

# A Study of Translation Rules for the Japanese Compound Motion Verbs

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## Abstract

It has been difficult to translate, by conventional methods, Japanese compound verbs, such as ‘Verb and Verb’ type and ‘Verb-te/de-Verb’ type. A method is proposed to translate Japanese compound motion verbs into English words using valency pattern pairs. Our method proposed for this translation is to divide such Japanese compound verbs into their constituent elements. This paper adopts intra-word relationship for translation by using lexicalization patterns for motion verbs. The constituent elements of Japanese compound verbs are classified with using the lexicalization patterns, and their combination of that patterns are compared with translated English words. The results show that the translation rules for Japanese compound motion verbs can be obtained by combining the lexicalization patterns.

## Keywords

Compound Verbs, Motion Verbs, Lexicalization Patterns, Conflation, Translation

## 1. Introduction

The purpose of this study is to make translation rules from Japanese compound motion verbs to English phrases and to have perspectives for building its automatic systems. Several studies have been made on compound noun machine translation (Miyazaki). There is a study that compiles Japanese and English corpus for Japanese compound verbs by using definitions of dictionary and example sentence pairs that had been generated by human power and makes a vast amount of valency pattern pairs for translation of Japanese compound verbs (Shirai).

As any of Japanese compound verbs can be generated by combining their constituent elements, it is impossible to make entry words in advance for all of the compound verbs in dictionaries. Translation methods using combining rules from constituent elements become more effective than translation pattern methods using Japanese compound verb appeared as entry words.

We have “Verb-te/de-Verb” type phrases “*ori-te-iku* = go down” or irregular word formation; such as “*kare-ha-oyoi-de-kawa-wo-wataru* = he swam across the river”, are frequently used in various sentences. If translation of Japanese compound verbs rely on only lexical entry in the dictionary, such patterns could not be translated properly.

Based on these backgrounds, we propose translation rules for Japanese compound verbs using the combination patterns of their constituent elements. We have two types of verbs in Japan. One is originated in Japan and the others come from China. By combining these two types, we can make four kinds of compound verbs. In this paper, we will treat with verbs combining Japan original verbs.

We analyze Japanese compound motion verbs and obtain their constituent elements. Their combination patterns are important to make translation rules. We have several studies related to motion verbs in cognitive linguistics (Talmy) (Kageyama). According

to Talmy's classification of languages (1985) with respect to the way to conflate components of meaning about motion verbs, Japanese verbs are categorized as the 'motion and path' type. Matsumoto analyzed Japanese motion verbs in detail (Matsumoto 1997), not only 'motion and path' but also 'motion and manner' or 'motion and other factor'. Matsumoto also noted that such conflation patterns are useful for Japanese compound verbs. We adopt their conflation patterns for Japanese compound motion verbs in order to make translation rules of such verbs for machine translation.

For that purpose, we took the following process: (1) classification for motion verbs using conflation patterns, (2) analysis of Japanese compound verbs and their combination, (3) description of translation rules. This paper concludes with a general outline of the rest of this study and future works.

## 2. Classification for motion verbs

At the beginning, we explain lexicalization patterns of motion verbs. Talmy proposed lexicalization patterns of motion verbs by looking over several languages, and defined the following five factors for such verbs: (1) Motion (2) Path (3) Figure (4) Ground (5) Manner or Cause.

He said that the verbs have two of the factors by several ways. For example, a word 'descend' consists of 'motion and path (down)', and a word 'go around' consists of 'motion and manner'. Talmy defined motion with other components of meanings as 'conflation'. He demonstrated that languages can be classified into the following three main types with respect to the way to lexicalize verbs with the components:

- a. Conflation of motion and manner or cause
- b. Conflation of motion and path
- c. Conflation of motion and figure

According to this theory, Japanese verbs are classified into the type of 'motion and path'. Matsumoto analyzed Talmy's components of meaning in detail, and proposed 6 factors based on Talmy's: 'Figure', 'Path (Directional path)', 'Path (Ground path)', 'Manner', 'Concurrence state', 'Concurrence change' and 'Cause'. We use four factors defined as semantic factors of them to classify Japanese motion verbs: 'Directional path', 'Ground path', 'Manner' and 'Concurrence' as in Figure 1.

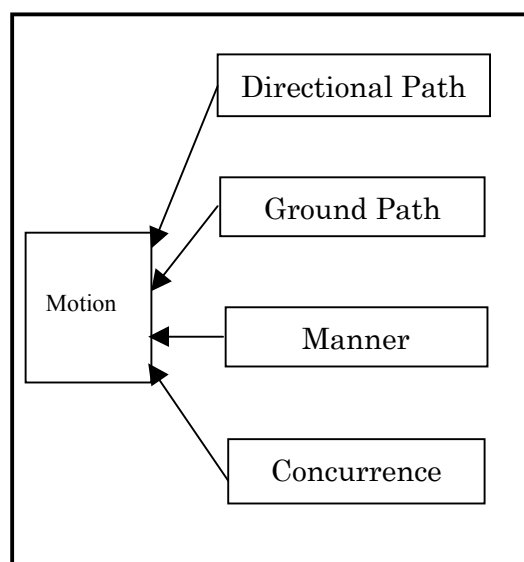


Figure 1. Semantic factors for motion verbs

Although there are syntactic and semantic approaches, we classify motion verbs using by semantic one.

A meaning of a motion verb can be expressed by the conflation of motion with semantic factors. We define a motion verb conflating of motion with semantic factor as a semantic factor verb. For example, a motion verb having 'Directional path' factor is defined as 'Directional path' verb. The verbs conflating semantic factors are listed below.

### (a) 'Directional Path' Verbs

*iku* 'go', *kuru* 'come', *noboru* 'climb', *kudaru* 'go down', *agaru* 'go up', *oriru* 'go down', *ochiru* 'fall down', *sizumu*

‘sink’, *modoru* ‘return’, *kaeru* ‘come back’, *susumu* ‘advance’

(b) ‘Ground Path’ Verbs

*koeru* ‘go over’, *wataru* ‘go across’, *touru* ‘go through’, *sugiru* ‘go past’, *Nukeru* ‘go through’, *kuguru* ‘go under’, *Mawaru* ‘go around’, *hairu* ‘enter’, *deru* ‘go out’, *tuku* ‘arrive’, *saru* ‘leave’

(c) ‘Manner’ Verbs

*aruku* ‘walk’, *hasiru* ‘run’, *nigeru* ‘run’, *hau* ‘crawl’, *suberu* ‘slide/slip’, *korogaru* ‘roll’, *haneru* ‘jump’, *mau* ‘fly’, *oyogu* ‘swim’, *tobu* ‘fly’, *nagareru* ‘flow’, *isogu* ‘haste’

(d) ‘Concurrence’ Verbs

*sagasu* ‘search’, *yobu* ‘call’, *utau* ‘sing’, *hakobu* ‘carry’, *nomu* ‘drink’, *osieru* ‘teach’, *uru* ‘sell’, *motu* ‘take’, *tureru* ‘bring’

### 3. Analysis of Japanese Compound verbs and their combination

Japanese makes extensive use of compounding to produce a various complex predicates [kageyama]

- a. Noun-Verb: *tabi-datu* “set out on a journey”
- b. Verb-Verb: *tobi-dasu* “jump out”, *tabe-suguru* “eat too much”
- c. Noun-Adjective: *te-atui* “cordial”, *sio-karai* “salty”
- d. Verb-Adjective: *musi-atui* “steaming hot”, *yomi-nikui* “hard to read”
- e. Verbal Noun-suru: *kyuukei-suru* “take a rest”, *huka-oi-suru* “chase too far”
- f. Verb-te Verb: *tabe-te miru* “try eating”, *arat-te-oku* “finish washing”

We will deal with type b and f using Japanese verbs as the constituent elements that consist of compound verbs. It seems to be necessary to distinguish type b with c because of their different behavior.

#### 3.1 Combination patterns of ‘Verb and

#### Verb’ type

Matsumoto analyzed such combination patterns include in motion verbs to list up five patterns: manner and ground path, manner and directional path, Concurrence and ground path, Concurrence and manner, ground path and ground path.

One compound verb has two constituent elements. First one is called as an anterior element and the other one is a posterior element. Each element can have a factor and a compound verb has two factors. The two factors are ordered by the following constraint.

Concurrence < manner < ground path < directional path

The factor which is located at the left side such as ‘Concurrence’ and ‘Manner’ tend to be used as an anterior element, while the factor which is located at the right side such as ‘Directional path’ tend to be used as a posterior element in compound verbs. For instance, in the case that manner and ground path consist of compound verb, constituent elements which are classified as manner would be an anterior element and ground path are located as a posterior element.

To examine such ordering for type b Japanese compound verbs, we extracted 91 verbs of type b compound verbs from lexical entries of Japanese to English dictionary (Maeda).

We have nine combination types of compound verbs:

(1) Ground Path and Ground Path:  
*touri-nukeru* “go past”, *hairi-komu* “get into”

(2) Ground Path and Directional Path:  
*uturi-yuku* “change”, *sugi-yuku* “go past”

(3) Ground Path and Manner:  
*watari-aruku* “go from one place to another”

(4) Concurrence and Ground Path:

*sagasi-mawaru* “search around”, *mochi-saru* “take away”

(5) Concurrence and Manner:

*mochi-aruku* “carry around”, *ture-aruku* “walk together”

(6) Manner and Ground Path:

*hai-deru* “crawl out”, *hane-deru* “spring out”

(7) Manner and Directional Path:

*kake-agaru* “run up”, *nagare-ochiru* “flow down”

(8) Manner and Manner:

*tobi-aruku* “run around”, *samayoi-aruku* “wander”

(9) Directional Path and Ground Path:

*kaeri-tuku* “come back”, *iki-suguru* “go past”

The combination patterns in table 1 show frequency of combination patterns as mentioned above.

Table 1. Frequency of Combination types

Combination types	Frequency
Ground and Ground	6
Ground and Directional	2
Ground and Manner	1
Concurrence and Ground	11
Concurrence and Manner	9
Manner and Ground	33
Manner and Directional	21
Manner and Manner	3
Directional and Ground	5
Total	91

It was found from Table 1 that ‘Manner and Ground’ is the most frequent type and ‘Manner and Directional’ is the next frequent type. The results clearly show that verb of ‘Manner’ type is frequently used as an anterior element. As ‘Concurrence’ verbs appear only as an anterior element, it is proper to apply the ordering for Japanese compound verbs to the entries in the dictionary.

Comparing with Matsumoto’s examples, the combination patterns we analyzed have

four more additional patterns: ‘Ground path and Directional path’, ‘Ground path and Manner’, ‘Manner and Manner’, and ‘Directional path and Ground path’. According to the ordering, the factor of Concurrence and Manner could not be located at a posterior element. One exceptional pattern was found in our data: ‘Ground path and Manner’. This example was *watari-aruku* ‘wander’, however, *watari-aruku* ‘wander’ expresses metaphorical meaning in this study, the example of ‘Ground path and Manner’ is reduced from our data.

### 3.2 Combination patterns of ‘Verb-te-Verb’

As ‘Verb-te/de-Verb’ pattern was not used as a lexical entry, we extracted 14 patterns from examples of Japanese to English dictionary. Table 2 shows the combination patterns of ‘Verb-te-Verb’.

Table 2. Frequency of ‘Verb-te-Verb’ type

Combination types	Frequency
Manner and Directional	5
Ground and Directional	3
Directional and Directional	2
Concurrence and Directional	3
Ground and Manner	1
Total	14

There are 5 patterns of ‘Verb-te/de-Verb’ in the dictionary:

- (a) ‘Manner and Directional path’  
*hasit-te-iku* ‘go running’
- (b) ‘Ground path and Directional path’  
*koe-te-iku* ‘go over/go beyond’
- (c) ‘Directional path and Directional path’  
*nobot-te-iku* ‘go up to/climb’
- (d) ‘Concurrence and Directional path’  
*hakon-de-iku* ‘carry away’
- (e) ‘Ground path and Manner’  
*watat-te-nigeru* ‘flee across’

In ‘Verb-te/de-Verb’ type, ‘Directional path’ appears frequently as a posterior element. Japanese verb *iku* ‘go’ of ‘Directional path’ is used frequently as a posterior element: such as *hasit-te-iku* and *hakon-de-iku*. Though a pattern of (e) does not follow the ordering for Japanese compound verbs, the other patterns of ‘Verb-te/de-Verb’ type almost follow the ordering.

#### 4. Translation Rules for Japanese compound motion verbs

We made translation rules by analyzing combination types with comparing compound verbs of ‘Verb-Verb’ type with those of ‘Verb-te/de-Verb’ type. The following three steps were made for the translation rules:

- (1) Making a list of translated English words for Japanese compound verbs and their constituent elements.
- (2) Comparing English words translated from Japanese compound verbs with those from the constituent elements.
- (3) Making translation rules for generating English words for the compound verbs using English words obtained from the constituent elements. A process of translation for Japanese compound verbs is illustrated in Figure 2. Japanese constituent element is indicated as J and English translated word is indicated as E.

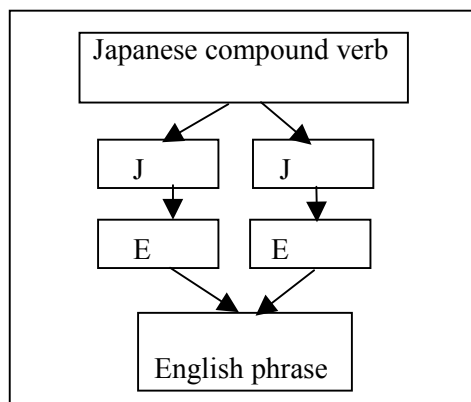


Figure 2. A process of translation  
It was found that translation rules are almost decided by the combination pattern of com-

ponents of meaning. That is to say, if the constituent element of compound verbs could be classified with components of meaning, translation rules are determined automatically. Let us examine translation rules in more detail.

#### 4.1 General rule

##### (1) General rule

An English expression for        are consisting of English verb translated from        and English adverb translated from       

##### (2) Condition

A condition of applying this regular rule is as follows:

= ‘Manner’, ‘Ground path’ or ‘Directional path’

and

= ‘Ground path’ or ‘Directional’

( The cases for a verb *iku* ‘go’ is excepted from the regular rule )

*hasiri-saru* ‘run away’

##### (3) Explanatory examples

Regular rules can be adopted to compound motion verbs that consist of ‘Ground path’ and ‘Directional path’ verbs as posterior element. Such compound verbs could not get translated words properly just by combination of the translated word. In the case of Japanese compound verb *aruki-mawaru*, and translated word of anterior element is ‘walk’ and that of posterior element is ‘go around’.

If we translate constituent element separately, translated English verb of *aruki-mawaru* might be ‘walk and go around’. However, the translated English verb of a whole compound word is ‘walk around’. A word *aruki-mawaru* should be translated as a single verb. A word *mawaru* can be used to represent some correlated property of path as a posterior element. It is therefore reasonable that *mawaru* as a posterior element should convert to an adverb ‘around’. Similarly, posterior element which involve the meaning

of directional path change to the meaning of direction, such as up and down. When posterior elements have ‘Ground path’ and ‘Directional path’ component, we have to prepare conversion rules. The conversion rules are shown in Figure 3.

This regular rule needs optional operation for ‘Ground path’ and ‘Ground path’ type. For example, *touri-nukeru* ‘pass through’ consists of *touru* ‘pass through/go past/go through’, *nukeru* ‘go past/pass through’. If we follow this regular rule as it is, a posterior element ‘*nukeru*’ converted to ‘through’ and translated word come to be ‘pass through’ and ‘through’. In the case that translated word as anterior element overlap an adverb as posterior element, we should delete overlapped adverb.

#### 4.2 ‘Concurrence’-type

##### (1) ‘Concurrence’-type rule

An English expression for AB are consisting of English verb translated from at anterior position and use preposition ‘with’ to connect with English adverb translated from using the progressive form [ing] at posterior position

##### (2) Condition

A condition of applying concurrence-type rule is as follows:

= ‘Concurrence’

and

= ‘Manner’ or ‘Ground path’

*sagasi-mawaru* ‘go around with searching’

##### (3) Explanatory examples

We define ‘Concurrence’ as conditions that two kinds of motion occur at the same time. A semantic head of Japanese compound verbs is usually located at a posterior element. When this type of Japanese compound verbs are translated into English, the word order should be changed. When we translate *sagasi-mawaru* into English, English of *mawaru* is located at the second position and

that of *sagasu* is located at the first position. In addition, the way of translating concurrence verbs depends on its anterior element. Translation rule for ‘*nomi-aruku*’ is different from the concurrence-type rule. As *nomi-aruku* means to drink at a few bars, *aruku* has a different nuance from actual walking movement. It is very difficult to translate such verbs only by combination patterns of semantic factors. Such verbs encoding metaphorical meanings should be treated as exceptions.

#### 4.3 ‘Verb-te/de-Verb’ type

##### (1) Rule for ‘Verb-te/de-Verb’-type

An English expression for AB are consisting of English verb translated from ‘go’ at anterior position and English adverb translated from at posterior position

##### (2) Condition

A condition of applying Verb-te/de-Verb-type rule is as follows:

= any motion verbs te/de form

and

= *iku* ‘go’

*koe-te-iku* ‘go over’

##### (3) Explanatory examples

If Japanese compound verbs using ‘te/de’ form include *iku* ‘go’ as a posterior element, a rule for ‘Verb-te/de-Verb’-type applies to such verbs. In this rule, Japanese words at posterior elements are translated into English verbs and Japanese words at anterior elements are translated into English adverbs. English verbs translated from Japanese posterior element are combined with English adverbs translated from Japanese anterior elements. Final English phrases are generated by such English words. In the case of *koe-te-iku* ‘go over’, *koeru* is translated into English adverb ‘over’ and *iku* is translated into English verb ‘go’, and the final English phrase becomes ‘go over’.

#### 4.4 Exceptions

##### (1) Rule for Exceptions

To add pairs of Japanese compound verbs and their translated phrase to a dictionary as it is

##### (2) Condition

A condition of applying exceptions is as follows:

- a. = 'Directional path'  
and  
= 'Manner' or 'Ground path'  
*sugi-yuku* 'go past', *watari-aruku* 'wander'
- b. = 'Concurrence'  
and  
= 'Manner' or 'Ground path'  
*nomi-aruku* 'drink at many bars'

##### (3) Explanatory examples

There are 2 types of exceptions. One is for 'Ground path' and 'Manner': *watari-aruku* 'wander'. It seems to be a rare case, therefore, this pattern should be described as it is in the dictionary. The second one is 'Concurrence' and 'Manner' or 'Ground path' combination, such as *nomi-aruku* 'barhop'.

Though our standpoint is that compound verbs are described as their constituent element in the dictionary, we have to use jointly a method of describing pairs of compound verbs and their translated words.

Figure 3 summarizes the translation algorithm using the rules. As the figure indicates, we do not treat metaphorical expressions nor undefined words. We handle the squared part in the figure in this study.

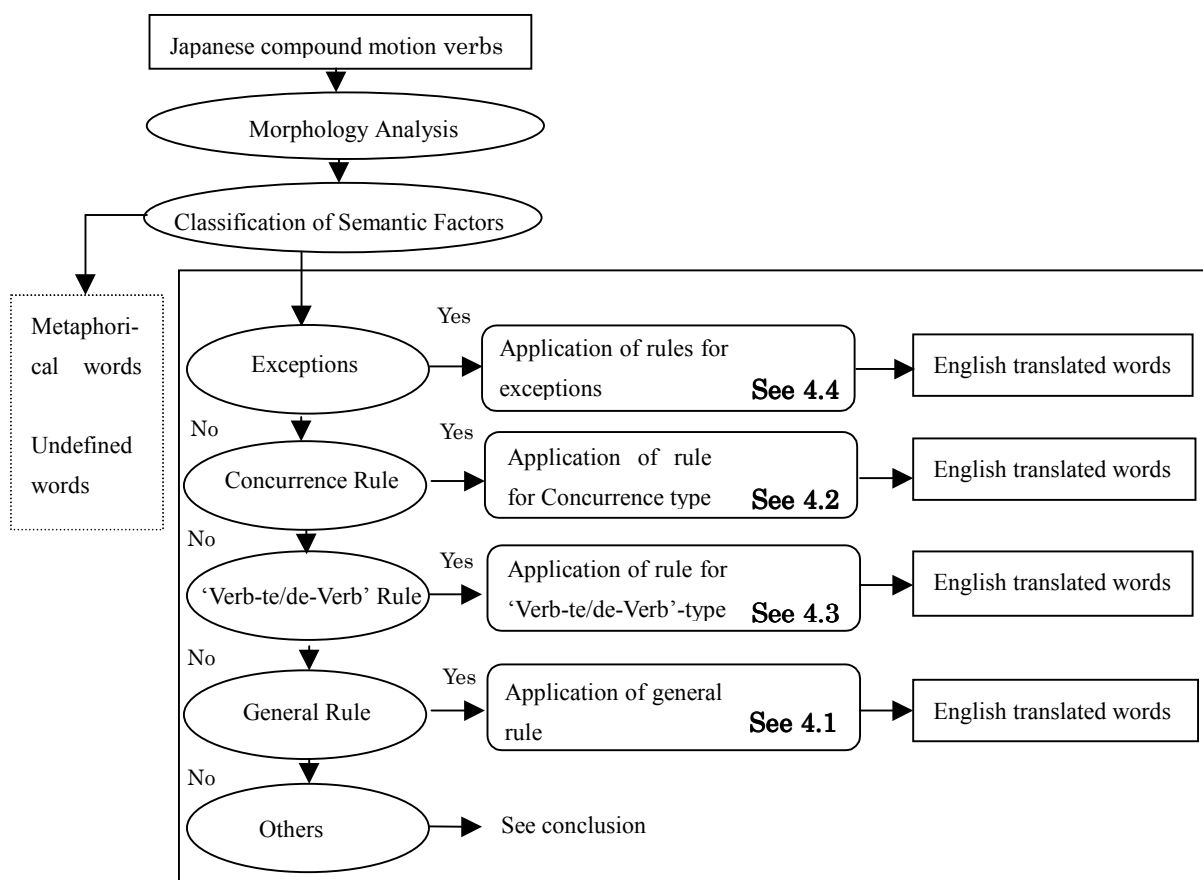


Figure 3: Translation algorithm

## Conclusion

In order to extract translation rules of Japanese compound motion verbs, we examined their constituent elements and combination patterns by using lexicalization patterns. The results of our study clearly show that the lexicalization patterns and their semantic factors are useful for making the translation rules.

We proposed four rules, a general rule, concurrence-type rule, ‘Verb-te/de-Verb’ type rule and rule for exceptions. The first three rules use a method in which the constituent elements are translated and then combined them by rules. The final rule, exceptions, makes entry words from the Japanese compound verbs. We will install these rules on machine translation systems to show their usefulness.

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