

Dependence on Context in case of English - Japanese Machine Translation I-5

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英和機械翻訳における文脈依存性 I-5

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Abstract

From Lesson 5 on, verb 'have' appears in the English textbooks for the first year grade junior high school students. Whether 'have' in the answer sentence to a question should be translated into Japanese in the present form or present progressive form depends on the context inherited from the preceding sentence. The selection of the adequate Japanese for 'hard' as an adverb is treated in this article while we have previously explained about the Japanese translation of 'hard' as an adjective. The adequate Japanese words for 'they' and 'them' are investigated in details. The Japanese are sensitive to whether 'they' or 'them' in question means male humans, female humans, humans in general, or inanimate objects. We also present two example cases where the sentence before the last gives an influence to the translation. In addition, several other items about context dependence are treated in this article.

Key words: machine translation, context dependence,
context inherited from the preceding sentences, US system.

1. The answer sentence to a question using 'have' or status verb

In some English textbooks for the first year grade junior high school students, verb 'have' shows up from Lesson 5. 'Have' is a very special verb in the sense that, as is also the case for 'be', it is also used as an auxiliary verb. Besides, it is a special verb in the sense that it is a status verb as indicated in its Japanese translation 'motte-iru'. Status

verbs, for example, 'know' = 'shitte-iru', 'live' = 'sunde-iru', 'have' = 'motte-iru', imply that some situation continues to hold for the present, and are often followed by 'te-iru' or 'de-iru' in their Japanese translations. But in certain cases they are also used in the original form as 'shiru', 'sumu', or 'motsu'. They sometimes correspond to English verbs in progressive forms (-ing forms) but sometimes they don't. This makes it difficult to correctly translate status verbs from English

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to Japanese or the other way around. This problem is explained at length in the author’s book [1], p.245-248.

Our US Translation System records the Japanese word for the verb in the preceding sentence in its original form (if the verb appears in a conjugated form, the conjugation is canceled when recorded). Thus the Japanese word for verb ‘have’ is recorded as ‘motsu’. It is convenient to keep a verb in its original form in view of various applications. When translating the answer sentence to a question sentence with verb ‘have’ as in example (1) below, however, we rewrite the Japanese for auxiliary verb ‘do’ with that of the verb ‘have’, and so we must take care that the verb has been recorded in its original (non-conjugated) form.

Kumi: Does Mike **have** a bicycle?
 久美「マイクは自転車を**持っていますか**?」
 Kumi: Maiku wa jitensha wo **motte-i-masu** ka?
 Ken: Yes, he **does**. (1)
 ケン「はい、**持っています**.」
 Ken: Hai, **motte-i-masu**.

The grammar rule for the translation of example (1) above

3; 6024; X; 0; LT; VZ=?; PJS=*ていますか? ; T0 <> N; T3 <> p; DJ3 <> 出来る; E3 <> may; J2 # Z; J3 # Z; J3 #+ VRS; J3 # SINKO; J3 #格; J3 # DES; 6665;

verifies not only that the verb in the preceding sentence is used for questioning (VZ=?), but also that the Japanese translation of the preceding sentence (PJS) contains the character string “te-i-masu ka?”. Consequently this rule rewrites the Japanese for ‘do’ by that of ‘have’, namely, ‘motsu’, and then makes it into its progressive form

(# SINKO) by attaching ‘-iru’ to ‘motte’, the adequate conjugated form of ‘motsu’. We remark that this generation rule can be applied not only to a question with verb ‘have’, but also to a question with a status verb in general.

2. Translation of “don’t, either”

Nancy: I **don’t like** rush hour.
 ナンシー「私はラッシュアワーが**好きでは
 ありません**.」
 Nanshii: Watashi wa rasshuawaa ga
suki-de-wa arimasen.
 Takeo: I **don’t, either**. (2)
 健夫(武男, 毅郎)「私も**好きではありま
 せん**.」
 Takeo: Watashi mo **suki-de-wa arimasen**.

The Japanese word for ‘don’t’ in example (2) above is rewritten by that for the verb in the preceding sentence (VR\$) via the following grammar rule;

3; 2406; X; 0; LT; J-1 <> 0; E3 = either; T1 = N; J0 #+ も; J1 # Z; J2 # Z; J1 #+ VRS; J3 # Z; J1 # DES; 6192;

The Japanese for the preceding verb has been recorded in its negative form (‘suki-de-wa nai’), and it is rewritten as it is. If there were the subject and the object preceding “, either”, the question of deciding which of the two is modified by ‘either’ would arise as in the case of “, too” in an affirmative sentence [4][5][6]. Since there is only one (pro)noun (‘watashi’) in sentence (2), postposition ‘mo’ corresponding to ‘either’ is automatically attached to the subject pronoun ‘watashi’.

3. 'science' as academic fields or a school subject?

Nancy: I have an American **science** book.
I have a **science** class today. (3)
ナンシー「私はアメリカの**科学(理科)**の本
を持っています。私は今日**理科**の授業があ
ります。」

Nanshii: Watashi wa Amerika no **kagaku**
(**rika**) no hon wo motte-i-masu. Watashi
wa kyou **rika** no juyou ga arimasu.

Keiko: Do you like **science**? (4)
恵子(景子, 慶子)「あなたは**理科**が好きで
すか?」

Keiko: Anata wa **rika** ga suki-desu ka?

Nancy: Yes. I study it **hard**. (5)
ナンシー「はい。私はそれを**熱心**に勉強し
ます。」

Nanshii: Hai. Watashi wa sore wo
nesshin-ni benkyou-shi-masu.

English noun 'science' is usually translated as 'kagaku' in Japanese, but in junior highschool textbooks it is sometimes translated as 'rika', the title of the school subject in which the students learn about scientific facts. In example (3) above, 'science class' is obviously the class of 'rika'. If 'science book' in (3) means the textbook for the class, it should be translated as "rika no hon". But "an American science book" does not necessarily mean the class textbook, and our translation system keeps the both candidates 'kagaku' and 'rika' for 'science' in that phrase. For 'science' in the succeeding sentence (4), the choice rule below

11; *理科; 2; E0 = science; ODZ =科目; 4320;

checks that the counting participle for the object in the preceding sentence (ODZ) is

'kamoku', the one for school subjects, and thus judges that the theme of the conversation is related to school subjects and selects 'rika' for 'science' as the adequate Japanese in the context.

4. Selection of the adequate Japanese for 'hard' (adverb case)

We showed in the previous article [6] , Section 4 that the English word 'hard' has various corresponding Japanese words and that it is often difficult to make a correct choice. The 'hard' in example (5) above is different from the one in the previous article in the sense that the attribute set of the verb of the preceding sentence (VZ) does not contain 'm' (sports or health), and therefore the choice rule below confirms it;

55; 苦しい; 2; E0 = hard; VZ <> m; S732;

and immediately deletes 'kurushii' from the candidates for 'hard'. And then several choice rules are applied successively to diminish the number of candidates, with all the adjective candidates thrown away leaving only adverb candidates untouched, and finally the choice rule below

66; *熱心に; 2; E0 = hard; JA = 3; TA = e; W460;

checks that 'hard' in (5) is preceded by a verb with 'e' attribute (education or culture), namely 'study', and consequently adopt 'nesshin-ni' for 'hard'. By the way, we have in our system dictionary two Japanese adverbs 'nesshin-ni' (diligently) and 'hageshiku' (fiercely) for 'hard' besides the four adjectives shown in the previous article [6] .

5. Japanese expression for “hi” (revisited)

As shown in the first article [3] of this series, we have presented three Japanese words “yaa”, “kon-nichi-wa” and “okaeri-nasai” for English interjection “hi”. The correct choice is determined by the analysis of the preceding sentences. In the example (6) below;

Hanako: **Hi**, Dennis. (6)
花子(華子)「こんにちは, デニス。」
Hanako: **Kon-nichi-wa**, Denisu.

the Japanese for ‘hi’ is selected to be ‘kon-nichi-wa’ by the following choice rule, which verifies that the preceding sentence (BS) does not contain “ is home!” before rejecting the candidate ‘okaeri-nasai’.

XX; * こんにちは ; 2 ; E0 = hi ; DJ-1 = 「 ; T-2 = W ; T-2 = h ; BS <> * is home! ; e610 ;

6. Whether the definite article ‘the’ should be translated as ‘sono’ or to be neglected?

The machine translation systems sold on the market are divided into two groups; the one translates the article ‘the’ always as ‘sono’ while the other always neglects the existence of ‘the’. Our US Translation System has about 520 grammar rules for the translation of a noun phrase headed by the definite article, which determine whether the article ‘the’ should be translated as ‘sono’ or neglected according to the context. This choice is related to various difficult problems and is explained at length in the author’s book [2] , p.235-238.

Let’s look at the following example;

Kumi: That is my father.
久美 「あれは私の父です。」
Kumi: Are wa watashi no chichi desu.

Meiling: Oh, he is a good drummer.
美玲 「ああ、彼はうまいドラマーです。」Meirin:
AA, kare wa umai doramaa desu.

Kumi: You see **the** girl over there. She is my friend, Maki. (7)
久美 「あちらに少女が見えますね。彼女は私の友人の Maki です。」
Kumi: Achira ni shoujo ga mie-masu ne.
Kanojo wa watashi no yuujin no Maki desu.

Meiling: Is she a drummer **too**? (8)
美玲 「彼女 も ドラマーですか?」
Meirin: Kanojo **mo** doramaa desu ka?

The grammar rule for the translation of “the girl” in sentence (7) above:

2 ; 81 ; 1 ; 0 ; E0 = the ; E0 <> all the ; DJ1 <> OJ\$; DJ1 <> SJ\$; DJ1 <> OJ2\$; DJ1 <> SJ2\$; E1 <> * BS ; DJ1 <> 国 ; DJ1 <> 場所 ; DJ1 <> 単語 ; DJ1 <> 問題 ; DJ1 <> 題目 ; D1 <> 冊 ; J0 # Z ; 2208 ;

checks that the Japanese noun (‘shoujo’ = girl) doesn’t coincide neither with the object (OJ\$) nor the subject (SJ\$) of the preceding sentence nor further with the object(OJ 2\$) nor the subject (SJ2\$) of the sentence before the last and moreover that the noun (girl) appears nowhere in the preceding English sentence (BS), and consequently ‘the’ is determined to be neglected (J0 # Z). Nevertheless, this criterion has lexical exceptions: Japanese words like ‘kuni’ (country), ‘basho’ (place), ‘tango’ (word), ‘mondai’ (problem), ‘daimoku’ (title), and the countable nouns counted by the participle ‘satsu’ (e.g. ‘shoseki’ book, ‘zasshi’ journal, ‘nooto’ note-

book, etc) without ‘sono’ at the head give unnatural or misleading impression even when they are not contained in the preceding sentence nor in the sentence before the last. These nouns are treated separately in our system.

7. Example cases where the sentence before the last influences the translation

In order to determine the noun modified by ‘too’ at the end of example (8) in the preceding section, we have to look two sentences back. The grammar rule for the translation of (8)

3 ; 3216 ; X ; 1 ; T0 = v ; T0 = ? ; FT ; LT ; E3 = too ; E2 = * BS2 ; J0 # VR ; J0 # DES ; J0 #+か ; J1 #+も ; J2 # OJ ; J3 # Z ; J1 < - > J2 ; 7067 ;

verifies that the noun (‘drummer’) is contained in the last-but-one sentence, and since the postposition ‘mo’ will not be attached to a repeated noun, it attaches ‘mo’ to the subject pronoun ‘kanojo’ to accomplish the translation. As seen in this example, it is sometimes insufficient to check only the preceding sentence but checking two sentences back is necessary. There is even a case where we have to check three sentences back. We will see such an example in a later article of this series of papers.

Now we present another example where the sentence before the last influences the translation. Common noun ‘king’ means the person of the highest rank in his country and proper noun ‘King’ is a family name as in “Martin Luther King, Jr”. But ‘King’ at the head of a sentence can not easily be known as a common noun or a proper noun. It is necessary to analyse the context. Let’s look at the following example sentences.

King: Let’s change places, Miller. . . . (9)

王 「身分を交換しましょう, 製粉業者。」

Ou: Mibun wo koukan-shi-mashou, seifun-gyousha.

Miller: No, thank you. I’m happy.

製粉業者 「いいえ, けっこうです. 私は幸福です。」

Seifun-gyousha: Iie, kekkou desu. Watashi wa koufuku-sesu.)

King: You’re happy. Why? (10)

王 「あなたは幸福です. なぜ？」

Ou: Anata wa koufuku-desu. Naze?

Miller: I have some good friends. I like

them. (11)

製粉業者 「私は親しい友人がいく人かいます. 私は彼等が好きです。」

Seifun-gyousha: Watashi wa shitashii yuujin ga i-masu. Watashi wa **karera** ga suki desu.

King: Do **they** like you? (12)

王 「彼等はあなたが好きですか？」

Ou: **Karera** wa anata ga suki desu ka?

Miller: Yes, they do. They like me very

much. We are friends. Do you have any friends? (13)

製粉業者 「はい, 好きです. 彼等は私がいへん好きです. 私達は友人です. あなたは友人がいますか？」

Seifun-gyousha: Hai, suki desu. Karera wa watasji ga taihen suki desu. Watashitachiwa yuujin desu. Anata wa yuujin ga i-masu ka?

First, concerning ‘King’ at the head of example (9) above, since the sentence also contains the word ‘Miller’, the following choice rule concludes that this conversational sentence is a part of the fable “A king and a miller” and selects the common noun ‘ou’ (king);

11 ; *王 ; 2 ; E0 = King ; FT ; DJ1 =「 ; EGS =* , Miller. ; 2142 ;

Of course, ‘Miller’ might also be a family name proper noun. But it would be too much accidental if Mr. King and Mr. Miller appear in the same sentence, and so we reject that possibility. Now that the Japanese word for ‘King’ in (9) is fixed, it follows that the translation of the ‘King’ at the head of example (10) two sentences ahead is determined. The choice rule for that:

11 ; *王 ; 2 ; E0 = King ; FT ; DJ1 =「 ; BS2 =* King ; JS2 =* 王 ; 2145 ;

verifies that the last-but-one English sentence (BS2) has ‘King’ at its head as the speaker of what follows, and that the translation of that sentence contains ‘ou’ (‘king’), the rule concludes that the speaker ‘King’ at the head of the present sentence should be translated into common noun ‘ou’.

8. Selection among ‘karera’, ‘kanojo-tachi’, ‘hito-bito’ and ‘sorera’ for ‘they’ and ‘them’

In English, there is only one plural pronoun ‘they’. In the delicate sense of us Japanese, this is unbelievably monotonous. Japanese language will not admit such monotony and force to select among ‘karera’ (male), ‘kanojo-tachi’ (female), ‘hitobito’ (people) and ‘sorera’ (inanimate) for ‘they’. A human translator might sometimes further manage to creat a more natural Japanese sentence by, for example, replacing a pronoun by its intended referent. Our translation system also tries to do the same sort of efforts but yet very insufficiently. The difficulty of selecting the adequate Japanese for ‘they’ is explained at length in the author’s book [1] ,

p.79-80. The European languages other than English have the masculine plural pronoun and the feminine plural pronoun, and in many of those languages there is further the neuter plural pronoun. Accordingly, the problem of the selection of the adequate translation for ‘they’ is a big problem for the translation from English to other European languages, too.

We are going to explain about the problem exhibiting some examples taken from Lesson 5 of the first year grade junior highschool textbooks.

Meiling: I have many Chinese tapes.
美玲「私は多くの中国語のテープを持っています。」

Meirin: Watashi wa ooku-no Chuugoku no teepu wo motte-i-masu.

Kumi: How many tapes do you have?
久美「あなたは何本のテープを持っていますか？」

Kumi: Anata wa nan-bon no teepu wo motte-i-masu ka?

Meiling: About thirty. They are presents from my aunt. They are her favorite songs. I like that song. (14)

美玲「およそ30です。それら（それらのテープ）は私のおばからの贈物です。

それらは彼女の大好きな歌です。私はあの歌が好きです。」

Meirin: Oyoso sanjuu desu. Sorera (Sorera no teepu) wa watashi-no oba kara-no okuri- mono desu. Sorera wa kanojo no daisuki-na uta desu. Watashi wa ano uta ga suki-desu.

In example (14) above, we find ‘they’ in two places. The first ‘they’ is followed by ‘be’ verb and then directly followed by a plural noun (‘presents’) without attribute ‘h’ (human), and so the following choice

rule immediately adopts ‘sorera’ for ‘they’;

22 ; *それら ; 2 ; E0 = they ; T1 = v ; J2 = 12 ;
 T2 <> h ; D500 ;

In contrast, the second ‘they’ has a noun phrase after ‘be’, which is headed by possessive ‘her’ and an adjective (‘favorite’). In such a case we should be more prudent. On the contrary to the case of personification where inanimate objects are treated as human beings, there are cases where human beings are figuratively described as some inanimate objects. In order to confirm that the second ‘they’ is not in such a context, the choice rule below;

22 ; *それら ; 2 ; E0 = they ; T1 = v ; J2 = 8 ;
 J3 = 5 ; J4 = 1 ; T4 = x ; T4 <> h ; SZ <> h ; OZ <>
 h ; D510 ;

checks that the attribute set of neither the subject (SZ) nor that of the object (OZ) of the preceding sentence contains ‘h’ (human).

By the way, the resolution of pronouns to their intended referents is a very important problem in the field of natural language processing as well as in linguistics, and abundance of articles are published by many researchers. In one of such articles by Hossain and Lee, we find the following comments: “This algorithm (in pronominal anaphora resolution) is based on the fact that pronouns are more likely to refer to entities mentioned recently in the discourse (usually no further than one or two sentences back)” [7]. Therefore it is a well-founded superiority of our US system that it is equipped with a mechanism of recording the preceding sentence, the sentence before the last, the results of the analysis of these sentences and their Japanese translations. Although I cited the comments above from [7], I think that the algorithm proposed in [7] as well as its

refined one cited in [7] are of typically Americano-European ways of thinking, namely the statistical estimation of the sum of the values of various evaluation functions with some weights determined by experiments, which is now flooding over the research world of natural language processing. This method is very unnatural compared with human linguistic activities and I don’t approve it at all.

As is the case for ‘they’, we have the same kind of difficulty in deciding the translation of its objective case ‘them’. In order to select the most adequate Japanese translation for ‘them’ in example (11) of the preceding section, the following two choice rules are applied successively:

22 ; 彼女 ; 2 ; E0 = them ; SZ <> xFX ; OZ <> W ;
 TA <> W ; C897 ;

This rule checks that the attribute set of the subject of the preceding sentence (SJ) does not contain any symbol indicating ‘plural’ and that the attribute set of the object of the preceding sentence (OZ) does not contain ‘W’ (woman) and further that the present sentence does not contain any word with ‘W’ attribute preceding ‘them’, and in consequence rejects ‘kanojo-tachi’ (female) from the candidates.

Next the rule below

22 ; * h ; 1 ; PLS ; F1JT = 1h ; F2T = xXF ; F1
 JT = 1x ; F2T = h ; E400 ;

confirms that the present sentence containing ‘them’ follows another sentence written on the same logical line (PLS). Such situation occurs when a speaker utters several sentences and then takes turns. The rule above looks up the first noun with ‘h’ (human) attribute backward from the end in the

sentence preceding the one containing ‘them’, and verifies that it has some attribute indicating ‘plural’, and then looks up similarly the first noun with attribute ‘plural’ from the end of the sentence preceding the one containing ‘them’ and that it has ‘h’ attribute. The logical consequence is that these first nouns from the end are in fact identical, and it has both ‘h’ and ‘plural’ attributes (‘friends’), and the choice rule adopts the one with ‘h’ attribute from the remaining candidates. This concludes that the adequate Japanese here for ‘them’ is ‘karera’ (male).

Now we show another example of deciding the translation of ‘they’ by referring to the context. In case of example (12) of the preceding section, the following three choice rules are successively applied to reject inadequate candidates one by one and finally the most adequate choice is decided to be ‘karera’ (male).

The first choice rule applied is;

22 ; 彼女 ; 2 ; T-1 <> r ; TA <> W ; TZ <> W ; SO <> W ; E030 ;

which verifies that there is no word with attribute ‘W’ (woman) back or ahead of ‘them’ (including remote ones) and that the attribute sets of the subject and the object of the preceding sentence (SO) do not contain ‘W’ and in consequence abandons ‘kanojo-tachi’ (female). Next the choice rule below;

22 ; 人びと ; 2 ; SO = h ; TZ <> vgK ; E170 ;

verifies that the attribute set of either the subject or the object of the preceding sentence (SO) contains ‘h’ (human) and that there is no word with attribute ‘g’ (geography i. e. name of a place) or ‘K’ (proper noun) or ‘v’ (‘be’ verb) ahead of ‘they’, and these facts make it reject ‘hito-bito’ (peo-

ple). In case there is a name of a place ahead of ‘they’, there are examples like

They speak English and French in Canada.
 カナダでは人びとは英語とフランス語を話
 します。
 Kanada de-wa **hito-bito** wa Eigo to
 Furansugo wo hanashi-masu.

in which ‘they’ should be translated as ‘hito-bito’ (people).

Now the candidates for ‘they’ in (12) are reduced to ‘karera’ (male) and ‘sorera’ (inanimate). Then the third rule

22 ; それら ; 2 ; E0 = they ; J1 = 34 ; T1 = u ; T1 <> P ; PJS <> * それら ; C937 ;

applies. This rule checks that ‘they’ in question has a verb with attribute ‘u’ (which means that the verb must have human beings as its agent) directly after it and checks further that the Japanese translation of the preceding sentence doesn’t contain ‘sorera’. Because of these, the rule above rejects ‘sorera’ and ‘they’ in question is determined to be ‘karera’.

As another example of determining the Japanese for ‘they’, we are going to see the case for “They like me very much.” in (13) right after what we have seen in (12). Different from the case (12), the following choice rule

22 ; それら ; 2 ; E0 = they ; J1 = 34 ; T1 = u ; T1 <> P ; PJS <> * それら ; C937 ;

is applied first and the candidate ‘sorera’ is abandoned. Since example (12) is an interrogative sentence, the translation of ‘like’ right after ‘they’ could not be immediately determined whether it is a verb ‘suki-dearu’ or preposition ‘no you-ni’, and hence the condition in the rule above that the word right after ‘they’ is a verb (J1 = 34) with a hu-

man agent (T1 = u) was not satisfied at the early stage.

Next the rule below

22 ; 人びと ; 2 ; E0 = they ; T0 = O ; OZ = FxX
 ; OZ = h ; SZ <> FxX ; D170 ;

applies and the candidate ‘hito-bito’ is abandoned. This rule checks that the attributes of the object of the preceding sentence (OZ) contains ‘plural’ (‘F’, ‘x’ or ‘X’) and ‘h’ (human) and that the attributes of the subject of the preceding sentence (SZ) doesn’t contain ‘plural’, and consequently judges that ‘they’ refers to the object of the preceding sentence (“some good friends”) and rejects ‘hito-bito’. As was shown in the example “They speak . . . in Canada.” a few paragraphs back, ‘hito-bito’ is adopted for ‘they’ when it means vaguely a large number of people in general and that kind of ‘they’ does not refer to any noun in the preceding sentences. In the case of example (12) the choice rule D170 above was not applied because the condition that “‘they’ in question begins with an upper-case letter (T0 = O)” was not satisfied (as it is an interrogative sentence). In case of (13), this condition is satisfied (as it is a declarative sentence). The choice rule D170 above might give rise to a wrong result if applied to an interrogative sentence, and hence it requires this “upper-case letter condition” for its application.

By the way when we say “the subject / object of the preceding sentence”, and if the preceding sentence doesn’t have a subject / object noun (pronouns will not be accepted to be recorded), the subject / object of the nearest sentence back continues to be recorded.

Next the same choice rule below

22 ; 彼女 ; 2 ; T-1 <> r ; TA <> W ; TZ <> W ; SO
 <> W ; E030 ;

is applied as was also the case for (12), and only ‘karera’ has remained and the Japanese for ‘they’ in (13) is fixed.

As we have seen in the two examples above, even in the process of determining the Japanese candidate for ‘they’ into the same ‘karera’, the applied choice rules and the order of their applications differ considerably according to the circumstances, e.g. whether in a declarative or interrogative sentence.

9. Whether ‘that’ should be translated into ‘ano’ or ‘sono’?

In case ‘that’ is used as a pronoun playing the role of the subject or object, we pointed out in the first article [3] of this series that there are cases where ‘that’ is translated as ‘are’ as well as ‘sore’. In a parallel way when ‘that’ precedes a noun to modify it, we are confronted with the problem of choosing between ‘ano’ and ‘sono’ for such ‘that’.

We find such ‘that’ in example (14) in the previous section, namely in “I like that song.” The choice rule applied to that ‘that’;

88 ; *あの ; 2 ; E0 = that ; J1 = 1 ; T1 <> t ; DJ1
 <> SJ\$; DJ1 <> OJ\$; d250 ;

verifies that the noun right after ‘that’ doesn’t have attribute ‘t’ (time) and that the noun coincides neither with the subject (SJ\$) nor the object (OJ\$) of the preceding sentence, and consequently adopts ‘ano’ for such ‘that’.

10. How to translate a sentence with soley a numeral?

The first sentence ”About thirty.” in example (14) two sections back could be regarded, if we neglect the context, as an answer to a question about the time, someone’s age, or something else about some num-

ber. So we analyse the preceding sentence, and recognize that the sentence is the answer to a question with “How many ...?”. The grammar rule below for the translation of this sentence:

3 ; 61 ; X ; 0 ; FT ; LT ; DJ0 =およそ ; T1 = n ; T1 <> xyz ; BS =* how many ; J1 #+です ; 6150 ;

checks that the numeral is preceded by adverb ‘oyoso’ (about) and that the preceding sentence contains “how many”, and thus simply add the declarative auxiliary verb ‘desu’ at the end to complete the sentence. We will show in the later issues of this series of articles that there are cases where the auxiliary verb ‘desu’ should not be added.

11. Is the verb transitive or intransitive?

In English, the same verb may be used as a transitive verb as well as an intransitive verb, and its meanings often differ considerably according as it is transitive or intransitive. It is too much simply-minded to think that a transitive verb is followed by a noun phrase (object) while an intransitive verb is not. It often happens that an intransitive verb is followed by a noun phrase (which is again followed by various words), while on the other hand the object of a transitive verb moves sometimes before the verb or it may even be omitted. So there is no simple criterion. Let’s look at the following example.

I am a king.
私は王です。
Watashi wa ou desu.

I do not **work**. (15)
私は働きません。
Watashi wa **hataraki**-masen.

As the Japanese translations for ‘work’ ,

we have six verbs ‘hataraitte-iru’ , ‘hataraku’ , ‘wo hatarakaseru’ , ‘wo ugokasu’ , ‘ugoku’ and ‘benkyou-suru’ . Various choice rules successively apply to the candidates to reject inadequate ones, and finally there remains only ‘hataraku’ (intransitive) and ‘wo hatarakaseru’ (transitive) . Then the following rule

33 ; * j ; 1 ; LT ; J1 <>| ; DJ2 <>「 ; DJ-1 <>」 ; DJ0 <> VR\$; T0 <> pP ; E-1 <> to ; J-1 <> 29 # ; TA <> v ; DJA <>何 ; O990 ;

works and the intransitive one (‘hataraku’) is selected. The rule O990 above checks first that ‘work’ is at the end of the sentence (LT) and thus the object does not exist after ‘work’ . Further, since the word preceding ‘work’ (E-1) is not ‘to’ , it is not in the infinitive construction in which the object of the transitive verb might move before ‘to’ . Besides, the attribute of this ‘work’ is neither ‘p’ (past) nor ‘P’ (past participle) and so it is not in the passive voice. Finally neither of the remaining Japanese candidates for ‘work’ coincides with the Japanese for the verb in the preceding sentence (VR\$) and so this ‘work’ is not a transitive verb with its object omitted. It sometimes happens that the object of a repeated transitive verb may be omitted. With all these conditions satisfied, ‘work’ in example (15) is judged to be intransitive.

12. Selection of Japanese for ‘then’ among ‘sou sure-ba’ , ‘sono toki’ , ‘sorekara’ , ‘sore-de-wa’ , ‘suruto’ and ‘sono koro ni-wa’

For adverb ‘then’ , we have, as its Japanese translations, ‘sou sure-ba’ , ‘sono toki’ , ‘sorekara’ , ‘sore-de-wa’ , ‘suruto’ and ‘sono koro ni-wa’ registered in our system dictionary, and we have to select the most adequate one according to the context. During the

translation process, several choice rules are successively and conveniently applied to abandon inadequate candidates.

Let's look at the following example:

King: No. I don't have any friends.
王 「いいえ。私は友人がいません。」
Ou: Iie. Watashi wa yuujin ga i-masen.

Miller: **Then**, you're not happy. . . . (16)
製粉業者 「それでは, あなたは幸福ではありません。」
Seifun-gyousha: **Sore-de-wa** anata wa koufuku-de-wa ari-masen.

In example (16) above, various choice rules are successively applied as usual to diminish the number of candidates, and among them, in particular, there is one which refers to the preceding sentence;

66 ; そうすれば ; 2 ; E0 = then ; PJS <> *なさい ; X600 ;

This rule checks that the translation of the preceding sentence is not an imperative mood containing "nasai", and in consequence rejects 'sou sure-ba' from the candidates.

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