Eye-movement patterns of subject-predicate processing in Japanese nested structures
Saki TSUMURA & Yuki HIROSE (The University of Tokyo)
stsumura25@g.ecc.u-tokyo.ac.jp

In sentence comprehension, linguistical inputs are associated with each other to complete dependencies between the elements. Subject-predicate dependency is one of such dependencies, and the parser integrates a predicate with its subject to build the dependency. Previous studies on the processing of subject-predicate dependency show that when the subject is far away from its predicate, it causes processing difficulty (i.e., locality effect). However, in Japanese, not all subject-predicate dependencies show the locality effect. For example, locality effect was observed when the matrix subject contains a negative polarity item in nested structures, while there is no locality effect in Japanese when the matrix and embedded subjects are referential noun phrases (NPs) in nested structures (Nakatani, 2009, 2014). In such cases where the locality effect was not observed, it is assumed that both matrix subject and embedded subject are reactivated when the embedded verb is processed, and then it decreases the processing cost at the matrix verb, because the matrix subject is reactivated just before the matrix verb position. The reactivation of both embedded subject and matrix subject can be explained by the cue-based parsing account (Lewis et al., 2005, 2006). Cue-based parsing accounts assume three stages: encoding, storage, and retrieval in memory, and they suggest that when the syntactic and semantic similarity of earlier items to the target item is increased, reading times on the target item increase. This similarity-based interreference could occur in both encoding and retrieval. In the present study, we conducted an eye-tracking experiment to investigate whether there is the locality effect and whether such similarity-based interference is observed in encoding and retrieval process, using Japanese wh-phrase “daremo” and “minna”.

The experimental sentences include “dare-mo-ga” (“wh+ ‘mo’+nominative case marker (NOM) ‘ga’” ‘everyone’) or “minna-ga” (“everyone’+ NOM ‘ga’ ‘everyone’) as a matrix subject, like sentences (1).

(1) a. Distant/Wh Condition:
誰もが/そのウェイトレスが/店内で/常連客を/殴ったと/信じなかったので…
Wh+‘mo’-NOM / [the waitress-NOM / restaurant-LOC / regular customer-ACC / hit-past-comp] / believe-not-past-because …
‘Everyone did not believe that the waitress hit the regular customer at the restaurant, so...’ / ‘Not everyone believed that...’

b. Distant/Non-Wh Condition:
みんなが/そのウェイトレスが/店内で/常連客を/殴ったと/信じなかったので…
‘Everyone did not believe that the waitress hit the regular customer at the restaurant, so...’ / ‘Not everyone believed that...’

c. Local/Wh Condition:
そのウェイトレスが/店内で/常連客を/殴ったと/誰もが/信じなかったので…
[the waitress-NOM / restaurant-LOC / regular customer-ACC / hit-past-comp] / Wh+‘mo’-NOM / believe-not-past-because …
‘Everyone did not believe that the waitress hit the regular customer at the restaurant, so...’ / ‘Not everyone believed that...’

d. Local/Non-Wh Condition:
そのウェイトレスが/店内で/常連客を/殴ったと/みんなが/信じなかったので…
‘Everyone did not believe that the waitress hit the regular customer at the restaurant, so...’ / ‘Not everyone believed that...’

Both “dare-mo-ga” and “minna-ga” are universal quantifiers, but the former contains wh element, while the latter does not. In distant conditions, the first NP is a wh-element while the second NP is a referential
(non-wh) NP, while both the first NP and the second NP are referential (non-wh) NPs. If the similarity status between two NPs modulates with the presence/absence of a wh-feature, it is expected that first two NPs are subject to the similarity effect, only in (1b) but not (1a). Therefore, the fixation time at embedded subject encoding position (second NP) and embedded verb retrieval position in non-wh condition (1b) would be longer than that of wh condition (1a). Also, locality effect would be observed in the wh conditions, leading the longer reading time (RT) for (1a) at the matrix predicate region, where the integration between matrix subject and matrix predicate occurs. However, if the similarity-based interference does not occur, the RT would not differ from each other at the encoding and retrieval position, and matrix verb position.

Thirty-seven native Japanese speakers participated in the eye-tracking experiment. The statistical analysis was conducted, using linear mixed-effects models. The results showed that at the matrix verb position, where the matrix subject and matrix predicate are integrated and the locality effect could be observed (“believe-not-past-because” region), there were no significant effects in the early measures, such as first pass reading time or first fixation duration. However, in second pass reading time, the interaction between distance and subject type was significant ($p < .01$). In wh condition, distant condition (1a) was read slower than local condition (1c) (i.e., locality effect), while in non-wh condition, the reading time in local condition (1d) was longer than in distant condition (1b) (i.e., anti-locality effect) (Figure 1). In total reading time, the interaction was also significant, showing the prolonged anti-locality effect in non-wh condition ($p < .05$) (Figure 2). It is assumed that anti-locality effect is observed when the greater distance increases the anticipation of the upcoming input, and the greater distance makes the integration process easier.

As for the encoding of the second NP in distant condition, the first pass reading time of non-wh condition (1b) was significantly longer than that of wh-condition (1a) ($p < .05$). This can be regarded as the similarity-based encoding interference at the second NP region. At the embedded verb position, where there is a possibility of reactivation of both matrix subject and embedded subject, there was no statistically significant differences in early measures. However, there were marginally significant effects in late measures such as second pass reading time and total reading time, showing the RT in wh condition (1a) was slightly longer than in non-wh condition (1b).

In summary, present eye-tracking experiment showed greater integration difficulties in nested sentences in late measures of eye-movement patterns. More specifically, locality effect was observed when the matrix subject contains the wh-quantifier, while anti-locality effect was observed when the matrix subject was the non-wh quantifier. The processing difficulty that was observed at subsequent second NP in early measures may reflect the interference of the information of new input’s encoding.
References