How Japanese-English Bilingual Children Process Japanese Particle *Wa* and *Ga* while Reading a Story: Case Study of Eye Movement Research and Miscue Analysis

Yoshitomo Yamashita
The University of Arizona

1. Introduction

How are the Japanese particle "wa" and "ga" are processed during the reading of a Japanese story, and how does the reader uses the particles to comprehend the sentence and story? The purpose of this case study is to investigate how Japanese -English bilingual children process the Japanese particles "wa" and "ga" in order to comprehend a Japanese text. The focus of this research is to determine if the reader might use this marker as the clue to comprehend a story and flow.

While reading a text, the reader tries to construct a parallel text in the mind by using multiple information such as printed letters, words, syntax, semantics, and text (Bernherdt, 1991, Givon 1995; Goodman 1970, 1996). The text constructed by the reader is not always same as printed text. The reading text and the mental text always interact with each other to help the reader comprehend the text and make correction where necessary (Givon, 1995, Goodman & Burk 1987). While the reader reads a text, the reader predicts and confirms his comprehension. The comprehension process of this kind of interaction shows readers miscues: the omission, substitutions, repetitions, and additions to the text. These miscues occur when he reader tries to make sense of the text. Goodman points out that this is the phenomena of active reading; therefore, he suggests that those active errors should be called "miscue' instead of reading errors. When the reader recognizes that the story does not make sense, the reader tries to comprehend by adjusting the mental text by means of the omission, substitutions, repetitions and, additions (Goodman, 1970; Goodman, Burk 1987, Bernett 1989). Furthermore, the reader's eye movement shows how the eyes stop to process certain words(fixation points) and how they move to comprehend the text (Rayner & McConkie, 1976, Rayner & Pollastek, 1989). By looking at the data of eye movements, the process of reading has been analyzed. However, by combining the miscue analysis and eye movements, we get a more accurate picture of language processing(Freeman, 2002; Paulson 2001, 2002; Ducket 2002; Freeman & Paulson, in press).

2. Characteristics of Japanese sentences

Before talking about Japanese particles and methodologies I will introduce the important characteristics of Japanese sentences required for reader comprehension. One of them is that Japanese word order is flexible as long as case particles are used. For example, in the following sentences "a". to sentence "d", are the information is the same as "I gave John an apple." Particle "ga", "o", and "ni" are used before the noun in each sentence. *Ga* is a case marker of the subject. "Ni" is a case marker of the indirect object, "o" is a case marker of the direct object.

a. Watashi –ga John-ni ringo –o yatta.
I- John- ID.O Apple – D.O give-Past
I gave John an apple.

b. Watashi-ga ringo-o John –ni yatta.

c. Ringo-o watashi-wa John-ni yatta.

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d. John-ni watashi-wa ringo-o yatta

These markers are short syllabic functional words. In Japanese language particles function as case in the sentences. The other markers are : (1) focused markers which are used global and text level such as “wa” (Topic), “ mo”, “dake”, (2) sentence final particles, which are used after clause and sentence as a signal to listener’s attention such as “yo”, “wa”, (3) conjunction marker which are used to as an connection as an logical connector such as “node”, and “kara”. In this paper I show how the reader uses the case marker “ga” and the focused marker “wa”

The Japanese particle “wa” is as indicator that reveals the function of certain noun phrases (NP) in the text. The function “wa” can be categorized into: 1) indicating old information, 2) emphasizing certain NP from the context, 3) making comparisons, and 4) indicating negative connotation with co-occurrence of negation at the predicate. “Wa” is the marker used to focus the reader’s attention on the NP above the information of the text. It relates the NP to the global story.

On the other hand, “ga” refers to local level functions such as: 1) marking the subject (including the subject marker in the subordinate clause), 2) focusing on the information that is the answer to Wh-questions, and 3) indicating new information.

My research investigated of the functions, how bilingual readers process the particles “wa” and “ga” in order to comprehend a text.

3. Previous study of eye movement

The eye movement research in English (Carpenter and Just, 1977) revealed that the eye fixated on 84 % of content words and eye fixated on 14% of functional words. Carpenter and Just also found that the more difficult words are more fixated by the readers’ eye. The easier words are less fixated. Can the result of Carpenter and Just’s research be applied to Japanese particles? In the case of Japanese, the particles play an important role in syntax. Word order is flexible and argument structure is marked by using Japanese particles. It is important to investigate if the Japanese functional word produce result s similar to those found in English.

Underwood and Batt (1996) found that the more difficult words, the more time is taken to fixate on words. It is not unknown if the same is true for Japanese. The correct use of Japanese particles is difficult to learn. However, it is difficult to measure how difficult they are. The fixation duration time on Japanese particle is usually longer than content words, and it may be related to comprehension of the sentences.

Rayner and Duffy (1986) found that the fixation duration on high frequency words is shorter than fixation duration time on low frequency words. The number of the fixation point on high frequency words is less than low frequency words. Rayner & McConkie (1976) found that the longer words have the longer fixation duration times. Japanese particles are short length and high frequency words. If Rayner and Duffy’s findings are applicable to Japanese particles, the number of fixation points should be less, and the length of the fixation duration time should be shorter. If Rayner & McConkies findings are applicable to Japanese particles, the length of fixation duration times should be short because Japanese particles are short mora unit, such as one or two morae.

4. The purpose and research question

The purpose of this study is to investigate the processing of Japanese particles and how these particles are used through interaction between the previous context and the upcoming word. I wish to ask how bilingual children process particles “wa” and “ga” while reading Japanese text aloud.

5. Procedure

The data was collected by using eye movement equipment and the procedure of miscue analysis. The eye movement data shows how long a reader’s eye takes to fixate on the text during reading. The fixation duration times are related to the reader’s comprehension of the text.

The miscues occurs when the reader’s comprehension differs from the reading text. Afterward, when the reader recognizes the differences, the reader tries to make sense for the correct

comprehension of the text. The reader then repeats, corrects, substitutes, and omits words. The miscue data is interpreted into information about how the reader processes the text. I corrected miscue on wa and ga when the reader are reading Japanese text. After finding the miscues, eye fixation duration times on "wa" and "ga "were collected. How fixation duration time and miscues are correlated is investigated.

The experiment was conducted with an eye tracker which was connected to a computer screen and the reading voice was recorded. The two readers read the Japanese text on the computer screen. Their eye movements were calibrated before reading the Japanese text. The subjects were asked to read aloud. They cannot stop to ask any question after starting reading. The reader must try to finish reading regardless of difficulty they may have with the text. After the reading, eye fixation data were collected. A miscue analysis was also conducted based on the recorded reading. Two bilingual Japanese children were the subjects, a fourteen year boy and an ten year old girl. The reading material was the story, "Zoo-no Mekata (The weight of an elephant)

6. Subjects

The subjects are a 14 year old boy and a ten year old girl.
The father is American and the mother is Japanese. Y was born in the United State and when he was six years old he moved to Japan. After he finished six years of elementary school , he moved back to the US. H was born in the US, and she went back to Japan with her parents until her third grade of Japanese elementary school. Then she moved back to the US. After they came back to the US, I conducted the research.

7. Reading material

The material is a traditional story in Japanese. The subjects read "Zoo no mekata (Weigh of the elephant)" from *Nihongo Kyouhon II* (The weight of an Elephant) by the institute of *kokusai gakuyuukai*

8. Apparatus

(1) Eye movement research: The software used for eye movement analysis was ASL Eyenal 5000. It gave values for eye fixation duration time
(2) Miscue analysis procedure

9. Result

9.1 The result of miscue data

Y and H's miscues can be summarized in the following examples: In the first sentence, the original sentence of the text is written. After the arrow (->) the sentence shows the how reader read the original sentence. The sign "–" shows omission miscue. Highlighted "wa" and "ga" indicate miscues.

Table 1

Y: 1. Kondo wa sono fune ni tairyoo no ishi o tsumasemashita.
→ Kondo ---sono fune ni tairyoo no ishi o tsumasemashita.
(Fixated: 1,117msc)

H: (1) *Hakari nado aru hazu **ga** arimasen.*
→ *Hakari nado aru hazu **wa** arimasen.* (No fixation point: Substitution miscue).
(2)*Anna kyodai na zou no mekata ga hakareru mono ka to omotta kara desu .*
→ *Anna kyodai na zou no mekata ----- hakareru mono ka to omotta kareadesu*
(No fixation point: Omission miscue).

(3)*Ousama kara **wa** mada wakaranai noka to saisoku saremasu.*
→ *Ousama kara -- mada wakaranai noka to saisoku saremasu*. (No fixation point: Omission miscue).

Y miscued "wa" in omission and this miscue is fixated. H miscued three "wa" in omission but there were no fixation. The data shows that the fixation does not always occur.

9.2 Data of eye movement data

The following tables show the percentage of the fixation points relative to the total number of "wa" or "ga" used in a text. In each table, the function of "wa" or "ga" is in the left column. The average fixation duration time is shown in the other two columns.

Table 2

Function of *Wa*	Y	H
A: Old Information	3/7(43%)	4/7(57%)
Average FDT	572msc	1483msc
B: Emphatic	1/3(33%)	2/3(67%)
Average FDT	483msc	1333msc
C: Contrastive	1/1*(100%)	0/1(0%)
Average FDT	567msc	0msc
D: Negation	1/1 (100%)	0/1(0%)
Average FDT	567msc	0 msc
Average of total FDT wa	549msc	1,408msc

Table 3

Function of *GA*	Y	H
A: New information	2/4(50%)	0/3(0%)
Average FDT	*750msc	0msc
B: Neutral	1/3 (33%)	1/ (33%)
Average FDT	681 msc	483 msc
C: Question & Answer	1/2 (50%)	2/2 (100%)
Average FDT	417msc	*350 msc
Average of total FDT ga	707 msc	383 msc

* Regression

In the function of 'old information" Y fixated three out of seven tomes. The average fixation duration time was 572 msc. H fixated four times. H's average fixation duration time was 1483 msc. In the function of emphatic "wa", Y fixated one out of three times. The average fixation duration time in Y's reading was 483 msc. H fixated two out of three times. The average of fixation duration time is 1,333 msc. In the contrastive "wa", Y fixated one out of one in the text. The fixation duration time was 567 msc. H did not fixated on it. In the function of negation of "wa". Y fixated one out of one times in the text. The fixation duration time is 567 msc. H did not fixated. Y's total fixation duration time in all function of "wa" was 549 msc. On the other hand, H's total duration time in all function of "wa" was 1,408 msc.

The eye fixation duration time data for "ga" in the table shows each function of "ga". In the function of new information, Y fixated two out of four ga. The average fixation duration time was 750 msc. H did not fixate " ga " indicating new information. In the function of neutral "ga", Y fixated one out of three times. The average fixation duration time was 681 msc. H fixated one out of three times. The average of H's fixation duration time was 483 msc. In the function of question and answer of "ga", Y fixated one out of two "ga", Fixation duration time was 417 msc. Y fixated two out of two in the text. In the total average of "ga" , Y's fixation duration time was 707 msc. H 's average of the fixation duration time is 383 msc.

10. Discussion

In his oral reading of the story, Y omitted *wa* in a sentence, but the eye fixation occurred on this "wa". This omission is not a carelessly un-pronounced particle. Y might try to confirm the function of *wa* to comprehend the sentence. On the other hand, H's miscues were not fixated. H might not use the function of these particles to comprehend the sentences. However, the eye movement data show interesting results. The average of Y's eye fixation duration time on "wa" was 549 msc and H's average of fixation duration times on "wa " was 1,408 msc.

Having a lower level acquisition of Japanese language, H took a longer time to process the item which connected to the content of the text. When he reader H needed to interact between the words and sentences and previous information of the text, H seemed to ignore the items. Therefore, H did not take time to process it.

Y is a more proficient reader than H. The reader Y could retell all of the story in detail after reading. H could not retell the story. However, Y fixated more on "ga" than H did, and the average of the fixation duration time was longer than H's. Y fixated four "ga" out of a total number of nine "ga" in the story. This result leads to three observations: 1)Proficient readers do not need longer time to read than un-proficient readers, however, Y took more time to read "ga" than H did, 2)the fixation duration time on ga is relatively longer than other fixation duration time. Especially Y, who took 707 msc to fixate on "ga". 3) Though longer words are often fixated (Rayner & McConkie, 1976); in contrast, "ga" is a just mora unit.

11. Finding and conclusion

When the level of language proficiency becomes high, the time necessary for the processing of "wa" becomes shorter. However the particle "Ga" still takes more time to process. In terms of "wa", a highly proficient reader can interact with prior text, and his/her prior knowledge of the text helps the reader to process the function of "wa". In fact, Y. is faster at processing "wa" than H. is. If processing "wa" involves a connection with the memory of the preceding text, this helps the reader to recognize the function of "wa". In terms of the contrastive "wa" and the negation "wa", H did not fixate these uses. This lack of fixation may be interpreted as ease in processing contrastive "wa" and negation; therefore they do not need fixations for processing. Alternatively, it could indicate that she could not recognize the negative or the contrastive use of "wa", since in the retelling H. stated that she could not understand the story line.

The results of the research is that the more Japanese language acquired, the less time is needed to process "wa " than needed to process "ga". The following three points emerge in this case study:

(1) With more Japanese language acquired, the processing of "wa" becomes faster than "ga". The reason is that the reader can anticipate encountering "wa" by interaction with former content.

(2) The reader may pay greater attention to the contractive "wa". The reason is that the reader tries to connect the previous content of the text to the upcoming word through "wa".

(3) The reader takes longer time to process "ga". Because the reader predicts the relationship between upcoming words and text, to anticipate the upcoming syntax and meaning, it requires more time to predict forward structure than to search for meaning of the appropriate function of ga through interacting with previous content.

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