How the movement of temporal adverbs can affect tense processing

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Language makes use of one or more linguistic devices (grammatical categories, lexical items, particles etc.) to express temporality. In Italian, temporal information is mainly expressed through the tense morphology and through optional adverbs such as deictics (e.g *ieri, la prossima settimana*). Despite their optionality, deictic temporal adverbs seem to play a crucial role in the processing of temporal information since they must denote a time interval that is coherent with the temporal features expressed by the verb, otherwise the sentence would be ungrammatical as shown in (1). We refer to this temporal feature coherence as the *temporal concord.*

(1)   a. Ieri Gigi comprò una chitarra nuova.
           'Yesterday Gigi bought a new guitar.'
        b. *Ieri Gigi comprerà una chitarra nuova.
           'Yesterday Gigi will buy a new guitar.'

Given that temporal adverbs can be located in different positions within the sentence, the main issue that will be addressed here is if (and how) deictic adverbs affect the processing of the temporal concord depending on their structural position. A theoretical proposal for the movement of temporal adverbs is provided, together with some experimental data on sentence comprehension.

According to the specifier-based approach (Cinque 1999, Alexiadou 2000), temporal adverbs are located in the specifier of TP. However, in that position the adverb seems to intervene in the *probe-goal* operation between the functional head that bears phi-features in AgrP and the subject inside the vP. For this reason a sentence like (2) is ungrammatical.

(2)   *Gigi ha ieri comprato una chitarra.
        'Gigi has yesterday bought a guitar.'
        [$_{AgrP}$ phi-f ha] … [$_{TP}$ ieri […[$_{vP}$ Gigi [$_{vP}$ comprato una chitarra…]…]…]
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The same effect was found (Belletti & Rizzi 2012) for intervening adverbial PPs containing a nominal phrase (e.g. *di corsa*), but interestingly not for adverbial PPs containing an adjectival phrase (e.g *di nuovo*). To preserve the subject-verb agreement, the phenomenon of *smuggling* is required, in which a chunk of vP moves towards a structural position higher than the position of the intervening element. Applying this hypothesis to temporal adverbs a) gives a new validation to the analysis of temporal adverbs as NPs (Enç, 1987) and b) explains why an adverb can be found at the end of a sentence (e.g. *Gigi ha comprato una chitarra ieri*, 'Gigi has bought a guitar yesterday') despite its initial position in [spec, TP].

The effect of intervenience disappears also when the adverb moves to the left periphery of the structure for prominence purposes: the adverb can move to [spec, ModP] where Mod is a dedicated head that makes any moved adverb prominent, not requiring a connection to the discourse context as in the case of a Topic, and not requiring a contrastive interpretation as in the case of a Focus (Rizzi, 2004a); the adverb can be also topicalized as an object of a main clause (e.g *Ieri, Gigi lo ricorderà come il giorno più bello della sua vita,* 'Yesterday, Gigi will remember it as the best day of his life') or as subject of a subordinate clause (e.g *Ieri,*

Gigi dirà che è stato il giorno più bello della sua vita, 'Yesterday, Gigi will say that it was the best day of his life'). Note that when the adverb is topicalized the temporal concord between the adverb and the main verb is not mandatory. To summarize, the main theoretical hypothesis is that a temporal adverb can be located after or before the main verb due to different structural movements: the adverb is located after the verb because of the checking of morphological features (namely, the preservation of subject-verb agreement); the adverb is located before the verb because of scope-discourse reasons (prominency or topicalization). The online processing of the temporal concord during sentence comprehension may thus be sensitive to these structural asymmetries. However, very little experimental literature has addressed the temporal concord from this point of view.

A behavioural study on the processing of tense in agrammatic aphasia (Faroqi-Shah & Dickey, 2009) shows that the temporal violation is easier to be detected (faster RTs) when the adverb is located after the verb (e.g. *My sister lived in New Hampshire next year*) respectively to the condition in which the adverb is located before (e.g. *Next year my sister lived in New Hampshire*), both for control and for aphasic participants.

Other experimental data in Italian (Biondo & Vespignani, submitted to CUNY) show that the larger and more sustained effect (mean RTs on temporal violations) appears when the adverb is located immediately before the verb (e.g. *Il conte ieri notte troverà il tesoro…*) while a smaller effect is present when the adverb is located after the verb (e.g. *Il conte troverà il tesoro ieri notte….*). Surprisingly, the condition in which the adverb is topicalized and located at the beginning of the sentence shows negligible effects and just a small numerical difference two words after the violated verb (e.g. *Ieri notte il conte troverà il tesoro…*).

These experimental findings on the processing difficulties of temporal violations seem to confirm that: 1) the temporal concord processing is sensitive to the critical constituent at which the temporal violation is detected and can vary depending on the structural position of the temporal adverb within the sentence; 2) when the adverb is located in the left periphery of the structure, the processing of tense is more complex, probably due to the scope-discourse properties involved in this structural dislocation; 3) given that there are cases in which the temporal concord between the main verb and a topicalized adverb is not mandatory, we can hypothesize that the parser during online processing may delay the checking of temporal information to later stages of processing, and this would explain the unexpected results of the last study presented here.

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