

Differential time courses for referential and syntactic active dependency formation

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Background Long-distance dependencies such as *wh*-dependencies (1) and referential cataphoric dependencies (2) pose a challenge for incremental processing because the first element (*what* in 1; *he* in 2) cannot fully be interpreted until the second element is encountered (the gap ‘___’; the antecedent *Magnus*):

(1) *John wondered what_i the chef marinated the pork chops in ____i yesterday.*

(2) *After he_i cleaned the stairwell, Ingrid greeted the Magnus_i.*

For both dependency types, there is evidence that the parser incrementally attempts to actively resolve the dependency in an upcoming object position before receiving bottom-up confirmation of a correct analysis (active Dependency Formation: DF)[5]. The similarity has raised the hypothesis that there is a single underlying active parsing mechanism for incremental processing both syntactic and referential dependencies [2]. This hypothesis predicts a similar time course for active DF triggered by *wh*-dependencies and by cataphors. Active DF for *wh*-dependencies has been shown to occur using a plausibility mismatch paradigm: In sentences such as (3), readers slow down at the verb (*wrote*) when a filler does not form a plausible object argument for that verb (*city*), as compared to sentences with a plausible filler (*book*)[e.g., 3,4].

(3) *We like the [city/book] that the author wrote with great dedication about ___...*

This plausibility mismatch effect (PMME) has been interpreted as evidence that the parser actively posits an object gap ‘early’: The object gap is posited before processing the semantics of the main verb. The slowdown occurs when the semantics of the verb result in an implausible parse with the posited object gap (‘writing a city’). In this study, we test whether comprehenders also actively posit an antecedent for a cataphor in object position of an upcoming verb before processing its semantics (early-active DF), or whether comprehenders wait until they reach the object position before positing the antecedent (late-active DF, [1]).

Experiment (SPR in Norwegian, N=74) In sentences with cataphors (Fig.1), we manipulated 2x2 Cataphor-Match (whether the main subject Matched/Mismatched the cataphor’s gender) and Verb-Animacy (whether the main verb allowed an Animate object (*yell at*) or not (*clear away*)). In a separate set of control items, we manipulated the animacy of *wh*-fillers to match or mismatch the object-animacy requirements of the main verb (Fig.1).

Predictions Cataphor items: Active DF is expected to lead to a gender-mismatch slowdown at/immediately after the subject. In the Mismatch conditions, the cataphor is not resolved at the subject, so the parser continues its search for an antecedent [5]. If antecedent search follows early-active DF it should posit the antecedent in object position before processing the verb. Thus, we expect a PMME at the verb when it does not allow an animate object argument, in the Mismatch conditions. Wh-items: Early-active DF is expected to lead to a slowdown at or immediately after the verb when the filler mismatches the verb’s animacy restrictions.

Results We analyzed log-transformed RTs using LMEMs. Cataphor items (Figs.2,3) yielded 37-71ms gender-mismatch effects at the subject and spillover region ($t = 2.55; 4.34$), replicating previous demonstrations of active DF [1-2]. Contrary to predictions of early-active DF, there was no significant PMME at the verb or the two spillover regions: we observed no main effect or Animacy * Match interactions (all models $t < 1.4$). The wh-items (Fig.4) show a significant animacy-mismatch effect at the verb-spillover region (59ms, $t = 2.78$).

Conclusion We observed evidence for early-active DF triggered by syntactic *wh*-dependencies but not by referential cataphoric dependencies. The results suggest that the parser does not apply a one-size-fits-all active parsing strategy when confronted with dependencies where the second element is expected. Instead, our results suggest that DF triggered by different dependency types differs at least in the timing of active commitment: commitment to an antecedent appears to be delayed relative to prediction of a gap. We are currently running an eye-tracking version of the experiment to investigate the time course of referential DF in more detail.

Cataphor items, Animate verb-Match/Mismatch

Etter at [hun/han] har vasket trappa, skal Ingrid sannsynligvis kjefte på
 After COMP [she/he] has cleaned stairwell.DEF, will Ingrid probably yell at
 den irriterende leietakeren som alltid setter søppelet i gangen.
 the annoying tenant who always puts garbage.DEF in hallway.DEF.

Cataphor items, Inanimate verb-Match/Mismatch

Etter at [hun/han] har vasket trappa, skal Ingrid sannsynligvis rydde bort
 After COMP [she/he] has cleaned stairwell.DEF, will Ingrid probably clear away
 den irriterende sykkelen som leietakeren har satt i gangen.
 the annoying bicycle that tenant.DEF has put in hallway.DEF.

Wh-items, Match/Mismatch

Ivar ville vite [hva/hvem] kokken marinerte veldig gode karbonader [i/for] da han
 Ivar wanted to.know [what/who] chef.DEF marinated very good pork-chops [in/for] when he
 forberedte kveldsskiftet.
 prepared evening-shift.DEF.

Figure 1. Example item set.

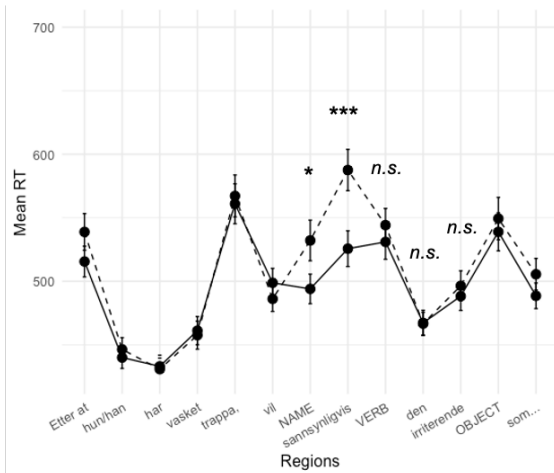


Figure 2. Cataphors: animate verbs (mean RTs).

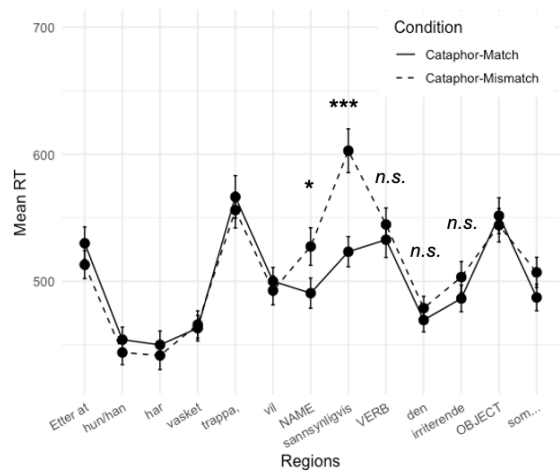


Figure 3. Cataphors: inanimate verbs (mean RTs).

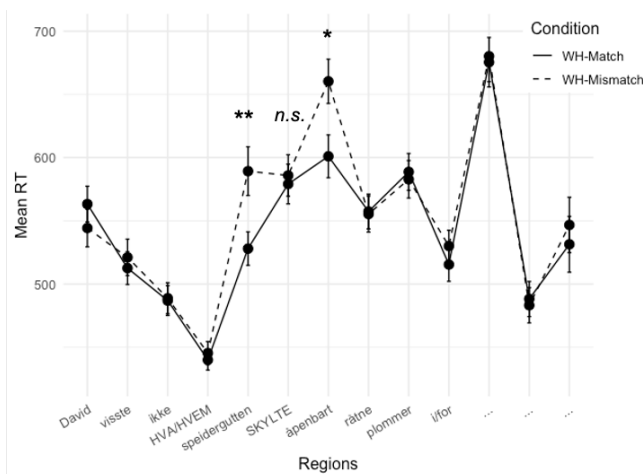


Figure 4. Wh-dependencies (mean RTs).

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