Explicit QUD for Scope Ambiguity Resolution

- Sentences involving two scope-taking elements are often ambiguous:
  - Classic example: A student likes every teacher.
  - To derive the surface scope and the inverse scope readings, linguistic theories have proposed Scope Shifting Operations, such as quantifier raising or type-shifting.
  - Empirical studies using various methods have shown that the inverse scope reading is in general less accessible (Karttunen & MacDonald, 1993; Anderson, 2004; Raffray & Pickering, 2010; Chmila & Bott, 2015; Musolino & Lidi, 2006; Conroy et al, 2008; Gualmini et al, 2008; a.o.)

Factors that affect the accessibility of the inverse scope reading:
- Structural properties between the two scope-taking elements
- Lexical properties of a quantifier
- Contextual information / world knowledge
- Question under Discussion (QUD)

Focus: Using "how-many" questions, we investigated whether explicit QUDs would facilitate the accessibility of inverse scope readings in ambiguous sentences involving comparative quantifiers.

We focus on the scope interaction between negation and a comparative quantifier phrase (CQP) in the object position:
- CQPs in the object position are said to be generally restricted in their scope taking possibilities, but it can interact with negation (e.g. Takahashi, 2006; Syrett & Brasoveanu, 2019)
- (1) Mary hasn’t read more than two of Tolstoy’s 12 novels.
  - a. Surface: Mary has read no more than 2 T-novels. (Neg>CQP)
  - b. Inverse: More than 2 T-novels are not Mary has not read them. (CQP>Neg)

Semantics & Pragmatics of ‘How-Many’ Questions

Asking a ‘how-many’ question:
- Seeking the maximal degree d.s.t. the question nucleus is true of d. (Rullman, 1995)
- A ‘how-many’ question is asked against a background assumption that the numeral answer has some utility in the discourse. The utility interacts with (world knowledge based) expectations.
  - (2) “How many tax returns have you filed since 2010?” (Expect all)
  - (3) “How many times have you gotten married?” (Expect some)
- For (2), knowing d-many for (P)x implicates not d-many for (P)(x), for any d > d, which tells you how close you get to the expectation. But there is no corresponding utility for ExpectSome events as in (3).

Question-Answer Congruence: answering ‘how-many’ questions
- A negative ‘how-many’ question should have ‘d-many NP’ scope over negation: having negation scoping above ‘d-many NP’ is a violation of negative islands.
- Consequently, a congruent answer to a negative ‘how-many’ question should also have ‘d-many NP’ taking scope over negation.
- Negative question: [how-many novels], [read(Mary, x)].
- Congruent answer: [d-many novels], [read(Mary, x)]
- Incongruent answer: [d-many novels], [read(Mary, x)]
- Thus, for a scopally ambiguous sentence, the inverse scope (1b) will be a congruent answer to the negative question “How many T-novels hasn’t Mary read?”.

Experiments: Naturalness ratings (+ binary forced choice task)

Materials (N = 24 for Exp 1; N = 32 for Exp 2)

<table>
<thead>
<tr>
<th>Context</th>
<th>QUD</th>
<th>Answer</th>
<th>Continuation (Exp 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploit Event</td>
<td>Positive QUD</td>
<td>I wonder how many cupcakes Mary has tasted</td>
<td>In fact, there is only one that she has tasted.</td>
</tr>
<tr>
<td>ExpectAll Event</td>
<td>Positive QUD</td>
<td>I wonder how many cupcakes Mary hasn’t tasted</td>
<td>In fact, there are three that she hasn’t tasted.</td>
</tr>
<tr>
<td>ExpectSome Event</td>
<td>Positive QUD</td>
<td>I wonder how many cupcakes has Mary eaten.</td>
<td>In fact, there is only one that she has eaten.</td>
</tr>
<tr>
<td>ExpectAll Event</td>
<td>Negative QUD</td>
<td>I wonder how many cupcakes Mary hasn’t tasted</td>
<td>In fact, there are three that she hasn’t tasted.</td>
</tr>
</tbody>
</table>

Experiment 1:
- Procedure: Participants were trained and instructed to:
  - (1) rate the QUD sentence with respect to the context, and
  - (2) rate the Answer sentence with respect to both the context and the QUD.
- Results:
  - QUD sentences: a main effect of QUD Type (p < .001, t = 8.217), a main effect of Event Type (p < .05, t = 4.507); no significant interaction.
  - Answer sentences: a main effect of QUD Type (p < .001, t = 3.901), a main effect of Event Type (p < .005, t = 3.025), and a significant interaction (p < .05, t = -1.999).
  - Answers to Neg-Some Questions are disproportionately degraded

Experiment 2: Results
- Procedure: same as Exp 1, but participants were additionally asked to choose between two Continuation sentences, one of them is a natural continuation for Surface Scope and the other one for Inverse Scope.
- Results:
  - QUD sentences: a main effect of QUD Type (p < .001, t = 4.44), a main effect of Event Type (p < .05, t = 2.46); no significant interaction.
  - Answer sentences: a main effect of QUD Type (p < .001, t = 2.55), no effects of Event Type; no significant interaction.
  - Continuation binary choice: a main effect of QUD Type (p < .001, t = -4.11), no-effects of Event Type; no significant interaction.

Discussion

Replication of the ratings for QUD:
- The main effect of QUD Type: low frequency of negative ‘how-many’ questions (Corpora: 0.50% in COA, 0.36% in TIME)
- The main effect of Event Type: higher utilities for answering a ‘how-many’ question involving ExpectAll events
- But discrepancy between Exp1 and Exp2 regarding the ambiguous Answer sentences:
  - Negative QUDs improve the ratings for inverse scope in Exp1, but this effect was not observed in Exp2.
  - Possible reasons: False positive in Exp 1? Change of training phase? Length of Experiment 2?

Forced choice task for the Continuation sentence in Experiment 2 as a way to probe the actual scope assignment:
- Poor performance when the participants were in a Negative QUD condition.

Selected References