A Psycholinguistic Study of Nominative-Genitive Conversion Construction in Japanese

ATSUSHI YUHAKU and SATORU NAKAI

1 Introduction

The present paper is a report of an experimental study of how the Nominative-Genitive Conversion construction (henceforth NGC) is processed online by native speakers of Japanese. NGC has been hotly debated from the theoretical point of view, but its online processing has not received a comparable focus. This experimental study is an attempt, using the self-paced reading method, to clarify how its online processing is performed, with the emphasis on a sentence processing strategy.

2 The Theoretical and Experimental Background of NGC

In Japanese, the nominative marker *ga* and the genitive marker *no* can be used interchangeably in the relative clause preceding a noun, or in the complement clause preceding *koto* "fact" as seen below:

(1) a. Taro-wa Hanako-*ga* kaita hon-o yonda.
Taro-TOP Hanako-NOM write-PAST book-ACC read-PAST[1]
'Taro read a book Hanako had written.'
b. Taro-wa Hanako-*no* kaita hon-o yonda.
Taro-TOP Hanako-GEN write-PAST book-ACC read-PAST
'Taro read a book Hanako had written.'

(2) a. Watasi-wa daitoryo-*ga* sinda koto-o siranakatta.
I-TOP president-NOM die-PAST fact-ACC know-NEG-PAST

'I did not know that the president had died.'

b. Watasi-wa daitoryo-*no* sinda koto-o siranakatta.
I-TOP president- GEN die-PAST fact-ACC know-NEG-PAST
'I did not know that the president had died.'

NGC has been repeatedly debated in generative syntax and other linguistic frameworks since Harada (1971) published his work (see also Bedell,1972; Harada, 2002; Harada, 1976; Hiraiwa, 2002; Miyagawa, 1993; Nakai, 1980; Ochi, 2001; Saito, 2004; Sakai, 1994; Shibatani, 1975; Watanabe, 1996; HPSG: Kikuta, 2002; Cognitive Grammar: Koguma, 2005). These studies have focused on how NGC is derived in syntax, and especially how the noun with the genitive marker *no* is derived.

In early generative studies, this construction is derived by the Ga-No Conversion Rule. Harada (1971) proposes the following rule.

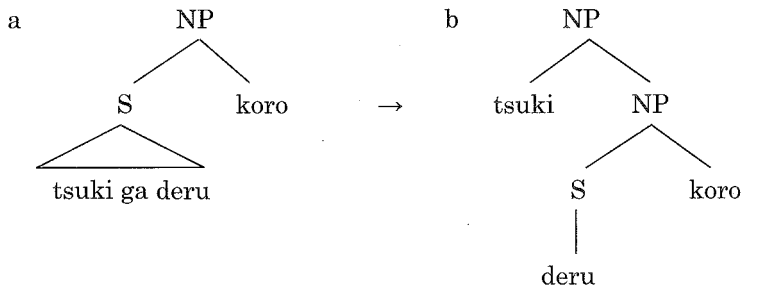
(3) Ga-No Conversion (optional)

X	$[_{NP}$	$[_{S}$ Y	- NP	*-ga*	- Z	- PRED$]_{S}$	-N$]_{NP}$	- W
	1	2	3	4	5	6	7	8
→	1	2	3	*no*	5	6	7	8

This rule changes *ga* into *no* but does not change the sentence structure. The noun+*no* remains in the subject position after the rule has been applied. But Bedell (1972) argues that there is no rule such as Ga-No Conversion, but that a different rule (shown in (4)) changes the structure as seen in (5).

(4) *No* is introduced between any two nouns or noun phrases which are constituents of the same larger noun phrase.

(5)



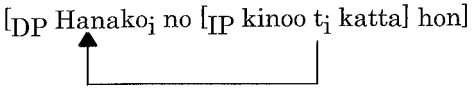
According to Bedell's analysis, *tsuki no* is not in the subject position, but in the genitive position, like *Taro-no* in *Taro-no hon* "Taro's book".

In Harada's analysis, the genitive-marked noun remains in the subject position whereas in Bedell's analysis, the genitive-marked noun moves to the genitive position. Thus, the debate has been focused on where the genitive-marked noun is: in the subject position or in the genitive position.

This problem of whether the genitive-marked noun is in the subject position or in the genitive position, which was posed by Harada and Bedell in their early generative grammar analyses, has remained unresolved up to today. In the framework of the Principles and Parameters approach (Chomsky, 1995), there are still two approaches to the problem of the derivation of NGC (see Maki & Uchibori, 2008 for an overview).

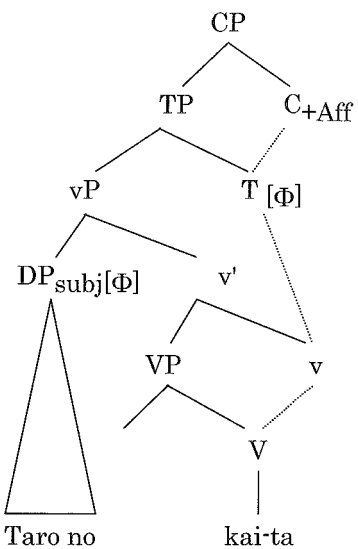
One approach, which is on the same track as Bedell's, is that the genitive-marked noun is moved to the specifier position of the relative head noun (Miyagawa, 1993; Ochi, 2001). For example, Miyagawa proposes the following structure for the genitive-marked noun.

(6)



The other approach, which is on the same track as Harada's, proposes that there is no movement of the genitive-marked noun (Hiraiwa, 2002; Kikuta, 2002; Saito, 2004). For example, Hiraiwa proposes that a C-T-v-V head amalgamate checks the genitive-marked noun like the following:

(7)



Although there have been many theoretical analyses of NGC, there have been just a few psycholinguistic studies which deal with the processing of NGC by native speakers of Japanese. Harada (1976) is one of the few examples. He asked university students to recall and repeat the sentences which included nominative-marked nouns and genitive-marked nouns.

The result of his study was that there was no significant difference between the two types of sentences. The problem of Harada's study, however, is that it is an off-line processing of NGC and therefore his study tells nothing about the online processing of NGC. Thus, this paper is the first study that deals with an online processing of NGC.

3 Incremental Processing Model and Reanalysis

In psycholinguistics, the processing of sentences is supposed to be performed incrementally (see Aoshima, Phillips & Weinberg, 2004; Inoue & Fodor, 1995; Kamide & Mitchell, 1999; Miyamoto, 2002; Muraoka, 2005). That is, the parser[2] begins to build the structure of the sentence on the basis of the incoming input, predicting what will come next, and interpret the meaning of the sentence without waiting for the end of the sentence. Our experiments presupposed this incremental processing model (see Miyamoto, 2008 for an overview).

The other important concept, which is inevitable in the incremental processing model of sentence processing, is so-called "reanalysis". We should here explain reanalysis before we proceed further.

Japanese is a head-final language. The verb appears at the end of the sentence, and allows scrambling rather freely (Inoue & Fodor, 1985), so it is not until the end of the sentence that the complete interpretation can be achieved. However, according to the incremental processing model, the parser begins to build the structure of the sentence and interpret the meaning as soon as the first words or phrases come in. Therefore, when the final input is different from what the parser has predicted, it must return to the beginning of the sentence and make a reanalysis of the sentence. The following examples will help illustrate reanalysis:

(8) Taro-wa Hanako-ni otya-o ...
Taro-TOP Hanako-DAT tea-ACC

When the parser meets this input, it assumes that the input is a part of a simple sentence and that the dative verb like *dasu* "serve" will follow, as seen in (9).

(9) Taro-wa Hanako-ni otya-o dasita.
Taro-TOP Hanako-DAT tea-ACC serve-PAST
'Taro served tea to Hanako.'

This is because the parser is assumed to posit as simple a structure as possible (Miyamoto, 2002; Yamashita, 1997).

On the other hand, when the input does not end with a verb as in (9) but a noun like *zyosei* "woman" follows, the parser must make a reanalysis of the predicted structure and posit a relative clause like the following.

(10) Taro-wa Hanako-ni otya-o dasita zyosei-o mita.
Taro-TOP Hanako-DAT tea-ACC serve-PAST woman-ACC see-PAST
'Taro saw a woman who served tea to Hanako.'

It has been reported by many researchers that the parser uses the information of case makers when parsing the input structure (Miyamoto, 2002; Muraoka, 2005; Sakamoto & Yoshinaga, 2006; Uehara & Bradley, 2002). For example, Miyamoto (2002) assumes that the parser posits the left boundary of a clause when it hears or reads a nominative marker.

If Miyamoto's assumption is right, when the parser hears or reads a nominative marker, it posits the left boundary of a clause (indicated by the left bracket ([ )) and predicts the continuation of a subordinate clause.

Furthermore, when a verb continues in reality, the parser judges the verb to be the verb of the subordinate clause and does not have to make a reanalysis.

(11) Taro-wa Hanako ga ...
(prediction) Taro-wa [Hanako ga VP...
(reality) Taro-wa [Hanako ga VP.. (without a reanalysis)

On the other hand, when *no* occurs, as shown in (12), the parser predicts that not a verb but a noun phrase will follow because the parser posits the simplest structure as shown above and because *no* is generally used as the genitive marker (Nambu, 2007). As a result, when a verb follows in reality, the parser must posit the left boundary of a subordinate clause and reanalyze the noun+*no* as the subject of the subordinate clause.

(12) Taro-wa Hanako no ...
(prediction) Taro-wa Hanako no NP ...
(reality) Taro-wa [Hanako no VP ... (with a reanalysis)

In psycholinguistic experiments, it is well-known that when reanalysis occurs, the parser stops the processing at the point where the unpredicted element appears and takes more time to resume the processing. In the following example, it will take more time to process at the position of the verb (indicated by the downward arrow), because the verb *kaita* "write" appears against the parser's prediction that a noun will follow.

↓

(13) Taro-wa Hanako-no kaita hon-o yonda.
Taro-TOP Hanako-GEN write-PAST book-ACC read-PAST

Our experiments aimed to prove that native speakers of Japanese use a sentence processing strategy that says "when a noun+*no* appears, expect a noun comes next," based on the incremental model of sentence processing and reanalysis[3]. The next section describes the experiment.

4 Experiment 1

4.1 Participants

Twenty university students (18-23 years old; Mean age = 20.2 years old; SD = 1.24) participated in the first experiment. Almost all of them (19 students) were from the Hokuriku area (Fukui, Ishikawa, and Toyama) of Japan. Among them, 12 students were analyzed, who correctly answered more than 60 percent of the questions. They were all paid for their participation.

4.2 Procedure

Each stimulus was shown randomly on a computer screen by a self-paced reading method by using SuperLab 4.0 (Cedrus, USA). Participants pushed the space key on a keyboard – as fast as they could in order to facilitate recollection – so as to show each segment one after another. They were also required to answer yes-no comprehension questions in order to check whether they concentrated on the task. The participants took part in practice sessions until they correctly mastered the procedure. The experiment took about 10 minutes, including the practice session.

4.3 Stimulus

There were four stimuli, including *ga* and *no* respectively, in addition to 24 filler sentences. Both *ga* stimuli and *no* stimuli have the same structure as seen below:

(14) NP1-wa [ADV NP2-ga/-no V1 NP3-o V2] V3

The examples[4] are given below:

(15) *ga* stimuli

Keiko-wa kinou Ziro-ga yonda hon-o
Keiko-TOP yesterday Jiro-NOM read-PAST book-ACC
suteta-to itta.
throw-away-PAST-COMP say-PAST
'Keiko said that she threw away the book that Jiro read yesterday.'

(16) *no* stimuli

Takesi-wa suguni Misayo-no tabeta ryouri-o
Takeshi-TOP soon Misayo-GEN eat-PAST dish-ACC
katazuketa-to itta.
put-away-PAST-COMP say-PAST
'Takeshi said that he soon put away the dish Misayo ate.'

Different verbs were used in the V1 section for each stimulus, but the familiarity index (Amano & Kondo, 1999) for each verb had no significant difference between both types of stimuli ($p = .24$). The number of letters and moras was also controlled. In addition, the genitive marker *no* was not used in the filler sentences in order to avoid a priming effect.

If our assumption is right, the V1 section is the point where the reanalysis will occur and the response time will become longer for the *no* stimuli than for the *ga* stimuli.

4.4 Results

Only correct responses from twelve participants were analyzed. First of all, responses over more than 1000 ms for the V1 section were excluded.

Furthermore, responses beyond mean ± two standard deviations were also excluded. As a result, the average response time for the *no* stimuli was 505.37 ms, while that for the *ga* stimuli was 437.13 ms. The difference of the response time between the two types of stimuli was proved to be significant by a *t*-test (p = .014)

4.5 Discussion

The result shows that our prediction was right. In other words, it is confirmed that the parser needs more processing time when it reads a verb which follows the genitive marker *no* than when it reads a verb which follows the nominative marker *ga*. That is, the parser uses the processing strategy that a noun follows the genitive marker.

However, we must differentiate between the possibility that the parser has the processing strategy that a noun follows the genitive marker and the possibility that the complex usage of the genitive-marked noun itself causes the time difference. For example, the noun+*no* also functions as an object in addition to a subject or a possessor. In the following example, *eigo+no* functions as the object of the predicate *sukida* "like".

(17) eigo-no sukina syounen
English-GEN like boy
'a boy who likes English'

In order to reconfirm that the cause of the greater reponse time in Experiment 1 is due to the reanalysis but not due to the complexity or multifunctions of the noun+*no*, we performed another experiment, which compared the noun +*no* which functions as the subject with the noun+*no* which functions as the possessor.

5 Experiment 2

5.1 Prediction

If the complexity of the noun+*no* itself causes the difference in response time in Experiment 1, the processing time is the same in the underlined section for both sentences (18) and (19). If the response time is different between the two types of sentences, then it will confirm our hypothesis that the cause of the greater response time in Experiment 1 is due to the reanalysis.

(18) noun+*no* as the subject

	Taro-wa Hanako no ...
(prediction)	Taro-wa Hanako no NP
(reality)	Taro-wa [Hanako no VP (with a reanalysis)

(19) noun+*no* as the possessor

	Taro-wa Hanako no ...
(prediction)	Taro-wa Hanako no NP ...
(reality)	Taro-wa Hanako no NP ... (without a reanalysis)

5.2 Participants

Eighteen university students (18-21 years old; Mean age = 18.9 years old; SD = 0.85) participated in Experiment 2. All of them were from the Hokuriku area of Japan. Among them, 12 students were analyzed, who correctly answered more than 60 percent of the questions. They were all paid for the participation.

5.3 Procedure

The same procedure as Experiment 1 was used.

5.4 Stimulus

There were four stimuli including the noun+*no* as the subject and the noun+*no* as the possessor with 24 filler sentences. The filler sentences were the same as those used in Experiment 1. Each stimulus had the following structure.

(20) noun+*no* as the subject
NP1-wa [ADV NP2-no V1 NP3-o V2] V3

(21) noun+*no* as the possessor
NP1-wa [ADV1 NP2-no NP3-o ADV2 V2] V3

The examples are given below.

(22) noun+*no* as the subject
Hazuki-wa kinou Atusi-no katta hon-o
Hazuki-TOP yesterday Atsushi-GEN buy-PAST book-ACC
karita-to itta.
borrrow-PAST-COMP say-PAST
'Hazuki said that she borrowed the book that Atsushi bought yesterday.'

(23) noun+*no* as the possessor
Keiko-wa kinou Ziro-no nimotu-o gomibako-ni
Keiko-TOP yesterday Jiro-GEN belonging-ACC trash-can-DAT
suteta-to itta.
throw-away-PAST-COMP say-PAST
'Keiko said that she threw away Jiro's belongings in the trash can yesterday.'

The familiarity index (Amano & Kondo, 1999) for each stimulus in V1

and NP3 had no significant difference between both types of stimuli (p = .71) and the number of letters was also controlled. The number of moras, however, for V1 and NP3 in all was different (V1: 13 moras; NP3: 18 moras), so regression analysis was used in order to adjust the influence of mora (Miyamoto, 2002).

If the prediction in section 5.1 is true, there will be a difference in response time between the V1 section for *no* stimuli as the subject and the NP3 section for *no* stimuli as the possessor.

5.5 Results

Only correct responses from the twelve participants were analyzed. The same procedure as Experiment 1 was used. First of all, responses over more than 1000 ms for the V1 and NP3 sections were excluded. Furthermore, the responses beyond mean ± two standard deviations were also excluded. As a result, the average response time for the V1 section was 507.69 ms while that for NP3 was 400.86 ms. The difference of the response time between the two types of stimuli was proved to be significant by a *t*-test (p = .0001)

5.6 Discussion

The result that the difference of the response time between the two types of stimuli was proved significant confirmed our hypothesis that the cause of the greater response time in the interpretation in Experiment 1 was caused by the reanalysis. This confirmed our prediction that the parser uses the processing strategy that a noun phrase follows *no*, and that reanalysis occurs when it meets a verb which follows the genitive marker *no*.

6 General Discussion

This paper showed the results of the two experiments regarding how NGC was processed online. Experiment 1 compared the two types of noun phrases, one with *ga* and the other with *no* , both of which function as the subject, and found that the noun+*no* required more processing time than the noun+*ga*. Experiment 2 compared two types of sentences: one in which the noun+*no* was used as the subject and the other in which the noun+*no* was used as the possessor, and confirmed that the former took more processing time than the latter. Based on these facts, we conclude that the parser uses the strategy that a noun should follow *no* when it hears or reads sentences containing *no*.

This processing strategy may be due to the fact that Japanese is a head-final language and that it allows scrambling rather freely. In order to satisfy the requirement that the online processing should be performed without delay, the parser may adopt this strategy regarding the genitive marker *no*.

It has been proved that native speakers of Japanese use several processing strategies besides the strategy we propose. A similar strategy to ours has been proposed by Sakamoto and Yoshinaga (2006), who examined how the parser processes the two types of noun phrases, both of which are followed by *ga*: one as the subject and the other as the object.

(24) noun+*ga* as the subject

[Takasi-ga [Kaori-ga okotta]-to kinou
Takashi-NOM Kaori-NOM get-angry-PAST-COMP yesterday
Teruko-ni itta].
Teruko-DAT say-PAST
'Takashi said to Teruko yesterday that Kaori got angry.'

(25) noun+*ga* as the object

[[Takasi-ga Kaori-ga sukida]-to kino Teruko-ni
Takashi-NOM Kaori-NOM like-Past-COMP yesterday Teruko-DAT
itta].
say-PAST
'Takashi said to Teruko yesterday that he liked Kaori.'

They found that more processing time was needed for the noun+*ga* as the object in the underlined place above in (25). They concluded that the parser thought the second appearance of *ga* to be the nominative marker, putting a left boundary of the clause and had to make a reanalysis in a later point.

7 Conclusion

This paper examined how Nominative-Genitive Conversion construction was processed online with the emphasis on the processing strategy that a noun follows the genitive marker *no* in two experiments. The two experiments confirmed that the parser has a processing strategy that it should expect a noun to follow when it sees or hears the genitive marker *no*. When this expectation is not met as in NGC, in which a verb follows the genitive marker, the parser has to make a reanalysis, which leads to more processing time than in the case of the nominative marker *ga*.

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Notes

1 The following abbreviations are used in this paper:
ACC = Accusative
COMP = Complementizer
DAT = Dative
GEN = Genitive
NEG = Negation
NOM = Nominative
PAST = Past tense
TOP = Topic

2 In this paper, the parser is defined to be a system that can process the input but not a person who parses.

3 The most well-known example which needs a reanalysis is the so-called garden-path sentence. See the following example:

The horse raced past the barn fell.

When the parser comes to *barn*, it interprets the sentence to consist of the subject *horse* + verb *raced* + the prepositional phrase *past the barn*, but when the verb *fell* appears, the parser must throw away this interpretation and rebuild the sentence structure and reinterpret the sentence to consist of the subject *horse* + past participle *raced* + prepositional phrase *past the barn* + the verb *fell*.

4 See the APPENDIX for the list of the stimuli.

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APPENDIX

The List of the Stimulus Sentences Used in the Experiments 1 and 2.

A. *no* stimuli used in Experiment 1

1. Hiromi-wa kinou Tetuya no utatta uta-o
   Hiromi-TOP yesterday Tetsuya-GEN sing-PAST song-ACC
   kiita-to itta.

hear-PAST-COMP say-PAST

'Hiromi said that she heard the song that Tetsuya sang yesterday.'

2. Hazuki-wa kinou Atusi-no katta hon-o
Hazuki-TOP yesterday Atsushi-GEN buy-PAST book-ACC
karita-to itta.
borrrow-PAST-COMP say-PAST
'Hazuki said that she borrowed the book that Atsushi bought yesterday.'
3. Kumiko-wa kyou Takasi-no haita kutu-o
Kumiko-TOP today Takashi-GEN put-on-PAST shoes
aratta-to itta.
wash-PAST-COMP say-PAST
'Kumiko said that she washed the shoes that Takashi put on today.'
4. Takesi-wa suguni Misayo-no tabeta ryouri-o
Takeshi-TOP soon Misayo-GEN eat-PAST dish-ACC
katazuketa-to itta.
put-away-PAST-COMP say-PAST
'Takeshi said that he soon put away the dish Misayo ate.'

B. *ga* stimuli used in Experiment 1

5. Keiko-wa kinou Ziro-ga yonda hon-o
Keiko-TOP yesterday Jiro-NOM read-PAST book-ACC
suteta-to itta.
throw-away-PAST-COMP say-PAST
'Keiko said that she threw away the book that Jiro read yesterday.'
6. Naoki-wa kyou Tamaki-ga karita kane-o
Naoki-TOP today Tamaki-NOM loan-PAST money-ACC
kaesita-to itta.
pay-back-PAST-COMP say-PAST

'Naoki said that he paid back the money that Tamaki loaned today.'

7. Kaori-wa kinou Taro-ga totta syasin-o
   Kaori-TOP yesterday Taro-NOM take-PAST picture-ACC
   mita-to itta.
   see-PAST-COMP say-PAST
   'Kaori said that she saw the picture that Taro took yesterday.'
8. Kenzou-wa kinou Tukasa-ga osieta zyugyou-o
   Kenzo-TOP yesterday Tsukasa-NOM teach-PAST class-ACC
   uketa-to itta.
   receive-PAST-COMP say-PAST
   'Kenzo said that she received the class that Tsukasa taught yesterday.'

C. stimuli of noun+*no* as the subject in Experiment 2
   The stimuli of the noun+*no* as the subject were the same used for *no* stimuli used in Experiment 1

D. stimuli of noun+*no* as the possessor in Experiment 2

9. Keiko-wa kinou Ziro-no nimotu-o gomibako-ni
   Keiko-TOP yesterday Jiro-GEN belonging-ACC trash-can-DAT
   suteta-to itta.
   throw-away-PAST-COMP say-PAST
   'Keiko said that she threw away Jiro's belongings in the trash can yesterday.'
10. Kumiko-wa kyou Takasi-no saihu-o daigaku-de
    Kumiko-TOP today Takashi-GEN purse-ACC on-campus
    hirotta-to itta.
    pick-up-PAST-COMP say-PAST
    'Kumiko said that she picked up Takashi's purse on campus today.'

11. Nobuo-wa kinou Misayo-no ryouri-o zitaku-de
Nobuo-TOP yesterday Misayo-GEN dish-ACC at-home
tabeta-to itta.
eat-PAST-COMP say-PAST
'Nobuo said that he ate Misayo's dish at home yesterday.'
12. Ziro-wa kesa Hanako-no keitai-o kyousitu-de
Jiro-TOP this-morning Hanako-GEN mobile-phone in-class
mituketa-to itta.
find-PAST-COMP say-PAST
'Jiro said that he found Hanako's mobile phone in class this morning.'