Processing and domain selection: Quantificational variability effects

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Introduction

Sentences with adverbs of quantification, like *mostly*, fail to express their domain of quantification explicitly, and often are ambiguous between interpretations that quantify over individuals (*most of the students*) and those that quantify over times (*most of the time*):

(1) The students were *mostly* in the classroom.
   a. *Most of the students* were in the classroom.
   b. The students were in the classroom *most of the time*.

Research questions

How does the language processor treat sentences with semantically ambiguous domains of quantification? What are the interpretive preferences that determine which quantificational domain is selected during sentence processing?

1. Domain selected immediately and on principle
2. Domain selected immediately but at random
3. Domain unspecified during sentence comprehension

No Extra Times (NET) Principle

We argue that domains for quantification are selected immediately and guided by the following domain-general principle:

(2) A sentence describes a single occasion, unless there is evidence to the contrary. (Majewski)

Predictions

If the language processor selects the quantificational domain immediately and is guided by NET, then it should encounter difficulty when the preferred domain is not supported. We test this prediction in two experiments.

Experiment 1: Are sentences with *mostly* interpreted like explicit quantification over individuals? Is switching the quantificational domain across sentences costly?

Experiment 2: When the preferred quantification over individuals reading is not plausible, when does the cost of revision appear in online processing?

Experiment 1: Naturalness

Design 6 conditions, crossing quantification in context {QA - Ambiguous, QI - Individuals, QT - Times} and quantification in the continuation sentence {CI - Individuals, CT - Times}
Items and participants 24 sextets & 48 UMass undergraduates

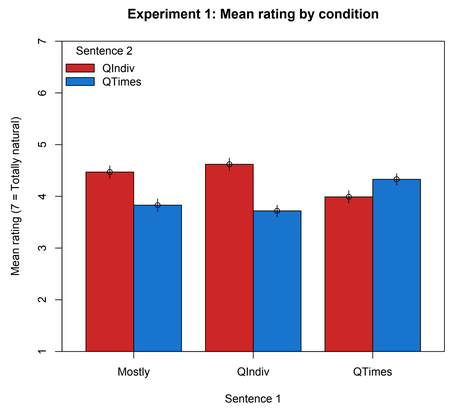
(3) **Context**:
   QA. The students were mostly here.
   QI. Most of the students were here.
   QT. The students were here most of the time.

(4) **Continuation**:
   CI. Some of them weren't however.
   CT. Some of the time they weren't however.

Question and rating scale
How natural does the second sentence sound after reading the first? (7 = totally natural)

1 | 2 | 3 | 4 | 5 | 6 | 7

Ratings data



Results *Data fit with linear mixed effects model, treating subjects and items as random effects*

☞ **Congruence**: Penalty for continuing QI with CT, $p < 0.001$, and for continuing QT with CI, $p < 0.001$.

☞ **NET**: Penalty for continuing QA with CT, $p < 0.001$.

★ **Ambiguous domains of quantification interpreted just like explicit quantification over individuals. Pattern expected if interpretation of the quantificational domain for *mostly* avoids unnecessary times.**

Experiment 2: Design and norming

Design The referents of some nouns can be easily conceived of as spatially disconnected parts, while others cannot: nouns denoting individuals receive an implausible and gruesome reading when appearing with *mostly* and a locative phrase. By NET, the implausible reading should be preferred initially, and revising to a multiple times interpretation should be taxing on the processor.
Items and participants 24 triplets, analyzed in 4 regions; 34 UMass undergraduates.

(5) a. **Ambiguous**: |1 The army
   b. **Divisible**: |1 The attack
   c. **Non-Divisible**: |1 The inspector
   |2 was mostly |3 in the capital |4 according to the newspapers |

Norming 36 subjects chose a QIndiv or QTimes paraphrase (or both).

Sentence form	Percentage of Interpretations		
	QIndiv	QTimes	Both
Ambiguous	67.6	21.9	10.5
Divisible	81.5	13.9	4.6
Non-Divisible	3.1	96.3	0.6

☞ Clear bias for Non-Divisible and Divisible conditions

☞ Ambiguous condition shows a greater split between paraphrases

Experiment 2: Eye movement recording

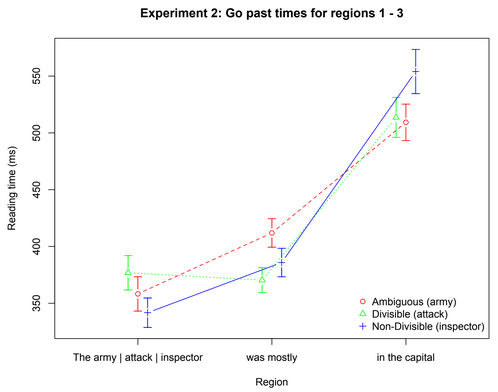
Analysis: Data cleaned of eye blinks, long and short fixations, and fixations over 3 standard deviations from the mean for normally distributed measures (first pass, first fixation, and go past times). Linear mixed effects regression models, treatment coded, with Ambiguous as baseline. All effects described were significant $p < 0.05$.

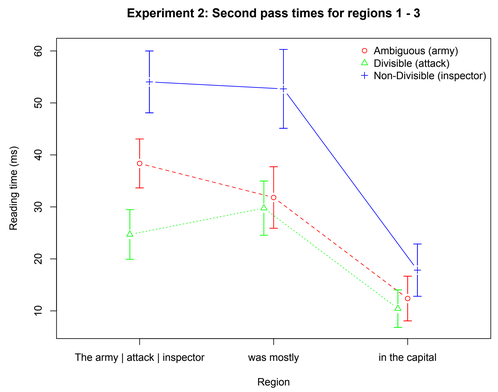
☞ **Summary for Non-Divisible**: Readers encountered difficulty upon reading the locative phrase *in the capital* and returned to previous regions, where they spent more time re-reading previous text as compared to other conditions. Compared to the Ambiguous condition, the Non-Divisible condition showed:

- Longer *go past times* on Region 3.
- Increased *regressions out* of Regions 3 and 4.
- Increased *regressions in* to Regions 1 – 3.
- Longer *second pass times* on Regions 1 and 2.

☞ **Summary for Ambiguous**: Ambiguous items elicited early processing costs on the quantifier region *was mostly* and prompted greater regressions in to the region with the sentential noun.

- Shorter *first fixation*, *first pass*, and *go past* times on Region 2 over the other two conditions.
- Increased *regressions in* to Region 1 over the Divisible condition.





★ **As predicted by NET, readers exhibited increased difficulty when viewing the Non-Divisible condition compared to the Divisible condition. In addition, reading difficulty appeared relatively early in the Ambiguous condition, suggesting an initial cost for resolving the ambiguity.**