The processing of French relative clauses: effect of semantics and the morphological cue

Claire Delle Luche[1], Michel Hoen[2], Frédérique Gayraud[3], & Fanny Meunier-Hoen[4]

1- claire.delleluche@etu.univ-lyon2.fr, 2 – hoen@isc.cnrs.fr, 3 – gayraud@univ-lyon2.fr, 4 – meunier@univ-lyon2.fr

Laboratoire Dynamique Du Langage, UMR CNRS 5596, Université Lumière Lyon 2, France

Introduction

Relative clause (RC) processing studies have seen the development of extensive research (Caplan, & Waters, 1999; Gibson, 1998; King, & Just, 1991). According to the DLT (Gibson, 1998, 2000) two processing costs, the memory and the integration costs, tax the reader's working memory. These costs can be calculated for each word, the highest being found on verbs. The difference between Subject and Object RC is located on the RC verb. The integration cost is characterised by a P600 and the memory cost by a LAN (Kaan, & al., 2000; Fiebach, Schlesewsky, & Friederici, 2002; Phillips, & al., 2001).

A factor may also influence the relative difficulty of RC processing. Unlike the English complementizer *that* which is ambiguous, some languages like German and French have a morphological cue that indicates the type of the RC. Consequently, the reader is able to anticipate the role of the filler in the RC. Unfortunately, no evidence was found yet (Fiebach, et al., 2002).

However, language processing relies also on semantic information. Usually, semantic role assignment is assumed to take place on the verb, but Weckerly and Kutas (1999) demonstrated that the role assignment is made on the subject of an Object RC, that is, before the processing of the RC verb. The aim of this work is to test the effect of the morphological and a semantic cue (congruency) on the processing French Subject and Object RCs. The following ERP responses are expected:

(1) Subject, Congruous *Le policier qui arrête l'assassin signe la déposition.* (LAN, P600)

(3) Subject, Incongruous *L'assassin qui arrête le policier signe la déposition* (LAN, N400+, P600)

(2) Object, Congruous *L'assassin que le policier arrête signe la déposition.* (LAN+, P600)

(4) Object, Incongruous *Le policier que l'assassin arrête signe la déposition.* (LAN+, N400+, P600)

Method

Participants

12 native speakers of French, right handed (4 female), mean age = 22,9).

Materials

120 experimental sentences were built according to a 2*2 design (Syntax*Semantics):

(1) Subject, Congruous *Le policier qui arrête l'assassin signe la déposition.* (The policeman that$_{Subject}$ arrested the murderer signed the statement)

(2) Subject, Incongruous *L'assassin qui arrête le policier signe la déposition.* (The policeman that$_{Subject}$ arrested the murderer signed the statement)

(3) Object, Congruous *L'assassin que le policier arrête signe la déposition.* (The murderer that$_{Object}$ the policeman arrested signed the statement)

(4) Object, Incongruous *Le policier que l'assassin arrête signe la déposition.* (The murderer that$_{Object}$ the policeman arrested signed the statement)

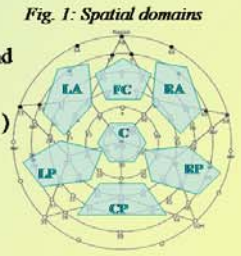
Procedure

- Word by word presentation with a moving window paradigm
- 800ms/word, 400ms (blank)
- Each sentence was followed by a comprehension question

ERP recording & data analysis

- 65 Ag/AgCl electrodes mounted on a geodesic net
- EEG and EOG were continuously recorded and segmented 100ms before and 1000ms after word onset
- 7 spatial domains (cf. Fig. 1)
- 2 time windows:
  - 300-450ms
  - 500-800ms

Fig. 1: Spatial domains



Results

Behavioural results

Object RCs are more difficult than Subject RCs, leading to longer response times. No effect of Semantics nor interaction were found.

Table 1: Mean number of errors (s.d.)

	Congruous	Incongruous
Subject RC	1,58 (1,5)	3,33 (2,2)
Object RC	3,83 (1,8)	4,08 (3,7)

Electrophysiological results

- Effects of Syntax
  - **Complementizer, LAN:** the amplitude of the LAN is larger for Object RCs in the left anterior domain.
  - **Main clause verb, LAN:** the amplitude of the LAN is larger for Object RCs in the anterior domain.
  - **Main clause verb, P600:** the amplitude of the posterior P600 is equally large, either for Object and Subject RCs.

Fig. 2: Relative pronoun

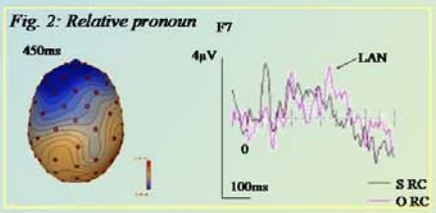


Fig. 3: Main clause verb

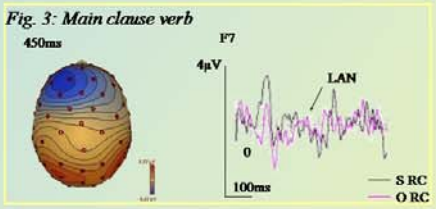
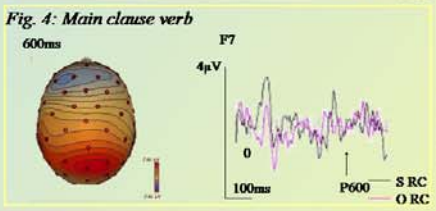
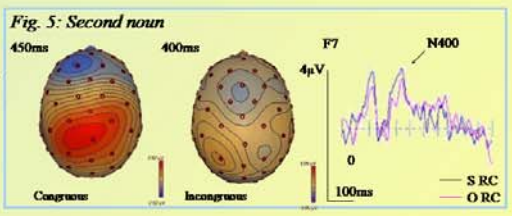


Fig. 4: Main clause verb



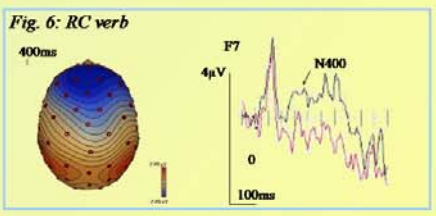
- Syntax*Semantics interaction
  - **Second noun, Object RC:** a LAN is observed for the Congruous condition while a central N400 is observed for the Incongruous condition.
  - **Second noun, Subject RC:** no difference across conditions

Fig. 5: Second noun



  - **RC verb, Subject RC:** the central N400 is larger and longer for Incongruous trials

Fig. 6: RC verb



  - **RC verb, Object RC:** a left posterior P600 is observed for Congruous and Incongruous trials

Fig. 7: RC verb

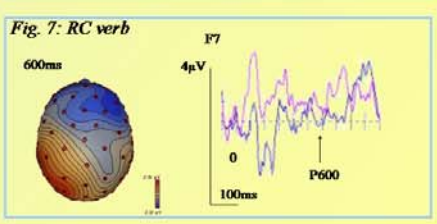


Fig 2-7: Grand averaged voltage data. Negative potentials are plotted downwards. The 3D interpolations are shown on the left.

Discussion

Where the error rate is not sensitive enough to capture an effect of Semantics or a Syntax*Semantics interaction, the ERP data are. If the results observed on Object RCs confirm those from Weckerly and Kutas (1999), the Subject RC condition allows us to add further implications of Semantics in the syntactic processing: considering a semantically cued Subject-Verb-Object triplet, the semantic role assignment takes place when reading the second constituent (the verb in Subject RCs, the subject in Object RCs). This demonstrates that readers attempt to anticipate the semantic roles even before reading the verb.

These data also add further support for the DLTheory (Gibson, 1998, 2000; Kaan, et al., 2000): a high integration cost exhibits a P600 while the memory cost exhibits a LAN, the two being located on the verbs.

Finally, the data obtained on the complementizers demonstrates, for the first time to our knowledge, that a morphological cue leads to a processing difference. A *que* introducing an Object RC, more difficult than a Subject RC, induces a larger LAN, suggesting that the syntactic role assignment takes place that early.

References

Caplan, D., & Waters, G. (1999). Verbal working memory and sentence comprehension. *Behavioral and Brain Science, 22*, 77-126.

Fiebach, C., J., Schlesewsky, M., & Friederici, A. D. (2002). Separating syntactic memory costs and syntactic integration costs during parsing: The processing of German WH-questions. *Journal of Memory and Language, 47*, 250-272.

Gibson, E. (1998). Linguistic complexity: Locality of syntactic dependencies. *Cognition, 68*, 1-76.

Gibson, E. (2000). The dependency locality theory: A distance-based theory of linguistic complexity. In A. Marantz (Ed.), *Image, language, brain: Papers from the first Mind Articulation Project symposium* (pp. 95-126). Cambridge, MA: MIT Press.

Kaan, E., Harris, A., Gibson, E., & Holcomb, P. (2000). The P600 as an index of syntactic integration difficulty. *Language and Cognitive Processes, 15*(2), 159-201.

King, J. W., & Just, M. A. (1991). Individual differences in syntactic processing: The role of working memory. *Journal of Memory and Language, 30*, 580-602.

Phillips, C., Kazanina, N., Wong, K., & Ellis, R. (2001). *ERP evidence on the time course of processing demands in Wh-dependencies.*

Weckerly, J., & Kutas, M. (1999). An electrophysiological analysis of animacy effects in the processing of object relative sentences. *Psychophysiology, 36*, 559-570.