Do Higher Reanalysis Costs Promote Lingering Memory of Initial Misparse?: Evidence from Japanese Garden-Path Sentences

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Introduction

This study aims to demonstrate the direct correlation between the reanalysis cost of the garden-path sentences and the lingering effect of incorrect initial analyses. The lingering effect, observed subsequent to reanalysis during reading garden-path sentences, denotes the persistence of the initially incorrect analysis in memory [1]. Previous studies showed that the lingering effect is greater under conditions where the reanalysis cost is higher, e.g., a parser commits to an initial parse longer, or an initial analysis appears plausible [2-4]. Consequently, they argued that the reanalysis cost is relevant to the strength of the persistence of initial analyses.

However, few studies have hitherto uncovered the direct connection between reanalysis cost and the lingering effect [3]. This gap arises from previous studies utilizing the gender mismatch effect and accuracy for comprehension questions to measure the lingering effect. These metrics were calculated by aggregating data from multiple trials, which precludes corresponding the lingering effect to reanalysis cost within a single trial. Therefore, the current study employs reaction time for comprehension questions as the index for evaluating the lingering effect.

We used Japanese garden-path sentences shown in (1). Because a relative clause precedes a lexical head without any makers, the structure is ambiguous between a Main Clause (MC) analysis (*pianisuto* "a pianist" is an agent of *hiita* "played") or a Relative Clause (RC) analysis (*pianisuto* "a pianist" is not agent of *hiita* "played"). Readers initially opt for an MC analysis and then reanalyze to an RC analysis at the disambiguation region (*barerina-o* "ballerina-ACC").

Methods

52 native Japanese speakers participated in the experiment. We manipulated the length of the initial analysis by adding elements before verbs or/and after verbs, as exemplified in (1). A broad spectrum of reanalysis costs has been observed for these stimuli [5]. Participants read a garden-path sentence at their own pace and then answered a comprehension question, where they chose which of the two nouns was the correct agent of the event denoted by the initial analysis. Reading times for disambiguation regions and spill-over reflect the extent of reanalysis cost, while response times for the comprehension questions indicated the magnitude of the lingering effect.

We analyzed data from 50 participants who achieved more than 80% correct responses to comprehension questions. We constructed Bayesian linear mixed-effect models, with response time to comprehension questions (only correct responses) as the dependent variable and reading times at the critical region (i.e., disambiguation word) and the spill-over region as fixed effects.

Results and Discussion

As shown in Table 1 and Figure 1, there was no main effect of reading times at the critical region. Conversely, we observed that longer reading times at the spill-over region correlated with an increase in the response time to comprehension questions. This effect achieved decisiveness, as indicated by the Bayes factor [6]. Our results suggest that the memory of the initial analysis of garden-path sentences lingers because of the difficulty to recover from misanalysis, consistent with the previous studies [2-4].

Table 1. Estimated effects of reading times for response times of comprehension questions.

	Coefficient	SE	Lower-CrI	Upper-CrI	BF_{10}
Intercept	6.51	0.20	6.13	6.87	
Critical Region	0.01	0.02	-0.03	0.05	0.12
Spill-Over	0.10	0.02	0.06	0.15	3692.80

Stimuli (disambiguation occurs at the underlined phrases)

1) a. –PreV; –PostV

Pianisuto-ga	***piano-o***	Ø	***Hiita***	Ø
pianist-NOM	[$_{RC}$ piano-ACC		Played	]
bareriina-o	***mitsuketa.***			
ballerina-ACC	found			

"A pianist found a ballerina who played the piano."

b. +PreV; –PostV

Pianisuto-ga	***piano-o***	***tanoshisouni***	***Hiita***	Ø
pianist-NOM	[$_{RC}$ piano-ACC	happily	Played	]
bareriina-o	***mitsuketa.***			
ballerina-ACC	found			

"A pianist found a ballerina who happily played the piano."

c. –PreV; +PostV

Pianisuto-ga	***piano-o***	Ø	***Hiita***	***kamoshirenai***
pianist-NOM	[$_{RC}$ piano-ACC		Played	might]
bareriina-o	***mitsuketa.***			
ballerina-ACC	found			

"A pianist found a ballerina who might have played the piano."

d. +PreV; +PostV

Pianisuto-ga	***piano-o***	***tanoshisouni***	***Hiita***	***kamoshirenai***
pianist-NOM	[$_{RC}$ piano-ACC	happily	Played	might]
bareriina-o	***mitsuketa.***			
ballerina-ACC	found			

"A pianist found a ballerina who might have happily played the piano."

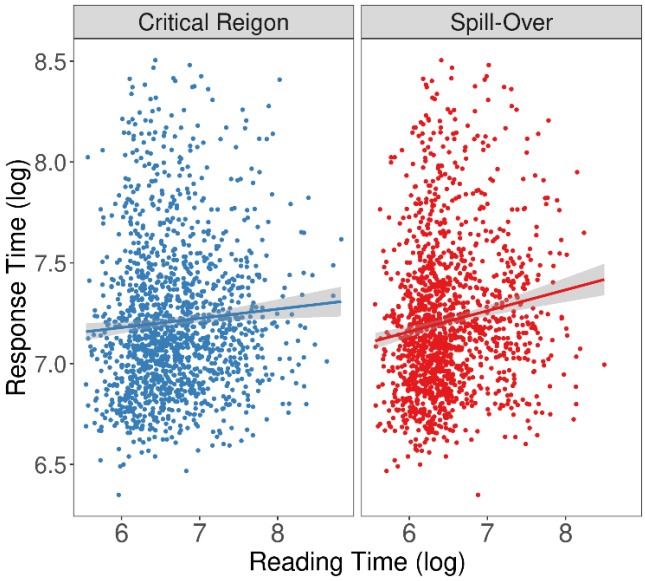

Figure 1. Correlation between response times to comprehension questions and reading times.

References

[1] Slattery et al. (2013). *J. Mem. Lang*. [2] Ferreira & Henderson. (1991). *J. Mem. Lang*. [3] Huang & Ferreira. (2021). *J. Mem. Lang*. [4] Nakamura & Arai. (2016). *CogSci*. [5] Emura et al. (2023). *IEICE Tech. Rep.* [6] Jeffreys. (1961). *The theory of probability*.