Anticipating Upcoming Discourse Relations:
Using Eye Movements To Measure Verb-Driven Pragmatic Expectation

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1. Question
Given existing evidence for expectation-driven processing at the levels of sounds, words, and syntactic structures, do we find that comprehenders also generate expectations at a pragmatic level?

2. Pragmatic Expectations
Testing ground: two relations taken from the wider inventory of implicit discourse coherence relations which are inferred to hold between clauses (Kehler 2002)

- Explanations: infer that 2nd clause explains 1st
  Theo congratulated Miriam. She had won the spelling bee.

- Occasions: infer sequence of events
  Heather bounced a basketball to Josh. He caught it.

Previous work: story continuations show verbs guide coherence expectations (Rohde et al. 2006, Kehler et al. 2008)

Implicit Causality (IC) Verbs → Explanations
(come, amuse, scold, detest, etc.)

Transfer-of-Possession (TOP) Verbs → Occasions
(bounce, give, hand, pass, etc.)

3. Discourse-Relation Classification Paradigm

Implicit learning with tube ‘classifier’ (McMurray & Aslin 2004)

- Task: for each item in implicit learning phase, the participant...
  ... launches ball
  ... hears a two-sentence story
  ... guesses story classification (left or right)
  ... receives visual/auditory feedback for correct classification

Sample materials:

- Explanation: Leo takes the bus to work. He doesn’t have a car.
  Occasion: Melissa ran towards Trevor. They embraced.

Goal: learn mapping of, e.g. Explanation = left / Occasion = right (relation-region mapping reversed for half the participants)

Eyetracking hypothesis

- If verb-driven contextual guide coherence expectations
- And if comprehenders can learn a relation—region mapping
- Then hearing a coherence-biasing cue in sentence1 should yield anticipatory looks to the region corresponding to the expected coherence relation before sentence2 is heard

IC verbs → more looks to Explanation region
TOP verbs → more looks to Occasion region

4. Experimental Design

Implicit learning training phase

Task: learn classification w/10 correct items in a row or all 60 items

Materials: half Explanations, half Occasions

Post-training quiz: 24 items with no feedback

Speeded-response task with eyetracking

Task: launch ball for sentence1, click emerging ball for sentence2

Explanations: infer sequence of events

- Given existing evidence for expectation-driven processing at the discourse level... (extends work on McMurray & Aslin 2004)

- How to interpret/evaluate early and late timecourse effects?

5. Results

Critical measure: preference for looking to the Explanation region vs. Occasion region during sentence1, calculated as relative proportions of eye fixations in 100 ms ‘bins’

Verb-driven biases: Following the critical verb, listeners begin showing a preference to look at the region associated with the appropriate discourse relation.

Training differences: Not all subjects were equally successful in learning relation-region pairings during training. This appears to affect the strength of verb-driven expectations in the test phase:

- Negative linear coefficient: slope in TOP condition is lower (overall shape of curves is different)
- Negative quadratic coefficient: change in slope in TOP condition is lower (reaching target later)
- IC cue is incorporated earlier and in a more meaningful way for those who learned the relation-region mapping

6. Analysis

- T-tests per ‘bin’:
  Goals: Identify points where relative proportions of Exp. vs. Occ looks are significantly different from zero for both IC/TOP

- Effects for Training-Success Participants (n=7 of 22):
  - IC condition differs from zero 1600ms after verb
  - TOP condition differs from zero 900ms after verb

- Effects for Training-Failure Participants (n=5 of 22):
  - IC condition differs from zero 400-600ms after verb
  - TOP condition differs from zero 2100ms after verb

- Growth Curve Analysis (Mirman, Dixon, & Magnuson, 2008)
  - Goal: model looks to expected coherence region
  - Strategy: series of regression models to fit curves to data, first collapsed across participants and conditions, then with added variables to check for improved fit (avoid multiple analyses across discrete windows, as with t-tests)
  - Analysis: Adding verb type improves model fit, but differently depending on success/failure in training phase

7. Summary

Findings:
- Psychological plausibility of Explanation/Occasion relations
- Evidence for expectations at discourse level (extends work on expectations at phonological/morphological/syntactic levels)
- Introduces new paradigm for testing comprehenders’ intuitions about structure that is implicit in all coherent discourse

Open questions:
- How to interpret GCA results and verb type differences?
- What factors beyond verb type influence comprehenders’ expectations about upcoming discourse relations? (A preceding Explanation?) An open question in the discourse?

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