The processing of *wh*-questions in Italian: evidence from an eye-tracking study

Elena Pagliarini, Mirta Vernice, Maria Teresa Guasti
Università degli Studi di Milano-Bicocca

In Italian, questions including *wh*-elements such as *chi* (i.e., who) and *quale-NP* (i.e., which-NP) are temporary ambiguous, as they could lead to a subject or an object interpretation. Additionally, Italian is a pro-drop language that allows post-verbal subject. Thus, in a sentence such as (1), the post-verbal NP could be either the direct object or an inverted subject of the sentence, in absence of verbal agreement or semantic/contextual disambiguation:

(1) Chi bacia la ragazza?
    Who kiss-3SG the girl?

Cross-linguistic evidences indicate that the *wh*-subject extraction (WSE) interpretation involves less processing costs as compared to the *wh*-object extraction (WOE), in line with the Minimal Chain Principle (MCP) (De Vincenzi, 1991). In Italian, the preference for the WSE has been studied by means of self-paced reading and ERP methodology. In particular, a self-paced reading experiment revealed that the WOE in *chi* questions disambiguated through verbal agreement elicited longer reading times at the verb region as compared to the WSE (De Vincenzi et al., 2004). In another unpublished study, a similar evidence was found for *quale-NP* questions. Additionally, a longer reading time at the post-verbal NP was found when *quale-NP* had to be interpreted as the object (De Vincenzi, unpublished manuscript). An ERP study showed a P300 and a P600 at the verb region in *chi* questions involving WOE as compared to WSE (Penolazzi et al., 2005). Accordingly, in another ERP study, a P600 emerged at the verb region in *quale-NP* questions involving a WOE (De Vincenzi, unpublished manuscript). These data suggest that there are similarities (detection of the incongruence at the verb) and differences (integration of the post-verbal NP) in *chi* and *quale NP* questions. Since previous works did not directly compare the processing of *chi* and *quale-NP* questions, these differences and similarities can be spurious effects. This is even more true in light of the fact that a subject/object asymmetry was not found by De Vincenzi (1991) in *quale-NP* questions, in which disambiguation was offered by lexical/pragmatic information. To shed light on how Italian speakers process questions, two eye-tracking studies were conducted in which we manipulated type of *wh*-element (*quale-NP* vs. *chi*) in questions with number morphology disambiguation on the verb. Sentences were adopted and modified from De Vincenzi (De Vincenzi, unpublished manuscript). First, since WOE is dispreferred we predict to find longer reading time and more regressions in WOE both in *chi* and *quale*-NP questions due to reanalysis. Second, though there are no previous evidence that provide a direct comparison between *chi* and *quale-NP*, we predict to find longer reading times in *quale-NP* questions, as here the *quale-NP* is D-linked (Pesetsky, 1987) and thus its processing is more demanding. **Experiment 1.** The aim was twofold. First, we aimed at disentangling whether *chi* and *quale-NP* are processed differently. Second, we asked whether the preference for the WSE holds both for *chi* and *quale-NP* questions. Our independent variables were: Extraction site (subject (WSE) vs. object (WOE)) and Type of *wh*-element (*chi vs. quale-NP*). The 48 experimental sets (see 2 a-d) were administered within participants to 33 participants (mean age 25;8):

(2) a. [1] Puoi dirmi [1]/[2] chi [2]/[3] saluta [3]/[4] i nonni [4]/[5] alla partenza in stazione? [5]/
    b. [1] Puoi dirmi [1]/[2] chi [2]/[3] salutano [3]/[4] i nonni [4]/[5] alla partenza in stazione? [5]/
        Can you tell me/who/greet-3SG vs. greet-3PL /the grandparents/at the departure at the station?/
    c. [1] Puoi dirmi [1]/[2] quale nipote [2]/[3] saluta [3]/[4] i nonni [4]/[5] alla partenza in stazione? [5]/
    d. [1] Puoi dirmi [1]/[2] quale nipote [2]/[3] salutano [3]/[4] i nonni [4]/[5] alla partenza in stazione? [5]/
        Can you tell me/which grandson/greet-3SG vs greet-3PL/the grandparents/at the departure at the station?/

At region 2 (*wh*-element), the analysis of the first pass reading time revealed significantly longer reading times in *quale*-NP questions than in *chi* questions, though controlling for region length. At region 3 (verb), there were longer total reading times in questions involving a WOE as compared to WSE. Additionally, the significant interaction between Type of *wh*-element and Extraction suggested that with WSE, *chi* questions were read faster than *quale-NP* questions, whereas WOE slowed down reading times with both *wh*-elements. There were more regressions from region 3 to a previous region in *quale-NP* questions, but interestingly, area 3 received more regressions from a later region in *chi* questions. At region 4 (post-verbal NP), longer first pass reading time was found in *quale-NP* questions. At region 4, *chi* questions caused significantly longer total reading times and more regressions than *quale-NP* questions. Note however that the effect found at region 4 could be due to a spillover effect. **Experiment 2.** (41 participants, mean age 23;2). We basically replicated Experiment 1, except that we added an additional region between the verb and the post-verbal NP, presenting a PP, in all the experimental sentences:

(3) [1]Puoi dirmi [1]/[2] chi [2]/[3] saluta [3]/[4] con tristezza [4]/[5] i nonni [5]/[6] alla partenza in stazione? [6]/
      Can you tell me/who/greet-3SG/with sadness/the grandparents/at the departure at the station?/

We did so in order to disentangle the nature of the effects previously found at post-verbal NP region. Reading times and regressions basically replicate those of Experiment 1. Crucially, at region 5 (post-verbal NP), *chi* questions caused more regressions and longer total reading times, whereas *quale-NP* questions caused longer first pass reading time. **Discussion.** The verb area received more regressions from a later region in *chi* questions. Additionally, the significant interaction indicates that the verb region is read slower both in *chi* and *quale-NP* questions in WOE. This suggests that the subject-object extraction asymmetry holds both for *chi* and *quale-NP* questions, in contrast with results on other languages in which the subject/object asymmetry seems to be evident only in *which-NP* questions (Friedmann et al., 2008; Hickok e Avrutin, 1995; Avrutin 2000). We attribute the difference between our findings and others' to the different structures of questions in the languages involved (Guasti et al., 2012). Moreover, longer reading times with *quale-NP* questions suggest that verb processing in *quale-NP* questions is more demanding than in *chi* questions, thus confirming our second prediction. At the post-verbal NP region, the comparison between early and late measure indicate that *who* and *which-NP* integrate the post-verbal NP to a different extent. Experiment 2 confirms these results and rule out the possibility that effects at the post-verbal NP region are due to spillovers. We propose that the longer first pass reading times at the *wh*-element region and at the post-verbal NP region in *quale-NP* questions area are the reflection of lexical integration. Interestingly the consistency of the regressions and total reading times found in Experiment 1 and 2 at the post-verbal NP region support the hypothesis that the integration of the post-verbal NP requires less processing in *quale-NP* questions in comparison with *chi* questions. We propose it might be due to predictability: readers do not expect to find a NP after the verb in *chi* questions whereas in *quale-NP* questions they postulate the NP as soon as the *quale-NP* phrase is encountered (Reichle et al., 1998). This is turn may be due to the fact that the structural position of the subject in the two types of questions is different (Cardinaletti, 2004).

Selected references: De Vincenzi, M., 1991, *Syntactic parsing strategies in Italian*. Dordrecht: Kluwer Academic Publishers; **De Vincenzi, M., Guasti, M.T., Di Matteo R.,** unpublished manuscript, Comprehending Interrogative Sentences: A reading time and ERP study; **De Vincenzi, M., Di Matteo, R., Job, R.,** 2004, Comparing wh-questions interpretation in Italian sentences, *Psychonomic*, Minneapolis, Minnesota; **Penolazzi, B., De Vincenzi, M., Angrilli, A., Job, R.,** 2005, Processing of temporary syntactic ambiguity in Italian "who"-questions: a study with event-related potential, Neuroscience Letters, 227, pp. 91-96.