

Processing of Wh-Adjuncts in Filler-Gap Dependencies: ERP Study in Italian

Kirill Chuprinko¹(kirill.chuprinko@ung.si), Marco Sala^{2,3}, Artur Stepanov¹, Francesco Vespignani³

¹University of Nova Gorica, ²University of Geneva, ³University of Padova

Background: ERP studies of filler-gap dependencies (FGDs) have focused primarily on fillers such as object *what*, leaving out FGDs with wh-adjuncts such as *where*. These studies reported P600 effects at the verb immediately preceding the canonical position of the filler [2,3,4]. The P600 was interpreted as a syntactic integration index. As well, the sustained anterior negativity (SAN) was elicited in the regions between the filler and its canonical position and interpreted as a signature of holding the filler in working memory [2,4]. In the gap-based accounts of FGDs, silent gaps are part of the syntactic representation, and the filler integrates with the gap [2]. In contrast, the Direct Association Hypothesis (DAH) assumes a direct link between fillers and verbs, such that the filler is integrated with the verb without reference to a gap position [5]. Structurally, the gap of *where* follows VP, while for *what*, it immediately follows V. For both wh-adjuncts, such as *where*, and wh-arguments such as *what*, DAH predicts the integration with the verb, while the gap-based accounts only predict the integration of *what* with the verb, but not the integration of *where*. We present an ERP study that explores FGD processing with respect to the different gap positions of wh-adjuncts and wh-arguments. We compare SAN and P600 effects in sentences with wh-adjunct and wh-argument fillers. **Method:** Italian speakers (n=32) read sentences in RSVP mode (SOA=500ms, 40 sentences per condition, 120 filler sentences) and answered comprehension questions after 25% of trials. Experimental sentences had an embedded clause with complementizers meaning *that*, *what*, *where*. We ran preliminary analyses extracting 2500-ms epochs that were time-locked to the complementizer onset (500ms prestimulus baseline). EEG amplitudes in *that*, *what*, and *where* conditions were compared. For SAN testing, linear mixed-effects models were fit in three time windows (0–1500ms, 500ms each). To test the P600 at the verb, models were fit in five windows (1500–2500ms, 200ms each). **Results:** No significant SAN-like effect was detected in the time windows between the complementizer and verb onsets. We found a P600 effect whereby the anterior channels were more positive in the *what* condition in comparison to *that* condition ($p < 0.05$ in 1900–2100ms, 2100–2300ms, 2300–2500ms) while the amplitude between the sentences in the *where* and *that* conditions did not significantly differ in the same region and time interval. **Discussion:** The P600 effect at the verb with *what* and its absence with *where* is consistent with the gap-based view of FGDs but not the DAH. The absence of SAN is unexpected but is compatible with FGD studies that failed to detect the SAN in embedded clauses [1,2]. Overall, the preliminary results show the relevance of the adjunct-argument distinction in the processing of FGDs, illustrated by the differences in P600 at the verb.

References

- [1] Aura Cruz Heredia, Bethany Dickerson, and Ellen Lau. Towards understanding sustained neural activity across syntactic dependencies. *Neurobiology of Language*, 3(1):87–108, 2022.
- [2] Christian J Fiebach, Matthias Schlesewsky, and Angela D Friederici. Separating syntactic memory costs and syntactic integration costs during parsing: The processing of german wh-questions. *Journal of Memory and Language*, 47(2):250–272, 2002.
- [3] Edith Kaan, Anthony Harris, Edward Gibson, and Phillip Holcomb. The p600 as an index of syntactic integration difficulty. *Language and cognitive processes*, 15(2):159–201, 2000.
- [4] Colin Phillips, Nina Kazanina, and Shani H Abada. Erp effects of the processing of syntactic long-distance dependencies. *Cognitive Brain Research*, 22(3):407–428, 2005.
- [5] Martin Pickering and Guy Barry. Sentence processing without empty categories. *Language and cognitive processes*, 6(3):229–259, 1991.

Figures and Tables

Figure 1. ERP response (Fz channel) for different experimental conditions

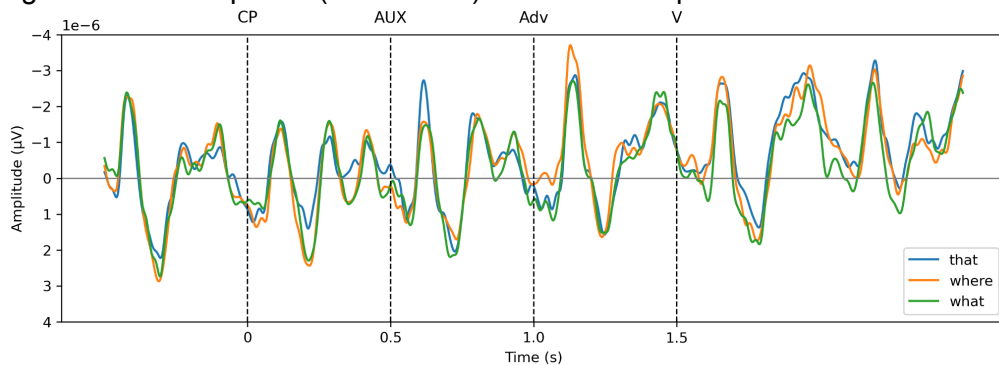
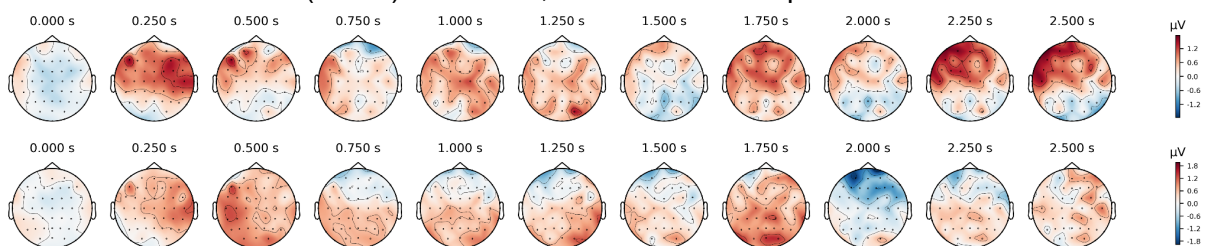


Figure 2. Topographic distribution of voltage differences between *what* and *that* (above) and between *when* and *that* (below) conditions, locked to the complementizer onset



Control and wh-adjunct conditions examples:

Alessandro non sapeva che/dove avevi furtivamente rubato un panino durante la pausa pranzo.

A. NEG know.IMPF that that/where have.2SG.IMPF stolen a sandwich during the break lunch

‘Alessandro did not know that/where you had secretly stolen during the lunch break.’

Wh-argument condition examples:

Alessandro non sapeva cosa avevi furtivamente rubato durante la pausa pranzo. A. NEG know.IMPF cosa have.2SG.IMPF secretly stolen a sandwich during the break lunch

“Alessandro did not know what you had secretly stolen during the lunch break.”

Supplemental Information

Italian has a strong tendency to omit the subject pronouns, and the person feature is realised on the auxiliary verb in complex tenses. The default word order with overt lexical NPs in subject position differs in embedded *che*-clauses and questions: the subject is preverbal in the former and postverbal in the latter case. Given these two facts, we decided to only use the 1st and 2nd person phonologically null subjects in the embedded clause. We assumed that 3rd person marker on the auxiliary verb may activate the expectation for the lexical NP subject later in the sentence in wh-question conditions. In addition, avoiding the 3rd person prevents a possible coreference with the subject of the matrix clause.

The complementizer *che* can mean a wh-subject or a wh-object “what”. However, it seems that such usage is very rare and probably restricted to some dialects or registers. We conducted a short post-experiment survey where participants were asked to choose whether they prefer *che* or *cosa* as a “what” complementizer. Only two participants marked that they prefer *che* as “what”. Also, *cosa* is an acceptable variant of “what” complementizer, but the standard option would be *che cosa*. We opted for *cosa* instead of *che cosa* to avoid a temporary ambiguity of *che* between “that” meaning and as a part of *che cosa* (“what”).