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Discourse-linking and long-distance syntactic dependency formation

The background and aims of the study

Lexically-specified or D(iscourse)-linked *wh*-phrases (e.g. *which horse*) possess properties which are distinct from their non D-linked counterparts (e.g. *who*). In particular, it seems that *wh*-dependencies which form with a D-linked antecedent are

less sensitive to constraints like islands (Chomsky 1962; Ross 1967) and Superiority (Chomsky 1973). For example, (1a) shows a non D-linked *wh*-island violation which is ungrammatical, but notice that the grammaticality of the same violation is significantly ameliorated when the antecedent is D-linked in (1b).

- (1) (a) *Who did Jim wonder whether Mary loved_?
 (b) Which man did Jim wonder whether Mary loved_?

Pesetsky (1987) accounted for this by positing that D-linked dependencies can form via unselective binding rather than the conventional *wh*-movement, on the basis that constraints such as islands and Superiority are thought of as constraints on movement specifically. The present study aimed to test this formal account of D-linking effects by examining its psychological reality during processing.

Locality constraints motivate the idea that *wh*-movement unfolds successive-cyclically (= using multiple within-clause steps), leaving a representation of the antecedent at each clause-boundary as it does so. Binding, however, is thought to co-index an antecedent with its underlying position in a single operation. It has previously been possible to identify the real-time online instantiation of intermediate antecedent representations during the processing of long-distance *wh*-dependencies (Gibson & Warren 2004; Marinis et al. 2005). The present study appropriates the method used in these studies while adding a +/-D-linked antecedent condition. If Pesetsky (1987) is correct, evidence of the intermediate reactivation of antecedents during long-distance *wh*-dependency formation should be restricted to those with non D-linked antecedents. This is because, according to the theory, only non D-linked dependencies should form in multiple steps if D-linked ones use a (single-step) binding operation.

The experimental method and materials

The main task used a self-paced reading method (Just et al. 1982) in which participants read through sentences segment-by-segment while reaction-time software recorded the reading time for each one. Longer reading times were associated with greater processing cost. The materials included two critical manipulations. The first was whether the *wh*-dependency being set-up had a D-linked antecedent or not (+/-D-linking) and the second was whether or not the dependency included an intervening (CP) clause-boundary which could provide the syntactic space for an intermediate representation of the antecedent to be instantiated (+/-Intermediate representation). Since Gibson & Warren 2004 and Marinis et al. 2005 among others used materials on which these are based, and found that the effects being searched for in the critical region are specific to those including *wh*-dependency formation, additional no-*wh*-movement control conditions were foregone. The critical conditions are shown in (2)-(5):

- (2) **-D-Linking; + Intermediate representation:** The manager wondered **who** the secretary claimed [CP *who* that the new salesman had pleased *who* in the meeting].
 (3) **-D-Linking; -Intermediate representation:** The manager wondered **who** the secretary's claim about the new salesman had pleased *who* in the meeting.
 (4) **+D-Linking; + Intermediate representation:** The manager wondered **which gentleman** the secretary claimed [CP *which gentleman* that the new salesman had pleased *which gentleman* in the meeting].

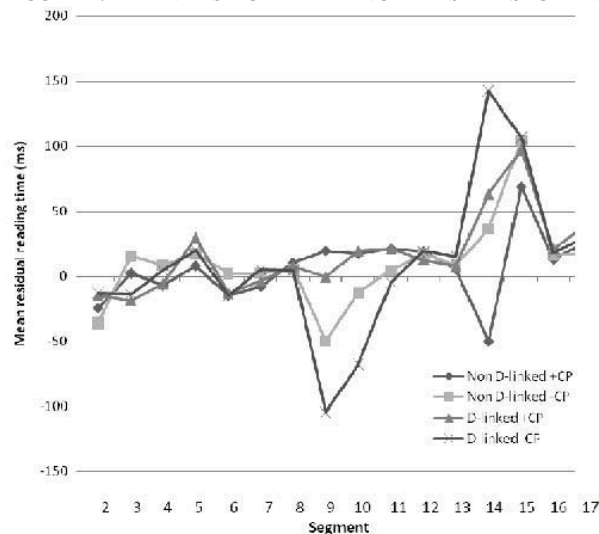
(5) **+D-Linking; -Intermediate representation:** The manager wondered **which gentleman** the secretary’s claim about the new salesman had pleased **which gentleman** in the meeting.

The rationale was that an intermediate representation of an antecedent would facilitate subsequent antecedent reactivation at the underlying verb position since it would make that argument more locally activated in the parse. Thus, if Pesetsky’s (1987) theory is to be consistent with these data, such facilitation should be restricted to dependencies with non D-linked antecedents.

Results and discussion

Figure 1 displays the average residual reading times for each segment. Reading times at the critical subcategoriser (*pleased*), which was Segment 14, were statistically significantly quicker in conditions with an intervening CP relative to conditions without one. Planned comparisons revealed this was true for both non D-linked and D-linked antecedents. Thus, these data suggest that both non D-linked and D-linked antecedents were reactivated at intermediate clause-boundaries within their dependencies. It is argued that this is consistent with multiple-step movement-type dependency formation, but inconsistent with single-step binding-type dependency formation. As such, these data are not consistent with Pesetsky’s hypothesis.

FIGURE 1. MEAN RESIDUAL READING TIMES PER SEGMENT (MS).



These data may also provide reason for positing a new processing-based theory for the amelioration effects of D-linking on certain constraints, in which the widely-attested early-discourse structure instantiation it provides (e.g. Radó 1998; Frazier & Clifton 2002; Diaconescu & Goodluck 2004) “stabilises” potential constraint violations as and when they arise in a time-locked position in the parse. This would account for the data seen in Segment 9 of Figure 1, whereby the presence of a D-linked antecedent significantly reduces processing time when encountering what is argued to be a *potential* island boundary.

Finally, these data provide the first evidence of successive-cyclicity occurring online during long-distance dependency formation involving complement clauses, and thus lend support to the formalisms and theories which propose such multiple-step

dependencies in these environments. Additionally, a dissociation is revealed between the kind of antecedent reactivation found at underlying subcategorisers versus that which is found at intermediate positions. While the lexical-specificity of D-linked antecedents significantly increases the amount of time taken for reconstructing them at the verb (as can be seen in Segment 14 of Figure 1), this is not the case for intermediate reactivations, where a D-linked antecedent is reactivated significantly faster than a non D-linked one (as is demonstrated by the +CP conditions of Segment 9 in Figure 1). Thus, it is argued that while antecedent reconstruction at the verb involves full lexical information access, at intermediate positions it is likely to be a purely structural phenomenon.

Concluding remarks

The data collected in the present study provide some quantified psycholinguistic evidence which indicates that intermediate representations of antecedents are present in long-distance *wh*-dependencies, both when they are non D-linked and crucially when they are D-linked. As such, the ameliorative properties of D-linking over certain “movement” constraints like islands do not seem to be explicable, as Pesetsky (1987) suggests, with an unselective binding account. This is because the presence of intermediate representations is indicative of successive-cyclic movement-type dependency formation rather than single-step binding-type dependency formation.

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