

Introduction

The effect of mistaken words on the sentence comprehension process has been studied for Western languages. In a previous study, if a sentence has a word that violates semantic or world knowledge violation word, N400 ERP component appears during the reading of the sentence (Hagort et al., 2004). Our study presented in this paper used electroencephalography (EEG) to examine whether the process of finding incorrect words due to semantic or world knowledge violation in Japanese sentences is the same as the process in Western languages.

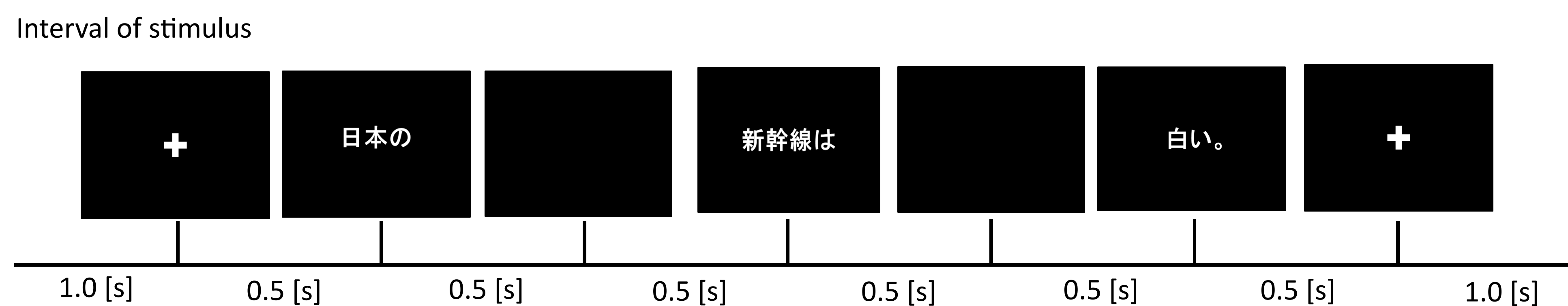
Method

In the experiment, we presented three kinds of sentences as visual stimuli. The first ones were completely correct sentences, the next ones included a word that violated world knowledge, and the last ones included a word that violated semantics. An example of the sentence is “Japanese Shinkansen is white/black/irritable and very fast”. The first version of the sentence is understandable and correct. The alternative color of black is easy to understand. However, it is well known that the Japanese Shinkansen is white. Therefore, this version of sentence is false. The last one has a violation of semantic constraint. Irritable is not suitable for explaining appearance of train.

Each sentence was split into segments. Each segment was shown to participants for 0.5 seconds with 0.5 second intervals.

Participants

Of the 10 right-handed males tested, we selected 6 subjects because of the data of the remaining subjects were contaminated by noise. They are healthy graduate school students, and native Japanese speakers. They don't have history of psychiatric or neurological illness or alcohol abuse. They have no visual deficit.



Example

1) Correct

Japanese Shinkansen is white and very fast.
(新幹線は白くとても速い。)

2) World knowledge violation

Japanese Shinkansen is black and very fast.
(新幹線は黒くとても速い。)

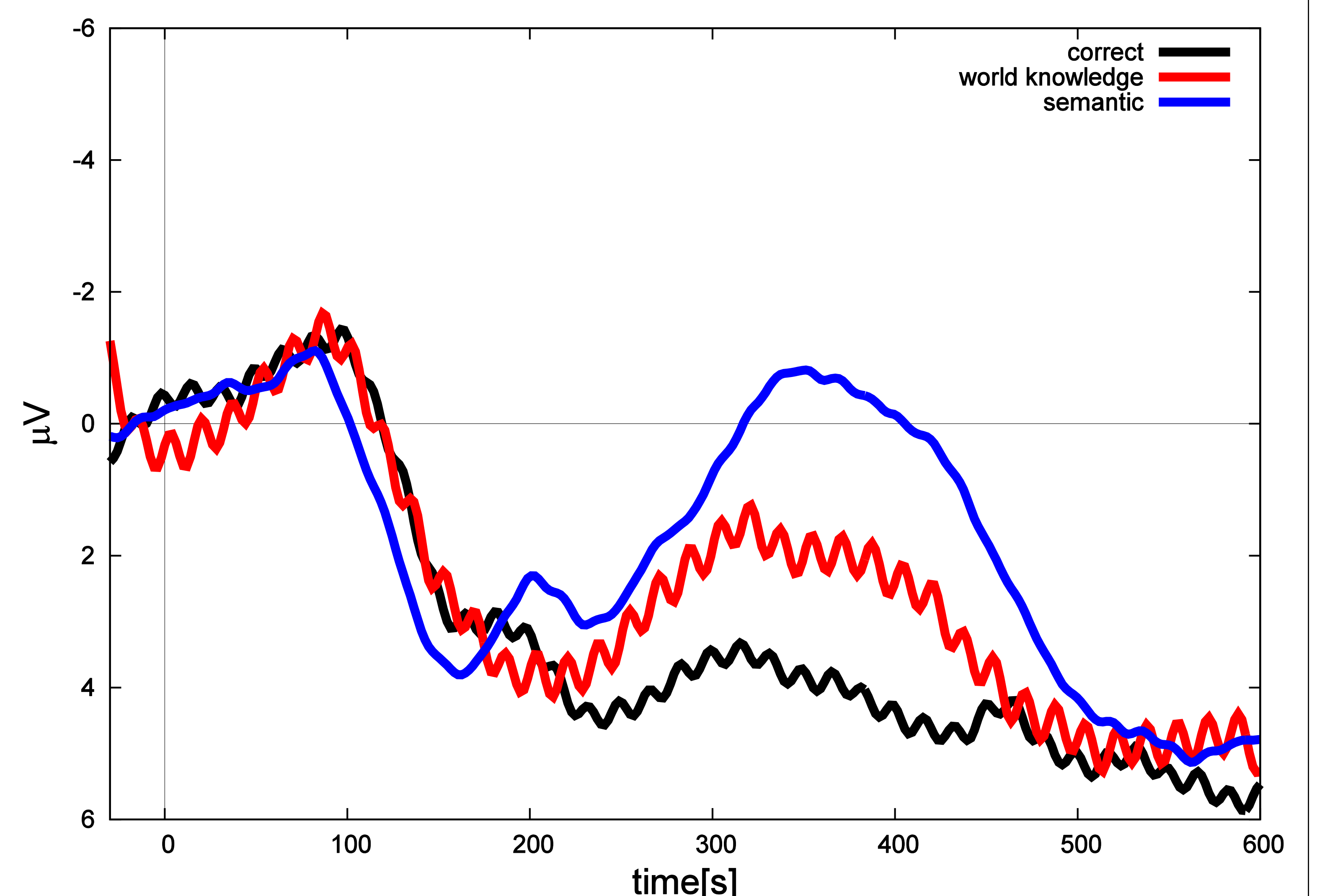
3) Semantic violation

Japanese Shinkansen is irritable and very fast.
(新幹線は怒りっぽくとても速い。)

Result

As a result, a negative shift appeared after words that violated world knowledge and semantics were presented. According to the Hagoort et al. (2004), the peak of this negative shift was shown to occur at about 400 ms which indicate the N400 component. However, the peak shown in this study occurred at about 350 ms in the parietal area (Cz). Amplitude of N400 also different from the previous study. According to the previous study, differential of amplitude between World knowledge violation and semantic violation had no significant difference whereas in this study, their ERPs showed a significant difference.

ERPs are time locked to the presentation of the critical word. Difference of three kinds of ERPs were not identical [$F=3.03$, $P<0,001$]. The size of effect of semantic violations was larger than World knowledge violations ($P<0.001$) and world knowledge violations one was larger than correct ($p<0.001$).



Discussion

The result was similar to the previous study. This early N400 phenomenon indicates that Japanese words can be processed faster than those of Western languages. It may be partly due to the processing of Japanese Kanji characters, which also similarly appeared in Chinese study (Zheng Ye et al., 2005). Difference of N400 amplitude between world knowledge violation and semantic violations may come from the grammatical form of Japanese. In Japanese sentences, the reader cannot tell until the end of a sentence whether the sentence is true or not, so effect of N400 was reduced when world knowledge violation words were presented.

Acknowledgement

Part of this research was executed under the Commissioned Research for “Research and Development on Medical Communication Support System for Asian Languages based on Knowledge and Language Grid” of National Institute of Information and Communications Technology (NICT), Japan.

Introduction

- If a sentence has a word that violates semantic or world knowledge, N400 appears (Hagort et al., 2004)
- Our study presented in this paper used electroencephalography (EEG) to confirm whether Japanese sentences cause N400 ERP component

Method

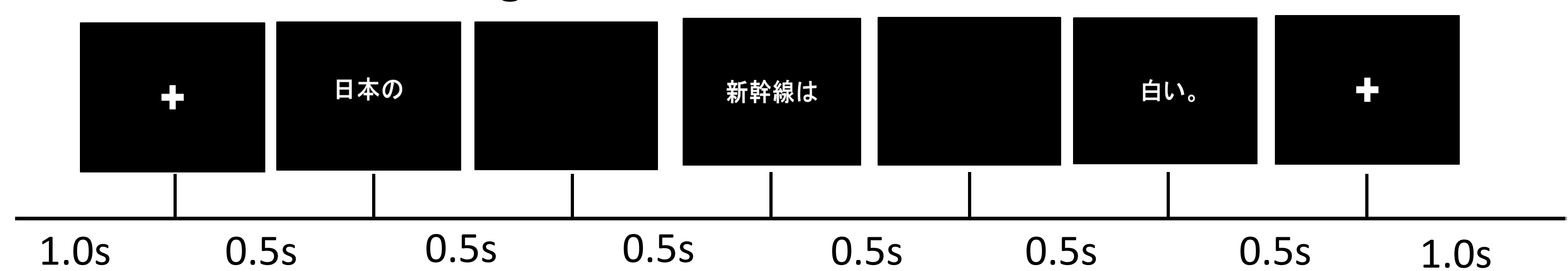
- Presented three kinds of sentences as visual stimuli are sentences (3 × 90 sentences)

1. Completely correct sentences
2. A word that violated world knowledge
3. A word that violated semantics

Critical word Stimuli

- 1) Correct : understandable and correct
Japanese Shinkansen is white and very fast.
(新幹線は白くとても速い。)
- 2) World knowledge violation : understandable but not true
Japanese Shinkansen is black and very fast.
(新幹線は黒くとても速い。)
- 3) Semantic violation : has a violation of semantic constraint
Japanese Shinkansen is irritable and very fast.
(新幹線は怒りっぽくとても速い。)

- Each sentence was split into segments
- Each segment was shown for 0.5 sec
- Intervals of segments 0.5 sec



Participants

- 6 subjects
- Healthy graduate school students
- Native Japanese speaker
- Not have history of psychiatric or neurological illness or alcohol abuse
- No visual deficit

Result

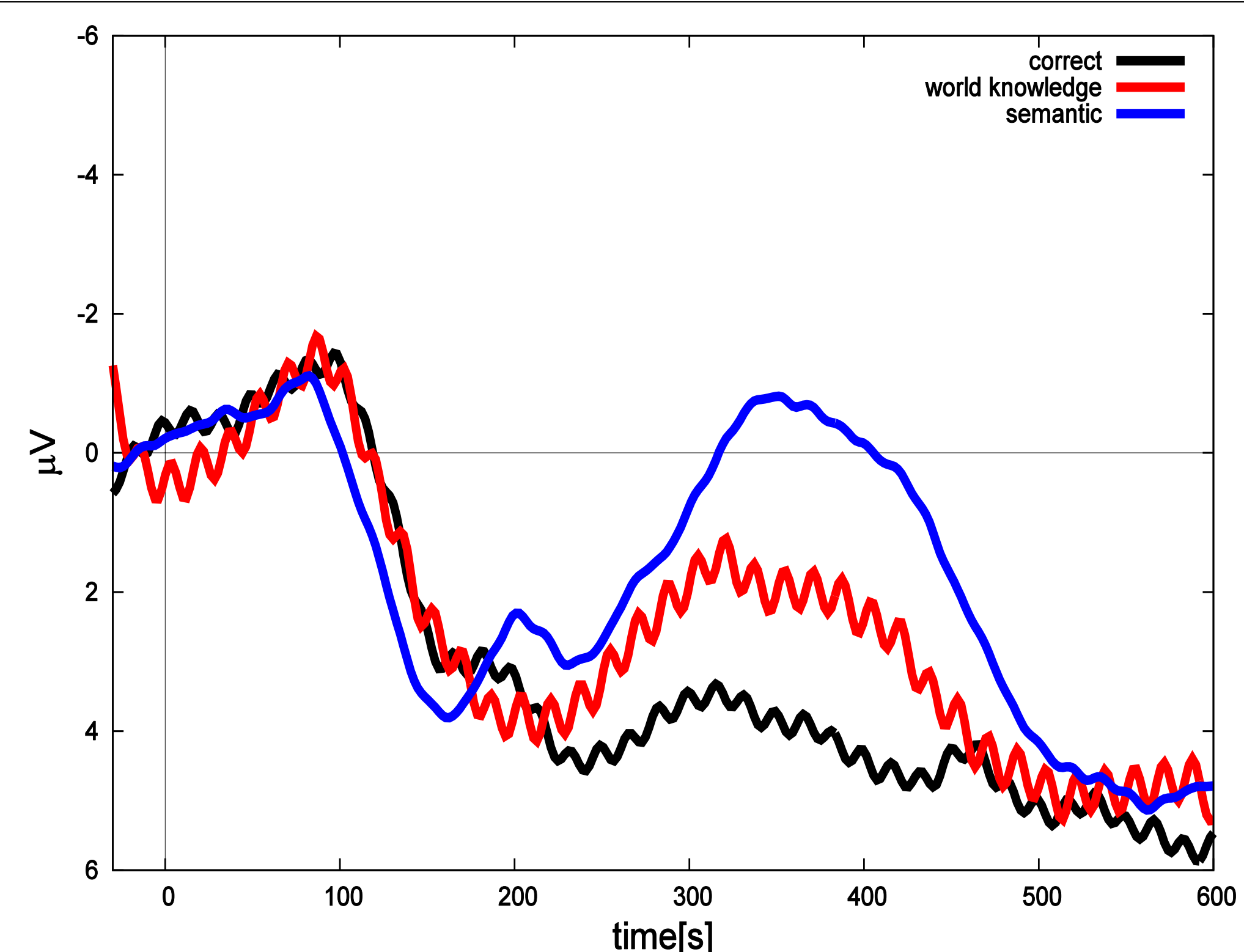
- Negative shift appeared after critical words

Previous study (Hagoort et al., 2004):

- The peak of this negative shift was shown to occur at about 400 ms
- World knowledge and semantic had no significant difference

In this study:

- The peak occurred at about 350 ms (Cz)
- ERPs showed a significant difference between world knowledge and semantic violations



ERPs are time locked to the presentation of the critical word. Difference of three kinds of ERPs were not identical [$F=3.03, P<0.001$]. The size of effect of semantic violations was larger than World knowledge violations ($P<0.001$) and world knowledge violations one was larger than correct ($p<0.001$).

Discussion

- Early N400 phenomenon indicates that Japanese words can be processed faster than those of Western languages
 - It may be partly due to the processing of Japanese Kanji characters, which also similarly appeared in Chinese study (Zheng Ye et al., 2005).
- Difference of N400 amplitude between world knowledge violation and semantic violations may come from the grammatical form of Japanese
- In Japanese sentences, the reader cannot tell whether a sentence is true or false until the end of a sentence

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