

What processing data from Hebrew tell us about the merger of adjuncts

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Introduction. In the various approaches to sentence processing, the processor is assumed to build structure as soon as possible, with no delay till disambiguation. Consequently, adjuncts are assumed to be merged instantaneously (Frazier & Rayner, 1982, Pritchett 1992). While this is clearly the null hypothesis with regard to processing, several authors have argued on theoretical grounds that in the formation of sentences, adjuncts are merged only after the rest of the structure is built ("late-merger of adjuncts", e.g. Lebeaux 1991). Thus, it might seem that sentence processing and sentence formation are guided by different sets of principles.

We tackle this issue empirically, exploiting data from the processing of Hebrew sentences with clause-initial PP-adjuncts. Based on our results, we argue that the merge of such adjuncts is not necessarily instantaneous. This supports the view that sentence processing and sentence formation are handled by the same computational system (e.g. Chomsky 1995).

Background assumptions. Processing guideline (Pritchett 1992): the processor attempts to satisfy predicate-argument relations asap. Processing breakdown: Viewing reanalysis as syntactic movement, Siloni (2004) suggests that processing breakdown leading to a perceived garden path (GP) effect occurs when reanalysis-movement cannot take place since the relocated constituent has to be moved (internally-merged) to a non-c-commanding position.

The relevant aspects of Hebrew grammar. The realization of subject position: Unaccusative verbs in Hebrew allow their subject position to be realized either by the theme argument (undergoing A-movement), or by *pro*_{expl} (Rizzi 1982). The latter option does not exist for unergative and transitive verbs. The surface position of the main verb: The verb in Hebrew raises to I, and can raise to C, if some phrase is adjoined to CP. If the verb raises to C, the subject surfaces post-verbally, regardless of the type of the verb.

The experiment. Task: judgment of processing difficulty (OK/GP). Participants: 59 students from Tel Aviv University. Materials: The questionnaire included four experimental conditions: two conditions with unaccusative verbs (coded as [+unaccusative]), with and without a post-verbal DP (coded as ±DP) (1), (2), and two conditions with unergative or transitive verbs (coded as [-unaccusative]), ±DP (3), (4). There were two sentences per condition, and 29 filler sentences, which were either OK or uncontroversial GP (e.g. (5)).

- (1) axarey she-dina shateta mic nishpax al ha-shulxan.
after that-Dina drank juice spilled on the-table
'After Dina drank, juice spilled on the table.'
- (2) axarey she-dina shateta mic nishpax yain al ha-shulxan
after that-Dina drank juice spilled wine on the-table
'After Dina drank juice, wine spilled on the table.'
- (3) leaxar she-dina siyma lecayer shalosh banot niku et ha-ulam
after that-Dina finished to-draw three girls cleaned acc the-hall
'After Dina finished drawing, three girls cleaned the hall.'
- (4) bediyuk kshe-dina siyma lecayer shalosh banot mac'u ha-banim et ha-matmon
exactly when-Dina finished to-draw three girls found the-boys acc the-treasure
'Right when Dina finished drawing three girls, the boys found the treasure.'
- (5) ha-more amar la-yeladim she-ha-rofe gamar livdok lirkod
the-teacher said to+the-children that-the doctor finished to-examine to-dance
'The teacher told the children that the doctor finished examining to dance.'

Results

Condition	1	2	3	4	5
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Percentage of sentences judged as GP	83.8	28.8	50	64.4	98.3
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Under the above assumptions regarding processing, all the structures should have led to a full GP, because all involve a reanalysis-movement to a non-c-commanding position (the movement from the object position of the embedded verb to spec,IP of the main clause). This is so since it is tacitly assumed that once the main predicate is encountered and the main clause projected, the PP-adjunct is instantaneously merged with it.

Since (1)-(4) evoked GP effects significantly different from the non-controversial GP sentence (5), it is safe to conclude that this is not the case in Hebrew.

The account. Since all the tested structures include a clausal PP-adjunct (presumably adjoined to CP), all of them allow for triggered inversion; thus, once the main verb is encountered, there are two possible processing options: the main verb can be analyzed as being raised up to C, or it can be analyzed as being raised just from V to I.

Since in the [-unaccusative] conditions ((3), (4)), these are the only two available options, and given the fact that the sentences in this condition induced GP effect only around chance, it is reasonable to conclude that the two possible positions of the verb affect the processing of these structures, regulating the temporal aspect of the merge of the PP with the main clause. If the main verb is analyzed in C, it forces immediate merge of the PP with the CP, since [-unaccusative] verb-movement to C must be triggered by material in the CP. If the verb is analyzed in I, no thematic considerations force the attachment of the adjunct. The first option would lead to the GP effect, because it will necessarily involve reanalysis-movement to a non-c-commanding position, as explained above. In contrast, the second option will result in smooth processing; it will not involve the problematic reanalysis-movement, as the relevant DP will be externally, rather than internally, merged into spec-IP. (In our talk, we will address the rate difference attested between (3) and (4).)

Taking into account the fact that unaccusatives can realize their subject position either by a lexical DP or by *pro_{expl}*, in the [+unaccusative] conditions each of the above options gives rise to two options, once the main verb is encountered, resulting in four processing options:

- a. The main verb is analyzed in C:
 - (ai) Spec-IP is realized by the lexical DP
 - (aii) Spec-IP is realized by *pro_{expl}*
- b. The verb is analyzed in I:
 - (bi) Spec-IP is realized by the lexical DP
 - (bii) Spec-IP is realized by *pro_{expl}*

28.8% GP on condition (2) suggests that among the four options, only one leads to GP, while the other three result in smooth processing. The opposite is attested on condition (1) (83% GP) (1). This is so since in this condition, spec,IP has to be realized by the lexical DP (initially analyzed as the object of the embedded verb). This can be achieved without reanalysis-movement if the processor takes option (bi). All the other options will involve illicit reanalysis-movement, assuming that in option (bii), although the merge of the PP is not immediate, it nevertheless occurs prior to the reanalysis. In the +DP condition (spec,IP is realized by *pro_{expl}*), the only option that will result in GP is (ai), as it will necessarily involve reanalysis-movement of the preverbal DP back to its initial position. In all other options, either there is no reanalysis at all, because spec,IP is occupied correctly by *pro_{expl}* ((aii), (bii)), or the required reanalysis does not involve movement, because due to the analysis of the main verb in I, the PP is not merged yet with the main clause ((bi)).

Selected references

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