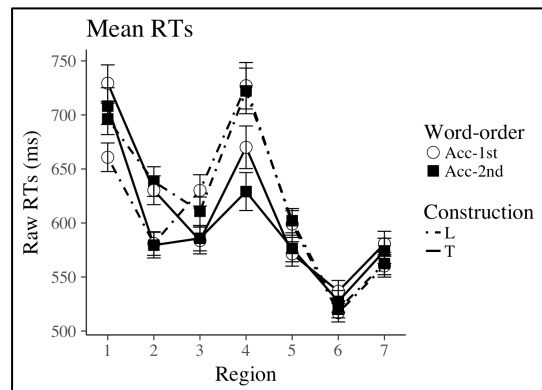
Figure 13. The mean raw RTs in Experiment 3

Figure 14 and Figure 15 show the results of the preverbal region and the verb region.

As for the analyses, linear mixed-effects models were fitted with subject and item as random intercepts, predicting reading time of the regions from the Construction factor and the Word-order factor. At the preverbal region shown in Figure 14, there was a main effect of the Construction type ($t = -2.64$, $p < .01$) in such a way that the T-type variant was read faster than the L-type one while there was no main effects of the Word-order type ($t = -1.32$, $p = 0.19$). In addition, there was a trend toward an interaction between these two factors ($t = 1.79$, $p = 0.07$). Planned paired comparison revealed that the acc-2nd was read slower than the acc-1st within the L-type construction ($t = 2.17$, $p = 0.03$) and the T-type construction was read faster than the L-type within the acc-2nd conditions ($t = -2.92$, $p < .01$).
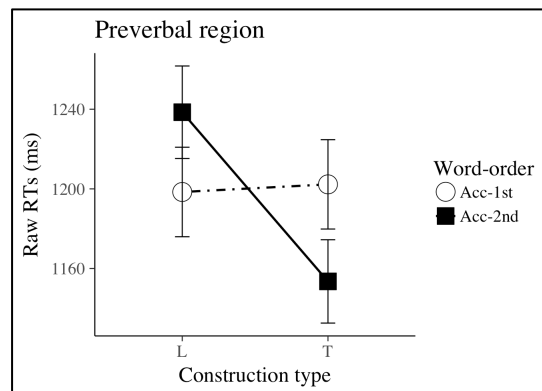
Figure 14. The mean raw RTs at the preverbal regions in Experiment 3

At the verb region shown in Figure 15, there was a main effect of the Construction type ($t = -5.06$, $p = < .01$) in such a way that the T-type was processed faster than the L-type while no main effect of the Word-order was found ($t = 0.19$, $p = 0.85$). Again, there was no interaction between these two factors ($t = 0.37$, $p = 0.71$).
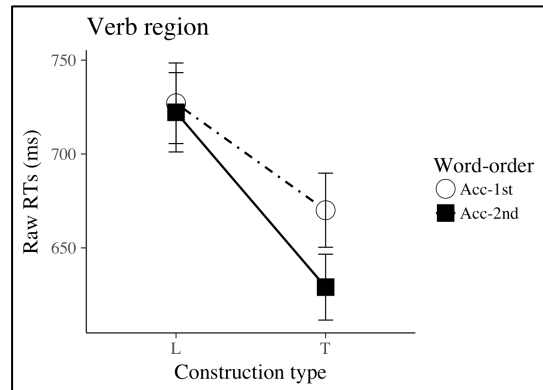
Figure 15. The mean raw RTs at the verb region in Experiment 3

4.5.4. Discussion

Similarly to Experiment 2, there was a main effect of the Construction type at the preverbal region in such a way that the T-type construction was processed faster than the L-type one even before the verb appeared. This result supports the existence of the processing difference between the Construction type at the preverbal region: the combination of {dat, acc} facilitates the structure building and an expectation for the forthcoming verb, which should be related to a movement event.

The interaction found at the preverbal region was only a trend: within the L-type construction, the acc-2nd was read slower than the acc-1st. This does not conform to the prediction that the acc-1st of the L-type was difficult to process because the oblique NP intervenes between the accusative-marked NP and the verb.

At the verb region, a main effect of the Construction type was found. The participants attempted to comprehend the relation between the arguments and its predicate when the verb appeared. Thus, in this study using the T-oriented verbs, the NPs marked with the T-type construction pattern (*-o-ni/-ni-o*) were successfully matched with the verbs while the NPs marked with the L-type construction pattern (*-o-de/-de-o*) conflicted with them. In the

case of this experiment, all the verbs included in the experiment were the T-oriented verbs, so it was not surprising that the T-type construction was significantly read faster at the verb region than the L-type construction. This indicates that the speakers of Japanese attempt to make use of head information in order to check an anticipated structure at the verb region, and processing difficulty occurs when the anticipated structure is not compatible the verb.

4.6. Experiment 4: A self-paced reading study with L-oriented verbs

The purpose of Experiment 4 was to examine how the Construction types interact with the Word-order types when the participants process the locative alternation sentence with the L-oriented verbs attested in Experiment 1a and 1b.

4.6.1. Materials

Again, the experiment was conducted with a 2x2 factorial design crossing the Construction factor (T-type/L-type) and the Word-order factor (acc-first/acc-second order). The L-oriented verbs attested in the norming study were used in the current SPR study. The item sentences consisted of the two clauses. The verbs used in this experiment were the L-oriented ones attested in Experiment 1a–b: *oou* 'cover', *mitasu* 'fill', *tomeru* 'fasten', *shibaru* 'bind', *iru* 'shoot', *someru* 'dye'. Some sample material sentences are shown below, slashed indicating region boundaries:

(83)   a.   T-type variant × accusative-first order

      Kankyaku-ga /   *sutooru-o* /   *kata-ni*   /   *oot-ta node*

      audience-nom /   stole-acc /   shoulder-dat   /   cover-past because

shihainin-wa / *reeboo-o* / *yowame-ta.*

manager-top / air.conditioning-acc / weaken-past

b.　T-type variant ✕ accusative-second order

Kankyaku-ga / *kata-ni* / *sutooru-o*/ *oot-ta node*

audience-nom / shoulder-dat / stole-acc / cover-past because

shihainin-wa / *reeboo-o* / *yowame-ta.*

manager-top / air.conditioning-acc / weaken-past

'The manager turned down the air-condition because the audience put the stole about her shoulder.'

c.　L-type variant ✕ accusative-first order

Kankyaku-ga / *kata-o* / *sutooru-de* / *oot-ta node*

audience-nom / shoulder-acc / stole-obl / cover-past because

shihainin-wa / *reeboo-o* / *yowame-ta.*

manager-top / air.conditioning-acc / weaken-past

d.　L-type variant ✕ accusative-second order

Kankyaku-ga / *sutooru-de* / *kata-o* / *oot-ta node*

audience-nom / stole-obl / shoulder-acc / cover-past because

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shihainin-wa / *reeboo-o* / *yowame-ta*.

manager-top / air.conditioning-acc / weaken-past

'The manager turned down the air-condition because the audience covered her shoulder with the stole.'

Again, a total of 24x4 target sentences were prepared and distributed over four lists using a Latin-square design. The experiment also included 16 locative sentences from another experiment, 16 acceptable and 16 unacceptable filler sentences. A total of 72 sentences were pseudo-randomly presented to each participant.

The predictions were as follows: Again, at the preverbal region, there would be a main effect of the Construction type in such a way that the T-type construction is processed faster than the L-type one. On the other hand, at the verb region, the Construction effect would be observed in the opposite direction to the preverbal region. That is, the L-type construction would be read faster than the T-type because the verbs included in this experiment were the L-oriented verbs, which was compatible with the L-type construction only. The Effect of Word-order would be found such that the acc-3nd order is read faster. In addition, the L-type construction x the acc-1st condition might result in an interaction because the acc-1st led to more processing difficulty than the acc-2nd.

4.6.2. Participants and Procedures

Again, 109 participants were recruited via Lancers, who were native speakers of Japanese and their mean age was 39.2. 108 JPY were paid each for the participation. As in Experiment 2 and 3, they did their task on Ibex Farm.

4.6.3. Results

Prior to the analyses, 3 participants were excluded because their overall accuracy rates of the comprehension questions were less than 70%, and 2 were excluded because their mean RTs were greater than the grand mean of the mean RTs by more than 3 SDs. In addition, the data of the RTs shorter than 150ms and longer than 5000ms were removed from the analyses. The overall mean RTs are summarized in Figure 16:
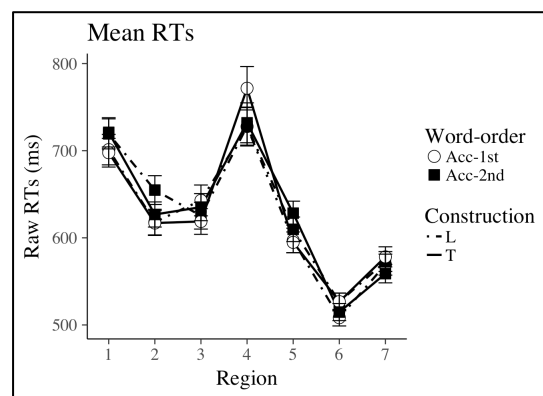
Figure 16. The mean raw RTs in Experiment 4

Figure 17 and Figure 18 show the results of the preverbal region and the verb region. As for the analyses, linear mixed-effects models were fitted with subject and item as random intercepts, predicting reading time of the regions from the Construction factor and the Word-order factor. At the preverbal region shown in Figure 17, there was only a trend of main effects of the Construction factor ($t = -1.74$, $p = 0.08$) in such a way that the T-type was read faster while there was no main effect of the Word-order factor ($t = -0.04$, $p = 0.97$). There was no significant interaction between the construction and the word-order ($t = 0.06$, $p = 0.95$).
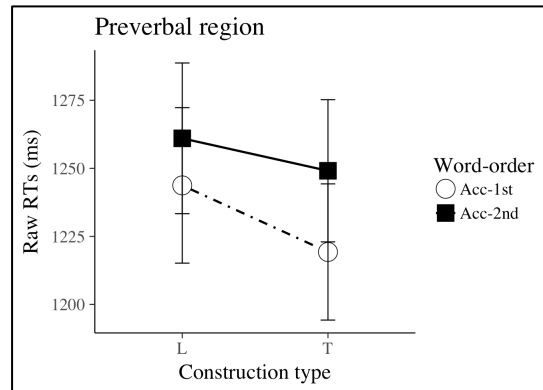
Figure 17. The mean raw RTs at the preverbal region in Experiment 4

At the verb region shown in Figure 18, there was a main effect of the Construction factor ($t = 2.16$, $p < .05$) in such a way that the T-type variant was significantly slower than the L-type, and a marginal trend of main effect of the Word-order factor ($t = 1.67$, $p = 0.1$) in such a way that the acc-1st was read slower than the acc-2nd. Furthermore no significant interaction between these two factors was found ($t = 1.17$, $p = 0.24$).
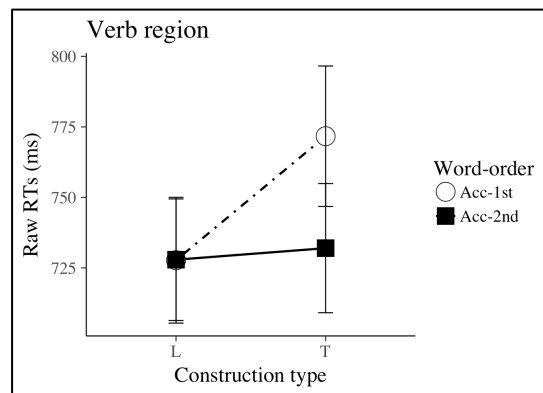
Figure 18. The mean raw RTs at the verb region in Experiment 4

4.6.4. Discussion

At the preverbal region, as predicted, the T-type construction was read faster than the

L-type construction. This was due to the combination of the dative case and the accusative case in the T-type construction, which was building a motion event structure without head-information. On the other hand, in the verb region, a main effect of the Construction type was found in the opposite direction to the results found at the preverbal region, confirming that the verbs used in this experiment were L-oriented, not getting along with the T-type construction. This indicates that the participants attempted at the verb region to establish a semantic relation between the verb meaning and the preceding NPs, which were marked with each pattern of case markings, and such semantic processing was reflected in the longer RTs.

The main effect of of the Word-order factor was not observed at the preverbal region while the marginal trend was found at the verb region in such a way that the acc-1st was read slower than the acc-2nd. It is assumed that the accusative-marked NP should be adjacent to the verb because of its argument status although the effect was marginal.

4.7. General Discussion

Experiments 2, 3 and 4 examined the processing of the T-type construction and the L-type construction with each class of verbs. The regions of interest were the preverbal region, where the first object and the second one were put together, and the verb region. The results at the preverbal region are summarized in Table 3.

Verb type	Construction type	Word-order type	Interaction
Alternating	trend ($t = -1.91$)	ns	ns
T-oriented	* ($t = -2.64$)	ns	trend ($t = 1.79$)
L-oriented	trend ($t = -1.74$)	ns	ns

Table 3. Summary of the results at the preverbal region in Experiments 2–4

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Strong trends and a main effect of the Construction type were found in all the cases in such a way that the T-type construction was read faster than the L-type construction. These results support the pre-head assumption that there is an asymmetry in the processing of the constructions even before the verb appears, contrary to the prediction of the head-driven accounts that the verb meaning exclusively plays an important role for the approval of the constructions. I assume that this processing difference is due to the roles the different oblique case markers play: -*ni* '-dat' in the T-type and -*de* '-with' in the L-type. The dative marker of NP is a type of argument, which is an eventive structure builder. The combination of the accusative and the dative is related to the motion event. On the other hand, -*de* '-with' is a postposition not tied to any specific eventive structure, and is more context-dependent. So the case of the L-type requires greater processing cost than the T-type, because the former has less predictive power than the latter as to what kind of event the forthcoming verb would denote.

Second, there were no main effects of the Word-order type at the preverbal region in the experiments. The missing of the effect of Word-order might indicate that the word-order itself cannot be an informative cue in the processing of the pre-head region in the locative alternation, and the combination of the case-marking is more likely to be used for processing at least at the preverbal region, although a strong conclusion cannot be drawn from a null result.

Verb type	Construction type	Word-order type	Interaction
Alternating	ns	ns	* ($t = -2.17$)
T-oriented	* ($t = -5.06$)	ns	ns
L-oriented	* ($t = 2.16$)	trend ($t = 1.67$)	ns

Table 4. Summary of the results at the verb region in Experiments 2–4

The results at the verb region are summarized in Table 4. As for the Construction factor, as predicted, there were no differences between the two constructions in Experiment 2 with the alternating verbs. This result was not surprising because the alternating verb can allow both types of the construction. The participants computed the semantics involved in the alternating verb and the preceding case marking patterns, not affected by the facilitated processing of the T-type construction at the preverbal region. On the other hand, the Construction factor at the verb region with T-oriented verbs in Experiment 3 was observed in the opposite direction to the case of the L-oriented verbs in Experiment 4. The T-type construction was compatible with the T-oriented verb while the L-type construction was compatible with the L-oriented verb. This result at the verb region indicates that the matching between the verb semantics and the case-marking pattern was computed at the verb region.

The effects of Word-order were not found at the verb region, except for the trend in Experiment 4 with the L-oriented verbs: Experiment 4 showed a trend of the effect of Word-order in such a way that the acc-1st was slower. The acc-1st order sequence consists of the accusative-marked NP and the oblique-marked NP. So the acc-1st in the case of T-type construction shows a sequence of [-*o* '-acc', -*ni* '-dat', V] whereas the one of L-type construction shows a sequence of [-*o* '-acc', -*de* '-with', V]. Based on that the case marker varies in the constructions, the processing load at the verb region would increase when the preceding oblique marker was incompatible with the construction preferred by the verb. Given that the verbs included in Experiment 4 were L-oriented verbs, the acc-1st order in the T-type construction triggered processing difficulty when the participants encounter a L-oriented verb. Such an effect of the acc-1st order was not found in Experiment 3 with the T-oriented verbs, but it is assumed that the contrast of the acc-1st order at the verb region

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might be due to the lexical inconsistency among the object NPs in material sentences included in each experiment.

In sum, in Japanese locative alternation, a sentence is semantically processed depending on the case-marking pattern and its semantically related type of event before the verb appears. Then after the verb appears, the parser computes whether the preceding NP meets the grammatical roles assigned by the verb.

As revealed in Experiments 2–4, there were pre-head processing in such a way that the T-type was read faster than the L-type at the preverbal region where the verb had not appeared yet. This indicates that the participants process the T-type sequence differently from the L-type sequence by taking advantage of the case-marking patterns. The dative marker -*ni* is an argument and the combination of the accusative and the dative maker trigger an expectation of a motion event, while -*de* '-with' is not. In addition to such a pre-head processing at the preverbal region, the participants make use of verb information in order to compute the compatibility of the verb semantics with the preceding argument structure.

Both at the preverbal region and the verb region, the effects of Word-order in the T-type construction were rarely found, except for the trend in Experiment 4. These observations do not conform to Koizumi & Tamaoka (2004) who argue that the acc-2nd order is canonical in ditransitive sentences. One possible suggestion is suggested that the word-order information is not used in semantic comprehension. However, I cannot draw a strong conclusion here, because this is a null result.

The purpose of the current study was to examine (i) the processing load of the two constructions in locative alternation and (ii) the effect of the Word-order factor on each construction. However, there were some limitations with regard to the experimental design in this current study. The first problem was the lexical inconsistency: different lexical items

were included before the preverbal region and the critical verb region. Generally the overall regions except for the target region should be kept constant, but the lexical inconsistency was unavoidable in the case of locative alternation because two constructions include different case-marking patterns and the theme/location alternates between such different case markings. In order to control for this limitation, I will deal with *bump* alternation in Japanese in the next chapter. *Bump*-alternation, which is originally called *tama-ate daikan* 'bullet-hit alternation', is similar to the locative alternation in that it includes theme/location object NPs. Unlike the locative alternation, the case marking pattern in *bump*-alternation is always -acc-dat in both variants of the alternation whereas the theme and the location NPs alternate between the dative and the accusative. By making use of *bump*-alternation, the lexical inconsistency in locative alternation can be controlled for.

Chapter 5.   *Bump*-alternation

In this section, I deal with a type of alternation similar to locative alternation, which I call *bump*-alternation. Sadanobu (1990a) first examined this alternation, labeling it *tama-ate daikan* ('bullet-hit' alternation), which is an alternation between the theme object and the goal/location object, except that the case-marking pattern is kept constant and both of variants denote a movement event (Sadanobu 1990a, 1990b, 1993). The representative examples with *ateru* 'hit' are shown in (84):

(84)   a.   *Tama-o*   *mato-ni*   *ateru* [mobile object variant]

               bullet-acc   target-dat   hit

        '(lit.) hit the bullet to the target' = 'make the bullet hit the target'

        b.   *Mato-o*   *tama-ni*   *ateru* [immobile object variant]

               target-acc   bullet-dat   hit

        '(lit.) hit the target to a bullet' = 'hit the target with a bullet'

(Sadanobu 1990a: 46)

Tama 'bullet' appears as the accusative object and *mato* 'target' appears as the dative object in (84a) while *mato* 'target' appears as the accusative object and *tama* 'bullet' appears as the dative one in (84b). That is, the theme/location objects alternate between the accusative/dative cases in Japanese *bump* alternation[2]. Sadanobu defines the theme as the object moving more than the other, and the goal (location) as the object moving less than

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[2] Although the English translation for (84a) sounds odd, Japanese *ateru* means 'to cause something to hit somewhere' and it takes a mobile object as its direct object. Thus *ateru* in Japanese may be closer to *bump* in English than *hit*. This is the reason why I call this alternation *bump alternation*.

the other, so in this thesis I will henceforth call the variants in (84a-b) the *mobile object variant* and the *immobile object variant,* respectively.

There are English counterparts with such a hitting verb, as shown in (85), although it should be noted that the pattern of the prepositional phrases is different from the examples in (84):

(85)   a.   Brian hit the stick against the fence.   [mobile object variant]

        b.   Brian hit the fence with the stick.   [immobile object variant]

(Levin 1993: 67)

The mobile object variant in (85a) takes *the stick* as the accusative object and *the fence* as the object of *against* while the immobile object variant in (85b) takes *the fence* as the accusative object and *the stick* as the object of *with*. The examples in (84a-b) in Japanese and the examples in (85a-b) in English are parallel in that they denote a movement event and show an alternation between theme/location objects. Here I refer to the definition of *bump*-alternation raised by Sadanobu (1990a, 1990b):

(86)   Definition of *Tama-ate daikan* 'bullet-hit alternation' (transitive)

      In a transitive sentence which denotes a movement, a sentential meaning does not change when a NP marked with *-o* and the NP marked with *-ni* or *-kara* alternate between each other.

(Sadanobu 1990a: 1–2)

Here 'a sentential meaning' refers to a truth-conditional meaning. That is, Sadanobu points out that both of variants denote the same event in which the agent causes the mobile object

to move, and then bump into the immobile one. However, according to my intuition, it is odd to interpret both events in (84a) and (84b) as designating the same event: In particular, it is difficult to interpret the immobile object variant in (84b) in the same way as (84a). To me, (84b) sounds like the target is somehow moved and made a hit to the bullet, which is of course pragmatically odd. This is because the immobile object is marked with the accusative while the mobile one is marked with the dative, which induces a pragmatically anomalous interpretation; the induced interpretation is that the agent causes the target to move toward the bullet.

However, it should be noted that this type of alternation sounds more feasible when an appropriate type of the mobile object is used, as in (87):

(87)　　a.　*Doamiraa-o*　　　*denchuu-ni*　　　*ateta/butsuketa.*　　[mobile object]

　　　　　　door.mirror-acc　　utility.pole-dat　　hit/bumped

　　　　　　'bumped the door mirror against the utility pole'

　　　　b.　*Denchuu-o*　　　*doamiraa-ni*　　　*ateta/butsuketa.* [immobile object]

　　　　　　utility.pole-acc　　door.mirror-dat　　hit/bumped

　　　　　　'bumped the utility pole with the door mirror'

Examples in (87) include a hitting verb *ateta* 'hit' or *butsuketa* 'bumped', a mobile object *doamiraa* 'door mirror' and an immobile object *denchuu* 'utility pole'. Here the immobile object variant in (87b) sounds more feasible than the immobile object one in (84b) even though *denchuu* 'utility pole' in (87b) is the immobile entity. What is a difference in acceptability judgments between the immobile object variants of (84b) and (87b) besides the choice of objects?

In order to account for the difference in acceptability judgment between (84b) and (87b),

I claim that different kinds of mobile object NPs induce different types of causation. In the next section I point out that the event denoted by (87b) involves an extended causation and its byproduct, *perspective shift*. Then I report the results of two acceptability judgment experiments in section 5.2[3] and section 5.3, which examined how the causation type interacts with the acceptability judgments of both variants. Then I discuss online processing of *bump*-alternation sentences through two SPR studies in section 5.4 and section 5.5.

5.1. Causation types

Talmy (1988, 2000) points out that the types of causation are classified into onset causation and extended causations. Onset causation consists of two stages in events, that is, the agent's causative action on the object, followed by an autonomous event of the theme's movement. The following example denotes an onset causation event.

(88)   The carton slid (all the way) across the grass from a (single) gust of wind
        blowing on it.

(Talmy 2000: 493)

In (88), a single gust of wing blowing corresponds to a causative action and the carton's movement corresponds to an autonomous event. So this event consists of two stages and can be called as an onset causation event.

Unlike onset causation, extended causation depicts events in which two events occur simultaneously, in conjunction with each other:

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[3] The results in section 5.2 were previously presented at *the 32nd meeting of Konan English Literary Society* (Aoki & Nakatani 2016a) and at *the Workshop on Cognitive Aspects of the Lexicon* (Aoki & Nakatani 2016b).

(89)   The carton slid across the grass from the wind blowing on it (steadily).

(Talmy 2000: 494)

In this event, the carton continues to move while the wind blows on it. Such a synchronicity of the causative event (i.e., wind blowing) and the movement of the object (i.e., the movement of the carton) is the main characteristic of an extended causation event.

Following the classification of the causation type mentioned above, the examples in (84) and (87) can be regarded as an instance of onset causation and extended one, respectively. In (84), the agent pulls the trigger of a gun, which corresponds to a causative event, and then the bullet autonomously moves to the target. This entire event can be construed as a two-stage event, so it can be regarded as an instance of onset causation. On the other hand, the case of (87) can be construed as an instance of extended causation. In this event, a door mirror is the mobile object, which is a part of a car while a utility pole is the immobile one. The door mirror continues to move while the agent continues to drive the car, so the causation occurs in conjunction with the movement of the mobile object, indicating a case of extended causation event.

Moreover, it should be noted that there is a cognitive difference between onset causation and extended one. I would like to posit a hypothesis that the immobile object variant in Japanese *bump*-alternation is more acceptable in the case of extended causation event because of a perceptual illusion triggered by extended causation. Such perceptual illusions, which I call *perspective shift*, make the agent perceive the immobile object as if it were a mobile one. For example, consider the situation where a boy is approaching a pizza shop. From the objective viewpoint, it is considered that the boy is moving toward the shop. On the other hand, from the boy's subjective perspective, he may perceive the event in such a way that the shop is coming closer to him. The same shift may apply to the immobile

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object variant in Japanese *bump*-alternation: in (87b), the agent simultaneously moves toward the immobile utility pole while driving a car with door mirrors. So the agent perceives the immobile pole as an object moving toward him, resulting in a hit of the door mirror at the pole. The shift may improve the degradedness of the immobile object variant on the premise that the immobile-object variant is basically unacceptable because the Japanese *bump*-verbs only allow a mobile thing as the direct object.

My research question is whether there is an interaction between Causation type (i.e., whether the event denotes onset or extended causation) and Object type (i.e., which of object NPs the variant takes as the accusative object, the mobile or immobile entity): in particular, whether the difference in the Causation type improves the acceptability of the immobile object variant.

In order to examine these questions, I conducted two acceptability judgment studies and two SPR studies using transitive *bump*-alternation and intransitive *bump* alternation.

5.2. Experiment 5: Acceptability judgments on transitive *bump*-alternation

The purpose of the acceptability judgments on transitive *bump*-alternation was to examine how the Causation type interacts with the Object type when the participants judge the naturalness of the *bump*-alternation sentences.

5.2.1. Materials

In this experiment, materials were prepared using a 2x2 factorial design. The first factor was the Causation type: onset vs. extended. The mobile object was varied so that the sentences would be interpreted as either onset causation or extended one. The immobile object was kept constant within each item. For example, if the mobile object NP was an

entity like a ball, the event would be expected to be construed as onset causation. By contrast, if the mobile object NP was an entity like a body part of the agent, which would be moved in conjunction with the agent's act, the event would be expected to be construed as extended causation. The second factor was the Object type. The mobile object variant had the mobile theme marked with accusative case *-o* and the immobile theme with dative case *-ni*. The other variant, the immobile object variant had the immobile object marked with accusative case *-o* and the mobile object with dative case *-ni*. The verbs used in the materials were either *ateru* 'to make something hit' or *butsukeru* 'bump'. Some sample materials are shown in (90) and (91).

(90) Item with *ateru* 'hit'

a. Extended causation x mobile object condition

Yopparai-ga *ganmen-o* *kootsuuhyooshiki-ni* *ate-ta.*

drunken.man-nom face-acc traffic.sign-dat hit-past

'A drunken man hit his face against the traffic sign.'

b. Extended causation x immobile object condition

Yopparai-ga *kootsuuhyooshiki-o ganmen-ni* *ate-ta.*

drunken.man-nom traffic.sign-acc face-dat hit-past

'A drunken man hit the traffic sign with his face.'

c. Onset causation x mobile object condition

Yopparai-ga *ishitsubute-o* *kootsuuhyooshiki-ni* *ate-ta.*

drunken.man-nom pebble-acc traffic.sign-dat hit-past

'A drunken man hit the pebble against the traffic sign (= made the pebble hit the sign).'

d. Onset causation x immobile object condition

Yopparai-ga kootsuuhyooshiki-o ishitsubute-ni ate-ta.

drunken.man-nom traffic.sign-acc pebble-dat hit-past

'A drunken man hit the traffic sign with the pebble.'

(91) Item with *butsukeru* 'bump'

a. Extended causation x mobile object condition

Musuko-ga kata-o genkantobira-ni butsuke-ta.

son-no shoulder-acc entrance.door-dat bump-past

'My son bumped his shoulder against the entrance door.'

b. Extended causation x immobile object condition

Musuko-ga genkantobira-o kata-ni butsuke-ta.

son-nom entrance.door-acc shoulder-dat bump-past

'My son bumped the entrance door with his shoulder.'

c. Onset causation x mobile object condition

Musuko-ga setsubun-no mame-o genkantobira-ni butsuke-ta.

son-nom *setsubun*-gen beans-acc entrance.door-dat bump-past

'(lit.) My son bumped beans for the *setsubun* festival to the entrance door.'

= 'My son threw beans for the *setsubun* festival against the entrance door.'

d. Onset causation x immobile object condition

Musuko-ga   genkantobira-o   setsubun-no   mame-ni butsuke-ta.

son-nom   entrance.door-acc *setsubun*-gen beans-dat bump-past

'(lit.) My son bumped the entrance door with beans for the *setsubun* festival.'

= 'My son hit the entrance door with beans for the *setsubun* festival.'

It was predicted that there would be a main effect of the Object type in such a way that the mobile object condition was significantly acceptable than the immobile condition. This is because the agent causes the mobile object to move to the immobile goal while it is pragmatically odd that the agent causes the immobile to move to the mobile one. The mobile object variants would be more acceptable than the immobile one in both of onset causation and extended one. If the perspective shift was triggered by extended causation and it improved the acceptability of the immobile object variant, then this would lead to the interaction between the two factors.

5.2.2. Participants and Procedures

Participants were 105 native speakers of Japanese, recruited via Lancers. They were asked to judge the naturalness of each sentence on a five-point Likert scale by clicking one of radio buttons labeled 1–5. Here '1' corresponds to 'unnatural' and '5' corresponds to 'most natural'. As the compensation, 54 JPY was paid for each participant after the task.

This experiment was conducted using Lancers' built-in questionnaire function (when I was not yet familiar with Ibex Farm). A total of 16x4 target sentences were manually distributed into four lists using a Latin square design. Each list also included the same 32 fillers, among which 11 unacceptable sentences, and 21 unacceptable ones. A total of 48 sentences were pseudo-randomized. In order to counterbalance potential ordering effects,

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the more four lists with a reverse order were prepared. The participants were exposed to one of these eight lists. Each list was shown to 10–15 participants.

5.2.3. Results

Before the analyses, the data of one subject was excluded because all the sentences were rated 5. The grand mean of all items was 2.94. The mean acceptability rating for each of the four conditions is shown in Figure 19.
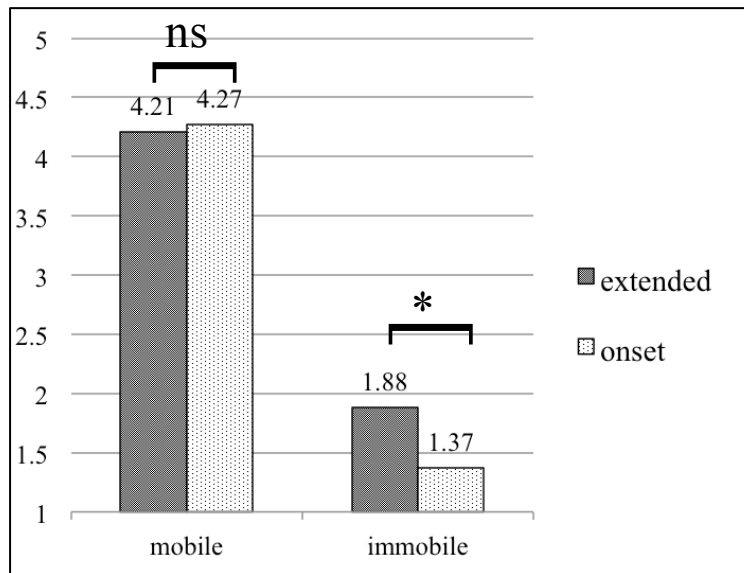
Figure 19. The mean ratings of the transitive *bump*-alternation sentences

A linear mixed effects model analysis was conducted, with subject and item as random intercepts, predicting ratings from the Causation factor and the Word-order factor. The results revealed that (i) there was a main effect of the Object type in such a way that the mobile condition showed a significant higher acceptability than the immobile one ($t = 19.45$) and (ii) a main effect of the Causation type in such a way that the extended causation was higher than the onset ($t = 2.32$), and (iii) a significant interaction between these two factors ($t = -2.70$). Furthermore, planned paired comparisons revealed that (i) the

extended causation variant was more acceptable than the onset causation within the immobile object condition ($t = 3.91$), and (ii) there was no difference between the causation type in the mobile object condition ($t = -0.42$).

5.2.4. Discussion

In this experiment, a main effect of the Object type was found in such a way that the mobile object variant was significantly more acceptable than the immobile one. This is because of pragmatic anomalous in the immobile object sentence: the participants interpreted the immobile sentence as an event where the agent causes the immobile entity to move toward the mobile object. This is in contrast to Sadanobu's observation that the immobile variant is interpreted as the same event denoted by the mobile object one. Additionally, the extended causation condition was significantly more acceptable than the onset one. This is because the onset x immobile object condition was less acceptable than the extended causation while the mobile object condition showed high acceptability in both of the causation types.

Most importantly, there was a significant interaction between the Causation type and the Object type. As predicted, the extend causation played a role in improving the acceptability of the immobile-object frame than the onset causation. This can be due to the perspective shift. Extended causation triggers the perspective shift in such a way that the agent can interpret the immobile object as if it were a mobile one, and the mobile object may be considered immobile because the agent moves along with the mobile object. This could have led the participants to interpret the immobile object sentences as mobile object variants, so the acceptability of the immobile object sentences was improved.

Here the question arises whether the perspective shift occurs in the case of intransitive *bump*-alternation. Sadanobu points out that *bump*-alternation can occur in both of transitive

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and intransitive verbs. The intransitive examples are as follows:

(92) a. *Tama-ga*   *mato-ni* *ataru.*   [mobile subject variant]

bullet-nom   target-dat hit.

'The bullet hits the target.'

b. *Mato-ga*   *tama-ni*   *ataru.*   [immobile subject variant]

target-nom   bullet-dat hit.

'(lit.) the target hits the bullet.' = 'The target is hit with the bullet.'

(Sadanobu 1990a: 46)

The examples in (92a-b) include *ataru* 'hit', an intransitive counterpart of the transitive *ateta* 'hit' used in Experiment 5. Intransitive *bump*-alternation consists of the mobile subject variant in (92a) and the immobile subject variant in (92b). The mobile entity and the immobile one are marked with nominative case in each variant, while they are marked with accusative case in the transitive counterparts in (84). The variants in intransitive *bump*-alternation lack an overt agent, which is overtly expressed in the transitive counterparts. However, as for decausativized verbs (e.g., *ataru* 'hit' and *butsukaru* 'bump', including an *-ar-* suffix), Kageyama (1996) argues that the agent covertly exists in the semantic structure although it is suppressed and not projected in the syntactic structure. The question is whether the perspective shift would occur in intransitive *bump*-alternation and improve the acceptability of the immobile subject variant, even though the overt agent does not appear in the intransitive sentences.

5.3. Experiment 6: Acceptability judgments on intransitive *bump*-alternation

The purpose of the current acceptability judgments on intransitive *bump*-alternation was to examine how the Causation type interacts with the Subject type when the participants judge the naturalness of the variants in intransitive *bump*-alternation.

5.3.1. Materials

This experiment also had a 2x2 factorial design crossing the Causation factor (extended/onset) and the Subject factor (mobile/immobile), in the same way as the transitive counterpart. Here it should be noted that the factor is named 'causation' even though the sentences were intransitive, under the assumption that the covert agent is present in the semantic structure. The mobile object NP was varied so that the sentence could be interpreted to be either of the {onset/extended}. In the case that the mobile object NP was a ballistic entity, an event would be regarded as onset causation with the covert agent. If the mobile object keeps moving while the covert agent causes it to move, an event would be classified into an extended causation event. The second factor was the Subject factor consisting of {mobile subject / immobile subject}. The mobile entity is marked with -*ga* '-nom' in the case of mobile subject variant while the immobile one is marked with -ga '-nom' in the case of immobile subject variant. The verbs used in this experiment were either *ataru* 'hit' or *butsukaru* 'bump'. Some examples of the items are listed below:

(93) Item with *ataru* 'hit'

    a.   Extended causation x mobile subject condition

        Raketto-ga   kabe-ni   atat-ta.

        Racket-nom   wall-dat hit-past

'The racket hit against the wall.'

b.   Extended causation x immobile subject condition

Kabe-ga   *raketto-ni*   *atat-ta.*

Wall-nom   racket-dat   hit-past

'(lit.) The wall hit against the racket.'

= 'The wall collided with the racket.'

c.   Onset causation x mobile subject condition

Tenisubooru-ga   *kabe-ni* *atat-ta.*

Tennis.ball-nom   wall-dat hit-past

'The tennis ball hit against the wall.'

d.   Onset causation x immobile subject condition

Kabe-ga   *tenisubooru-ni atat-ta.*

Wall-nom   tennis.ball-dat hit-past

'(lit.) The wall hit against the tennis ball.'

= 'The wall collided with the tennis ball.'

(94) Item with *butsukaru* 'bump'

a.   Extended causation x mobile subject condition

Saidomiraa-ga   *denchuu-ni*   *butsukat-ta.*

Side.mirror-nom   utility.pole-dat bump-past

'My side mirror bumped against the utility pole.'

b. Extended causation x immobile subject condition

Denchuu-ga   saidomiraa-ni   butsukat-ta.

Utility.pole-nom   side.mirror-dat   bump-past

'(lit.) The utility pole bumped against my side mirror.'

  = 'The utility pole collided with my side mirror.'

c. Onset causation x mobile subject condition

Akikan-ga   dentyuu-ni   butsukat-ta.

Empty.can-nom   utility.pole-dat bump-past

'The empty can bumped against the utility pole.'

d. Onset causation x immobile subject condition

Dentyuu-ga   akikan-ni   butsukat-ta.

Utility.pole-nom   empty.can-dat bump-past

'(lit.) The utility pole bumped against the empty can.'

= 'The utility pole collided with the empty can.'

As predictions, the immobile subject is predicted to be less acceptable because an event denoted by the immobile subject variant would be considered pragmatically anomalous. Additionally, if the intransitive items include causation triggered by the covert agent, there would be an interaction between the Causation type and the Subject type, as observed in Experiment 5: the perspective shift induced by extended causation could improve the acceptability judgment on the immobile subject variant.

5.3.2. Participants and Procedures

Participants were 100 native speakers of Japanese, recruited via Lancers, and their mean age was 41.9. 84 JPY was paid for the compensation. They were asked to judge the naturalness of the sentences after an access on an experimental page of Ibex farm through a link on Lancers. The judgments were done on a seven-point Likert scale by clicking one of the boxes numbered 1–7. Here '1' corresponds to 'unnatural' and '7' corresponds to 'most natural'.

The experiment was conducted as filler items of Experiment 1b in section 4.3. A total of 16x4 target sentences were distributed over four lists using a Latin-square design. The experiment included 12 acceptable filler sentences, 12 unacceptable filler sentences and 16 sentences from another experiment. A total of 56 sentences were pseudo-randomly presented to the participants.

5.3.3. Results

The overall ratings were shown in Figure 20. Again, prior to the analyses, 10 participants were excluded from the data because their z-scores for the acceptable fillers were less than -2, or those of the unacceptable fillers were higher than 2. The grand mean of all items was 4.36.
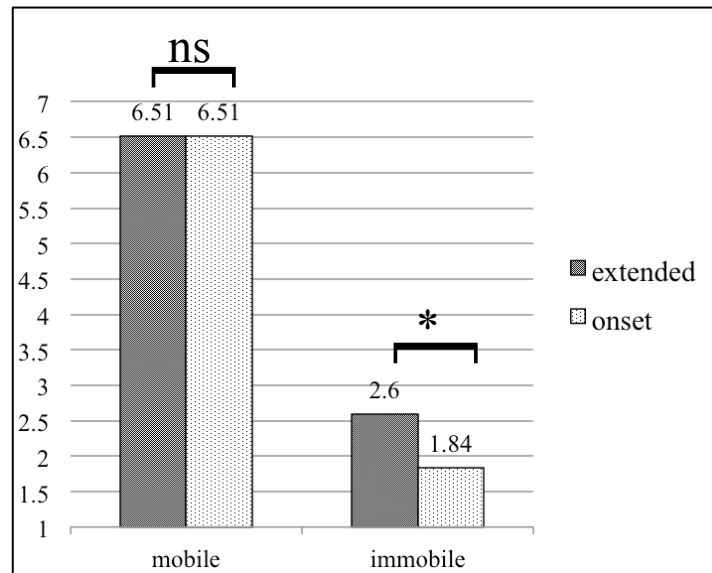
Figure 20. The mean ratings of the intransitive *bump*-alternation

A linear mixed effects model analysis was conducted, with subject and item as random intercepts, predicting ratings from the Causation factor and the Word-order factor. First, there was a main effect of the Subject factor ($t = 22.29$) in such a way that the mobile subject sentences were significantly more acceptable than the immobile subject sentences. Second, there was a main effect of the Causation factor ($t = 3.56$) in such a way that the onset causation sentence was significantly more unacceptable than the extended causation one. This was the same behavior as the result of the onset causation observed in the transitive counterparts in section 5.2. Finally, there was a significant interaction between the two factors ($t = -2.82$). Planned paired comparison revealed that the extended causation was significantly more acceptable than the onset one ($t = 7.76$) within the immobile subject conditions. On the other hand, there were no differences of the Causation factor within the mobile subject conditions ($t = 0.72$).

5.3.4. Discussion

This acceptability judgment study on the intransitive *bump*-alternation replicated the results of the transitive counterparts in Experiment 5: The main effect of the Subject factor, the main effect of the Causation factor, and the interaction between the two factors were found.

As for the Subject factor, the extended variants were significantly more acceptable than the onset ones. Again, this was due to the pragmatic anomalous immobile subject variants: the immobile variant denotes an event in which the covert agent causes the immobile object to move to the mobile object. So this result is counterevidence against Sadanobu's argument that the two variants denote the same event.

Like in Experiment 5, there was a difference of the Causation factor in such a way that the onset variants were significantly more unacceptable than the extended ones. This difference is due to the onset x immobile conditions: there was a significant difference of the Causation within the immobile subject variants while there were no significant differences of the Causation within the mobile subject variants. Such a difference of the acceptability judgments means that there is a distinction of the Causation type even in the intransitive verbs, which lack the overt agent.

In turn the more acceptable extended x immobile condition led to the interaction between the two factors. Extended causation has an effect on the Subject factor differently from onset one: the perspective shift triggered by extended causation makes the participant perceive as if the immobile object was a mobile object because the covert agent moves along with the mobile object. On the other hand, in the case of onset causation, the covert agent does not move after he works on the mobile object and the mobile one autonomously starts to move to the immobile one.

To sum the results of Experiment 5 and Experiment 6, the acceptability judgments on *bump*-alternation were subject to the presence of the agent's perspective shift, even when the agent were covert in the sentence. No matter whether the agent overtly appears in a sentence, extended causation triggered the perspective shift: the overt/covert agent can move along with the mobile entity while causing it to hit, and the agent's perception also moves to the immobile entity, triggering an illusion of the immobile one as moving entity. By contrast, onset causation does not trigger such a shift because the agent does not move to the immobile entity.

5.4. Experiment 7: A self-paced reading study on the transitive *bump*-alternation

In this section, I report the results from a self-paced reading experiment for the items used in Experiment 5. The purpose of the current self-paced reading study was to test the effects of causation type and the object/subject type in online processing, in particular, whether processing of the causation type and the object type was observed even before the verb appeared.

5.4.1. Materials

This experiment was a SPR version of Experiment 5 discussed in section 5.2, which had a 2x2 factorial design crossing the Object type (mobile/immobile) and the Causation type (onset/extended). Therefore the material sentences included in this SPR were basically the same as the ones used in Experiment 5 except that I added a second clause to each of the original stimuli to avoid sentence wrap-up effects. The material sentences each consisted of the main clause with a main transitive verb, which was either *ateru* 'hit' or

butsukeru 'bump', suffixed with a conjunction such as *-node* 'because', followed by a second clause. Some sample material sentences are shown below, where slashes indicate region boundaries:

(95) Item with *ateru* 'hit'

      a.   Extended causation x mobile object condition

           Yopparai-ga /   *booshi-o* /   *kootsuuhyooshiki-ni*   /   *ateta-node*

           drunken.man-nom hat-acc   traffic.sign-dat   hit-because

           booshi-ga   /   *dooro-ni* /   *ochi-ta.*

           hat-nom   road-dat   fall-past.

           'A drunken man hit his hat against a traffic sign, so the hat fell to the road.'

      b.   Extended causation x immobile object condition

           Yopparai-ga /   *kootsuuhyoosiki-o* /   *booshi-ni* /   *ateta-node*

           drunken.man-nom traffic.sign-acc   pebble-dat   hit-because

           booshi-ga   /   *dooro-ni ochi-ta.*

           hat-nom   /   road-dat fall-past.

           'A drunken man hit a traffic sign with his hat, so the hat fell to the road.'

      c.   Onset causation x mobile object condition

           Yopparai-ga /   *ishitsubute-o* /   *kootsuuhyoossiki-ni* /   *ateta-to*

           drunken.man-nom pebble-acc   traffic.sign-dat   hit-comp

keikan-kara / kibishiku / chuui sare-ta

policeman.from   severely   be.scolded-past

'A policeman severely scolded a drunken man for his hitting a pebble against a traffic sign.'

    d.   Onset causation x immobile object condition

Yopparai-ga / kootsuuhyoossiki-o / ishitsubute-ni / ateta-to

drunken.man-nom traffic.sign-acc   pebble-dat   hit-comp

keikan-kara / kibishiku / chuui sare-ta.

policeman.from   severely   be.scolded-past

'A policeman severely scolded a drunken man for his hitting a traffic sign with a pebble'

It was predicted that there would be an interaction between the Causation type and the Object type even before the verb appeared if the participants anticipated what type of causation was involved in an event by making use of the case-marking pattern and types of entities: the immobile object variant might be processed faster in the extended causation type than the onset one, in accordance with the results of the acceptability judgment in Experiment 5.

5.4.2. Participants and Procedures

100 native speakers of Japanese, recruited on Lancers, participated in this SPR experiment, and their mean age was 39.2. 108 JPY were paid each for participation. The experiment was executed through Ibex Farm's experiment web page whose link was pasted

on Lancers.

A total of 16x4 target items were distributed over four lists using a Latin square design, to which 24 sentences from another experiment and 24 acceptable filler sentences were added. A total of 64 sentences were pseudo-randomly presented to the participants. After each sentence, they were asked to answer a comprehension question on yes/no regarding the content of the preceding item.

5.4.3. Results

Before the analyses, 4 participants were excluded because IP addresses were identical and it was doubtful whether they were actually different participants. 3 participants were excluded because their overall accuracy rates of the comprehension questions were less than 70%, and 2 were excluded because their mean RTs were greater than the grand mean of the mean RTs by more than 3SDs. The data of the RTs shorter than 150ms and longer than 5000ms were removed from the analyses.

To adjust for differences in word length, a regression equation predicting reading time from word length, in terms of number of characters, was prepared for each participant, using all filler and experimental items (Ferreira & Clifton 1986). At each region, a residual reading time was calculated by subtracting the reading time predicted by the participant's regression equation from the actual measured reading time. Figure 21 shows the mean residual RTs at the overall regions:
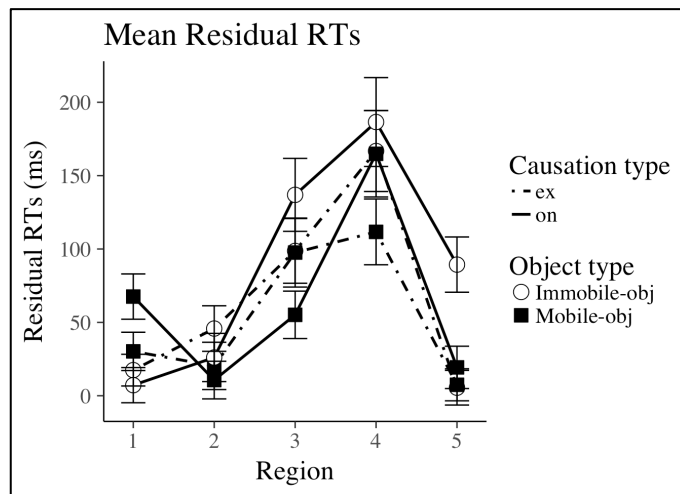
Figure 21. The mean residual RTs at overall regions in Experiment 7

In this experiment, the Word-order factor was not included. So the regions of interest were R3, an immediately preverbal region marked with dative case, and R4, a verb region.

A linear mixed-effects model analysis was conducted, with subject and item as random intercepts, predicting residual reading time of the regions from the Causation factor and the Object factor. Figure 22 shows the mean residual RTs for the preverbal object region. Here there were no main effects of the Causation type ($t = 0.17$, $p = 0.87$) while there was a trend toward a main effect of the Object factor ($t = -1.82$, $p = 0.07$). Additionally, there was a trend toward a significant interaction between these two factors ($t = 1.87$, $p = 0.06$). Planned paired comparison revealed that there were no differences between the Object types within the extended causation types ($t = -0.23$, $p = 0.82$) while the mobile object type was significantly read faster than the immobile object one within the onset types ($t = -2.56$, $p = 0.01$).

Figure 22. The mean residual RTs at the preverbal region in Experiment 7

As for the verb region shown in Figure 23, there were no main effects of the Causation factor ($t = -1.00$, $p = 0.32$), main effects of the Object factor ($t = -0.69$, $p = 0.50$) or interactions between the two factors ($t = -0.25$, $p = 0.80$).
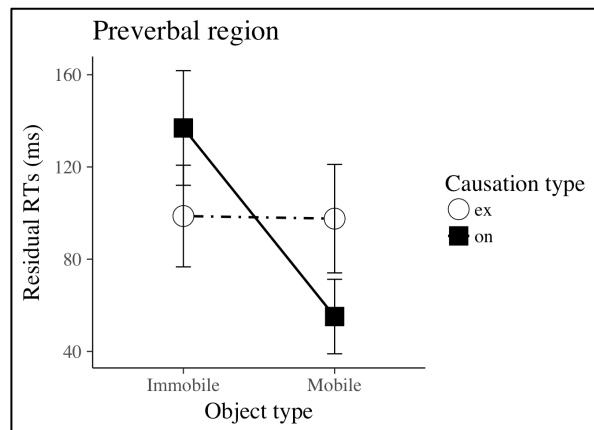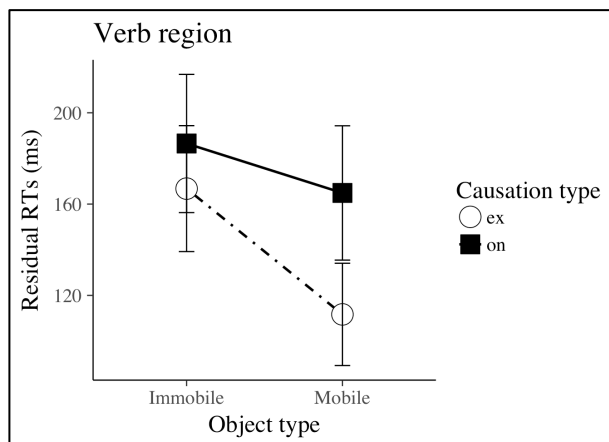

Figure 23. The mean residual RTs at the verb region in Experiment 7

At the spillover region shown in Figure 24, there were main effects of the Causation type ($t = -3.51$, $p < .01$) such that the extended causation type was read faster, and the Object type ($t = -2.12$, $p = 0.03$) such that the mobile object type was read faster.

Furthermore a significant interaction between these factors was found ($t = 2.60$, $p < .01$). Planned pairwise comparisons revealed that the mobile object type was significantly read faster than the immobile one within the onset conditions ($t = -2.81$, $p < .01$) and the onset type was significantly read slower than the extended one within the immobile conditions ($t = 3.92$, $p < .01$).
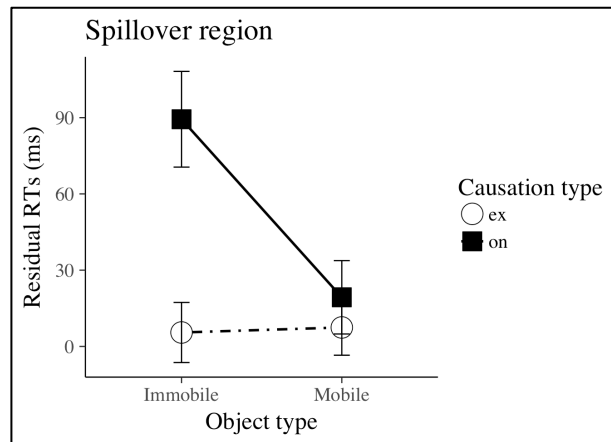
Figure 24. The mean residual RTs at the spillover region in Experiment 7

5.4.4. Discussion

As for the preverbal region, an interaction was found although it was a trend: Such a trend of interaction leads to the fact that the extended causation facilitated processing of the immobile object type, in contrast with the onset causation type where the immobile object type was significantly read slower than the mobile one. Thus this result indicates that the participants make use of the Causation factor when processing the *bump*-alternation sentences, even before the verb appears. It is suggested that participants anticipated the movement event from the case-marking pattern, as well as its potential theme and goal, even though the verb was not yet available. For example, in the mobile object condition, the mobile entity was marked with accusative while the immobile one was marked with dative. Then participants inferred an onset causation event from such a case-marking

pattern and types of entities when the mobile one was an entity like a ball, which was supposed to autonomously move to the immobile object. Conversely, when the mobile entity was marked with dative and the immobile was marked with accusative, it was difficult to process the immobile object variant when the mobile object was a ball because the agent was not supposed to move along with the mobile object, so the perspective shift was not triggered. On the other hand, the perspective shift was available when the agent continuously manipulated the mobile entity, and it can facilitate processing of the immobile object variant. So the Causation type interacts with processing of the immobile object variant.

At the verb region, a main effect of the Causation type was found. This result is considered to correspond to the result of the acceptability judgment experiment in Experiment 5: The better ratings for the extended causation can account for the shorter RTs for the extended one.

Although clear main effects or an interaction were not found at the verb region, the interaction was found at the spillover region. Again, it can be seen that the immobile object variant was processed faster in the extended causation type than the onset one. Given that a causation event was processed in keeping with the verb meaning at the verb region, such a processing of the full event might be found at the spillover region.

5.5. Experiment 8: A self-paced reading study on the intransitive *bump*-alternation

In Experiment 8 in the current section, the intransitive *bump*-alternation sentences used in Experiment 6 in section 5.3 were included as materials for the purpose of examining whether the intransitivity would lead to different processing patterns in the *bump*-alternation sentences. More specifically, the goal of the current study was to examine

whether there is a perspective shift even in the case of the intransitive *bump*-alternation, and how the perspective shift interacts with processing load.

5.5.1. Materials

This experiment had a 2x2 factorial design crossing the Subject type (mobile/immobile) and the Causation type (onset/extended), which was the same design used in the acceptability judgment study in Experiment 6. Material sentences consisted of two clauses. The target clause included the subject marked with nominative marker *-ga*, the object marked with dative marker *-ni*, and either intransitive *atat-ta* 'hit' or *butsukat-ta* 'bumped' as the main verb, suffixed with conjunction such as *-node* 'because'. The second clause was added to the target sentence to avoid sentence wrap-up effects. Some sample material sentences are shown below, where slashes indicate region boundaries:

(96) Item with *ataru* 'hit'

　　a. Extended causation x mobile subject condition

| *Raketto-ga* | / | *kabe-ni* | / | *atat-ta node* | / | *kabe-ga* | / | *hekonde* | / |
| Racket-nom | / | wall-dat | / | hit-past because | / | wall-nom | / | dented so | / |

aset-ta.
be.upset-past

'The wall was dented because the racket hit against the wall, so I was upset.'

　　b. Extended causation x immobile subject condition

| *Kabe-ga* | / | *raketto-ni* | / | *atat-ta node* | / | *kabe-ga* | / | *hekonde* | / |
| Wall-nom | / | racket-dat | / | hit-past because/ | | wall-nom | / | dented so | / |

aset-ta.

be.upset-past

'(lit.) The wall was dented because the wall hit against the racket, so I was upset.'

= 'The wall was dented because the wall collided with the racket, so I was upset.'

c. Onset causation x mobile subject condition

Tenisubooru-ga	/	*kabe-ni*	/	*atat-ta to*	/	*basukebuin-ga*	/
Tennis.ball-nom	/	wall-dat	/	hit-past that	/	basketball.player-nom	

nankuse-o	/	*tsuketa.*
complaint-acc	/	said

'The basketball player complained that the tennis ball hit against the wall.'

d. Onset causation x immobile subject condition

Kabe-ga	/	*tenisuubooru-ni*	/	*atat-ta to*	/	*basukebuin-ga* /
Wall-nom	/	tennis.ball-dat /		hit-past that	/	basketball.player-nom

nankuse-o	/	*tsuketa.*
complaint-acc	/	said

'(lit.) The basketball player complained that the wall hit against the tennis ball.

= 'The basketball player complained that the wall collided with the tennis ball.'

As predictions, if the participants inferred the causation type from a case-marking pattern and a static/dynamic relation between the object NPs even before the verb appears, an

interaction between the causation type and the subject type would be found: the immobile subject variant might be processed faster in the extended causation than the onset causation, in accordance with the results of the acceptability judgment in Experiment 6.

5.5.2. Participants and Procedures

111 native speakers of Japanese were recruited through Lancers and participated in this experiment, and their mean age was 40.6. As the compensation, 108 JPY were paid to each participant. The experiment was run on Ibex Farm.

A total of 16x4 target sentences were distributed over four lists using a Latin square design. This experiment was conducted simultaneously to Experiment 4 (section 4.6), so 24 experimental items from Experiment 4 were spaced among the 16 target sentences of the current experiment, along with 16 acceptable filler sentences and 16 unacceptable filler sentences. A total of 72 sentences were pseudo-randomly presented to the participants. After each self-paced reading task, they were asked to answer a comprehension question on yes/no.

5.5.3. Results

As mentioned in Experiment 4, prior to the analyses, 2 participants were excluded because IP addresses were identical and it was doubtful whether they were actually different participants. 3 participants were excluded because their overall accuracy rates of the comprehension questions were less than 70%, and 2 were excluded because their mean RTs were greater than the grand mean of the mean RTs by more than 3SDs. The data of the RTs shorter than 150ms and longer than 5000ms were removed from the analyses. In the same way to Experiment 7, a regression equation predicting reading time from word length was prepared for each participant, using all filler and experimental items to adjust for

differences in number of characters. At each region, a residual reading time was calculated. The mean residual RTs in the overall regions were summarized in Figure 25:
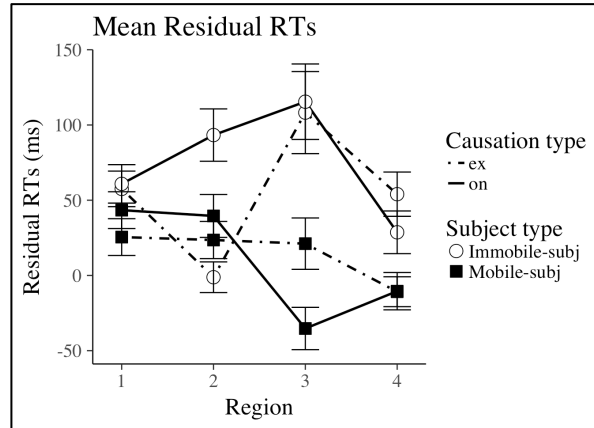
Figure 25. The mean residual RTs at the overall regions in Experiment 8

A linear mixed-effects model analysis was conducted, with subject and item as random intercepts, predicting reading time of the regions from the Causation factor and the Object factor. Figure 26 represents the results of the preverbal region. First there was a main effect of the Causation type ($t = -4.11$, $p < .01$) in such a way that the extended causation was significantly read faster. A main effect of the Subject type was not found ($t = -0.99$, $p = 0.32$). Furthermore, a significant interaction between the two factors was found ($t = 2.93$, $p < .01$). Planned paired comparison revealed that the mobile object type was significantly read faster than the immobile one within the onset types ($t = -2.39$, $p = 0.02$) and the onset causation type was significantly read slower than the extended causation type within the immobile object types ($t = 4.68$, $p < .01$).
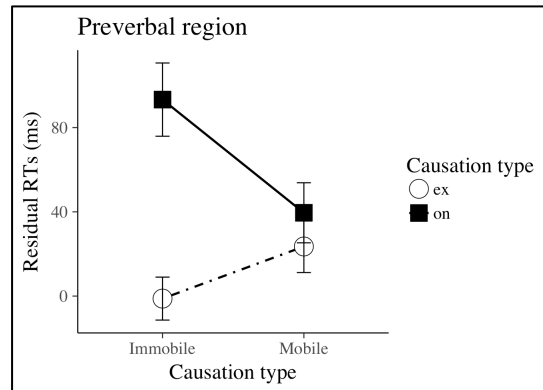
Figure 26. The mean residual RTs at the preverbal region in Experiment 8

On the other hand, at the verb region shown in Figure 27, there were no main effects of the Causation type ($t = 1.21$, $p = 0.23$). As for the Subject type, the main effect was found ($t = -6.02$, $p < .01$), where the RTs for the mobile subject was significantly shorter. Finally, an interaction between the two factors was not found ($t = 1.62$, $p = 0.11$).
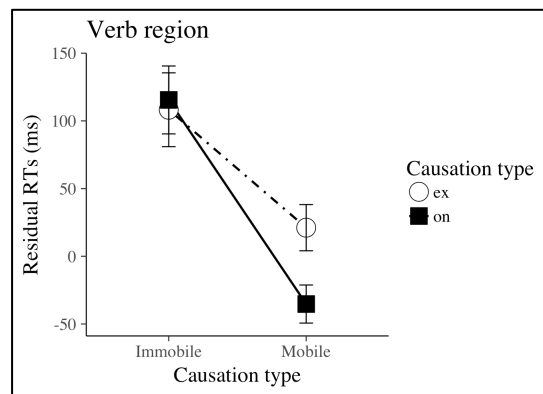
Figure 27. The mean residual RTs at the verb region in Experiment 8

Additionally, the effect of the Subject types was also found at the spillover region ($t = -4.21$, $p < .01$) where the mobile subject was read faster than the immobile one. There were no differences according to the Causation type ($t = -0.89$, $p = 0.37$) or significant

interaction ($t = -0.98$, $p = 0.33$), as shown in Figure 28.
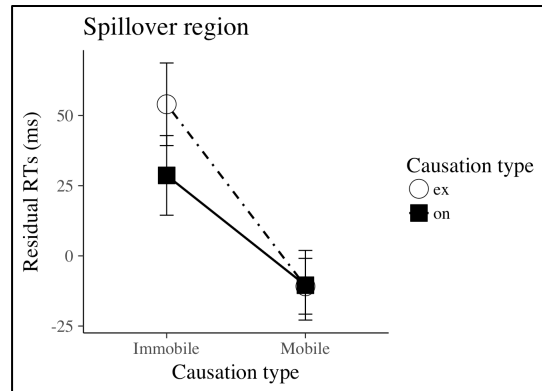
Figure 28. The mean residual RTs at the spillover region in Experiment 8

5.5.4. Discussion

At the preverbal region, the interaction between the Causation factor and the Subject factor was found as predicted. That is, the immobile subject variant was easier to process in the extended causation condition than in the onset causation one. This result indicates that the participants started the eventive calculation before the verb appeared. It was difficult to infer a movement event from the immobile subject variant with onset causation, where the immobile entity was interpreted as the mobile one. This is because onset causation does not trigger the perspective shift. On the other hand, the perspective shift in extended causation facilitated interpretation of the immobile entity as the mobile one.

At both of the verb region and the spillover region, the Subject effect was found in such a way that the mobile-subject variant was processed faster than the immobile subject one. The cause for such an opposite direction requires further investigation.

5.6. General discussions

Through the current chapter, I treated *bump*-alternation in Japanese, which is similar to the locative alternation in that the object NPs' thematic roles are theme or location, and its case-marking pattern alternates between two variants: in the mobile object variant, the mobile object is marked with accusative while the immobile is marked with dative. In the immobile object variant, the immobile object is marked with accusative while the mobile is marked with dative. The case-marking pattern is kept constant between both of the variants. Basically the immobile object variant is considered to be less acceptable because it is pragmatically anomalous to infer an event where the immobile object is moving toward the mobile one. My prediction was that the causation type would interact with the Object/Subject factor: specifically, processing difficulty of the immobile object variant might be improved by perspective shift triggered by extended causation. In an extended causation event, the agent moves along with the mobile object, so he can perceive the immobile object as if it were moving toward him. This perspective shift facilitates processing of the immobile object variant.

I conducted two acceptability judgment studies (Experiment 5 and 6), and two self-paced reading studies (Experiment 7 and 8) in order to examine how the causation type interacts with the object/subject type in the case of the transitive/intransitive *bump*-alternation. As for the acceptability judgment studies in both the transitive *bump*-alternation and the intransitive one, the interactions between the Causation factor and the Object factor were found in such a way that the immobile object variant was more acceptable in the extended causation condition than the onset one.

The results at the preverbal region of the two SPR studies are summarized in Table 5.

	Causation	Mobile vs. immobile type	Interaction
Transitive	ns	trend ($t = -1.82$)	trend ($t = 1.87$)
Intransitive	* ($t = -4.11$)	ns	* ($t = 2.93$)

Table 5. Summary of the results at the preverbal region in Experiments 7–8

At the preverbal region in the transitive case, an interaction was only a trend: the greater RTs for the immobile object were observed in the onset causation type while there were no differences of the object type within the extended one. In the intransitive case, there was an interaction in such a way that the onset type was read faster in the mobile object while the immobile object variant was read slower in the onset type. As reported in Experiment 5 and 6, the immobile object/subject variant is basically unacceptable. It follows from this that extended causation facilitates processing of the immobile object/subject variant, i.e., the immobile object/subject variant was processed in the same way to the mobile object/subject variant when the event denotes extended causation.

Although there were no interactions at the verb regions in both of Experiment 7–8 as shown in Table 6, an interaction at the spillover region was found in Experiment 7 in Table 7: the onset causation type was read faster in the mobile object variant than the immobile one, and the immobile object variant was read slower in the onset causation type than the extended one. As for this effect, it can be inferred that the verb meaning was processed in addition to an anticipated causation type and then the interpretation full event was constructed, resulting in processing load, which was found at the spillover region.

	Causation	Mobile vs. immobile type	Interaction
Transitive (Exp. 7)	ns	ns	ns
Intransitive (Exp. 8)	ns	* ($t = -6.02$)	ns

Table 6. Summary of the results at the verb region in Experiments 7–8

	Causation	Mobile vs. Immobile type	Interaction
Transitive (Exp. 7)	* ($t = -3.51$)	* ($t = -2.12$)	* ($t = 2.60$)
Intransitive (Exp. 8)	ns	* ($t = -4.21$)	ns

Table 7. Summary of the results at the spillover region in Experiments 7–8

In the current chapter, it was empirically revealed that there was a difference of processing difficulty between the two variants in *bump*-alternation through the offline and online studies. The two acceptability judgment studies revealed that the extended causation type improved the acceptability of the immobile object variant. In the two self-paced reading studies, such an interaction between the Causation type and the Object/Subject type was observed, even before the verb was encountered. This result was compatible with my prediction: that is, extended causation was contributed to facilitated processing of the immobile object/subject variant. Thus it suggests that the perspective shift lightens processing load on the immobile object/subject variant before the verb does not appear.

In conclusion, the verb does not exclusively determine whether the variants are allowed, but pre-head processing starts before the verb is encountered: in the case of *bump*-alternation, the participants infer one of the causation types from the object NPs and their case markers even before the verb appears. The causation types contributed to processing difficulty of each variant in *bump*-alternation.

Chapter 6.   Conclusion

Through this thesis, I attempted to address the following questions: (i) whether the asymmetry between the variants in the argument structure alternation in Japanese can be quantitatively attested, (ii) how the participants make use of the object NPs and the case-marking patterns for processing of the alternation, and (iii) whether the participants start such a processing even before the verb is encountered. The alternation I treated was locative alternation and *bump*-alternation.

In Chapter 2, I outlined the previous theoretical approaches, i.e., the lexical rule approach by Pinker (1989), the construction grammar approach by Goldberg (1995, 2002, 2006), and the lexical-constructional approach by Iwata (2008). I pointed out that the previous theoretical approaches have an idea in common that the possibility of the alternation is centered on a verb. Then I compared the classifications of the verbs allowing locative alternation in English and Japanese. It was indicated that the acceptability judgments on each variant might depend on the choice of the object NPs, so this is one of reasons why there are disagreements over the classification of the alternating verbs.

Chapter 3 was dedicated to literature review of previous experimental studies. I reviewed four experimental studies: the processing study by Carlson & Tanenhaus (1988), the forced-choice and the elicitation task for child and adult participants by Gropen *et al* (1991), the fMRI study by Christensen & Wallentin (2011), and the corpus study for Polish and Spanish data in Wojciench (2014). These experimental studies suggest that the two variants in the alternation do not show the same behavior, unlike the ideas proposed by theoretical approaches.

In order to address the questions of (i) whether the asymmetric processing difficulty of the alternation can be found, (ii) how the participants make use of the object NPs and the

case-marking patterns, and (iii) whether such a processing difficulty is observed at the preverbal region, I conducted four acceptability judgment studies and five self-paced reading studies on locative alternation and *bump*-alternation. In Chapter 4, three self-paced reading studies were conducted for each class of verbs attested in norming studies. The results of the self-paced reading studies showed that the T-type construction was read faster than the L-type at the preverbal region for all types of verbs (Experiment 2, 3 and 4). Additionally, there was an interaction between the Construction type and the Word-order type at the verb region in the case of Experiment 2, which examined the alternating verbs. These findings indicate that processing difficulty of the variants in locative alternation is not the same even before the verb is encountered. Such an asymmetry of processing difficulty was found even in the case of the alternating verbs.

In Chapter 5, two acceptability judgment studies and two self-paced reading studies were conducted on *bump*-alternation in order to examine how the Causation type and the Object/Subject type would interact. The two acceptability judgment studies showed that there was an interaction between the two factors in such a way that extended causation, which would trigger perspective shift, improved the acceptability of the immobile object/subject variant. The interactions found in Experiment 7 and 8 showed that extended causation facilitated processing immobile object/subject variant, compared with onset causation. These results suggest that perspective shift played a role in processing cost on the immobile object/subject variants in *bump*-alternation, and importantly, this effect was found pre-verbally.

In conclusion, the possibility of the theme/location alternation is not exclusively centered on the verb, i.e., head information. Unlike the head-driven idea proposed by the theoretical approaches, the pre-head parser works on the processing of the theme/location alternation, computing the variants by making use of the semantic relations between the

object NPs, and the case-marking patterns making inferences on the type of event, even before the verb is available.

Appendix

1. Item sentences in Experiment 1a

T: T-type construction condition / L: L-type construction condition

(1, T)　　　職人はペンキを壁に塗った。

(1, L)　　　職人は壁をペンキで塗った。

(2, T)　　　大学生はジュースをコップに注いだ。

(2, L)　　　大学生はコップをジュースで注いだ。

(3, T)　　　ホールスタッフは布をテーブルに覆った。

(3, L)　　　ホールスタッフはテーブルを布で覆った。

(4, T)　　　ウェイターは水をグラスに満たした。

(4, L)　　　ウェイターはグラスを水で満たした。

(5, T)　　　看護師は包帯を腕に巻いた。

(5, L)　　　看護師は腕を包帯で巻いた。

(6, T)　　　八百屋はいちごを箱に詰めた。

(6, L)　　　八百屋は箱をいちごで詰めた。

(7, T)　　　秘書は花を部屋に飾った。

(7, L)　　　秘書は部屋を花で飾った。

(8, T)　　　配管工はごみをパイプに詰まらせた。

(8, L)　　　配管工はパイプをごみで詰まらせた。

(9, T)　　　デザイナーは宝石をドレスにちりばめた。

(9, L)　　　デザイナーはドレスを宝石でちりばめた。

(10, T)　　　アルバイトは針を手に刺した。

(10, L)　　　アルバイトは手を針で刺した。

(11, T)　　　内装業者は壁紙を壁にはった。

(11, L)	内装業者は壁を壁紙ではった。
(12, T)	小学生はごみを穴に埋めた。
(12, L)	小学生は穴をごみで埋めた。
(13, T)	幼稚園児は箱を廊下に積み上げた。
(13, L)	幼稚園児は廊下を箱で積み上げた。
(14, T)	農家は干し草を荷車に積んだ。
(14, L)	農家は荷車を干し草で積んだ。
(15, T)	司書は本を本棚に詰め込んだ。
(15, L)	司書は本棚を本で詰め込んだ。
(16, T)	リフォーム業者はペンキを壁に吹き付けた。
(16, L)	リフォーム業者は壁をペンキで吹き付けた。
(17, T)	隣人は水を歩道にまいた。
(17, L)	隣人は歩道を水でまいた。
(18, T)	和菓子職人はきなこを餅にまぶした。
(18, L)	和菓子職人は餅をきなこでまぶした。
(19, T)	店長はご飯を皿に盛りつけた。
(19, L)	店長は皿をご飯で盛りつけた。
(20, T)	小学生はお菓子を部屋にちらかした。
(20, L)	小学生は部屋をお菓子でちらかした。

2. Item sentences in Experiment 1b

T: T-type construction condition / L: L-type construction condition

| (1, T) | 大学生はご飯を皿に山盛りにした。 |
| (1, L) | 大学生は皿をご飯で山盛りにした。 |

(2, T)	司書は本を机に山積みにした。
(2, L)	司書は机を本で山積みにした。
(3, T)	建設業者は水をセメントに混ぜた。
(3, L)	建設業者はセメントを水で混ぜた。
(4, T)	庭師は除草剤を庭に撒きつくした。
(4, L)	庭師は庭を除草剤で撒きつくした。
(5, T)	カメラマンは写真を掲示板に貼りつくした。
(5, L)	カメラマンは掲示板を写真で貼りつくした。
(6, T)	販売員はテープを箱に留めた。
(6, L)	販売員は箱をテープで留めた。
(7, T)	鍼灸師は針を横腹に突き刺した。
(7, L)	鍼灸師は横腹を針で突き刺した。
(8, T)	大工はひもを木材に縛った。
(8, L)	大工は木材をひもで縛った。
(9, T)	遭難者は縄を木にくくった。
(9, L)	遭難者は木を縄でくくった。
(10, T)	料理研究家はバターをパスタにからめた。
(10, L)	料理研究家はパスタをバターでからめた。
(11, T)	お父さんは釘を柱に打った。
(11, L)	お父さんは柱を釘で打った。
(12, T)	弓道部員は矢を的に射た。
(12, L)	弓道部員は的を矢で射た。
(13, T)	ホールスタッフはビールをグラスにいっぱいにした。
(13, L)	ホールスタッフはグラスをビールでいっぱいにした。
(14, T)	アルバイトはネギを酢味噌にあえた。

(14, L)　　　　　アルバイトは酢味噌をネギであえた。

(15, T)　　　　　デザイナーは染料を布に染めた。

(15, L)　　　　　デザイナーは布を染料で染めた。

(16, T)　　　　　リフォーム業者はタイルを床に敷き詰めた。

(16, L)　　　　　リフォーム業者は床をタイルで敷き詰めた。

3. Item sentences in Experiment 2

Construction factor {T / L} x Word-order factor {Acc-1st / Acc-2nd}

(1, T, Acc-1st)　　職人が / ペンキを / 壁に / 塗ったので / 汚れは / 少し / 薄くなった。

(1, T, Acc-2nd)　　職人が / 壁に / ペンキを / 塗ったので / 汚れは / 少し / 薄くなった。

(1, L, Acc-1st)　　職人が / 壁を / ペンキで / 塗ったので / 汚れは / 少し / 薄くなった。

(1, L, Acc-2nd)　　職人が / ペンキで / 壁を / 塗ったので / 汚れは / 少し / 薄くなった。

(2, T, Acc-1st)　　パン屋が / バターを / パンに / 塗ったので / サンドイッチは / おいしく / 仕上がった。

(2, T, Acc-2nd)　　パン屋が / パンに / バターを / 塗ったので / サンドイッチは / おいしく / 仕上がった。

(2, L, Acc-1st)　　パン屋が / パンを / バターで / 塗ったので / サンドイッチは / おいしく / 仕上がった。

(2, L, Acc-2nd)　　パン屋が / バターで / パンを / 塗ったので / サンドイッチは / おいしく / 仕上がった。

(3, T, Acc-1st)　　ネイリストが / マニキュアを / 爪に / 塗ったので / 女性客は / 上機嫌で / 帰った。

(3, T, Acc-2nd)　　ネイリストが / 爪に / マニキュアを / 塗ったので / 女性客は / 上機嫌で / 帰った。

(3, L, Acc-1st)　　ネイリストが / 爪を / マニキュアで / 塗ったので / 女性客は / 上機嫌で / 帰った。

(3, L, Acc-2nd)　　ネイリストが / マニキュアで / 爪を / 塗ったので / 女性客は / 上機嫌で / 帰った。

(4, T, Acc-1st)　　メイク係が / ルージュを / 唇に / 塗ったので / アイドルは / 気分が / 高揚した。

(4, T, Acc-2nd)　　メイク係が / 唇に / ルージュを / 塗ったので / アイドルは / 気分が / 高揚した。

(4, L, Acc-1st)　　メイク係が / 唇を / ルージュで / 塗ったので / アイドルは / 気分が / 高揚した。

(4, L, Acc-2nd)　　メイク係が / ルージュで / 唇を / 塗ったので / アイドルは / 気分が / 高揚した。

(5, T, Acc-1st)　　アルバイトが / 針を / 手に / 刺したので / 上司は / 救急箱を / 探した。

(5, T, Acc-2nd)　　アルバイトが / 手に / 針を / 刺したので / 上司は / 救急箱を / 探した。

(5, L, Acc-1st)　　アルバイトが / 手を / 針で / 刺したので / 上司は / 救急箱を / 探した。

(5, L, Acc-2nd)　　アルバイトが / 針で / 手を / 刺したので / 上司は / 救急箱を / 探した。

(6, T, Acc-1st)　　店主が / 串を / 鶏肉に / 刺したので / 新人は / 手さばきに / 感動した。

(6, T, Acc-2nd)　　店主が / 鶏肉に / 串を / 刺したので / 新人は / 手さばきに / 感動した。

(6, L, Acc-1st)　　店主が / 鶏肉を / 串で / 刺したので / 新人は / 手さばきに / 感動した。

(6, L, Acc-2nd)　　店主が / 串で / 鶏肉を / 刺したので / 新人は / 手さばきに / 感動した。

(7, T, Acc-1st)　　シェフが / 包丁を / ブロック肉に / 刺したので / 見習いは / オーブンを / あたためた。

(7, T, Acc-2nd)　　シェフが / ブロック肉に / 包丁を / 刺したので / 見習いは / オーブンを / あたためた。

(7, L, Acc-1st)　　シェフが / ブロック肉を / 包丁で / 刺したので / 見習いは / オーブンを / あたためた。

(7, L, Acc-2nd)　　シェフが / 包丁で / ブロック肉を / 刺したので / 見習いは / オーブンを / あたためた。

(8, T, Acc-1st)　　写真屋が / 押しピンを / 掲示板に / 刺したので / カレンダーは / きちんと / 固定された。

(8, T, Acc-2nd)　　写真屋が / 掲示板に / 押しピンを / 刺したので / カレンダーは / きちんと / 固定された。

(8, L, Acc-1st)　　写真屋が / 掲示板を / 押しピンで / 刺したので / カレンダーは / きちんと / 固定された。

(8, L, Acc-2nd)　　写真屋が / 押しピンで / 掲示板を / 刺したので / カレンダーは / きちんと / 固定された。

(9, T, Acc-1st)　　小学生が / お菓子を / 部屋に / ちらかしたので / 母親は / 仕方なく / 掃除した。

(9, T, Acc-2nd)　　小学生が / 部屋に / お菓子を / ちらかしたので / 母親は / 仕方なく / 掃除した。

(9, L, Acc-1st)　　小学生が / 部屋を / お菓子で / ちらかしたので / 母親は / 仕方なく / 掃除した。

(9, L, Acc-2nd)　　小学生が / お菓子で / 部屋を / ちらかしたので / 母親は / 仕方なく / 掃除した。

(10, T, Acc-1st)　　男子生徒が / 消しかすを / 机に / ちらかしたので / 女子生徒は / 座るのを / 嫌がった。

(10, T, Acc-2nd)　　男子生徒が / 机に / 消しかすを / ちらかしたので / 女子生徒は / 座るのを / 嫌がった。

(10, L, Acc-1st) 男子生徒が / 机を / 消しかすで / ちらかしたので / 女子生徒は / 座るの
を / 嫌がった。

(10, L, Acc-2nd) 男子生徒が / 消しかすで / 机を / ちらかしたので / 女子生徒は / 座るの
を / 嫌がった。

(11, T, Acc-1st) 課長が / 靴下を / リビングに / ちらかしたので / 義母は / 嫌そうに /
拾った。

(11, T, Acc-2nd) 課長が / リビングに / 靴下を / ちらかしたので / 義母は / 嫌そうに /
拾った。

(11, L, Acc-1st) 課長が / リビングを / 靴下で / ちらかしたので / 義母は / 嫌そうに /
拾った。

(11, L, Acc-2nd) 課長が / 靴下で / リビングを / ちらかしたので / 義母は / 嫌そうに /
拾った。

(12, T, Acc-1st) 園児が / おもちゃを / 砂場に / ちらかしたので / PTA 役員は / 陰で / 噂
した。

(12, T, Acc-2nd) 園児が / 砂場に / おもちゃを / ちらかしたので / PTA 役員は / 陰で / 噂
した。

(12, L, Acc-1st) 園児が / 砂場を / おもちゃで / ちらかしたので / PTA 役員は / 陰で / 噂
した。

(12, L, Acc-2nd) 園児が / おもちゃで / 砂場を / ちらかしたので / PTA 役員は / 陰で / 噂
した。

(13, T, Acc-1st) 遭難者が / 縄を / 木に / くくったので / 捜索隊に / すぐに / 発見され
た。

(13, T, Acc-2nd) 遭難者が / 木に / 縄を / くくったので / 捜索隊に / すぐに / 発見され
た。

(13, L, Acc-1st)　遭難者が / 木を / 縄で / くくったので / 捜索隊に / すぐに / 発見され
た。

(13, L, Acc-2nd)　遭難者が / 縄で / 木を / くくったので / 捜索隊に / すぐに / 発見され
た。

(14, T, Acc-1st)　隣人が / ひもを / 古新聞に / くくったので / 大家さんは / ルール違反を
/ 告げ口した。

(14, T, Acc-2nd)　隣人が / 古新聞に / ひもを / くくったので / 大家さんは / ルール違反を
/ 告げ口した。

(14, L, Acc-1st)　隣人が / 古新聞を / ひもで / くくったので / 大家さんは / ルール違反を
/ 告げ口した。

(14, L, Acc-2nd)　隣人が / ひもで / 古新聞を / くくったので / 大家さんは / ルール違反を
/ 告げ口した。

(15, T, Acc-1st)　女医が / ヘアゴムを / 髪に / くくったので / 点滴の / 用意が / 始まっ
た。

(15, T, Acc-2nd)　女医が / 髪に / ヘアゴムを / くくったので / 点滴の / 用意が / 始まっ
た。

(15, L, Acc-1st)　女医が / 髪を / ヘアゴムで / くくったので / 点滴の / 用意が / 始まっ
た。

(15, L, Acc-2nd)　女医が / ヘアゴムで / 髪を / くくったので / 点滴の / 用意が / 始まっ
た。

(16, T, Acc-1st)　配送業者が / ビニールひもを / 荷台に / くくったので / カバーを / ゆっ
くり / おろした。

(16, T, Acc-2nd)　配送業者が / 荷台に / ビニールひもを / くくったので / カバーを / ゆっ
くり / おろした。

(16, L, Acc-1st) 配送業者が / 荷台を / ビニールひもで / くくったので / カバーを / ゆっくり / おろした。

(16, L, Acc-2nd) 配送業者が / ビニールひもで / 荷台を / くくったので / カバーを / ゆっくり / おろした。

(17, T, Acc-1st) 料理研究家が / バターを / パスタに / からめたので / 香りは / スタジオ内に / 充満した。

(17, T, Acc-2nd) 料理研究家が / パスタに / バターを / からめたので / 香りは / スタジオ内に / 充満した。

(17, L, Acc-1st) 料理研究家が / パスタを / バターで / からめたので / 香りは / スタジオ内に / 充満した。

(17, L, Acc-2nd) 料理研究家が / バターで / パスタを / からめたので / 香りは / スタジオ内に / 充満した。

(18, T, Acc-1st) 和菓子屋が / 黒蜜を / アイスに / からめたので / 常連客は / 新メニューを / 期待した。

(18, T, Acc-2nd) 和菓子屋が / アイスに / 黒蜜を / からめたので / 常連客は / 新メニューを / 期待した。

(18, L, Acc-1st) 和菓子屋が / アイスを / 黒蜜で / からめたので / 常連客は / 新メニューを / 期待した。

(18, L, Acc-2nd) 和菓子屋が / 黒蜜で / アイスを / からめたので / 常連客は / 新メニューを / 期待した。

(19, T, Acc-1st) 主婦が / ソースを / 肉団子に / からめたので / 娘は / 待ちきれず / つまみ食いした。

(19, T, Acc-2nd) 主婦が / 肉団子に / ソースを / からめたので / 娘は / 待ちきれず / つまみ食いした。

(19, L, Acc-1st)　主婦が ／ 肉団子を ／ ソースで ／ からめたので ／ 娘は ／ 待ちきれず ／ つ
まみ食いした。

(19, L, Acc-2nd)　主婦が ／ ソースで ／ 肉団子を ／ からめたので ／ 娘は ／ 待ちきれず ／ つ
まみ食いした。

(20, T, Acc-1st)　オーナーが ／ シロップを ／ ワッフルに ／ からめたので ／ 取材班は ／ カメ
ラを ／ まわした。

(20, T, Acc-2nd)　オーナーが ／ ワッフルに ／ シロップを ／ からめたので ／ 取材班は ／ カメ
ラを ／ まわした。

(20, L, Acc-1st)　オーナーが ／ ワッフルを ／ シロップで ／ からめたので ／ 取材班は ／ カメ
ラを ／ まわした。

(20, L, Acc-2nd)　オーナーが ／ シロップで ／ ワッフルを ／ からめたので ／ 取材班は ／ カメ
ラを ／ まわした。

(21, T, Acc-1st)　ホールスタッフが ／ ビールを ／ グラスに ／ いっぱいにしたので ／ 客は ／
喜んで ／ 飲み干した。

(21, T, Acc-2nd)　ホールスタッフが ／ グラスに ／ ビールを ／ いっぱいにしたので ／ 客は ／
喜んで ／ 飲み干した。

(21, L, Acc-1st)　ホールスタッフが ／ グラスを ／ ビールで ／ いっぱいにしたので ／ 客は ／
喜んで ／ 飲み干した。

(21, L, Acc-2nd)　ホールスタッフが ／ ビールで ／ グラスを ／ いっぱいにしたので ／ 客は ／
喜んで ／ 飲み干した。

(22, T, Acc-1st)　看板娘が ／ バスケットを ／ キャンディに ／ いっぱいにしたので ／ 子供た
ちは ／ わらわらと ／ 集まった。

(22, T, Acc-2nd)　看板娘が ／ キャンディに ／ バスケットを ／ いっぱいにしたので ／ 子供た
ちは ／ わらわらと ／ 集まった。

(22, L, Acc-1st)　看板娘が / キャンディを / バスケットで / いっぱいにしたので / 子供たちは / わらわらと / 集まった。

(22, L, Acc-2nd)　看板娘が / バスケットで / キャンディを / いっぱいにしたので / 子供たちは / わらわらと / 集まった。

(23, T, Acc-1st)　家政婦が / お湯を / 浴槽に / いっぱいにしたので / 執事は / 遠慮がちに / たしなめた。

(23, T, Acc-2nd)　家政婦が / 浴槽に / お湯を / いっぱいにしたので / 執事は / 遠慮がちに / たしなめた。

(23, L, Acc-1st)　家政婦が / 浴槽を / お湯で / いっぱいにしたので / 執事は / 遠慮がちに / たしなめた。

(23, L, Acc-2nd)　家政婦が / お湯で / 浴槽を / いっぱいにしたので / 執事は / 遠慮がちに / たしなめた。

(24, T, Acc-1st)　トップモデルが / 洋服を / クローゼットに / いっぱいにしたので / 弟は / 浪費癖に / うんざりした。

(24, T, Acc-2nd)　トップモデルが / クローゼットに / 洋服を / いっぱいにしたので / 弟は / 浪費癖に / うんざりした。

(24, L, Acc-1st)　トップモデルが / クローゼットを / 洋服で / いっぱいにしたので / 弟は / 浪費癖に / うんざりした。

(24, L, Acc-2nd)　トップモデルが / 洋服で / クローゼットを / いっぱいにしたので / 弟は / 浪費癖に / うんざりした。

4. Item sentences in Experiment 3

Construction factor {T / L} x Word-order factor {Acc-1st / Acc-2nd}

(1, T, Acc-1st)　　大学生が / ジュースを / コップに / 注いだので / OB は / アルコールを / 希望した。

(1, T, Acc-2nd)　　大学生が / コップに / ジュースを / 注いだので / OB は / アルコールを / 希望した。

(1, L, Acc-1st)　　大学生が / コップを / ジュースで / 注いだので / OB は / アルコールを / 希望した。

(1, L, Acc-2nd)　　大学生が / ジュースで / コップを / 注いだので / OB は / アルコールを / 希望した。

(2, T, Acc-1st)　　ホールスタッフが / ビールを / グラスに / 注いだので / 客は / 喜んで / 飲み干した。

(2, T, Acc-2nd)　　ホールスタッフが / グラスに / ビールを / 注いだので / 客は / 喜んで / 飲み干した。

(2, L, Acc-1st)　　ホールスタッフが / グラスを / ビールで / 注いだので / 客は / 喜んで / 飲み干した。

(2, L, Acc-2nd)　　ホールスタッフが / ビールで / グラスを / 注いだので / 客は / 喜んで / 飲み干した。

(3, T, Acc-1st)　　執事が / 紅茶を / カップに / 注いだので / 香りが / あたりに / 立ち込めた。

(3, T, Acc-2nd)　　執事が / カップに / 紅茶を / 注いだので / 香りが / あたりに / 立ち込めた。

(3, L, Acc-1st) 執事が / カップを / 紅茶で / 注いだので / 香りが / あたりに / 立ち込めた。

(3, L, Acc-2nd) 執事が / 紅茶で / カップを / 注いだので / 香りが / あたりに / 立ち込めた。

(4, T, Acc-1st) 祖父が / お茶を / 湯のみに / 注いだので / 息子は / 茶菓子を / 用意した。

(4, T, Acc-2nd) 祖父が / 湯のみに / お茶を / 注いだので / 息子は / 茶菓子を / 用意した。

(4, L, Acc-1st) 祖父が / 湯のみを / お茶で / 注いだので / 息子は / 茶菓子を / 用意した。

(4, L, Acc-2nd) 祖父が / お茶で / 湯のみを / 注いだので / 息子は / 茶菓子を / 用意した。

(5, T, Acc-1st) 八百屋が / いちごを / 箱に / 詰めたので / 奥さんは / のし紙を / 準備した。

(5, T, Acc-2nd) 八百屋が / 箱に / いちごを / 詰めたので / 奥さんは / のし紙を / 準備した。

(5, L, Acc-1st) 八百屋が / 箱を / いちごで / 詰めたので / 奥さんは / のし紙を / 準備した。

(5, L, Acc-2nd) 八百屋が / いちごで / 箱を / 詰めたので / 奥さんは / のし紙を / 準備した。

(6, T, Acc-1st) トップモデルが / 洋服を / クローゼットに / 詰めたので / 弟は / 浪費癖に / うんざりした。

(6, T, Acc-2nd) トップモデルが / クローゼットに / 洋服を / 詰めたので / 弟は / 浪費癖に / うんざりした。

(6, L, Acc-1st)　　　トップモデルが / クローゼットを / 洋服で / 詰めたので / 弟は / 浪費癖に / うんざりした。

(6, L, Acc-2nd)　　　トップモデルが / 洋服で / クローゼットを / 詰めたので / 弟は / 浪費癖に / うんざりした。

(7, T, Acc-1st)　　　バックパッカーが / 着替えを / かばんに / 詰めたので / 清掃スタッフは / チップを / 期待した。

(7, T, Acc-2nd)　　　バックパッカーが / かばんに / 着替えを / 詰めたので / 清掃スタッフは / チップを / 期待した。

(7, L, Acc-1st)　　　バックパッカーが / かばんを / 着替えで / 詰めたので / 清掃スタッフは / チップを / 期待した。

(7, L, Acc-2nd)　　　バックパッカーが / 着替えで / かばんを / 詰めたので / 清掃スタッフは / チップを / 期待した。

(8, T, Acc-1st)　　　祖母が / ご飯を / 油揚げに / 詰めたので / 子どもたちは / 台所に / 集まった。

(8, T, Acc-2nd)　　　祖母が / 油揚げに / ご飯を / 詰めたので / 子どもたちは / 台所に / 集まった。

(8, L, Acc-1st)　　　祖母が / 油揚げを / ご飯で / 詰めたので / 子どもたちは / 台所に / 集まった。

(8, L, Acc-2nd)　　　祖母が / ご飯で / 油揚げを / 詰めたので / 子どもたちは / 台所に / 集まった。

(9, T, Acc-1st)　　　内装業者が / 壁紙を / 壁に / はったので / リビングは / 雰囲気が / 変わった。

(9, T, Acc-2nd)　　　内装業者が / 壁に / 壁紙を / はったので / リビングは / 雰囲気が / 変わった。

(9, L, Acc-1st)　内装業者が / 壁を / 壁紙で / はったので / リビングは / 雰囲気が / 変わった。

(9, L, Acc-2nd)　内装業者が / 壁紙で / 壁を / はったので / リビングは / 雰囲気が / 変わった。

(10, T, Acc-1st)　和紙職人が / 紙を / 障子に / はったので / 和室は / 見違えるほど / 綺麗になった。

(10, T, Acc-2nd)　和紙職人が / 障子に / 紙を / はったので / 和室は / 見違えるほど / 綺麗になった。

(10, L, Acc-1st)　和紙職人が / 障子を / 紙で / はったので / 和室は / 見違えるほど / 綺麗になった。

(10, L, Acc-2nd)　和紙職人が / 紙で / 障子を / はったので / 和室は / 見違えるほど / 綺麗になった。

(11, T, Acc-1st)　大道具係が / 暗幕を / 舞台に / はったので / 照明係は / 手順を / チェックした。

(11, T, Acc-2nd)　大道具係が / 舞台に / 暗幕を / はったので / 照明係は / 手順を / チェックした。

(11, L, Acc-1st)　大道具係が / 舞台を / 暗幕で / はったので / 照明係は / 手順を / チェックした。

(11, L, Acc-2nd)　大道具係が / 暗幕で / 舞台を / はったので / 照明係は / 手順を / チェックした。

(12, T, Acc-1st)　販売員が / 保護フィルムを / スマホに / はったので / 新入社員は / スピードに / 圧倒された。

(12, T, Acc-2nd)　販売員が / スマホに / 保護フィルムを / はったので / 新入社員は / スピードに / 圧倒された。

(12, L, Acc-1st) 販売員が / スマホを / 保護フィルムで / はったので / 新入社員は / スピードに / 圧倒された。

(12, L, Acc-2nd) 販売員が / 保護フィルムで / スマホを / はったので / 新入社員は / スピードに / 圧倒された。

(13, T, Acc-1st) 農家が / 干し草を / 荷車に / 積んだので / 納屋は / きれいに / 空っぽだ。

(13, T, Acc-2nd) 農家が / 荷車に / 干し草を / 積んだので / 納屋は / きれいに / 空っぽだ。

(13, L, Acc-1st) 農家が / 荷車を / 干し草で / 積んだので / 納屋は / きれいに / 空っぽだ。

(13, L, Acc-2nd) 農家が / 干し草で / 荷車を / 積んだので / 納屋は / きれいに / 空っぽだ。

(14, T, Acc-1st) 配送業者が / 段ボールを / 荷台に / 積んだので / 新人は / 配送先を / 確認した。

(14, T, Acc-2nd) 配送業者が / 荷台に / 段ボールを / 積んだので / 新人は / 配送先を / 確認した。

(14, L, Acc-1st) 配送業者が / 荷台を / 段ボールで / 積んだので / 新人は / 配送先を / 確認した。

(14, L, Acc-2nd) 配送業者が / 段ボールで / 荷台を / 積んだので / 新人は / 配送先を / 確認した。

(15, T, Acc-1st) 利用者が / 本を / 机に / 積んだので / 司書は / 顔を / しかめた。

(15, T, Acc-2nd) 利用者が / 机に / 本を / 積んだので / 司書は / 顔を / しかめた。

(15, L, Acc-1st) 利用者が / 机を / 本で / 積んだので / 司書は / 顔を / しかめた。

(15, L, Acc-2nd) 利用者が / 本で / 机を / 積んだので / 司書は / 顔を / しかめた。

(16, T, Acc-1st)　　秘書が / 書類を / デスクに / 積んだので / 社長は / 判子を / 押し続け
　　　　　　　　　た。

(16, T, Acc-2nd)　　秘書が / デスクに / 書類を / 積んだので / 社長は / 判子を / 押し続け
　　　　　　　　　た。

(16, L, Acc-1st)　　秘書が / デスクを / 書類で / 積んだので / 社長は / 判子を / 押し続け
　　　　　　　　　た。

(16, L, Acc-2nd)　　秘書が / 書類で / デスクを / 積んだので / 社長は / 判子を / 押し続け
　　　　　　　　　た。

(17, T, Acc-1st)　　隣人が / 水を / 歩道に / まいたので / 午後は / 涼しく / 過ごせた。

(17, T, Acc-2nd)　　隣人が / 歩道に / 水を / まいたので / 午後は / 涼しく / 過ごせた。

(17, L, Acc-1st)　　隣人が / 歩道を / 水で / まいたので / 午後は / 涼しく / 過ごせた。

(17, L, Acc-2nd)　　隣人が / 水で / 歩道を / まいたので / 午後は / 涼しく / 過ごせた。

(18, T, Acc-1st)　　庭師が / 除草剤を / 庭に / まいたので / 雑草は / まったく / 生えなかっ
　　　　　　　　　た。

(18, T, Acc-2nd)　　庭師が / 庭に / 除草剤を / まいたので / 雑草は / まったく / 生えなかっ
　　　　　　　　　た。

(18, L, Acc-1st)　　庭師が / 庭を / 除草剤で / まいたので / 雑草は / まったく / 生えなかっ
　　　　　　　　　た。

(18, L, Acc-2nd)　　庭師が / 除草剤で / 庭を / まいたので / 雑草は / まったく / 生えなかっ
　　　　　　　　　た。

(19, T, Acc-1st)　　孫娘が / 殺虫剤を / 玄関に / まいたので / においが / 玄関中に / 充満し
　　　　　　　　　た。

(19, T, Acc-2nd)　　孫娘が / 玄関に / 殺虫剤を / まいたので / においが / 玄関中に / 充満し
　　　　　　　　　た。

(19, L, Acc-1st)　　孫娘が ／ 玄関を ／ 殺虫剤で ／ まいたので ／ においが ／ 玄関中に ／ 充満した。

(19, L, Acc-2nd)　　孫娘が ／ 殺虫剤で ／ 玄関を ／ まいたので ／ においが ／ 玄関中に ／ 充満した。

(20, T, Acc-1st)　　運転手が ／ 芳香剤を ／ 車内に ／ まいたので ／ たばこ臭は ／ かなり ／ 薄くなった。

(20, T, Acc-2nd)　　運転手が ／ 車内に ／ 芳香剤を ／ まいたので ／ たばこ臭は ／ かなり ／ 薄くなった。

(20, L, Acc-1st)　　運転手が ／ 車内を ／ 芳香剤で ／ まいたので ／ たばこ臭は ／ かなり ／ 薄くなった。

(20, L, Acc-2nd)　　運転手が ／ 芳香剤で ／ 車内を ／ まいたので ／ たばこ臭は ／ かなり ／ 薄くなった。

(21, T, Acc-1st)　　看護師が ／ 包帯を ／ 腕に ／ 巻いたので ／ 患者は ／ 大げさだと ／ 苦笑した。

(21, T, Acc-2nd)　　看護師が ／ 腕に ／ 包帯を ／ 巻いたので ／ 患者は ／ 大げさだと ／ 苦笑した。

(21, L, Acc-1st)　　看護師が ／ 腕を ／ 包帯で ／ 巻いたので ／ 患者は ／ 大げさだと ／ 苦笑した。

(21, L, Acc-2nd)　　看護師が ／ 包帯で ／ 腕を ／ 巻いたので ／ 患者は ／ 大げさだと ／ 苦笑した。

(22, T, Acc-1st)　　監督が ／ 腕時計を ／ 手首に ／ 巻いたので ／ 日焼けあとが ／ くっきりと ／ 残った。

(22, T, Acc-2nd)　　監督が ／ 手首に ／ 腕時計を ／ 巻いたので ／ 日焼けあとが ／ くっきりと ／ 残った。

(22, L, Acc-1st) 監督が / 手首を / 腕時計で / 巻いたので / 日焼けあとが / くっきりと / 残った。

(22, L, Acc-2nd) 監督が / 腕時計で / 手首を / 巻いたので / 日焼けあとが / くっきりと / 残った。

(23, T, Acc-1st) 買い物客が / ストールを / 首に / 巻いたので / 店員は / 必死に / 勧めた。

(23, T, Acc-2nd) 買い物客が / 首に / ストールを / 巻いたので / 店員は / 必死に / 勧めた。

(23, L, Acc-1st) 買い物客が / 首を / ストールで / 巻いたので / 店員は / 必死に / 勧めた。

(23, L, Acc-2nd) 買い物客が / ストールで / 首を / 巻いたので / 店員は / 必死に / 勧めた。

(24, T, Acc-1st) 養護教諭が / 絆創膏を / 指に / 巻いたので / 生徒は / ほっとして / 笑った。

(24, T, Acc-2nd) 養護教諭が / 指に / 絆創膏を / 巻いたので / 生徒は / ほっとして / 笑った。

(24, L, Acc-1st) 養護教諭が / 指を / 絆創膏で / 巻いたので / 生徒は / ほっとして / 笑った。

(24, L, Acc-2nd) 養護教諭が / 絆創膏で / 指を / 巻いたので / 生徒は / ほっとして / 笑った。

5. Item sentences in Experiment 4

Construction factor {T / L} x Word-order factor {Acc-1st / Acc-2nd}

(1, T, Acc-1st)　ホールスタッフが ／ 布を ／ テーブルに ／ 覆ったので ／ ソムリエも ／ 準備を ／ 手伝った。

(1, T, Acc-2nd)　ホールスタッフが ／ テーブルに ／ 布を ／ 覆ったので ／ ソムリエも ／ 準備を ／ 手伝った。

(1, L, Acc-1st)　ホールスタッフが ／ テーブルを ／ 布で ／ 覆ったので ／ ソムリエも ／ 準備を ／ 手伝った。

(1, L, Acc-2nd)　ホールスタッフが ／ 布で ／ テーブルを ／ 覆ったので ／ ソムリエも ／ 準備を ／ 手伝った。

(2, T, Acc-1st)　配送業者が ／ カバーを ／ 荷物に ／ 覆ったので ／ 新人は ／ 配送先を ／ 確認した。

(2, T, Acc-2nd)　配送業者が ／ 荷物に ／ カバーを ／ 覆ったので ／ 新人は ／ 配送先を ／ 確認した。

(2, L, Acc-1st)　配送業者が ／ 荷物を ／ カバーで ／ 覆ったので ／ 新人は ／ 配送先を ／ 確認した。

(2, L, Acc-2nd)　配送業者が ／ カバーで ／ 荷物を ／ 覆ったので ／ 新人は ／ 配送先を ／ 確認した。

(3, T, Acc-1st)　有名女優が ／ フードを ／ 頭に ／ 覆ったので ／ 通行人は ／ 誰だか ／ わからなかった。

(3, T, Acc-2nd)　有名女優が ／ 頭に ／ フードを ／ 覆ったので ／ 通行人は ／ 誰だか ／ わからなかった。

(3, L, Acc-1st)　有名女優が ／ 頭を ／ フードで ／ 覆ったので ／ 通行人は ／ 誰だか ／ わからなかった。

(3, L, Acc-2nd)　　　有名女優が ／ フードで ／ 頭を ／ 覆ったので ／ 通行人は ／ 誰だか ／ わからなか

った。

(4, T, Acc-1st)　　　観客が ／ ストールを ／ 肩に ／ 覆ったので ／ 支配人は ／ 冷房を ／ 弱めた。

(4, T, Acc-2nd)　　　観客が ／ 肩に ／ ストールを ／ 覆ったので ／ 支配人は ／ 冷房を ／ 弱めた。

(4, L, Acc-1st)　　　観客が ／ 肩を ／ ストールで ／ 覆ったので ／ 支配人は ／ 冷房を ／ 弱めた。

(4, L, Acc-2nd)　　　観客が ／ ストールで ／ 肩を ／ 覆ったので ／ 支配人は ／ 冷房を ／ 弱めた。

(5, T, Acc-1st)　　　ウェイターが ／ 水を ／ グラスに ／ 満たしたので ／ 客は ／ 一気に ／ 飲み干し

た。

(5, T, Acc-2nd)　　　ウェイターが ／ グラスに ／ 水を ／ 満たしたので ／ 客は ／ 一気に ／ 飲み干し

た。

(5, L, Acc-1st)　　　ウェイターが ／ グラスを ／ 水で ／ 満たしたので ／ 客は ／ 一気に ／ 飲み干し

た。

(5, L, Acc-2nd)　　　ウェイターが ／ 水で ／ グラスを ／ 満たしたので ／ 客は ／ 一気に ／ 飲み干し

た。

(6, T, Acc-1st)　　　大学生が ／ お菓子を ／ 空きっ腹に ／ 満たしたので ／ 夕飯を ／ ほとんど ／ 残し

た。

(6, T, Acc-2nd)　　　大学生が ／ 空きっ腹に ／ お菓子を ／ 満たしたので ／ 夕飯を ／ ほとんど ／ 残し

た。

(6, L, Acc-1st)　　　大学生が ／ 空きっ腹を ／ お菓子で ／ 満たしたので ／ 夕飯を ／ ほとんど ／ 残し

た。

(6, L, Acc-2nd)　　　大学生が ／ お菓子で ／ 空きっ腹を ／ 満たしたので ／ 夕飯を ／ ほとんど ／ 残し

た。

(7, T, Acc-1st)　　　仲居さんが ／ お湯を ／ 浴槽に ／ 満たしたので ／ 女将は ／ お客さんを ／ 案内し

た。

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(7, T, Acc-2nd)　　仲居さんが / 浴槽に / お湯を / 満たしたので / 女将は / お客さんを / 案内した。

(7, L, Acc-1st)　　仲居さんが / 浴槽を / お湯で / 満たしたので / 女将は / お客さんを / 案内した。

(7, L, Acc-2nd)　　仲居さんが / お湯で / 浴槽を / 満たしたので / 女将は / お客さんを / 案内した。

(8, T, Acc-1st)　　看板娘が / キャンディを / バスケットに / 満たしたので / 子供たちは / 続々と / 集まった。

(8, T, Acc-2nd)　　看板娘が / バスケットに / キャンディを / 満たしたので / 子供たちは / 続々と / 集まった。

(8, L, Acc-1st)　　看板娘が / バスケットを / キャンディで / 満たしたので / 子供たちは / 続々と / 集まった。

(8, L, Acc-2nd)　　看板娘が / キャンディで / バスケットを / 満たしたので / 子供たちは / 続々と / 集まった。

(9, T, Acc-1st)　　販売員が / テープを / 箱に / 留めたので / ラッピングは / もうすぐ / 完成だ。

(9, T, Acc-2nd)　　販売員が / 箱に / テープを / 留めたので / ラッピングは / もうすぐ / 完成だ。

(9, L, Acc-1st)　　販売員が / 箱を / テープで / 留めたので / ラッピングは / もうすぐ / 完成だ。

(9, L, Acc-2nd)　　販売員が / テープで / 箱を / 留めたので / ラッピングは / もうすぐ / 完成だ。

(10, T, Acc-1st)　　美容師が / ヘアピンを / 前髪に / 留めたので / モデルは / センスを / 疑った。

(10, T, Acc-2nd) 美容師が ／ 前髪に ／ ヘアピンを ／ 留めたので ／ モデルは ／ センスを ／ 疑った。

(10, L, Acc-1st) 美容師が ／ 前髪を ／ ヘアピンで ／ 留めたので ／ モデルは ／ センスを ／ 疑った。

(10, L, Acc-2nd) 美容師が ／ ヘアピンで ／ 前髪を ／ 留めたので ／ モデルは ／ センスを ／ 疑った。

(11, T, Acc-1st) 秘書が ／ クリップを ／ 書類に ／ 留めたので ／ 先輩は ／ 文句を ／ 言った。

(11, T, Acc-2nd) 秘書が ／ 書類に ／ クリップを ／ 留めたので ／ 先輩は ／ 文句を ／ 言った。

(11, L, Acc-1st) 秘書が ／ 書類を ／ クリップで ／ 留めたので ／ 先輩は ／ 文句を ／ 言った。

(11, L, Acc-2nd) 秘書が ／ クリップで ／ 書類を ／ 留めたので ／ 先輩は ／ 文句を ／ 言った。

(12, T, Acc-1st) 課長が ／ ホッチキスを ／ 資料に ／ 留めたので ／ 同僚は ／ その隙に ／ さぼった。

(12, T, Acc-2nd) 課長が ／ 資料に ／ ホッチキスを ／ 留めたので ／ 同僚は ／ その隙に ／ さぼった。

(12, L, Acc-1st) 課長が ／ 資料を ／ ホッチキスで ／ 留めたので ／ 同僚は ／ その隙に ／ さぼった。

(12, L, Acc-2nd) 課長が ／ ホッチキスで ／ 資料を ／ 留めたので ／ 同僚は ／ その隙に ／ さぼった。

(13, T, Acc-1st) 大工が ／ ひもを ／ 廃材に ／ 縛ったので ／ 見習いは ／ 業者に ／ 電話した。

(13, T, Acc-2nd) 大工が ／ 廃材に ／ ひもを ／ 縛ったので ／ 見習いは ／ 業者に ／ 電話した。

(13, L, Acc-1st) 大工が ／ 廃材を ／ ひもで ／ 縛ったので ／ 見習いは ／ 業者に ／ 電話した。

(13, L, Acc-2nd) 大工が ／ ひもで ／ 廃材を ／ 縛ったので ／ 見習いは ／ 業者に ／ 電話した。

(14, T, Acc-1st) 遭難者が ／ バンダナを ／ 枝に ／ 縛ったので ／ 捜索隊に ／ すぐに ／ 発見された。

(14, T, Acc-2nd)　遭難者が / 枝に / バンダナを / 縛ったので / 捜索隊に / すぐに / 発見され

　　　　　　　　た。

(14, L, Acc-1st)　遭難者が / 枝を / バンダナで / 縛ったので / 捜索隊に / すぐに / 発見され

　　　　　　　　た。

(14, L, Acc-2nd)　遭難者が / バンダナで / 枝を / 縛ったので / 捜索隊に / すぐに / 発見され

　　　　　　　　た。

(15, T, Acc-1st)　隣人が / ガムテープを / 古新聞に / 縛ったので / 大家さんは / ルール違反を

　　　　　　　　/ 注意した。

(15, T, Acc-2nd)　隣人が / 古新聞に / ガムテープを / 縛ったので / 大家さんは / ルール違反を

　　　　　　　　/ 注意した。

(15, L, Acc-1st)　隣人が / 古新聞を / ガムテープで / 縛ったので / 大家さんは / ルール違反を

　　　　　　　　/ 注意した。

(15, L, Acc-2nd)　隣人が / ガムテープで / 古新聞を / 縛ったので / 大家さんは / ルール違反を

　　　　　　　　/ 注意した。

(16, T, Acc-1st)　看護師が / ゴムバンドを / 腕に / 縛ったので / 女医は / 注射器を / 取り出し

　　　　　　　　た。

(16, T, Acc-2nd)　看護師が / 腕に / ゴムバンドを / 縛ったので / 女医は / 注射器を / 取り出し

　　　　　　　　た。

(16, L, Acc-1st)　看護師が / 腕を / ゴムバンドで / 縛ったので / 女医は / 注射器を / 取り出し

　　　　　　　　た。

(16, L, Acc-2nd)　看護師が / ゴムバンドで / 腕を / 縛ったので / 女医は / 注射器を / 取り出し

　　　　　　　　た。

(17, T, Acc-1st)　弓道部員が / 矢を / 的に / 射たので / 顧問は / フォームを / ほめた。

(17, T, Acc-2nd)　弓道部員が / 的に / 矢を / 射たので / 顧問は / フォームを / ほめた。

(17, L, Acc-1st)　弓道部員が / 的を / 矢で / 射たので / 顧問は / フォームを / ほめた。

(17, L, Acc-2nd)　弓道部員が ／ 矢で ／ 的を ／ 射たので ／ 顧問は ／ フォームを ／ ほめた。

(18, T, Acc-1st)　猟師が ／ 猟銃を ／ キジに ／ 射たので ／ 猟犬は ／ 走って ／ 追いかけた。

(18, T, Acc-2nd)　猟師が ／ キジに ／ 猟銃を ／ 射たので ／ 猟犬は ／ 走って ／ 追いかけた。

(18, L, Acc-1st)　猟師が ／ キジを ／ 猟銃で ／ 射たので ／ 猟犬は ／ 走って ／ 追いかけた。

(18, L, Acc-2nd)　猟師が ／ 猟銃で ／ キジを ／ 射たので ／ 猟犬は ／ 走って ／ 追いかけた。

(19, T, Acc-1st)　忍者が ／ 毒矢を ／ 大将に ／ 射たので ／ 敵陣は ／ 悲しみに ／ 包まれた。

(19, T, Acc-2nd)　忍者が ／ 大将に ／ 毒矢を ／ 射たので ／ 敵陣は ／ 悲しみに ／ 包まれた。

(19, L, Acc-1st)　忍者が ／ 大将を ／ 毒矢で ／ 射たので ／ 敵陣は ／ 悲しみに ／ 包まれた。

(19, L, Acc-2nd)　忍者が ／ 毒矢で ／ 大将を ／ 射たので ／ 敵陣は ／ 悲しみに ／ 包まれた。

(20, T, Acc-1st)　首長が ／ 竹矢を ／ イノシシに ／ 射たので ／ 部族の ／ 祭りは ／ 盛り上がった。

(20, T, Acc-2nd)　首長が ／ イノシシに ／ 竹矢を ／ 射たので ／ 部族の ／ 祭りは ／ 盛り上がった。

(20, L, Acc-1st)　首長が ／ イノシシを ／ 竹矢で ／ 射たので ／ 部族の ／ 祭りは ／ 盛り上がった。

(20, L, Acc-2nd)　首長が ／ 竹矢で ／ イノシシを ／ 射たので ／ 部族の ／ 祭りは ／ 盛り上がった。

(21, T, Acc-1st)　デザイナーが ／ 染料を ／ 布に ／ 染めたので ／ 取材班は ／ カメラを ／ まわした。

(21, T, Acc-2nd)　デザイナーが ／ 布に ／ 染料を ／ 染めたので ／ 取材班は ／ カメラを ／ まわした。

(21, L, Acc-1st)　デザイナーが ／ 布を ／ 染料で ／ 染めたので ／ 取材班は ／ カメラを ／ まわした。

(21, L, Acc-2nd)　デザイナーが ／ 染料で ／ 布を ／ 染めたので ／ 取材班は ／ カメラを ／ まわした。

(22, T, Acc-1st)　幼稚園児が ／ くちなしを ／ ハンカチに ／ 染めたので ／ 園長は ／ 出来ばえに ／ 驚いた。

(22, T, Acc-2nd)　幼稚園児が ／ ハンカチに ／ くちなしを ／ 染めたので ／ 園長は ／ 出来ばえに ／ 驚いた。

(22, L, Acc-1st)　　幼稚園児が / ハンカチを / くちなしで / 染めたので / 園長は / 出来ばえに / 驚いた。

(22, L, Acc-2nd)　　幼稚園児が / くちなしで / ハンカチを / 染めたので / 園長は / 出来ばえに / 驚いた。

(23, T, Acc-1st)　　染め職人が / 藍を / 浴衣に / 染めたので / 着物愛好家は / じっと / 見つめた。

(23, T, Acc-2nd)　　染め職人が / 浴衣に / 藍を / 染めたので / 着物愛好家は / じっと / 見つめた。

(23, L, Acc-1st)　　染め職人が / 浴衣を / 藍で / 染めたので / 着物愛好家は / じっと / 見つめた。

(23, L, Acc-2nd)　　染め職人が / 藍で / 浴衣を / 染めたので / 着物愛好家は / じっと / 見つめた。

(24, T, Acc-1st)　　祖母が / 白髪染めを / 髪に / 染めたので / 雰囲気が / がらっと / 変わった。

(24, T, Acc-2nd)　　祖母が / 髪に / 白髪染めを / 染めたので / 雰囲気が / がらっと / 変わった。

(24, L, Acc-1st)　　祖母が / 髪を / 白髪染めで / 染めたので / 雰囲気が / がらっと / 変わった。

(24, L, Acc-2nd)　　祖母が / 白髪染めで / 髪を / 染めたので / 雰囲気が / がらっと / 変わった。

6. Item sentences in Experiment 5

Causation factor {ex(tended) / on(set) } x Object factor {mb(ile object) / im(mobile object) }

(1, ex, mb)　　こどもがひじをガードレールにあてた。

(1, ex, im)　　こどもがガードレールをひじにあてた。

(1, on, mb)　　こどもが雪玉をガードレールにあてた。

(1, on, im)　　こどもがガードレールを雪玉にあてた。

(2, ex, mb)　　おじいさんがすねをベンチにあてた。

(2, ex, im)　　　おじいさんがベンチをすねにあてた。

(2, on, mb)　　　おじいさんがゲートボールをベンチにあてた。

(2, on, im)　　　おじいさんがベンチをゲートボールにあてた。

(3, ex, mb)　　　弟がバンパーを縁石にあてた。

(3, ex, im)　　　弟が縁石をバンパーにあてた。

(3, on, mb)　　　弟がドッジボールを縁石にあてた。

(3, on, im)　　　弟が縁石をドッジボールにあてた。

(4, ex, mb)　　　選手が右ひざをまとにあてた。

(4, ex, im)　　　選手がまとを右ひざにあてた。

(4, on, mb)　　　選手が弾をまとにあてた。

(4, on, im)　　　選手がまとを弾にあてた。

(5, ex, mb)　　　少年が自転車をフェンスにあてた。

(5, ex, im)　　　少年がフェンスを自転車にあてた。

(5, on, mb)　　　少年がフリスビーをフェンスにあてた。

(5, on, im)　　　少年がフェンスをフリスビーにあてた。

(6, ex, mb)　　　酔っ払いが顔面を交通標識にあてた。

(6, ex, im)　　　酔っ払いが交通標識を顔面にあてた。

(6, on, mb)　　　酔っ払いが石つぶてを交通標識にあてた。

(6, on, im)　　　酔っ払いが交通標識を石つぶてにあてた。

(7, ex, mb)　　　後輩がラケットを壁にあてた。

(7, ex, im)　　　後輩が壁をラケットにあてた。

(7, on, mb)　　　後輩がテニスボールを壁にあてた。

(7, on, im)　　　後輩が壁をテニスボールにあてた。

(8, ex, mb)　　　家政婦がはたきを骨董品にあてた。

(8, ex, im)　　　家政婦が骨董品をはたきにあてた。

(8, on, mb)	家政婦が輪ゴムを骨董品にあてた。
(8, on, im)	家政婦が骨董品を輪ゴムにあてた。
(9, ex, mb)	営業マンがサイドミラーを電柱にぶつけた。
(9, ex, im)	営業マンが電柱をサイドミラーにぶつけた。
(9, on, mb)	営業マンが空き缶を電柱にぶつけた。
(9, on, im)	営業マンが電柱を空き缶にぶつけた。
(10, ex, mb)	友だちが荷物を柱にぶつけた。
(10, ex, im)	友だちが柱を荷物にぶつけた。
(10, on, mb)	友だちがビー玉を柱にぶつけた。
(10, on, im)	友だちが柱をビー玉にぶつけた。
(11, ex, mb)	掃除当番がほうきを窓ガラスにぶつけた。
(11, ex, im)	掃除当番が窓ガラスをほうきにぶつけた。
(11, on, mb)	掃除当番がボールを窓ガラスにぶつけた。
(11, on, im)	掃除当番が窓ガラスをボールにぶつけた。
(12, ex, mb)	男の子が頭をひさしにぶつけた。
(12, ex, im)	男の子がひさしを頭にぶつけた。
(12, on, mb)	男の子がどんぐりをひさしにぶつけた。
(12, on, im)	男の子がひさしをどんぐりにぶつけた。
(13, ex, mb)	サッカー選手が左足をゴールポストにぶつけた。
(13, ex, im)	サッカー選手がゴールポストを左足にぶつけた。
(13, on, mb)	サッカー選手がサッカーボールをゴールポストにぶつけた。
(13, on, im)	サッカー選手がゴールポストをサッカーボールにぶつけた。
(14, ex, mb)	女の子がおでこを天井にぶつけた。
(14, ex, im)	女の子が天井をおでこにぶつけた。
(14, on, mb)	女の子が松ぼっくりを天井にぶつけた。

(14, on, im)	女の子が天井を松ぼっくりにぶつけた。
(15, ex, mb)	いとこが足の指をテーブルにぶつけた。
(15, ex, im)	いとこがテーブルを足の指にぶつけた。
(15, on, mb)	いとこが投げ輪をテーブルにぶつけた。
(15, on, im)	いとこがテーブルを投げ輪にぶつけた。
(16, ex, mb)	息子が肩を玄関扉にぶつけた。
(16, ex, im)	息子が玄関扉を肩にぶつけた。
(16, on, mb)	息子が節分の豆を玄関扉にぶつけた。
(16, on, im)	息子が玄関扉を節分の豆にぶつけた。

7. Item sentences in Experiment 6

Causation factor {ex(tended) / on(set) } x Subject factor {mb(ile subject) / im(mobile subject) }

(1, ex, mb)	リュックがガードレールにあたった。
(1, ex, im)	ガードレールがリュックにあたった。
(1, on, mb)	雪玉がガードレールにあたった。
(1, on, im)	ガードレールが雪玉にあたった。
(2, ex, mb)	ランドセルがベンチにあたった。
(2, ex, im)	ベンチがランドセルにあたった。
(2, on, mb)	ゲートボールがベンチにあたった。
(2, on, im)	ベンチがゲートボールにあたった。
(3, ex, mb)	バンパーが縁石にあたった。
(3, ex, im)	縁石がバンパーにあたった。
(3, on, mb)	ドッジボールが縁石にあたった。

(3, on, im)　　　　縁石がドッジボールにあたった。

(4, ex, mb)　　　　釣り竿が岩にあたった。

(4, ex, im)　　　　岩が釣り竿にあたった。

(4, on, mb)　　　　水風船が岩にあたった。

(4, on, im)　　　　岩が水風船にあたった。

(5, ex, mb)　　　　車輪がフェンスにあたった。

(5, ex, im)　　　　フェンスが車輪にあたった。

(5, on, mb)　　　　フリスビーがフェンスにあたった。

(5, on, im)　　　　フェンスがフリスビーにあたった。

(6, ex, mb)　　　　帽子が交通標識にあたった。

(6, ex, im)　　　　交通標識が帽子にあたった。

(6, on, mb)　　　　石つぶてが交通標識にあたった。

(6, on, im)　　　　交通標識が石つぶてにあたった。

(7, ex, mb)　　　　ラケットが壁にあたった。

(7, ex, im)　　　　壁がラケットにあたった。

(7, on, mb)　　　　テニスボールが壁にあたった。

(7, on, im)　　　　壁がテニスボールにあたった。

(8, ex, mb)　　　　はたきが骨董品にあたった。

(8, ex, im)　　　　骨董品がはたきにあたった。

(8, on, mb)　　　　球が骨董品にあたった。

(8, on, im)　　　　骨董品が球にあたった。

(9, ex, mb)　　　　サイドミラーが電柱にぶつかった。

(9, ex, im)　　　　電柱がサイドミラーにぶつかった。

(9, on, mb)　　　　空き缶が電柱にぶつかった。

(9, on, im)　　　　電柱が空き缶にぶつかった。

(10, ex, mb) 荷物が柱にぶつかった。

(10, ex, im) 柱が荷物にぶつかった。

(10, on, mb) ビー玉が柱にぶつかった。

(10, on, im) 柱がビー玉にぶつかった。

(11, ex, mb) ほうきが窓ガラスにぶつかった。

(11, ex, im) 窓ガラスがほうきにぶつかった。

(11, on, mb) ボールが窓ガラスにぶつかった。

(11, on, im) 窓ガラスがボールにぶつかった。

(12, ex, mb) はしごが外壁にぶつかった。

(12, ex, im) 外壁がはしごにぶつかった。

(12, on, mb) ラジコン飛行機が外壁にぶつかった。

(12, on, im) 外壁がラジコン飛行機にぶつかった。

(13, ex, mb) くつがゴールポストにぶつかった。

(13, ex, im) ゴールポストがくつにぶつかった。

(13, on, mb) サッカーボールがゴールポストにぶつかった。

(13, on, im) ゴールポストがサッカーボールにぶつかった。

(14, ex, mb) キャリーバッグが塀にぶつかった。

(14, ex, im) 塀がキャリーバッグにぶつかった。

(14, on, mb) 砲丸が塀にぶつかった。

(14, on, im) 塀が砲丸にぶつかった。

(15, ex, mb) 腕時計がテーブルにぶつかった。

(15, ex, im) テーブルが腕時計にぶつかった。

(15, on, mb) 投げ輪がテーブルにぶつかった。

(15, on, im) テーブルが投げ輪にぶつかった。

(16, ex, mb) 傘が門にぶつかった。

(16, ex, im)　　　　門が傘にぶつかった。

(16, on, mb)　　　　ラグビーボールが門にぶつかった。

(16, on, im)　　　　門がラグビーボールにぶつかった。

8. Item sentences inExperiment 7

Causation factor {ex(tended) / on(set) } x Object factor {mb(ile object) / im(mobile object) }

(1, ex, mb)　　子供が / リュックを/　ガードレールに/　あてたので / 金具が / 少し/　削れた。

(1, ex, im)　　子供が / ガードレールを/　リュックに/　あてたので / 金具が / 少し/　削れた。

(1, on, mb)　　子供が / 雪玉を/　ガードレールに/　あてたと / 体育委員が / うれしそうに/ 自慢した。

(1, on, im)　　子供が / ガードレールを/　雪玉に/　あてたと / 体育委員が / うれしそうに/ 自慢した。

(2, ex, mb)　　小学生が / ランドセルを/　ベンチに/　あてたので / 革が / はがれて/　悲しんだ。

(2, ex, im)　　小学生が / ベンチを/　ランドセルに/　あてたので / 革が / はがれて/　悲しんだ。

(2, on, mb)　　小学生が / ゲートボールを/　ベンチに/　あてたと / 審判が / 冷たく/　言い放った。

(2, on, im)　　小学生が / ベンチを/　ゲートボールに/　あてたと / 審判が / 冷たく/　言い放った。

(3, ex, mb)　　弟が / バンパーを/　縁石に/　あてたので / 修理が / 大変だと/　嘆いた。

(3, ex, im)　　弟が / 縁石を/　バンパーに/　あてたので / 修理が / 大変だと/　嘆いた。

(3, on, mb)　　弟が / ドッジボールを/　縁石に/　あてたと / コーチが / 生徒たちを/　怒った。

(3, on, im)　　弟が / 縁石を/　ドッジボールに/　あてたと / コーチが / 生徒たちを/　怒った。

(4, ex, mb)　　観光客が / 釣り竿を/　岩に/　あてたので / 大物を / 取り逃がして/　落胆した。

(4, ex, im)　　観光客が / 岩を/　釣り竿に/　あてたので / 大物を / 取り逃がして/　落胆した。

(4, on, mb)　　観光客が / 水風船を/　岩に/　あてたと / 釣り人が / 迷惑そうに/　訴えた。

(4, on, im)　　観光客が / 岩を/　水風船に/　あてたと / 釣り人が / 迷惑そうに/　訴えた。

(5, ex, mb)　　少年が / 車輪を/　フェンスに/　あてたので / 荷台の / ダンボール箱が/　崩れた。

(5, ex, im)　　少年が / フェンスを/　車輪に/　あてたので / 荷台の / ダンボール箱が/　崩れた。

(5, on, mb)　　少年が / フリスビーを/　フェンスに/　あてたと / 隣人に / こっぴどく/　怒られた。

(5, on, im)　　少年が / フェンスを/　フリスビーに/　あてたと / 隣人に / こっぴどく/　怒られた。

(6, ex, mb)　　酔っ払いが / 帽子を/　交通標識に/　あてたので / 帽子が / 道路に/　落ちた。

(6, ex, im)　　酔っ払いが / 交通標識を/　帽子に/　あてたので / 帽子が / 道路に/　落ちた。

(6, on, mb)　　酔っ払いが / 石つぶてを/　交通標識に/　あてたと / 警官から / 厳しく/　注意された。

(6, on, im)　　酔っ払いが / 交通標識を/　石つぶてに/　あてたと / 警官から / 厳しく/　注意された。

(7, ex, mb)　　後輩が / ラケットを/　壁に/　あてたので / 壁が / へこんで/　焦った。

(7, ex, im)　　後輩が / 壁を/　ラケットに/　あてたので / 壁が / へこんで/　焦った。

(7, on, mb)　　後輩が / テニスボールを/　壁に/　あてたと / バスケ部員は / 難癖を/　つけた。

(7, on, im)　　後輩が / 壁を/　テニスボールに/　あてたと / バスケ部員は / 難癖を/　つけた。

(8, ex, mb)　　家政婦が / はたきを/　骨董品に/　あてたので / 祖父から / 大目玉を/　くらった。

(8, ex, im)　　　家政婦が / 骨董品を/　はたきに/　あてたので / 祖父から / 大目玉を/　くらっ
　　　　　　　　た。

(8, on, mb)　　　家政婦が / 球を/　骨董品に/　あてたので / 鑑定士は / 肝を/　冷やした。

(8, on, im)　　　家政婦が / 骨董品を/　球に/　あてたので / 鑑定士は / 肝を/　冷やした。

(9, ex, mb)　　　新入社員が / サイドミラーを/　電柱に/　ぶつけたので / ドライバーは / 冷や
　　　　　　　　汗を/　かいた。

(9, ex, im)　　　新入社員が / 電柱を/　サイドミラーに/　ぶつけたので / ドライバーは / 冷や
　　　　　　　　汗を/　かいた。

(9, on, mb)　　　新入社員が / 空き缶を/　電柱に/　ぶつけたので / 清掃員は / 若者を/　にらん
　　　　　　　　だ。

(9, on, im)　　　新入社員が / 電柱を/　空き缶に/　ぶつけたので / 清掃員は / 若者を/　にらん
　　　　　　　　だ。

(10, ex, mb)　　友達が / 荷物を/　柱に/　ぶつけたので / 箱から / 商品が/　飛び出た。

(10, ex, im)　　友達が / 柱を/　荷物に/　ぶつけたので / 箱から / 商品が/　飛び出た。

(10, on, mb)　　友達が / ビー玉を/　柱に/　ぶつけたので / 甥っ子は / 楽しそうに/　笑った。

(10, on, im)　　友達が / 柱を/　ビー玉に/　ぶつけたので / 甥っ子は / 楽しそうに/　笑った。

(11, ex, mb)　　掃除当番が / ほうきを/　窓ガラスに/　ぶつけたので / 窓が / 粉々に/　割れた。

(11, ex, im)　　掃除当番が / 窓ガラスを/　ほうきに/　ぶつけたので / 窓が / 粉々に/　割れた。

(11, on, mb)　　掃除当番が / ボールを/　窓ガラスに/　ぶつけたので / 野球少年は / すぐさま/
　　　　　　　　逃げ出した。

(11, on, im)　　掃除当番が / 窓ガラスを/　ボールに/　ぶつけたので / 野球少年は / すぐさま/
　　　　　　　　逃げ出した。

(12, ex, mb)　　息子が / はしごを/　外壁に/　ぶつけたと / 業者は / 素直に/　白状した。

(12, ex, im)　　息子が / 外壁を/　はしごに/　ぶつけたと / 業者は / 素直に/　白状した。

(12, on, mb)　　息子が / ラジコン飛行機を/　外壁に/　ぶつけたと / 中学生は / 故障を/　疑った。

(12, on, im)　　息子が / 外壁を/　ラジコン飛行機に/　ぶつけたと / 中学生は / 故障を/　疑った。

(13, ex, mb)　　サッカー部員が / くつを/　ゴールポストに/　ぶつけたと / 用務員は / 部員を/　叱った。

(13, ex, im)　　サッカー部員が / ゴールポストを/　くつに/　ぶつけたと / 用務員は / 部員を/　叱った。

(13, on, mb)　　サッカー部員が / サッカーボールを/　ゴールポストに/　ぶつけたと / 監督は / 部員を/　なじった。

(13, on, im)　　サッカー部員が / ゴールポストを/　サッカーボールに/　ぶつけたと / 監督は / 部員を/　なじった。

(14, ex, mb)　　部長が / キャリーバッグを/　塀に/　ぶつけたので / 車輪が / 完全に/　壊れた。

(14, ex, im)　　部長が / 塀を/　キャリーバッグに/　ぶつけたので / 車輪が / 完全に/　壊れた。

(14, on, mb)　　部長が / 砲丸を/　塀に/　ぶつけたと / 部員は / 慌てて/　報告した。

(14, on, im)　　部長が / 塀を/　砲丸に/　ぶつけたと / 部員は / 慌てて/　報告した。

(15, ex, mb)　　いとこが / 腕時計を/　テーブルに/　ぶつけたので / 文字盤に / ヒビが/　入った。

(15, ex, im)　　いとこが / テーブルを/　腕時計に/　ぶつけたので / 文字盤に / ヒビが/　入った。

(15, on, mb)　　いとこが / 投げ輪を/　テーブルに/　ぶつけたと / 祭り客は / 文句を/　言った。

(15, on, im)　　いとこが / テーブルを/　投げ輪に/　ぶつけたと / 祭り客は / 文句を/　言った。

(16, ex, mb)　　部員が / 傘を/　門に/　ぶつけたので / 風紀委員が / くすくす/　笑った。

(16, ex, im)　　部員が / 門を/　傘に/　ぶつけたので / 風紀委員が / くすくす/　笑った。

(16, on, mb) 部員が / ラグビーボールを/ 門に/ ぶつけたと / コーチは / 警備員に/ ぼや

いた。

(16, on, im) 部員が / 門を/ ラグビーボールに/ ぶつけたと / コーチは / 警備員に/ ぼや

いた。

9. Item sentences in Experiment 8

Causation factor {ex(tended) / on(set) } x Subject factor {mb(ile subbject) / im(mobile

subject) }

(1, ex, mb) リュックが / ガードレールに / あたったので / 金具が / 少し / 削れた。

(1, ex, im) ガードレールが / リュックに / あたったので / 金具が / 少し / 削れた。

(1, on, mb) 雪玉が / ガードレールに / あたったと / 体育委員が / うれしそうに / 自慢し

た。

(1, on, im) ガードレールが / 雪玉に / あたったと / 体育委員が / うれしそうに / 自慢し

た。

(2, ex, mb) ランドセルが / ベンチに / あたったので / 革が / はがれて / 悲しんだ。

(2, ex, im) ベンチが / ランドセルに / あたったので / 革が / はがれて / 悲しんだ。

(2, on, mb) ゲートボールが / ベンチに / あたったと / 審判が / 冷たく / 言い放った。

(2, on, im) ベンチが / ゲートボールに / あたったと / 審判が / 冷たく / 言い放った。

(3, ex, mb) バンパーが / 縁石に / あたったので / 修理が / 大変だと / 嘆いた。

(3, ex, im) 縁石が / バンパーに / あたったので / 修理が / 大変だと / 嘆いた。

(3, on, mb) ドッジボールが / 縁石に / あたったと / コーチが / 生徒たちを / 怒った。

(3, on, im) 縁石が / ドッジボールに / あたったと / コーチが / 生徒たちを / 怒った。

(4, ex, mb) 釣り竿が / 岩に / あたったので / 大物を / 取り逃がして / 落胆した。

(4, ex, im) 岩が / 釣り竿に / あたったので / 大物を / 取り逃がして / 落胆した。

(4, on, mb) 水風船が / 岩に / あたったと / 釣り人が / 迷惑そうに / 訴えた。

(4, on, im) 　岩が / 水風船に / あたったと / 釣り人が / 迷惑そうに / 訴えた。

(5, ex, mb) 　車輪が / フェンスに / あたったので / 荷台の / ダンボール箱が / 崩れた。

(5, ex, im) 　フェンスが / 車輪に / あたったので / 荷台の / ダンボール箱が / 崩れた。

(5, on, mb) 　フリスビーが / フェンスに / あたったと / 隣人に / こっぴどく / 怒られた。

(5, on, im) 　フェンスが / フリスビーに / あたったと / 隣人に / こっぴどく / 怒られた。

(6, ex, mb) 　帽子が / 交通標識に / あたったので / 帽子が / 道路に / 落ちた。

(6, ex, im) 　交通標識が / 帽子に / あたったので / 帽子が / 道路に / 落ちた。

(6, on, mb) 　石つぶてが / 交通標識に / あたったと / 警官から / 厳しく / 注意された。

(6, on, im) 　交通標識が / 石つぶてに / あたったと / 警官から / 厳しく / 注意された。

(7, ex, mb) 　ラケットが / 壁に / あたったので / 壁が / へこんで / 焦った。

(7, ex, im) 　壁が / ラケットに / あたったので / 壁が / へこんで / 焦った。

(7, on, mb) 　テニスボールが / 壁に / あたったと / バスケ部員は / 難癖を / つけた。

(7, on, im) 　壁が / テニスボールに / あたったと / バスケ部員は / 難癖を / つけた。

(8, ex, mb) 　はたきが / 骨董品に / あたったので / 祖父から / 大目玉を / くらった。

(8, ex, im) 　骨董品が / はたきに / あたったので / 祖父から / 大目玉を / くらった。

(8, on, mb) 　球が / 骨董品に / あたったので / 鑑定士は / 肝を / 冷やした。

(8, on, im) 　骨董品が / 球に / あたったので / 鑑定士は / 肝を / 冷やした。

(9, ex, mb) 　サイドミラーが / 電柱に / ぶつかったので / ドライバーは / 冷や汗を / かい
　　　　　　　た。

(9, ex, im) 　電柱が / サイドミラーに / ぶつかったので / ドライバーは / 冷や汗を / かい
　　　　　　　た。

(9, on, mb) 　空き缶が / 電柱に / ぶつかったので / 清掃員は / 若者を / にらんだ。

(9, on, im) 　電柱が / 空き缶に / ぶつかったので / 清掃員は / 若者を / にらんだ。

(10, ex, mb) 　荷物が / 柱に / ぶつかったので / 箱から / 商品が / 飛び出た。

(10, ex, im) 　柱が / 荷物に / ぶつかったので / 箱から / 商品が / 飛び出た。

(10, on, mb)　　ビー玉が ／ 柱に ／ ぶつかったので ／ 甥っ子は ／ 楽しそうに ／ 笑った。

(10, on, im)　　柱が ／ ビー玉に ／ ぶつかったので ／ 甥っ子は ／ 楽しそうに ／ 笑った。

(11, ex, mb)　　ほうきが ／ 窓ガラスに ／ ぶつかったので ／ 窓が ／ 粉々に ／ 割れた。

(11, ex, im)　　窓ガラスが ／ ほうきに ／ ぶつかったので ／ 窓が ／ 粉々に ／ 割れた。

(11, on, mb)　　ボールが ／ 窓ガラスに ／ ぶつかったので ／ 野球少年は ／ すぐさま ／ 逃げ出した。

(11, on, im)　　窓ガラスが ／ ボールに ／ ぶつかったので ／ 野球少年は ／ すぐさま ／ 逃げ出した。

(12, ex, mb)　　はしごが ／ 外壁に ／ ぶつかったと ／ 業者は ／ 素直に ／ 白状した。

(12, ex, im)　　外壁が ／ はしごに ／ ぶつかったと ／ 業者は ／ 素直に ／ 白状した。

(12, on, mb)　　ラジコン飛行機が ／ 外壁に ／ ぶつかったと ／ 中学生は ／ 故障を ／ 疑った。

(12, on, im)　　外壁が ／ ラジコン飛行機に ／ ぶつかったと ／ 中学生は ／ 故障を ／ 疑った。

(13, ex, mb)　　くつが ／ ゴールポストに ／ ぶつかったと ／ 用務員は ／ サッカー部員を ／ 叱った。

(13, ex, im)　　ゴールポストが ／ くつに ／ ぶつかったと ／ 用務員は ／ サッカー部員を ／ 叱った。

(13, on, mb)　　サッカーボールが ／ ゴールポストに ／ ぶつかったと ／ 監督は ／ 部員を ／ なじった。

(13, on, im)　　ゴールポストが ／ サッカーボールに ／ ぶつかったと ／ 監督は ／ 部員を ／ なじった。

(14, ex, mb)　　キャリーバッグが ／ 塀に ／ ぶつかったので ／ 車輪が ／ 完全に ／ 壊れた。

(14, ex, im)　　塀が ／ キャリーバッグに ／ ぶつかったので ／ 車輪が ／ 完全に ／ 壊れた。

(14, on, mb)　　砲丸が ／ 塀に ／ ぶつかったと ／ 部員は ／ 慌てて ／ 報告した。

(14, on, im)　　塀が ／ 砲丸に ／ ぶつかったと ／ 部員は ／ 慌てて ／ 報告した。

(15, ex, mb)　　腕時計が ／ テーブルに ／ ぶつかったので ／ 文字盤に ／ ヒビが ／ 入った。

(15, ex, im)　　テーブルが / 腕時計に / ぶつかったので / 文字盤に / ヒビが / 入った。

(15, on, mb)　　投げ輪が / テーブルに / ぶつかったと / 祭り客は / 文句を / 言った。

(15, on, im)　　テーブルが / 投げ輪に / ぶつかったと / 祭り客は / 文句を / 言った。

(16, ex, mb)　　傘が / 門に / ぶつかったので / 風紀委員が / くすくす / 笑った。

(16, ex, im)　　門が / 傘に / ぶつかったので / 風紀委員が / くすくす / 笑った。

(16, on, mb)　　ラグビーボールが / 門に / ぶつかったと / コーチは / 警備員に / ぼやいた。

(16, on, im)　　門が / ラグビーボールに / ぶつかったと / コーチは / 警備員に / ぼやいた。

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