UNREPAIRABLE GARDEN-PATHS REVEAL REANALYSIS PROCESSING

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INTRODUCTION & BACKGROUND

• We know about basic sentence comprehension.
  • Due to incrementality, parser makes immediate syntactic commitments without knowledge of the right context.
  • If syntactic decision is consistent with the right context, parsing proceeds smoothly.
  • If not, the parser is garden-pathed - error signal indicates that the current syntactic analysis is unsustainable.

• Our question: How does the parser recover from a garden-path?
  • Our hypothesis: The parser attempts to re-parse the input.
  • Critically, re-parsing starts from the point of breakdown and works backwards through the tree (Fodor & Inoue 1998).
  • This study relies on the comprehension of unrepairable garden-paths - ungrammatical sentences that superficially resemble recoverable garden-paths and trigger reanalysis mechanisms.

• We compared the time-course of reanalysis for recoverable and unrepairable garden-path sentences.

• Two experiments investigated this question:
  • Experiment 1: Subjects read sentences while their eye movements were monitored, and afterwards made a grammaticality judgment.
  • Experiment 2: Subjects read sentences and were prompted to make a speeded grammaticality judgment at various points after the error signal to probe the time-course of reanalysis.

EXPERIMENT 1: EYE MOVEMENTS

Sentences
(1) Garden-Path: As the eagle attacked the vulture soared overhead.
(2) Control Garden-Path: As the eagle attacked the vulture soared overhead.
(3) Verb Decoy: After the frog caught the fly buzzed around the room.
(4) Preposition Decoy: As the fisherman satbathed on the beach his sheepdog slept happily.
(5) Grammatical Filler: Whenever the fisherman satbathed on the beach his sheepdog slept happily.
(6) Ungrammatical Filler: While Justin watched over the river but in the park,

• Garden-paths were constructed using optionally transitive verbs (transitivity:61%). Verb Decoys were constructed using obligatorily transitive verbs (transitivity: 91%), and Preposition Decoys using obligatorily transitive prepositions (virtually all prepositions are obligatorily transitive).

METHOD

• 20 Subjects, 246 Stimuli (20 Garden-Path, 20 Unambiguous Control, 20 Verb Decoy, 20 Preposition Decoy, 120 Grammatical and Ungrammatical Fillers)

• Subjects made a single grammaticality judgment after reading each sentence when they were ready to make their decision.

RESULTS

• Grammaticality judgments overall are accurate. (Fig. 1)

• 1st Pass regressions out of Verb2 (disambiguation region) indicate a garden-path effect for Garden-Path and a severe one for Decoy conditions. (Fig. 2)

• Regressions were made to regions containing words that needed to be re-parsed. (Fig. 3)
  • Regressions made to subordinate verb, especially for Verb Decoys, but not for Garden-Paths. Preposition Decoys did not differ from Garden-Path Controls.
  • More regressions to the NP/P region for Preposition Decoys than for Verb Decoys.

• More total reading time spent on parts of the sentences that need to be syntactically restructured. (Fig. 4)

EXPERIMENT 2: SPEED-ACCURACY TRADE-OFF

Subjects made a rapid grammaticality judgment at one of four delays. Subjects then confirmed or revised their decision without time pressure.
  • Modified version of McElree (1993) Speed-Accuracy Tradeoff
  • Same stimuli as Experiment 1.

METHOD

• 40 Subjects, 246 Stimuli (same as Experiment 1)

DELAY STRUCTURE

As the eagle attacked the vulture soared overhead.

<table>
<thead>
<tr>
<th>time</th>
<th>0 ms</th>
<th>325 ms</th>
<th>650 ms</th>
<th>975 ms</th>
</tr>
</thead>
</table>

RESULTS

• Grammaticality judgments are sensitive to reanalysis.

• Sensitivity to reanalysis

• At 0ms all experimental conditions are the same.
  • Garden-Path and Decoy conditions all diverge rapidly by 325ms.
  • Asymptotic (i) differences: Difficulty in distinguishing Garden-Paths from Verb Decoys, but not Garden-Paths from Preposition Decoys.
  • Rate (ii) differences: Recognition of Preposition Decoys as ungrammatical compared to Garden-Paths occurs faster than for Verb Decoys compared to Garden-Paths.

CONCLUSIONS

• No triage. Reanalysis initiates regardless of repair needed. Failure to reanalyze may occur but only after measurable processing time.
  • Reanalysis is reparsing. In all garden-pathing conditions, the main verb initiates Steal of the subordinate clause’s HP object, triggering further errors depending on the condition:
    • Garden-Path: Subordinate verb’s transitivitiy is checked and changed to intransitive, repair is successful, and structure is ruled grammatical.
    • Verb Decoy: Subordinate verb’s transitivitiy is checked, but found to be obligatorily transitive, no change is allowed, repair is unsuccessful, and grammaticality falls off gradually.
    • Preposition Decoy: Subordinate preposition is always obligatorily transitive, no lexical look-up is necessary, repair is quickly abandoned, and grammaticality falls of rapidly.

• Reanalysis includes a lexical relook step. Unlike prepositional transitivitiy, verb transitivitiy information is not maintained by the parser and must be checked. This slows the rejection of Verb Decoys compared to Preposition Decoys.

REFERENCES & ACKNOWLEDGEMENTS


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