Predicting Attachment of the Light Verb –*suru* to Japanese Two-kanji Compound Words Using Four Aspects [1]

Katsuo Tamaoka [2]
Hiroshima University,Japan
Chizuko Matsuoka [3]
Keimyung University,Korea
Hiromu Sakai [4]
Hiroshima University, Japan
Shogo Makioka [5]
Osaka Prefecture University, Japan

Abstract. In the Japanese language, the light verb –*suru* can be attached to various two-kanji compound words containing a *verb-like* feature (or aspects) to allow them to be used as a verb. Using a large sample of the 2,000 two-kanji compound words, encompassing a little less than 80 percent of the total two-kanji compound words printed in 14 years of *Asahi Newspaper* issues, the present study investigates how much the light verb attachment is predicted by four aspects: *inchoative*, *durative*, *telic* and *stative*. A binary logistic regression analysis indicates that all four aspects are significant predictors. Among them, the *telic* aspect shows an overwhelmingly high predictive power. The quantitative theory type III analysis further demonstrates that, in contrast to the *stative* aspect, the *inchoative, durative* and *telic* aspects share a similar semantic feature of *time series*. Nevertheless, since the *telic* aspect overlaps not only the *time series* feature of the *inchoative* and *durative* aspects, but also the *stative* aspect, it is the most effective single predictor for light verb attachment, showing an extremely high prediction rate of 93.64 percent (751 cases out of 802) with errors of 6.36 percent (51 cases out of 802). These errors include 8 words with the *telic* aspect, 11 words with no *telic* aspect, and 32 words with none of the four aspects.

Keywords: light verb -suru, aspect, verb-likeness, two kanji-compound words, binary logistic regression analysis, Hayashi's Quantitative Theory Type III

1. Purpose and approach to the light verb attachment

In the Japanese language, many nouns can be used as a verb by simply adding the light verb –*suru* [6] as in 発表する 'to announce' created by a noun 発表 meaning 'announcement' plus

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[2] Address correspondence to: Katsuo Tamaoka, International Student Center, Hiroshima University 1-1, 1-chome, Higashihiroshima, Japan 739-8524. E-mail: ktamaoka@hiroshima-u.ac.jp.
[3] Chizuko Matsuoka, College of International Studies, Department of Japanese Studies, Keimyung University, 1000 Singdang-Dong, Dalseo-Gu, Daegu, 704-701, Korea. E-mail: chizuko@kmu.ac.kr.
[4] Hiromu Sakai, Graduate School of Education, Hiroshima University 1-1, 1-chome, Higashihiroshima, Japan 739-8524. E-mail: hsakai@hiroshima-u.ac.jp.
[5] Shogo Makioka, School of Humanities & Social Sciences, Osaka Prefecture University 1-1, Gakuen-cho, Sakai, Osaka 599-8531. E-mail:makioka@hs.osakafu-u.ac.jp.
[6] In the present study, using the theoretical framework of generative grammar, the term *light verb* is used for

the light verb *–suru*. Because the light verb itself does not have a specific meaning, the meaning of the noun determines the meaning of the compounded verb, as in the verb 'to announce' from the noun 'announcement'. However, the light verb cannot be attached to all Japanese nouns. It is assumed that some specific meanings possessed by nouns must determine whether or not the light verb can be attached to them. In this regard, Iida (1987) and Ito and Sugioka (2002) propose that nouns can be classified according to their *verb-like* features. Furthermore, Grimshaw (1990) pointed out that the degree of *verb-liken* features can be measured in terms of the aspectual properties of nouns. Thus, the present study investigates the aspectual properties of nouns which decide the light verb attachment.

Linguistic testing using suffix attachment was applied nouns to determine which aspects related to *time* the nouns possessed (Iida, 1987; Shibatani & Kageyama, 1988). For example, a suffix 中 meaning 'during' can be added to the end of a word 建設 meaning 'construction', to produce 建設中 'during construction'. Since this suffix-based derivation is possible, this word is judged to have the *durative* aspect. Likewise, a suffix 後 meaning 'after' can be added to the same word to form 建設後 'after construction', implying that this word contains the *telic* aspect. Using this type of linguistic testing, it is possible to judge whether nouns contain *verb-like* features. In addition to the *durative* and *telic* aspects, Kageyama (1996) proposes two more aspects, *inchoative* and *stative*. Matsuoka (2004, 2005) elaborates on these two additional aspects: *inchoative* (e.g., 販売 'sale', 輸入 'importation') and *stative* (存在 'existence', 占領 'occupation'). The present study approaches this investigation by asking to what degree the light-verb attachment to two-kanji compound words[7] can be predicted by these four aspects: *inchoative*, *durative*, *telic* and *stative*.

2. Selection of two-kanji compound words for investigation of light verb attachment

Using the *Asahi Newspaper* printed from 1985 to 1998, Amano and Kondo (2000) created a large lexical database (not corpus) of word printed-frequencies in the seventh volume of their series. The CD-ROM version of the lexical database (Amano & Kondo, 2003) is available through the *Sanseido* Web-site of www.sanseido-publ.co.jp/publ/ntt_database.html. This database contains 341,771 morphemic units for type frequency and 287,792,797 morphemes for token frequency. The frequency index of Amano and Kondo (2000) is the lexical database (not the corpus) which stored printed-frequency counts for lexical items appearing in the *Asahi Newspaper*. In this database, various inflections in a single verb or a single adjective were counted as a single lexical item using an infinitive form. For example, a verb *kaku* 'to write' (書く) which is classified as the consonant-stem verbs (五段活用) inflects as kak*a*(nai), kak*i*(masu), kak*u*, kak*e*(ba), kak*e* and kak*oo*. In the database, all these inflections were counted together as a single lexical item represented by the finite form (終止形) of the same word, *kaku*. The characteristics of this database may cause some problems in some linguistic studies. However, the present study only requires only the printed-frequencies of two-kanji

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the.*–suru* attachment to a noun, contrasting with other verbs called *heavy verbs*.

[7] Although these aspects are often found among Sino-Japanese two-kanji compound words (e.g.運転する meaning 'to drive', derived from a noun 'drive' plus the light verb *–suru*), it extends to originally Japanese words (such as おしゃべりする meaning 'to chat', derived from a noun 'chatting' plus *–suru*) and even alphabetic-loan words (such as デザインする meaning 'to design', derived from a noun 'design' plus *–suru*) (Matsuoka, 2004, 2005). However, the present study only focuses on the most commonly suffixed two-kanji compound words.

compound words, so that the database of Amano and Kondo (2000, 2003) is sufficient for our purposes.

In the database of Amano and Kondo (2000, 2003), the light verb *–suru* is recorded separately from two-kanji compound words. For example, 散歩する meaning 'take a walk' is composed of two parts. A two-kanji compound word such as 散歩 meaning 'a walk' cannot be a verb by itself. However, with the attachment of the light verb *–suru* (written in hiragana as する), this word can function as a verb in a sentence like 公園を散歩した meaning '[I] took a walk in the park' (the subject 'I' is an empty subject). In Amano and Kondo's database, the printed-frequency of 散歩 is 2,537. The light verb is classified as a *verb ending* (動詞語尾) which naturally appears very frequently, 1,374,420 times, including every word that incorparates a light verb. Thus, all two-kanji compound words (selected by taking the category of 'general nouns' and excluding the category of 'proper nouns') were easily chosen from the database, for a total of 41,140 types and 43,348,553 tokens.

To have a manageable sample of two-kanji compound words, 2,000 items were selected from the top-ranking items in token frequency. However, 30 items incoroproating kanji numerals, such as 第一 meaning 'the number one', 十月 meaning 'October', were excluded from the present study. For this reason, 30 items were added from a ranking of the 2001st to 2030th in order to obtain 2,000 two-kanji compound words. As shown in Table 1, the 30 excluded items represent about 0.07% of the total type frequency of two-kanji compound words and 1.00% (435,416 instances) of the total token frequency. As a result of this sampling procedure, the desired number of 2,000 compound words was reached. These compound words represent only 4.86% of the total 41,140 two-kanji compound general noun types found in 14 years of the *Asahi Newspaper*. However, the same 2,000 compounds represent 78.62% (frequency 34,078,508) of a total of 43,348,553 tokens, as shown in Table 1. Since the 2,000 compounds encompass a little less than 80 percent of the total two-kanji compound words printed in the *Asahi Newspaper*, this sample of 2,000 compounds meets the requirements of meaningful investigation into light verb attachment.

Table 1
Percentages of selected 2,000 two-kanji compound words and 30 excluded words
in proportion to total type and token frequencies

Number of words	Type Frequency	Type Freq %	Token Frequency	Token Freq %
Total	41,140	---	43,348,553	---
Selected 2,000 words	2,000	4.86%	34,078,508	78.62%
Excluded 30 words	30	0.07%	435,416	1.00%

3. Coding of aspects (X_1 to X_4) and light verb attachment (Y)

Each two-kanji compound word was coded as 1 if it is possible to attach a light verb to it, and coded as 0 if this is not possible. For example, a light verb is not attached to a compound word 社会 meaning 'society', so this word was coded as 0. In other words, a verb 社会する, a compound of 'society' plus *–suru*, does not exist in the Japanese language. Another compound word 計画 meaning 'a plan' can have a light verb attached (a compound of 'a plan' plus *–suru* and becomes 'to plan'), so this word was coded as 1. In this coding procedure, 802 out of the selected 2,000 two-kanji compound words (40.10%) were coded as 1.

The same process was used to code the existence of each of the four aspects in the 2,000 compounds. For instance, a compound word 交渉 meaning 'negotiation', to which the light verb can be added to form 交渉する meaning 'to negotiate', contains the *inchoative* aspect in its meaning. It can be easily understood that a combination of two compound words 交渉開始 ('negotiation' plus 'beginning') can be created. Thus, this word is coded 1 for the *inchoative* aspect. Likewise, this word also includes the *durative* aspect since a suffix of 中 can be attached to 交渉, as in 交渉中 meaning 'during negotiation'. This word is also coded 1 for the *durative* aspect. Similarly, a compound word 交渉終了 meaning 'completion of negotiation' can be created by compounding together 'negotiation' and 'completion'. Furthermore, the suffix 'after' 後 can be attached to this word as 交渉後 'after negotiation'. Thus, it is judged that the compound word 'negotiation' contains the *telic* aspect in its meaning and receives a 1 code for this aspect. However, the word 'negotiation' does not have the *stative* aspect as does, for example, the word 健康, 'health'. Thus, 'negotiation' is given 0 for this aspect. In sum, the word 交渉 is coded 1 for the *inchoative* aspect, 1 for the *durative* aspect, 1 for the *telic* aspect and 0 for the *stative* aspect. Values consist of only 1 if nouns contain an aspect or 0 when they do not contain an aspect. Variables to which 0 or 1 values are assigned are commonly referred to as *dummy variables*. In the present study, the four aspects were deemed X_1 for *telic*, X_2 for *durative*, X_3 for *stative*, and X_4 for *inchoative*.

4. Percentages of light verb attachments predicted by the four aspects

Once the presence or absence of the four aspectual properties of a two-kanji compound word has been calculated, it is possible to see to what extent these features predict whether or not the light verb is attached; that is, the simple predicted percentage of light verb attachment may be estimated.

Table 2

Predicted percentages of the light verb attachment by four aspects of 2,000 two-kanji compound words

Number of words	Aspects of compound words			
	Inchoative	Durative	Telic	Stative
(1) # of words obtained an aspect	203	497	759	74
(2) # of words not obtained an aspect	1,797	1,503	1,241	1,926
(3) # of words attached a light verb	202	483	751	68
(4) # of words not attached a light verb among (3)	1	14	8	6
(5) % of (1)/(3) … Partial prediction among (1)	99.51%	97.18%	98.95%	91.89%
(6) % of (3)/802 … Actual prediction among 802	25.19%	60.22%	93.64%	8.48%

Note 1: The light verb is attached to 802 two-kanji compound words out of 2,000 (40.10%).

Note 2: The percentage of (6) includes 32 two-kanji compound words with none of the four aspect. This is 3.39 percent of the 802 light-verb attached cases.

None of the four aspects was assigned to 32 of the two-kanji compound words to which the light verb was attached. Examples of these were 生活 /seikatu/ 'living', 意味 /imi/ 'meaning' and 平均 /heikiN/ 'average'. These two-kanji compound words can be used as a verb with an attachment of *–suru* as 生活する 'to live', 意味する 'to mean' and 平均する 'to average'. Although these words do not have any semantic features described by the four aspects, the

light verb –*suru* is attached to them. In this sense, these 32 words were considered as prediction errors by the four aspects. The error rate of this kind was 3.99 percent (32 out of 802).

As shown in Table 2, 203 two-kanji compound words were judged to have the *inchoative* aspect, of which the light verb could be attached to 202 words, or 99.51%. Only one noun possessing inchoative aspect, 戦争 'war', does not combine with the light verb, i.e. the form 戦争する does not occur[8]. It is noteworthy, however, that it is possible to add –*suru* if this word has the accusative case marker –*o*, as in 戦争をする [$_{vp}$ NP('war')-*o* V]. The light verb can be attached to 802 types out of 2,000; of these 802 types, the *inchoative* aspect only occurs with 202 types, or 25.19 percent.

Similarly, 497 two-kanji compound words were judged to have the *durative* aspect. Out of these 497, the light verb can be attached to 483 words, or 97.18%. This is 60.22% of the total of 802 types to which the light verb can be attached.

The highest prediction was provided by the *telic* aspect. A large group of 759 words contain this aspect. The light verb can be attached to 751 words, or 98.95%. This is 93.64% of the 802 words. Only 8 words do not have the light verb attachment.

The last aspect, *stative*, is seen with only 74 words. The light verb can be attached to 68 of these (i.e. 91.89% prediction). However, this accounts for just 8.48% of the 802 words to which the light verb can be attached.

In sum, as far as a simple cross-tabulation of the four aspects and light verb attachment shows, the *telic* aspect seems to be the best predictor, at more than 90% of the 2,000 selected compound words. Since the cross-tabulation in Table 2 only indicates a simple prediction of each aspect, a further analysis was conducted to estimate the predictive value of all four aspects together for attachment of the light verb. It should be also noted that the light verb was attached to 32 two-kanji compound words corresponding to none of the four aspects.

5. Data analyses

Two different analyses were conducted for binomial data of the four aspects and light verb attachment. First, a binary logistic regression analysis was used for the selected 2,000 two-kanji compound words. Second, Hayashi's Quantification Theory Type III was used to estimate the similarity of the four aspects.

5.1 Binary logistic regression analysis

Using SPSS 11.0J for Windows - Regression Models with the same version of Base System, a binary logistic regression analysis was conducted to predict the light verb attachment (Y) from the four aspects (X_1 = *telic*, X_2 = *durative*, X_3 = *stative*, X_4 = *inchoative*) among the selected 2,000 two-kanji compound words, including the aforementioned 32 cases with none of the four aspects. The results, reported in Table 3, give the following regression equation:

$$\text{Log}_2(Y) = -3.47 + 6.93X_1 + 2.90\,X_2 + 2.81X_3 + 3.74X_4 \, .$$

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[8] A combined form of the compound word 'war' plus the light verb as 戦争する may be used in colloquial speech, however it is not often accepted in writing. Thus, in this study, this word is judged not to have the light verb attachment.

The determination coefficient (or variable explained by this equation) using Nagelkerke R^2 is high at 0.913, indicating that the four aspects have a high predictive power. All four aspects are significant predictors as shown in Table 3.

Table 3

Binary logistic regression analysis for predicting the light verb attachment (Y)
by the four aspects (Xn) of 2,000 two-kanji compound words

Aspect	X_n	B	Wald	Significance	Exp(B)
Telic	X_1	6.93	312.32	0.00000	1025.79
Durative	X_2	2.90	40.07	0.00000	18.13
Stative	X_3	2.81	15.70	0.00007	16.66
Inchoative	X_4	3.74	8.51	0.00353	41.99

Note 1: A R^2 value is 0.913 by Nagelkerke R^2.

Note 2: B is coefficent while Eep(B) is an estimated odds ratio.

Note 3: The 32 words with no aspect attached were included in the present analysis.

Note 4: Prediction by the *inchoative* aspect is the weakest since 198 words obtained this aspect out of 203 (97.54%) are included in the telic aspect. The remaining five are either (1) two words predicted by a single inchoative aspect or (2) three words predicted by both inchoative and durative aspects.

As expected from the cross-tabulation in Table 2, the aspect with the highest predictive value is the *telic* aspect, having a Wald value of 312.32 ($p < .00001$). The *durative* aspect is the second strongest predictor, having a Wald value of 40.07 ($p < .00001$). The third strongest is the *stative* aspect with a Wald value of 15.07 ($p < .0001$). The least predictive variable is the *inchoative* aspect with a Wald value of 8.51 ($p < .01$). 770 words out of the 802 nouns to which the light verb can be added contain at least one of the four aspects, while 32 words do not have any of these aspects. This represents a 96.01% prediction rate for light verb attachment. Among them, the single *telic* aspect can predict the light verb attachment in 93.64% of cases (751 words out of 802 light-verb attached words) with errors of 6.36 percent (51 cases out of 802). These error cases include 8 words with the *telic* aspect, 11 words with no *telic* aspect, and 32 with none of the four aspects. This very small error rate is the result of the overwhelming predictive power of the *telic* aspect, as shown by its very large Wald value of 312.32 and a very high estimated odds ratio of 1025.79.

Table 4

Number of Overlaps as Classified by the Four Aspects

	Aspect	Telic	Durative	Stative	Inchoative	No overlap
X_1	Telic	759	473	65	198	246
X_2	Durative	473	497	29	197	21
X_3	Stative	65	29	74	3	9
X_4	Inchoative	198	197	3	203	2

Note: The total of two-kanji compound words with the four aspects is 794 out of 2,000.

The question which then arises is, how does the single variable of *telic* aspect predict light verb attachment so powerfully? The clue is in the overlap of these four aspects. As previously discussed, 759 two-kanji compound words had the *telic* aspect in their meanings. Among

these, the light verb was attached to the 751 words. Only eight words containing *telic* aspect (e.g., 葬儀 'funeral', 犯行 'crime', 軍縮 'disarmament' [9]) cannot be directly combined with the light verb. Table 4 shows that, surprisingly, the 759 words with *telic* aspect include 198 out of 203 words with *inchoative* aspect (97.54%), 473 out of 497 words with *durative* aspect (95.17%), and even 65 words out of 74 with *stative* aspect (87.84%). Since the 751 words with *telic* aspect to which the light verb can be attached constitute 93.64% of the 802 words to which the light verb can be attached, this specific aspectual property by itself covers a great majority of the words which allow light verb attachment.

5.2 Hayashi's Quantification Theory Type III

Hayashi's Quantification Theory Type III, of which model was created by Tokio Hayashi, is applied for investigating similarities of variables X_1 to X_4 with 0 and 1 binary data. The present study used the package created by a Japanese company of called *Esumi* produced software for the use of Hayashi's Quantification Theory Type I to Type III. Before making a strong prediction of the light verb attachment by the single aspect *telic*, Hayashi's Quantification Theory Type III was applied to estimate the similarity of the four aspects, by binary data of the four aspects using the 794 words which have at least one of the four aspects. The result is shown in Table 5. Three meaningful axes were found. The first axis has a high Eigenvalue of 0.480 with a high 53.6 percent of variability explained. The second axis has a reasonably high Eigenvalue of 0.261 with 29.1 percent of variability explained. The third axis has a rather low Eigenvalue of 0.156 with 17.3 percent of variability explained. The first and second axes together achieve an extremely high 83.6 percent of variability explained. Figure 1 depicts these two axes.

Table 5

Hayashi's Quantification Theory Type III analysis of the four aspects of two-kanji compound

	Aspect	1st Axis	2nd Axis	3rd Axis
X_1	Telic	0.000	-0.022	-0.013
X_2	Durative	-0.009	0.009	0.035
X_3	Stative	0.110	0.028	0.002
X_4	Inchoative	-0.018	0.051	-0.037
	Eigenvalue	0.480	0.261	0.156
	Variable Explained (%)	53.6%	29.1%	17.3%
	Accumulative Variable Explained (%)	53.6%	82.7%	100.0%

Note: This analysis was conducted using 794 words exhibiting at lease one of the four aspects.

Three aspects – *telic*, *durative* and *inchoative* – seem to lie roughly within the small range between 0.00 and -0.02 of the first axis (the Y-axis in Figure 1). The locations of these three aspects close to the Y-axis may suggest that they, unlike the *stative* aspect, share a single property which will be referred to here as *time series* since these aspects refer to a sequential series of initiation, duration and ending. A word like 放送 meaning 'a broadcast' has an initiation point to start the 'broadcast', and continues during the 'broadcast' until the end of the

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[9] Combined forms of these compound words may be used in colloquial speech, so that some cases of the light verb attachments may be acceptable. However, since the present study utilized the linguistic testing and intuition based mostly on written forms, a conservative position was adopted when determining whether or not the light verb could be attached.

'broadcast'. Thus, a single noun 'broadcast' can contain all the time series of the *inchoative*, *durative* and *telic* aspects. As such, the *time series* of the three aspects on the Y-axis, which provide nouns with a *verb-like* feature, can co-exist or exist independently in a single lexical item. Nevertheless, as indicated by the binary logistic regression analysis, of the three it is the *telic* aspect that is seen to be the dominant semantic feature in terms of making possible the attachment of a light verb. In addition, the *stative* aspect, which is plotted in a location apart from the other aspects, is also largely included in the *telic* aspect as shown in Table 4.
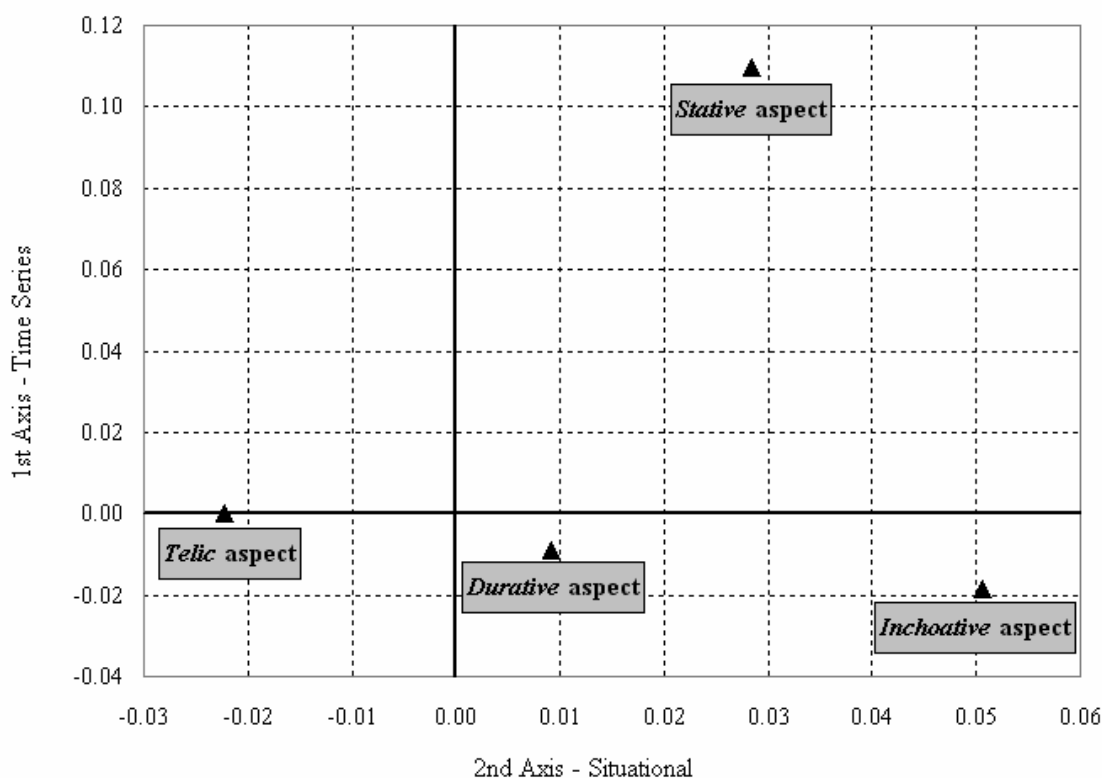

Figure 1 The four aspects of two-kanji compound words analyzed by Hayashi's Quantification Theory Type III

6. Conclusion – The most effective prediction for the light verb attachment

The present study investigated a unique linguistic characteristic of the light verb *–suru* which derives a verb form a noun when it is suffixed to that noun. However, the light verb cannot be attached to every noun, so the present study examined the four aspectual properties of nouns (Matsuoka, 2004, 2005) which may possibly determine light verb attachment. After investigating these four aspects in a large sample of 2,000 two-kanji compound words, a binary logistic regression analysis indicates that the dominant feature is the *telic* aspect. This single aspect can predict the light verb attachment of 93.64% of the 802 cases among the 2,000 words. In contrast, there are only 8 items (out of 759 two-kanji compound words containing the *telic* aspect) to which the light verb cannot be attached. This implies an error rate of 1.00% of the 802 words. In addition, 11 words were given the *telic* aspect although the light verb is not attached to them. These 11 words constituted 1.38% of the total. There were the 32 cases with none of the four aspects but the light verb was attached to these words. All

these cases together, the final error rate of the *telic* aspect predicting the light verb attachment resulted in 6.36 percent (51 cases out of 802). Again, it should be kept in mind that these 2,000 compound types cover a little less than 80% of the total two-kanji compound word tokens printed in the *Asahi Newspaper*. Therefore, the most effective approach to find the light verb attachment is simply as follows. If a word's meaning includes the *telic* aspect, then there is an extremely high probability that the light verb can be attached to that word. In this sense, the two-kanji compound words with the *telic* aspect were *unmarked* cases whereas others could be regarded as *marked* cases. The present study has produced clear statistical evidence of the importance of the *telic* aspect for light verb attachment. Finally, it should be noted that the linguistic judgments to determine the light verb attachment and aspects in the present study were made subjectively by the authors, so that we expect some slight differences depending on the person who makes the decisions. In this aspect, a study on inter-evaluator reliability should be conducted in future research.

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Statistic packages used for the present study

SPSS 11.oJ for Windows – Base System
SPSS 11.oJ for Windows – Regression Model
Esumi Excel - Suuryooka Riron [Quantification Theory] Version 1.0