

Memory and second language processing: a study on L1 Chinese learners of L2 Italian

Keywords: memory-span, second language processing, filler-gap dependencies

1. Memory and first/second language. Several studies investigated the relationship between memory-span and real time processing of filler-gap dependencies, both in first and second language. Among others, Cross-Modal Priming studies of Nakano et al. (2002), Felser & Roberts (2007) and Roberts et al. (2007) showed that higher-memory-span native speakers localize priming effect in the trace position of sentences with a wh-movement. This result is indicative of trace-based antecedent reactivation in native sentence processing.

On the other hand, the study of Felser & Roberts (2007) showed also that non-native speakers don't point out any structurally based antecedent reactivation but they point out evidence of maintained antecedent activation during the processing of the experimental sentence. Moreover, their results indicated that the learners' response to the decision task was not influenced by individual memory differences.

2. Our experiment: Purpose, subjects and method. Our purpose is to investigate whether filler integration is mediated by syntactic gaps in L2 learners wh-dependencies processing and to understand whether there is a correlation between memory-span and semantic or structural priming effect in both native and non-native speakers of Italian. For this aim, we replicated (with some differences) the study of Felser & Roberts (2007).

Subjects of our experiment were 27 adult Chinese beginner learners of Italian. 13 adult Italian native speakers participated in our study as control group.

All the participants of the experiment underwent an Italian memory-span test. Test materials consist of sets of two, three, four, five and six words. Participants were asked to listen to the lists of words and to recall each lists' words in each set in the order in which they had listened to them. Memory-span scores reflect the maximum set for which the participants could successfully recall the target words. According to their median scores in the memory-span test, both native speakers and L2 learners were divided into 2 subgroups: low-memory-span (low-MS) and high-memory-span (high-MS).

The Cross Modal Picture Priming task comprised 20 aurally presented Italian sentences with direct-object relatives (e.g. *Questa è la balena che la mamma ha visto nell'acquario ieri pomeriggio*, 'This is the whale that the mother saw in the aquarium yesterday afternoon') and 20 fillers. Pictures semantically related with the antecedent (images representing animals) or unrelated (images representing objects or plants) appeared on the screen at the offset of the verb (gap position) or 500 ms after (post-gap position). Participants' RTs resulting from a picture-based decision task were recorded. It is expected that faster RTs for semantically related pictures at gap positions are evidence for trace effect on priming decisions. Finally, participants had to answer a total of 7 written comprehension questions randomly interspersed throughout the experiment.

3. Our experiments: Results. Answers to the decision task which were wrong or beyond 2000 ms from the appearance of the picture were excluded from the analysis. Within groups ANOVA analysis were carried out. Summary of main results:

(1) Native Speakers (Ns): (A) ANOVA with the factor Memory-span (high, low) shows that RTs of low-MS NNs are significantly longer if compared to RTs of high-MS NNs ($p=0.006$). (B) ANOVA with the factors Memory-span, Matching (picture semantically related, picture unrelated) and Position (gap, post-gap) doesn't show any significant result in native speakers, grouped by memory span. In particular, analyzing the performance of high-MS speakers in the gap position, our results don't show any significant correlation between shorter RTs and semantically related picture in the gap position when compared to the post-gap position.

(2) Non-native speakers (NNs): (A) ANOVA with the factor Memory-span (high, low) shows that RTs of low-MS NNs are significantly longer if compared to RTs of high-MS NNs

($p=0.000$). (B) ANOVA with the factors Memory-span and Position shows that RTs of low-MS NNs are significantly longer both in gap ($p=0.003$) and post-gap ($p=0.053$) position, if compared to RTs of high-MS NNs. (C) Considering only high-MS NNs, there isn't any significant correlation between shorter RTs and semantically related picture in the gap position. (D) ANOVA with the factors Memory-span and Matching shows that RTs of low-MS NNs, compared to RTs of high-MS NNs, are significantly longer ($p=0.003$) only when pictures semantically related with the antecedent are shown. The same ANOVA carried out considering only high-MS NNs shows a significant RTs' difference between the two Matching conditions: when pictures are not semantically related with the antecedent, high-MS NNs answered significantly slower ($p=0.005$). The same result was not found in the other NNs group.

4. Our experiment: Discussion. (1) Native Speakers: our results show that, in the Ns group, RTs correlate with memory-span level, as result (A) shows, but not with Matching, Position or with their interaction. No trace reactivation was found in higher memory-span native speakers, as result (B) shows. The absence of significant results could be due to the small number of participants.

(2) Non-native speakers: In the NNs group, RTs correlate with memory-span levels, as result (A) shows. Comparing the performances of the two memory-span groups, analysis revealed that Position doesn't play a role, since low-MS NNs are slower in both the positions (gap, post-gap), which means that they are generally slower, as result (B) shows. Result (C) shows that no position-specific advantage was found even in high-MS NNs: they are not significantly faster in answering when semantically related pictures appear in the gap position rather than when it appears in the post-gap position. On the other hand, result (D) shows that a significant main effect of Matching was found: L2 learners with high-MS identify and classify picture showing a referent semantically related with the antecedent more easily than unrelated pictures, irrespective of the structural position. This effect wasn't found in the low-MS group.

5. Conclusion. Results of our experiment suggest that memory-span plays a role in native speakers' and non-native speakers' processing.

Contrary to Nakano et al. (2002), Felser & Roberts (2007) and Roberts et al. (2007), we didn't find any localized antecedent priming effect at the point of direct object gap in higher memory-span Ns but we found a general advantage in terms of RTs in high-MS Ns.

Contrary to the results of Felser & Roberts (2007), our results show that low-MS NNs performed generally slower than high-MS, thus suggesting that memory differences actually affect the learners' performance in the decision task.

Furthermore, our research shows that only high-MS NNs are primed by some semantic features of the pictures (probably the semantic relation with the antecedent, which comes before in the sentence) and this semantic priming effect is maintained all along the sentence.

This result represents the main finding of our research and it is consistent with the results of Felser & Roberts (2007) who found that L2 learners retained fronted wh-phrases (the antecedent) in memory during the processing of the experimental sentences but they did not retrieve them from memory at structurally defined gap sites, which suggests the presence of a maintained activation rather than of reactivation.

References

- Felser C. & Roberts L. (2007), Processing wh-dependencies in a second language: a cross-modal priming study, *Second language research*, 23 (1), 9-36.
- Nakano Y, Felser C, Clahsen H (2002), Antecedent priming at trace positions in Japanese long-distance scrambling, *J Psycholinguist Res.* 31(5), 531-71.
- Roberts et al (2007), Antecedent Priming at Trace Positions in Children's Sentence Processing, *Journal of Psycholinguistic Research* 36, 175-188.