THE INTRANSIGENCE OF INVERSE SCOPE: THE EFFECT OF DISCOURSE, PRIMING AND POPULATION DIFFERENCES

A DISSERTATION SUBMITTED TO THE GRADUATE DIVISION OF THE UNIVERSITY OF HAWAII IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

IN

LINGUISTICS

May 2013

By
Jung-Hee Kim

Dissertation Committee:

Kamil Ud Deen, Chairperson
Bonnie D. Schwartz
William O’Grady
Ho-Min Sohn
Thomas Craven

Keywords: Logic, Semantics, Pragmatics, Scope ambiguity, Quantifiers, Discourse, Priming, English,
ACKNOWLEDGMENTS

This dissertation is an effortful collaboration of three disciplines
– Linguistics, Philosophy, and Mathematics.

The three disciplines meet together in one place, under the common belief that
to understand human mind requires study of language.

I would like to thank Kamil Deen, the supervisor of this research. His open-mindedness
best fits with the essential character of this research topic and has thus made the outcome
possible.

I believe and hope and anticipate that our collaboration will continue, enhancing our
understanding of the area of research, thus benefiting people in general and in academia.

I wish to express sincere thanks to the other members of my dissertation committee,
Bonnie Schwartz, William O’Grady, and Ho-min Sohn, in the field of Linguistics, and
Thomas Craven, from the department of Mathematics, who have been incredibly patient
with me throughout the process.

Thanks to those colleagues who have given me encouragement and stimulation;
specially two of my colleagues in the department of Linguistics, Valerie Guerin and
Kathryn Wheeler, for their deep commited efforts to help polish sentences to be used in
experiments in every and each stage of this research.
Thanks also to eight hundred or more participants without whom this dissertation is not as
it is.

I should like to acknowledge my own intellectual debts to James Tiles of the Department of
Philosophy, whose teaching on pragmatism remains the philosophical foundation of my
linguistic work.

My special thanks must go to the department of Mathematics at the University of Hawai’i
; to Tom Ramsey for sharing difficult moments on earlier stages of this research
; to J. B. Nation who helped me to feel comfortable with the field of mathematics
; to Alex Gottlieb for sharing his outstanding skill of data analysis and statistics and also
sharing his deep insight on what empiricism means and how it is properly practiced.
; and other numerous mathematicians who warmly supported this research, Thomas Hoover,
Adolf Mader, Monique Chyba, and graduate mathematics students.

I tried to synthesize all these generous contributions into this work.
I hope they will find the result worthwhile.

Finally, people in ordinary daily lives, our pain, hunger, and agony
are the key inspiration that has produced me and this work.
We certify that we have read this dissertation and that, in our opinion, it is satisfactory in scope and quality as a dissertation for the degree of Doctor of Philosophy in Linguistics.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Contents</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>ii</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>x</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>xiii</td>
</tr>
</tbody>
</table>

**Chapter 1:** Introduction .................................................................. 1

2.1 Formal approach to language ......................................................... 6
2.2 Phenomenon of quantifier scope ambiguity ...................................... 7
  2.2.1 Quantifier scope ambiguity ................................................... 7
  2.2.2 Movement account: Quantifier Raising .................................... 11
2.3 Empirical findings: Surface scope preference .................................. 14
  (1) Marsden (2004, 2005) .................................................................. 14
  (2) Goro (2007) .............................................................................. 15
  (3) Kurtzman and MacDonald (1993); Tunstall (1998) - self-paced reading 17
  (4) Anderson (2004) ....................................................................... 18
2.4 Various factors that affect inverse scope accessibility ....................... 26
  2.4.1 Lexical .................................................................................... 26
  2.4.2 Pragmatic ................................................................................ 27
  2.4.3 Syntactic Constraints ............................................................. 28
  2.4.4 More on structural restrictions: Clause-boundedness of QR .......... 30
2.5 Discourse Constraints ...................................................................... 32
  2.5.1 The necessity of discourse considerations in inverse scope .......... 32
  2.5.2 Focus and Wide Scope ................................................................ 33
2.6 Research Goal: Establishing contextual sensitivity of inverse scope accessibility 34

**Chapter 2:** Background .................................................................... 6

2.1.1 Formal approach to language ......................................................... 6
2.2 Phenomenon of quantifier scope ambiguity ...................................... 7
  2.2.1 Quantifier scope ambiguity ................................................... 7
  2.2.2 Movement account: Quantifier Raising .................................... 11
2.3 Empirical findings: Surface scope preference .................................. 14
  (1) Marsden (2004, 2005) .................................................................. 14
  (2) Goro (2007) .............................................................................. 15
  (3) Kurtzman and MacDonald (1993); Tunstall (1998) - self-paced reading 17
  (4) Anderson (2004) ....................................................................... 18
2.4 Various factors that affect inverse scope accessibility ....................... 26
  2.4.1 Lexical .................................................................................... 26
  2.4.2 Pragmatic ................................................................................ 27
  2.4.3 Syntactic Constraints ............................................................. 28
  2.4.4 More on structural restrictions: Clause-boundedness of QR .......... 30
2.5 Discourse Constraints ...................................................................... 32
  2.5.1 The necessity of discourse considerations in inverse scope .......... 32
  2.5.2 Focus and Wide Scope ................................................................ 33

**Chapter 3:** Experiment: Exploring the effect of discourse (4 experiments) .... 36

3.1 Methodology Overview ....................................................................... 36
3.2 Experiment Procedure ....................................................................... 38
  (1) Instructions
  (2) Practice
  (3) Main survey
  (4) Post-experiment survey
3.3 Experiment 1: Expectation-context condition .................................... 41
  3.3.1 Purpose .................................................................................... 41
  3.3.2 Materials: Expectation discourse .......................................... 41
  Sample Target
  3.3.3 Fillers ..................................................................................... 44
  3.3.4 Control items .......................................................................... 44
4.2.1 Purpose

4.2.2 Design and Materials

4.2.3 Fillers

4.2.4 Procedure

4.2.5 Participants

4.2.6 Results

4.2.7 Discussion

4.2.8 12 frozen scope items selected

6 for the Baseline task and 6 for the Experimental task

4.3 Experiment 6A: Baseline Context – Enumeration Version

4.3.1 Purpose

4.3.2 Materials

4.3.3 Fillers

4.3.4 Control items

4.3.5 Materials: Summary

4.3.6 Procedure

4.3.7 Participants

4.3.8 Results of Target

4.3.9 Results of Control items

4.4 Experiment 7: Baseline-Experimental (Focal discourse)

(with Okay instruction)

4.4.1 Purpose

3 versions of instruction

4.4.2 Design and Materials: Two-Step Procedure

4.4.3 Sample Materials: Baseline Task

4.4.4 Sample Materials: Experimental Task

4.4.5.1 Sample of Target

4.4.5.2 Sample of fillers and negation

4.4.5.3 Control 2 items

4.4.6 Procedure of Two-Step Experiment

4.4.7 Participants

4.4.8.1 Results

4.4.8.1.1 Results of Target from Baseline and Experimental (Focal)

4.4.8.2 Results of Control 1 items - Baseline

4.4.8.3 Results of Control 2 items – Baseline and Experimental

4.4.9 Summary of Results and Discussion

4.5 Experiment 8: Pilot Baseline-Experimental (Focal)

(with Yes, people instruction)

4.5.1 Purpose

4.5.2 Participants and Procedure

4.5.3 Results

4.5.3.1 Results of Target from Baseline and Experimental (focal)

4.5.3.2 Results of Control items

4.5.3.3 Summary of Results and Discussion

4.6 Experiment 9: Experimental-Baseline Experiment

(with Yes, people instruction)
Chapter 5: Experiment: Investigation of the role of discourse
(4 experiments)................................................................. 135

5.1 Motivation............................................................... 135
5.2 Methodology Overview: two-step experiment.................. 135
5.3 Experiment Procedure............................................... 136
5.4 Participants............................................................ 139
5.5 Prediction and analysis method..................................... 140
5.6 Experiment 10 (Baseline-Experimental: Expectation context)........ 142
  5.6.1 Purpose.............................................................. 142
  5.6.2 Design and Procedure.......................................... 142
  5.6.3 Materials: Baseline.............................................. 142
  5.6.4 Fillers................................................................. 144
  5.6.5 Control items..................................................... 144
  5.6.6 Materials: Experimental Task – Expectation Discourse...... 145
  5.6.7 Fillers................................................................. 147
  5.6.8 Control 2 items (Frozen-scope)................................ 147
  5.6.9 Results............................................................... 148
5.7 Experiment 11 (Focal Context)..................................... 151
  5.7.1 Purpose.............................................................. 151
  5.7.2 Design and Procedure.......................................... 151
  5.7.3 Materials: Baseline.............................................. 151
  5.7.4 Materials: Experimental Task – Focal Discourse............ 151
  5.7.5 Fillers and Controls: Experimental Task...................... 153
  5.7.6 Results............................................................... 153
5.8 Experiment 12 (Expectation Context with Priming)................ 155
  5.8.1 Purpose.............................................................. 155
  5.8.2 Design and Procedure.......................................... 155
  5.8.3 Materials: Baseline Task...................................... 155
  5.8.4 Materials: Experimental Task – Expectation Discourse...... 155
  5.8.5 Fillers and Controls: Experimental Task...................... 157
  5.8.6 Results............................................................... 157
5.9 Experiment 13 (Focal Context with Priming)...................... 160
  5.9.1 Purpose.............................................................. 160
  5.9.2 Design and Procedure.......................................... 160
  5.9.3 Materials: Baseline Task...................................... 160
  5.9.4 Materials: Experimental Task – Focal Discourse............ 160
5.10 Experiment 14 (Baseline with Priming) ........................................... 164
  5.10.1 Purpose .................................................................................. 164
  5.10.2 Design and Procedure .............................................................. 164
  5.10.3 Results ................................................................................... 164

5.11 Results of Experiments 10-13: Control Items ........................................ 167
  5.11.1 Results of Control 1 items – Baseline ......................................... 167
  5.11.2 Results of Control 2 items – Baseline and Experimental ............... 168
  5.11.3 Results of Prime ...................................................................... 170

5.12 Results of Target versus Frozen: Within-experiment comparison ............ 171
  5.12.1 Experiment 10 (Baseline – Expectation) .................................... 172
  5.12.2 Experiment 11 (Baseline – Focal) ............................................. 173
  5.12.3 Experiment 12 (Baseline – Expectation with priming) ................. 175
  5.12.4 Experiment 13 (Baseline – Focal with priming) ........................ 176

5.13 Results of Target: Between-experiments comparison .......................... 177

5.14 Summary of Findings, Discussion, and Interim Conclusion .................... 179
  5.14.1 Similarity of the four groups in the Baseline ............................... 179
  5.14.2 No robust discourse effect ...................................................... 180
  5.14.3 No robust prime effect ............................................................ 181
  5.14.4 Strong evidence was found of structural sensitivity
  for inverse scope with every .......................................................... 182
  5.14.5 Frozen item variability: their marginal acceptance is meaningful .... 184
  5.14.6 Frozen response rates increased as Inverse response rates increased .. 185
  5.14.7 A strong rejection tendency
  towards inverse and frozen scope items both ................................... 186
  5.14.8 Individual analysis regarding Inverse scope ............................... 187

5.15 Individual Analysis: Low, Medium, and High Inverse Scope Participants .. 189
  5.15.1 Purpose .................................................................................. 189
  5.15.2 Grouping criterion ................................................................... 189
  5.15.3 Experiment 10: Expectation sample ........................................ 191
  5.15.4 Experiment 11: Focal sample ............................................... 193
  5.15.5 Experiment 12: Expectation with priming sample ..................... 194
  5.15.6 Experiment 13: Focal with priming sample .............................. 195
  5.15.7 Central observations ............................................................... 196

5.16 Conclusion: on the role of discourse ................................................... 198

Chapter 6: Conclusion ................................................................................. 202
  6.1 Conclusion .................................................................................... 202
  6.2 Future research ............................................................................. 206
  6.3 Method implication ......................................................................... 209
  6.4 Teaching Implication ..................................................................... 211

Appendix A: 12 target some-every sentences: Expectation Context ............. 213
Appendix B: Fillers (12 every-not sentences fillers, and 16 No-answer fillers) .... 225
Appendix C: Control 1 items (existential reading of some N) ....................... 227
<table>
<thead>
<tr>
<th>Appendix</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>Control 2 items (syntactic restriction of inverse scope with every)</td>
<td>229</td>
</tr>
<tr>
<td>E</td>
<td>Control 3 items (other quantifier pairs)</td>
<td>231</td>
</tr>
<tr>
<td>F</td>
<td>12 Target some-every sentences: Focal Context</td>
<td>233</td>
</tr>
<tr>
<td>G</td>
<td>12 Prime Items</td>
<td>241</td>
</tr>
<tr>
<td>H</td>
<td>16 Frozen scope norming stimuli (Experiment 6)</td>
<td>253</td>
</tr>
<tr>
<td>I</td>
<td>12 Bi-clausal frozen scope items (used in the experiments 7, 8, and 9 in Chapter 4)</td>
<td>253</td>
</tr>
<tr>
<td>J</td>
<td>12 Target some-every sentences: Baseline Context (Enumeration)</td>
<td>271</td>
</tr>
<tr>
<td>K</td>
<td>Experiment 6B (Baseline-Praraphrase)</td>
<td>283</td>
</tr>
<tr>
<td>L</td>
<td>Revised 12 bi-clausal frozen scope items (used in the experiments 10 through 13 in Chapter 5)</td>
<td>286</td>
</tr>
<tr>
<td>M</td>
<td>Summary of Results of Control 3 (other quantifier pairs)</td>
<td>291</td>
</tr>
<tr>
<td>N</td>
<td>Post-Experiment Survey: The logical interpretation of some</td>
<td>293</td>
</tr>
<tr>
<td>O</td>
<td>Post-Experiment Survey: Personal and Mathematics Education Background</td>
<td>300</td>
</tr>
<tr>
<td>REFERENCES</td>
<td></td>
<td>305</td>
</tr>
</tbody>
</table>
## LIST OF TABLES

Table 1  Results of Marsden (2004) (modified from Table 30, in p.195) .................................. 15
Table 2  Results of Goro (2007) ......................................................................................... 16
Table 3  Previous Studies: Experimental Findings: Inverse scope response .................. 24
Table 4  Experiment 1: Materials ......................................................................................... 48
Table 5  Experiment 1: Results: Target ................................................................................. 50
Table 6  Experiment 1: Results: Fillers .................................................................................. 50
Table 7  Experiment 2: Results: Target ................................................................................. 55
Table 8  Experiment 2: Results: Fillers .................................................................................. 55
Table 9  Experiment 3: Results: Target .................................................................................. 61
Table 10 Experiment 3: Results: Prime ................................................................................. 61
Table 11 Experiment 3: Results: Fillers ................................................................................. 62
Table 12 Experiment 4: Results: Target ................................................................................. 64
Table 13 Experiment 4: Results: Prime ................................................................................. 65
Table 14 Experiment 4: Results: Fillers ................................................................................. 65
Table 15 Experiments 1-4: Results: Target .......................................................... 67
Table 16 Experiments 1-4: Results: Control 1 .......................................................... 69
Table 17 Experiments 1-4: Results: Control 2 .......................................................... 71
Table 18 Experiments 1-4: Results: frequency of participants........................................ 76
Table 19 Experiments 3 and 4: Results: Prime .......................................................... 77
Table 20 Experiment 5: Norming Results: Frozen Scope Items ........................................ 92
Table 21 Experiment 5: Results: Frozen scope items (frozen subject every) .................. 93
Table 22 Experiment 5: Results: Frozen scope items (frozen object every) .................. 93
Table 23 Experiment 5: Results: Frozen scope items (relative clause) ......................... 94
Table 24 Experiment 6A: Baseline task: Materials .................................................. 100
Table 25 Experiment 6A: Results: Target ............................................................. 102
Table 26 Experiments 6A/6B: Results: Control 1 ...................................................... 103
Table 27 Experiments 6A/6B: Results: Control 2 ...................................................... 103
Table 28 Experiment 7: Baseline Task: Materials (repeated from experiment 6A) ............ 106
Table 29 Experiment 7: Experimental Task: Materials .................................................. 107
Table 30 Experiment 7: Results: Target in the Baseline task ........................................ 113
Table 31 Experiment 7: Results: Fillers in the Baseline task ......................................... 114
Table 32 Experiment 7: Results: Target in the Experimental task .................................. 114
Table 33 Experiment 7: Results: Control 1 in the Baseline task .................................... 115
Table 34 Experiment 7: Results: Control 2 in the Baseline task .................................... 115
Table 35 Experiment 7: Results: Control 2 in the Experimental task ......................... 116
Table 36 Experiment 8: Results: Target items in the Baseline task ................................. 120
Table 37 Experiment 8: Results: Fillers in the Baseline task ......................................... 121
Table 38 Experiment 8: Results: Target items in the Experimental task ...................... 121
Table 39 Experiment 8: Results: Fillers in the Experimental task .................................. 121
Table 40 Experiment 8: Results: Control 1 in the Baseline task .................................... 122
Table 41 Experiment 8: Results: Control 2 in the Baseline task .................................... 122
Table 42  Experiment 8: Results: Control 2 in the Experimental task……….. 123
Table 43  Experiment 9: Results: Target items in the Experimental task……….. 126
Table 44  Experiment 9: Results: Fillers in the Experimental task……….. 127
Table 45  Experiment 9: Results: Target items in the Baseline task……….. 127
Table 46  Experiment 9: Results: Fillers in the Baseline task……….. 127
Table 47  Experiment 7, 8 and 9: Results: Target Inverse……………… 130
Table 48  Summary of distribution of participants into Task Types……………… 139
Table 49  Experiment 10: Results: Target in the Baseline task……………… 149
Table 50  Experiment 10: Results: Target in the Experimental (Expectation) task…149
Table 51  Experiment 11: Results: Target in the Baseline task……………… 154
Table 52  Experiment 11: Results: Target in the Experimental (Focal) task……….. 154
Table 53  Experiment 12: Results: Target in the Baseline task……………… 158
Table 54  Experiment 12: Results: Target in the Experimental task……………… 158
Table 55  Experiment 13: Results: Target in the Baseline task……………… 161
Table 56  Experiment 13: Results: Target in the Experimental task……………… 161
Table 57  Experiment 14: Results: Target in the Baseline task……………… 165
Table 58  Experiment 14: Results: Target in the Experimental task……………… 165
Table 59  Experiment 14: Results: Prime in the Experimental task……………… 166
Table 60  Experiments 10-13: Results: Control 1 in the Baseline task……………… 167
Table 61  Experiments 10-13: Results: Control 2 in the Baseline task……………… 168
Table 62  Experiments 10-13: Results: Control 2 in the Experimental task……………… 170
Table 63  Experiments 10-13: Results: Control 2 in the Experimental task……………… 170
Table 64  Experiments 10-13: Results: Control 2 in the Experimental task……….. 170
Table 65  Experiments 10-13: Results: Control 2 in the Experimental task……….. 170
Table 66  Experiments 10-13: Results: Control 2 in the Experimental task……….. 170
Table 67  Experiments 10-13: Results: Control 2 in the Experimental task……….. 170
Table 68  Experiments 10-13: Results: Prime in the Experimental task……………… 170
Table 69  Experiments 10-13: Results: Baseline and Experimental tasks……………… 178
Table 70  Experiments 10-13: Results: Frequency of participants……………… 182
Table 71  Experiments 10-13: Results: Frequency of participants……………… 183
Table 72  Experiments 10-13: Results: Correlations between inverse-scope variables……………… 186
Table 73  Experiments 10-13: Results: Response patterns to Inverse and Frozen……………… 187
(frequency of participants)…………………………… 187
Table 74  Experiments 10-13: Results: Frequency of participants……………… 188
Table 75  Experiments 10-13: Results: Low, Medium and High groups……………… 191
in each experiment…………………………… 191
Table 76  Experiment 10: Results: Grouping of participants……………… 192
into Low, Medium and High inverse people……….. 192
Table 77  Experiment 10: Results: Shift Pattern…………………………… 192
Table 78  Experiment 11: Results: Grouping of participants……….. 193
into Low, Medium and High inverse people……….. 193
Table 79  Experiment 11: Results: Shift Pattern…………………………… 193
| Table 80 | Experiment 12: Results: Grouping of participants into Low, Medium and High inverse people | 194 |
| Table 81 | Experiment 12: Results: Shift Pattern | 194 |
| Table 82 | Experiment 13: Results: Grouping of participants into Low, Medium and High inverse people | 195 |
| Table 83 | Experiment 13: Results: Shift Pattern | 195 |
| Table 84 | Experiments 1-13: Results: Target items in the Baseline and Experimental tasks | 204 |
LIST OF FIGURES

Figure 1  Experiments 1-4: Results: Target ........................................... 67
Figure 2  Experiments 1-4: Results: Control 1................................. 69
Figure 3  Experiments 1-4: Results: Control 2................................. 72
Figure 4  Experiments 1-4: Results: Distribution of participants .......... 76
Figure 5  Experiments 3 and 4: Results: Prime................................. 77
Figure 6  Experiments 3 and 4: Results: Prime................................. 78
Figure 7  Experiments 7, 8 and 9: Results: Target and Frozen .......... 130
Figure 8  Experiments 8 and 9: Results: No ordering effect ............ 131
Figure 9  Experiments 8 and 9: Results: No instruction-type effect ..... 132
Figure 10 Experiment 10: Results from Inverse and Frozen
                   in Baseline-Expectation............................................. 172
Figure 11 Experiment 11: Results from Inverse and Frozen in Baseline-Focal ...... 173
Figure 12 Experiment 12: Results from Inverse and Frozen
                   in Baseline - Expectation with Prime ........................... 175
Figure 13 Experiment 13: Results from Inverse and Frozen
                   in Baseline-Focal with Prime .................................. 176
Figure 14 Experiments 10-13: Results in the Baseline and Experimental tasks...... 178
Figure 15 Experiments 10-13: Results:
                   proportion of yes responses to frozen scope items........... 184
Sentences with quantifiers of two different kinds (an existential quantifier such as *some* $N$ and a universal quantifier such as *every* $N$) give rise to two potential meanings. For example, *some child built every playhouse* can mean “Some single child built all the playhouses” (*some* > *every*: surface-scope) or “each playhouse was built by some possibly different child” (*every* > *some*: inverse-scope). Quantifiers and their scope have a rich and long history in logic and linguistic theory. Recently, the area has drawn the attention of empirical linguistics. Linguists in the empirical field broadly aim to understand cognitive process underlying actual scope interpretations among ordinary speakers in normal language comprehension. Indeed, some studies have found that there is a phenomenon of interpretative asymmetry or preference, such that the surface scope reading is preferred over the inverse scope reading. The nature of this inverse scope difficulty, grammatical or performance-related, remains to be characterized.

Quantifier scope interpretation critically involves syntactic parsing and building two (LF) representations. However, it also requires contextual processing. Ambiguous forms in language are normally interpreted with reference to the context (Wedgwood 2005:18). Actual scope interpretations no doubt should engage various modules of language comprehension, both grammatical (syntax/semantics) and non-grammatical (discourse). Linguists indeed increasingly recognize the importance of contextual considerations, admitting that syntactic-semantic considerations, although essential, do not suffice to explain a full range of actual scope behavior. It is agreed among linguists that actual scope interpretive constraints are interface phenomena – aspects of language that
seem to require the integration of syntactic knowledge with other types of knowledge in the cognitive domain (e.g. discourse, pragmatic, prosodic, parsing, etc.). It remains, however, uncertain what aspects of situational discourse are relevant and to what extent scope interpretations are discourse-relevant.

Empirical data is lacking on discourse and quantifier scope interpretation, even though it has been widely assumed that scope interpretation should no doubt be discourse-sensitive. The contribution of discourse upon inverse scope accessibility, in particular, has not received a systematic and rigorous investigation. This dissertation attempts to address this empirical gap by focusing on the degree to which how quantifier scope interpretations are sensitive to discourse. Specifically, the goal of this dissertation is to examine and document the context-sensitivity of inverse scope accessibility in sentences involving a some-N subject and an every-N object.

In the hope of identifying the kind of contextual feature that is relevant to inverse scope, we relied on an idea noted in the literature; quantifiers’ wide-scope reading is associated with an “emphasis effect” (often called a “focus effect”). The idea is roughly that, in a sentence like some boy built every playhouse, the inverse scope reading would be made prominent when focus is placed upon the restrictor set of every N (a set of playhouses in every playhouse). We manipulated this effect in two ways – using expectation and contrast focus.

We therefore constructed two linguistic contexts, manipulating emphasis as follows: (a) a context that manipulated the speaker’s expectation in the discourse (called ‘expectation context’); (b) a context that manipulated the restrictor set of every N, by making two sets available in discourse (called ‘contrast focus context’). To increase the
power of each contextual manipulation, we independently added another manipulation, priming (of a particular kind, see chapter 3 for details), to each discourse. That is, we crossed the two discourse conditions with a priming factor, resulting in four conditions. This gives us four conditions, as follows: (a) expectation context; (b) contrast focus context; (c) expectation context with priming; (d) contrast focus context with priming.

Lastly, we constructed another kind of discourse, without any emphasis manipulation (referred to as the ‘baseline’ context).

Our experiments are a comparative investigation of the relative effectiveness of these four discourse conditions on inverse-scope assignment, as opposed to the baseline condition. The difference in increase across the four experimental conditions should inform us on the relative efficacy of each condition on inverse scope access, thus revealing the optimal discourse conditions for inverse scope accessibility.

Summarizing, this investigation aims to establish the fact that discourse is indeed relevant in the accessibility of inverse scope as linguists have implicitly assumed, while also exploring to what extent different kinds of discourse are relevant. We therefore have these two research questions:

- Can discourse facilitate the accessibility of inverse scope in some-every sentences in English?
- Specifically, would the discourse property of speaker’s emphasis have any relevance to facilitating inverse scope accessibility?
These research questions were examined in a rigorous and systematic manner. Group chances were compared in scope response over four discourse conditions, while controlling for variation from individual differences. The task adopted was consistently a *sentence-context reading and verification task*. Readers read a story context and judged the acceptability of the test sentence relative to the discourse, by selecting yes or no.

We conducted a total of thirteen experiments, outlined below. First, in the four experiments in Chapter 3, we aimed to explore the effectiveness of our four contextual manipulations. The design was between-groups comparison, where individual variation was not controlled. Second, in the experiments in Chapter 4, we focused on adjusting details of task design and items. Finally, four experiments in Chapter 5 were the most crucial ones for us. Here we re-examined the power of our four discourse manipulations, and with the aid of discoveries from Chapter 4, used a much improved design and a better control of population variation.

**Chapter 3:**
- Experiment 1: Expectation
- Experiment 2: Focal
- Experiment 3: Expectation with priming
- Experiment 4: Focal with priming

**Chapter 4:**
- Experiment 5: Bi-clausal Frozen Control Items
- Experiment 6A: Baseline with an Enumeration Context
- Experiment 6B: Baseline with a Paraphrase Context
- Experiment 7: Baseline-Experimental (Focal) (yes, okay instruction)
- Experiment 8: Baseline-Experimental (Focal) (yes, people might say)
- Experiment 9: Experimental (Focal)-Baseline (yes, people might say)

**Chapter 5:**
- Experiment 10: Baseline-Experimental (Expectation)
- Experiment 11: Baseline-Experimental (Focal)
- Experiment 12: Baseline-Experimental (Expectation with priming)
- Experiment 13: Baseline-Experimental (Focal with priming)
The remainder of the dissertation is organized as follows. Chapter 2 introduces the phenomenon of quantifier scope, the ambiguity that arises thereof, and surveys theoretical and empirical background of quantifiers and scope ambiguity. I will present evidence that adults are overwhelmingly biased towards the surface scope interpretation (in a sentence like a boy climbed every mountain). I will then consider various linguistic factors influencing the availability of inverse scope. I then sketch some ideas about focus (emphasis) and scope, providing a view of the contextual manipulations we will use. In Chapters 3, 4, and 5, I present my main experiments investigating the role of discourse in the inverse scope interpretation of some-every sentences. Lastly, Chapter 6 presents a summary of the findings and the conclusions, as well as some suggestion for future research.
CHAPTER 2. BACKGROUND

In chapter 2, I present the theoretical background and previous empirical findings of quantifier scope ambiguity, followed by my research questions. In section (2.1), I sketch some fundamental assumptions of the generative linguistic analysis that is assumed in this dissertation. It points out that contextual investigation becomes an important agenda among empirical linguists in the formal tradition. I go on to introduce in section (2.2) the phenomenon of quantifier scope ambiguity and its syntactic account. In section (2.3), I present empirical findings of interpretative preference for surface scope. In section (2.4), I discuss various factors known to affect inverse scope, and I argue specifically that discourse considerations have not been investigated in a systematic manner. In section (2.5), I consider which aspects of context might be relevant to inverse scope readings. Finally, in section (2.6), I present my research questions.

2.1 Formal approach to language

This dissertation takes the formalist linguistic framework (so-called generative approach) as a basis for the empirical research that we shall produce here. In the generative framework, a model of meaning and language understanding in natural languages is an abstract formal system grounded on models of reasoning and inference in logic (cf., Moore 1986: 51; Allwood 1986: 67-68). The model generally assumes that comprehension engages the grammar-internal (syntax/semantics) and grammar-external modules (discourse/pragmatics). In what way the comprehension mechanism in fact works remains an important issue among empirical linguists.
I point out that contextual considerations bear special importance in any kind of empirical research on the formal line. Linguistic judgment has been used as a major source of data in this area. It is assumed that diverse extra-grammatical factors, contextual or cognitive, influence linguistic judgments. Therefore, it becomes an important agenda among formally-oriented empirical linguists to clarify the influence of extra-linguistic factors upon linguistic judgments.

Interpretation of doubly quantified sentences is known as a form-based (syntax/semantics) phenomenon. But an implicit belief exists among linguists such that contextual information, as opposed to their formal structure, should have some bearing on quantifiers and the scope judgments. Attention to contextual concerns has been neglected in this area. Therefore, it is worth investigating to what extent quantifiers and the scope judgments are of the sort that interfaces between the grammar-internal (syntax/semantics) and grammar-external modules (discourse/pragmatics). We now lay out the phenomenon to be investigated.

2.2 Phenomenon of quantifier scope ambiguity

2.2.1 Quantifier scope ambiguity

In English, sentences containing a universal quantifier every noun phrase (NP) and an existential quantifier some noun phrase (NP) (Some girl met every boy) (i.e., doubly quantified sentences) are known to be ambiguous between two readings. The sentence (1) has a subject existential quantifier NP and an object universal quantifier NP (henceforth some-every sentences), and has two possible interpretations, as illustrated below.
(1) Some girl met every boy.

(A) Surface scope (some > every)

a. \( \exists x \ [\text{GIRL}(x) \cap \forall y \ (\text{BOY}(y) \rightarrow \text{MET}(x, y))] \)

‘There exists an x, such that x is a girl and for every y, y is a boy, x met y.’
(roughly, ‘There is a particular girl x such that for all the boys y, x met y’)

(B) Inverse scope (every > some)

b. \( \forall y \ [\text{BOY}(y) \rightarrow \exists x \ (\text{GIRL}(x) \cap \text{MET}(x, y))] \)

‘For every y, if y is a boy, then there is a x, such that x is a girl and x met y.’
(roughly, ‘For all boys y, there is some girl x such that x met y’)

The first interpretation, given in (A), is that there is one girl who met all the boys.
The second interpretation, given in (B), is that, for each boy, a different girl met that boy.
Simply speaking, a doubly-quantified sentence like (1) is two-ways ambiguous between the
existential quantifier NP (some girl) specifying a single or multiple referents. In the latter
meaning, the choice of indefinite some girl can vary with the choice of universal every boy.

It is said that the (A)-type (single-reference) interpretation arises because some girl
takes wide scope over every boy, that is every boy occurs within the scope of some girl
(abbreviated as some > every). The (B)-type (multiple-reference) interpretation is said to
arise because every boy takes wide scope over some girl, in other words some girl occurs
within the scope of every boy (abbreviated as every > some). The first interpretation is
called the “surface scope” reading since some precedes every in the surface order and takes
wide scope over every, and thus the scope relation matches the surface order. The second
interpretation is called the “inverse scope” reading since every follows some in the surface
order and takes wide scope over the *some*, and thus the scope relation is the inverse of the surface order.

In classical logic, quantifier scope ambiguity is logically represented in terms of first-order logic (\(\forall\) for universal or \(\exists\) for existential) as in (1a) or (1b). In the generative linguistic tradition, they are abbreviated into (2a) or (2b), or represented in the Logical Form (LF) format as in (2a') or (2b').\(^1\)

\[
(2) \quad \text{Some girl met every boy.}
\]

\[a \ \exists x \ (\text{GIRL}) \ [\forall y \ (\text{BOY}) \ [\text{MET} (x, y)]]
\]

\[b \ \forall y \ (\text{BOY}) \ [\exists x \ (\text{GIRL}) \ [\text{MET} (x, y)]]
\]

\[a' \ \text{LF1: } [\text{IP some girl} [\text{IP every boy} [\text{IP t} \text{t} \text{t}]]] \text{ (some > every; surface scope)}
\]

\[b' \ \text{LF2: } [\text{IP every boy} [\text{IP some girl} [\text{IP t} \text{t} \text{t}]]] \text{ (every > some; inverse scope)}
\]

The fact that there are two distinct LF representations, each corresponding to one of the two interpretations, suggests that the sentence is disambiguated at LF by virtue of two distinct representations. These representations are obtained as the result of the application of a procedure referred to as Quantifier Raising (QR) (May 1977), as we shall elaborate below.

Such two-way ambiguity arises similarly with a sentence (3), with a subject universal quantifier NP and an object existential quantifier NP. Sentence (3) has two

---

\(^1\) Within the Government and Binding Theory (Chomsky 1981), it is generally assumed that there is a level of representation, called LF, which feeds into semantics. LF is supposed to encode all grammatically determined information that is relevant to interpretation (Higginbotham 1985: 549).
readings paraphrased in (A) and (B), with two LF’s where either universal or existential quantifier takes wide scope over the other.\(^2\)

(3) Every boy met some girl.

   (A) LF1: \[[IP every boy, [IP some girl, [IP tᵢ met tⱼ]]]]\ (every > some; surface scope)
   
   (‘For all boys y, there is some girl x such that x met y’)

   (B) LF2: \[[IP some girl, [IP every boy, [IP tᵢ met tⱼ]]]]\ (some > every; inverse scope)
   
   (‘There is a particular girl x such that for all the boys y, x met y’)

Such scope ambiguity is observed typically when a sentence has mixed quantifiers, one universal and the other existential. In English, universal quantifiers include every, all, and each, and existential quantifiers include some or a (known as indefinite articles), plural NPs (boys), and numeral NPs (two boys).\(^3\) Simplifying somewhat, scope ambiguity is the case where universal quantifier comes to affect the interpretation of an indefinite by

---

\(^2\) In the logical tradition, it is said that there is an asymmetric entailment relation between the surface and inverse scope readings in sentences like (1) *Some boy read every book*: the wide scope existential reading entails the wide scope universal reading. The entailment relation says that if the sentence is true under the surface scope context (some > every; which says that a single boy read all the books), it would necessarily be true under the inverse scope reading (every > some which says that each book was read by possibly a different boy). Simply, the *some-every* sentence, in the ‘single boy’ (some > every) situation, becomes true on both the surface and inverse readings. However, in the ‘multiple boys’ (every > some) situation, the *some-every* sentence is true only under the universal-wide (inverse scope) reading, and false under the existential-wide (surface scope) reading. The same entailment relation applies to sentences like (2) *Every boy read some book* (see Rakhlin 2007:111).

\(^3\) Types of universals are also known to affect interpretative preference (or possibility). When the object quantifier is all, as in *someone read all the books* (Marsden 2003: 497), the availability of inverse scope (all>someone) is severely diminished (Ioup 1975).
making it referentially dependent. Therefore, no such scope ambiguity arises with a sentence having two individual-denoting NPs (e.g., *John likes that book*, Reynolds 2005: 68) or two universal quantifiers (e.g., *Every boy named every planet*, Szabolcsi 2001: 609) or two existential quantifiers (e.g., *Some student read two books*, Beghelli 1993).

2.2.2 Movement account: Quantifier Raising

Given the ambiguity of sentences like (1), the question is how this ambiguity arises. This section will introduce the standard syntactic linguistic analyses on quantifier scope in the Chomskyan generative framework. The standard analysis stems from work in classical logic (Frege 1891, 1892), the orthodox view in philosophy of language and still an orthodox view in the linguistics literature.

The key point in the standard linguistic analysis is that quantifiers’ scope relations (surface or inverse) are determined as a consequence of a syntactic movement (May 1972, 1985; Aoun and Li 1993; Hornstein 1995; Beghelli and Stowell 1997). Linguists have proposed various versions of “movement” accounts (see for an overview Reinhart 2006; Szabolcsi 2001; Pylkkänen and McElree 2006; Glanzberg, 2002). We present one standard movement analysis, QR (Quantifier Raising) (Chomsky 1977; May 1977, 1985).

QR is simply an invisible operation that creates operator-variable structures by moving and adjoining the operators out of their basic argument position to the left of clausal boundaries (e.g. adjoining to IP). The moved operators come to bind the variables from their raised position. QR is supposed to apply to all quantifier phrases (either subject or object). Scope is then defined using the notion of c-command domain: a quantifier A has scope over a quantifier B if A c-commands B and that the c-commanding quantifier phrase
takes wide scope (May 1977). In a nutshell, scope ambiguities arise as a result of QR, represented at LF (Logical Form) by different c-command relations between two quantifiers.\(^4\)

To exemplify how this mechanism works, consider the sentence in (4) repeated below:

(4) Some girl met every boy.

a LF1: \([_{IP} \text{some girl}, _{IP} \text{every boy}, _{IP} \text{t}_i, \text{met } t_j]]\) (some > every; surface scope)

b LF2: \([_{IP} \text{every boy}, _{IP} \text{some girl}, _{IP} \text{t}_i, \text{met } t_j]]\) (every > some; inverse scope)

In LF 1 and LF2, both \textit{some girl} and \textit{every boy} are raised by QR to an IP adjoined position. In (4a), the subject \textit{some girl}, after QR, is raised higher than the object \textit{every boy}, and takes wide scope over \textit{every boy} as the former c-commands the latter. In (4b), the object \textit{every boy} is raised higher than the subject \textit{some girl} and takes wide scope over \textit{some girl} as the object, after QR, c-commands the subject. Sentence (4) is mapped to either (4a) or (4b) at LF, yielding the surface scope reading and the inverse scope reading, respectively.

Summarizing the QR account, an English sentence like \textit{Some boy read every book} is ambiguous between surface (\textit{some} > \textit{every}) and inverse scope (\textit{every} > \textit{some}): the surface and inverse scope is the result of an LF operation QR that moves one quantifier phrase across another quantifier phrase.

Before leaving this background section, we point out an important assumption regarding indefinites. As noticed, the term “quantifier” is used by logicians (also by formal

---

\(^4\) According to May (1977), \textit{Scope Principle} states that “A is syntactically licensed to take scope over B iff A c-commands B, B an operator.”
linguists) to refer to “operators that bind the variables which come within its scope” (Lyons 1977: 454). Importantly for us, indefinites (a boy, someone, some boy) in formal logic are also operators (existential quantifiers), not referring expressions (Russell 1919; King 1988: 430). In a sentence like some woman smiled, it therefore means that there exists at least one such woman that smiled. Keep in mind that indefinites as operators or quantifiers, not as referential expressions, can enter into different scope relations with respect to other operators like every. For that reason, it becomes important to make sure the knowledge of some N as an operator among native speakers, as this lexical knowledge is critical for carrying out scope shifting.

5 “According to Russell, a description does not, though its token, contribute an individual to a proposition. Descriptions are general terms. Russell emphasized this point many times over. Here are two typical examples” (Pupa 2008: 31).

Our question is; What do I really assert when I assert “I met a man”? Let us assume, for the moment, that my assertion is true, and that in fact I met Jones. It is clear that what I assert is not ‘I met Jones’. … We may go further; not only Jones, but no actual man, enters into my statement (Russell 1919: 167-8). (His emphasis)

6 It is however known that the semantics of indefinites in natural languages is notoriously complicated (see Pupa’s (2008) survey). Linguists and philosophers have growly recognized that indefinites can have dual function - quantifying term and referring expression (Lyons 1977: 454-455; Fodor and Sag 1982; Stedmon 1986:119). For instance, in some woman smiled, it can also mean that a particular student smiled. For another instance, a student in the syntax class cheated in the final exam (from Fodor and Sag 1982) can be a statement of existence, or a statement about a particular student. The semantic complexity of indefinites is not neatly generalized among linguists; some claim that indefinites can be not only quantificational but also free variables (Kamp 1981; Heim 1982), or choice function variables (Kratzer 1998; Reinhart 1997; c.f., Fodor and Sag 1982) (see Lidz and Musolino 2006, for a summary on linguists’ approaches to indefinites). Debates on the semantics of indefinites exist among philosophers, too. According to Pupa (2008:22-35), there are three kinds of traditions on indefinites: (a) Russellian theory that indefinite descriptions are quantifier phrase, not referring expressions; (b) Familiarity theory that claims that indefinite descriptions are referring expressions, not quantifier phrases (Strawson 1950); (c) Ambiguity thesis that speakers use descriptions not only as devices of quantification but also as devices of reference (Donnellan 1966).
2.3 **Empirical findings: Surface scope preference**

This section summarizes empirical evidence from recent experimental studies with native English adults’ data, judgment or reading time. The data come from sentences like (5) - a simple active transitive sentence with a subject indefinite NP and an object universal NP. The results consistently demonstrate that native English speakers dominantly prefer surface scope (a > every) over inverse scope (every > a).³

(5) A climber scaled every mountain.

(1) **Marsden (2004, 2005)**

Marsden (2004), a study of second language acquisition, tested native English speakers for sentences with a subject *someone/numeral* and an object *every/all the NP*. The existential subjects *someone or two tourists* were crossed with the universal object *every N or all the N*, therefore four pairs of quantifiers were used, as in (6).

(6) Test sentence:  
Someone stroked every cat.  
Someone carried all the suitcases.  
Three girls flew every kite.  
Two girls washed all the windows.

The task was a picture-sentence acceptability rating task. Two scope interpretations were depicted in the format of a picture – the surface-scope picture where one person stroked all of the three cats, and the inverse-scope picture where a different

³ Studies also tested sentences where *every* precedes *a* like *Every climber scaled a mountain* (Tunstall 1998; Anderson 2004). In this type of *every-a* sentences, no robust interpretative preference for either scope was found, although surface scope (*every > a*) appears to be relatively preferred over inverse scope (*a > every*) reading.
person stroke each of the three cats. Participants as a group were shown a picture and a sentence. They then judged how well the sentence matched the picture over a four-point scale, from completely unacceptable to completely acceptable. The participants could also choose can’t decide. Ratings above 1.5 were considered to show acceptance of the sentence-scope parings, while ratings below 1.5 were considered to show rejection.

Results from English native speakers (N=24) are presented in table 1. The subject-wide (surface) scope is judged acceptable on all four test types. However, the object-wide (inverse) scope is judged less acceptable – barely above 1.5, with a rating of 1.96 for someone-every, and 1.74 for numeral-every N. When the object quantifier is all, inverse scope was almost unacceptable, with a rating of 0.93 for someone-all the N and 0.85 for numeral-all the N.

<table>
<thead>
<tr>
<th>Test sentence</th>
<th>Mean value of rating (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Surface scope</td>
</tr>
<tr>
<td>Someone - every N</td>
<td>2.68 (0.36)</td>
</tr>
<tr>
<td>Someone - all the N</td>
<td>2.98 (0.68)</td>
</tr>
<tr>
<td>Numeral - every N</td>
<td>2.91 (0.14)</td>
</tr>
<tr>
<td>Numeral - all the N</td>
<td>2.95 (0.11)</td>
</tr>
</tbody>
</table>

Table 1. Results of Marsden (2004) (modified from Table 30, in p.195)

(2) Goro (2007)

Goro (2007), a child acquisition study, contains adult native English speakers’ data on sentences like someone ate every food.

(7) Test sentence: Someone ate every food.

The task was a game that Goro created. This task had two phases; first, a story of an eating contest was presented, and then followed by a Truth Value Judgment Task (abbreviated as
TVJT; Crain and Thornton 1998) (the details are in footnote 8). The percentage of accepting the surface scope reading was not reported, but it can be easily assumed to mark high scores. For the test sentence Someone ate every food, adult English speakers (N=29) accepted the inverse scope (every > some), only 33.6% of the time. It means that the participants rejected inverse scope 70% of the time. Additionally, individuals drastically varied regarding the probabilities of accepting the inverse scope, as table 2 shows.

<table>
<thead>
<tr>
<th>% of inverse scope acceptance</th>
<th>0%</th>
<th>25%</th>
<th>50%</th>
<th>75%</th>
<th>100%</th>
<th>Total N</th>
</tr>
</thead>
<tbody>
<tr>
<td>English adults (n)</td>
<td>14</td>
<td>3</td>
<td>3</td>
<td>6</td>
<td>3</td>
<td>29</td>
</tr>
</tbody>
</table>

Table 2. Results of Goro (2007)

Strikingly, almost half of the participants rejected the inverse scope interpretation for the four trials of the sentence someone ate every food. In sum, the results from Goro in the Goro’s (2007) eating game: There are 12 groups of animals; each consists of 3 animals of the same kind (e.g., 3 pigs, 3 elephants, etc.). Each group was invited to eat three pieces of food (e.g., a cream puff, banana, pepper). First, the child was told that there were two important rules in the game. The first rule was that all the foods must be eaten. The 2nd was that each one of the members of a team must get to eat something. Then the group wins the game and receives a gold medal. If one of the animals in a group is greedy and eats all of the foods all by himself, then the group receives a black cross. If a group refuses to eat one of the food, it also receives a black cross.

The game story then proceeded as follows:

Test item: 4 groups received gold medals
(each food got eaten by a different individual; inverse scope)

Filler item: 4 groups received black crosses
(all food got eaten by one greedy member; surface scope)

Filler item: 4 groups did not finish the last food
(the first two animals each ate a different food, but the last one didn’t eat the remaining food)

Finally, the puppet guessed how well each group did by saying the target sentence Someone ate every food. Participants were to judge whether the statement is true or false.
game-involving TVJT task demonstrated that the surface scope is overwhelmingly preferred in someone-every sentences.

(3) Kurtzman and MacDonald (1993); Tunstall (1998) - self-paced reading

Kurtzman and MacDonald (1993; experiment 1) report data for the surface scope preference from a compatibility judgment task. The test sentences were a-every sentences like an example A kid climbed every tree. Continuation sentences were used in order to infer whether readers interpreted the test sentence with surface or inverse scope. See (8) for an example.

(8) Test sentence: A kid climbed every tree.
   (a) Continuation Sentence 1 (singular): The kid was full of energy.
   (b) Continuation Sentence 2 (plural): The kids were full of energy.

The singular continuation in (8a) is compatible with the surface scope reading, whereas the plural continuation in (8b) is compatible with the inverse scope reading. The method was a “sentence-by-sentence” self-paced reading and judgment task. Participants read the quantified A-every sentences (with each sentence presented all at once, not word-by-word) and then read one of two continuation sentences, also presented all at once. Finally, participants were asked whether the second sentence “made sense” and was a “natural continuation” of the first.

Kurtzman and MacDonald’s task also included unambiguous trials acting as fillers, as follows.
Every kid climbed a different tree. The trees were full of apples.
Every kid climbed the same tree. The tree was full of apples.
A different kid climbed every tree. The kids were full of energy.
The same kid climbed every tree. The kid was full of energy.

Results from Kurtzman and MacDonald (1993) again confirmed an overwhelming preference for the surface scope interpretation. The singular continuation (surface scope) was judged compatible with *a-every* sentences about 81% of the time. The plural continuation (inverse scope) was judged to be compatible with *a-every* sentences only about 23% of the time.

**Tunstall (1998)**, in a replication of Kurtzman and MacDonald, measured how long it took for participants to read the sentences. Results (N=40) showed that participants took faster to read a singular continuation such as (8a) than a plural continuation such as (8b), consistent with a general preference for the surface scope reading.

Summarizing, Kurtzman and MacDonald (1993) and Tunstall (1998) demonstrated a strong surface scope preference in *a-every* sentences – singular continuation sentences were far more often judged compatible with the quantifier *a-every* sentences, and singular continuations were read much faster than plural continuations.

**Anderson (2004)**

Anderson (2004) presents robust evidence for the inverse scope reading incurring a heavy processing cost. Using a similar (though not identical) method to Kurtzman and MacDonald (1993) and Tunstall (1998), Anderson added various other manipulations to probe readers’ surface scope preference.
(4.1) Anderson (2004): Experiment 1: off-line forced choice without context

In an off-line paper and pencil task, participants read a-*every* quantified sentences and two paraphrase sentences (presented all at once). One paraphrase was for inverse scope and the other for surface scope. See (10) for an example.

(10) Test Sentence: A cashier greeted every customer.

(a) Surface Scope Paraphrase: One cashier greeted customers.
(b) Inverse Scope Paraphrase: Several cashiers greeted customers.

Participants were then forced to choose one reading, by circling the paraphrase that corresponded to their initial interpretation of the sentence. The surface-scope paraphrase was chosen 81 % of the time, and the inverse-scope paraphrase only 19 % of the time. While the inverse scope interpretation was not completely inaccessible to participants in this forced-choice task, the default preference was strongly for the surface-scope interpretation.

(4.2) Anderson (2004): Experiment 2: off-line forced choice with context

In another off-line paper and pencil task, the same set of *a-every* sentences from Experiment 1 were tested, this time, in a context that supported either the surface-scope or the inverse-scope interpretation. The inverse-biased story context depicted that the activity was likely to be undertaken by multiple members of the group. The surface-biased context made it more likely that a single member of the group would take part in the activity. Participants read a story context, followed by a test sentence. At the end, participants
received a post-context comprehension question with two possible answers – One (surface-scope) or Several (inverse-scope). See (11) for an example.

(11) Sample Context

(a) Surface scope-biased context
The members of the gourmet club decided to publish a cookbook of their favorite recipes. They wanted the recipes to be easy enough for an inexperienced cook. The president of the club requested that someone volunteer to test the recipes to make sure that the instructions were correct.

Test Sentence: A member of the club tested every recipe.

(b) Inverse scope-biased context
The members of the gourmet club decided to publish a cookbook of their favorite recipes. They wanted the recipes to be easy enough for an inexperienced cook. Members who nominated recipes were required to test the recipes to make sure that the instructions were correct.

Test Sentence: A member of the club tested every recipe.

(12) Sample post-context question: How many members tested recipes?
   a. One  b. Several

The results showed that in the surface-biased contexts, participants selected the answer One, 81% of the time, interpreting a-every sentences as surface scope. On the other hand, in the inverse scope contexts, participants selected the answer Several, indicating an inverse scope reading, 53% of the time. It can be said that context indeed increased inverse
scope responses of the test *a-every* sentences, up from 19% in the surface scope context to 53% in the inverse scope context. Nevertheless, the preference for the surface scope reading persisted even with contextual support (81% for surface scope versus 53% for inverse scope).

(4.3) Anderson 2004: Experiment 4; word-by-word self-paced reading

An on-line method was used to obtain reading time evidence. Participants read *A-every* sentences word-by-word using a self-paced reading technique. They continued to read a singular or plural continuation sentence also word-by-word. At the end, participants responded to a post-context question. See (13) for an example.

(13) Test sentence: An experienced climber scaled every cliff.

Continuation Sentence 1: The climber was very skilled.

Continuation Sentence 2: The climbers were very skilled.

Post-context question: How many climbers scaled cliffs?

a. One b. Several

The dependent measure was how long it took for participants to read the continuation sentences. The results (N=29) (from reading time calculated over the entire continuation sentence) showed that participants took longer to read plural (inverse-scope) continuation than singular (surface-scope) continuation sentences. In terms of judgment data, participants chose the inverse-scope response *Several* only 41% of the trials after a plural continuation (cf., 13% after a singular continuation). Their selection of the surface-scope response *One*, however, reached 87% after a singular continuation (cf., 59% of trials
after a plural continuation). The results once again confirm the difficulty of inverse scope relative to surface scope in *a-every* sentences.

**4.4) Anderson 2004: Experiment 5. sentence-by-sentence self-paced reading with context**

Participants first read a context (sentence-by-sentence) and then read the test sentence, followed by one of two continuation sentences (also sentence-by-sentence). At the end, participants responded to a post-context question. The dependent measure was reading time of the test items on which participants gave an inverse-scope answer to the post-question. See (14) for an example.

(14)  
Surface Scope Context: (same as in 4.2)  
Inverse Scope Context: (same as in 4.2)  
Test sentence: An experienced climber scaled every cliff.  
Continuation Sentence 1: The climber was very skilled.  
Continuation Sentence 2: The climbers were very skilled.  
Post-context question: How many climbers scaled cliffs?  
   a. One   b. Several

Participants (N=30) accepted the inverse scope answer (Several) 56% the time, in the condition most favorable for inverse scope - after the plural continuation in the inverse-scope context (cf., 30% after a singular continuation in the inverse-scope context). The surface answer rate (One) was as high as 75% after a singular continuation in the surface context (cf., 45% after a plural continuation in the surface context). It can be inferred from the data that the plural continuation failed to disambiguate the quantified sentence entirely. Anderson (ibid., p. 99) also notes that “the quantified sentences were not disambiguated by the following continuation
sentence, and that the responses to the comprehension questions are a more trustworthy indicator of the interpretation.” For that reason, Anderson decided to conduct another experiment, inserting a post-context question alone as a disambiguating tool.

(4.5) Anderson 2004: Experiment 6: word-by-word self-paced reading with post-question

Participants read *a-every* sentences word-by-word (same sentences as in Experiment 4), followed by a post-context question, without a story context or a continuation sentence. See (15) for an example.

(15) Test sentence: An experienced climber scaled every cliff.
    Post-context question: How many climbers scaled cliffs?
                        a. One  b. Several

Reading time was compared on quantified sentences according to participants’ answer to post-context questions. The results (N=36) found that *a-every* sentences clearly interpreted as inverse scope (*several*) were read significantly more slowly than those clearly interpreted as surface scope (*one*). The data clearly confirmed the surface scope preference in *a-every* sentences. The proportion of inverse response was not reported.

Summary of Anderson’s findings

1. The surface-scope paraphrase was selected significantly more often than the inverse-scope paraphrase (81 % versus 19 %, experiment 1).
2. The inverse scope was persistently dis-preferred even with contextual support (81 % versus 53 %, experiment 2).
3. *A-every* sentences interpreted as inverse-scope were read much slower than the sentences interpreted as surface-scope (experiment 6).

4. Inverse-scope continuation sentences were also read more slowly than surface scope continuation sentences (experiments 4 and 5).

Thus Anderson presents empirical evidence that assigning inverse scope to doubly quantified sentences incurs a processing cost even in a context that reliably supports the inverse-scope interpretation (ibid., p.32).

Below in Table 3, we summarize experimental findings for inverse scope difficulty from the previous studies, focusing on judgment data.

<table>
<thead>
<tr>
<th>Study</th>
<th>Test sentence</th>
<th>Task</th>
<th>Inverse Response Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marsden (2004)</td>
<td>Someone stroked every cat.</td>
<td>A picture-sentence acceptability rating task (on a four-point scale)</td>
<td>1.96</td>
</tr>
<tr>
<td>Goro (2007)</td>
<td>Someone ate every food.</td>
<td>A game task with TVJT (Truth Value Judgment Task)</td>
<td>33.6%</td>
</tr>
<tr>
<td>Kurtzman and MacDonald (1993)</td>
<td>A kid climbed every tree.</td>
<td>Sentence-Continuation compatibility judgment task</td>
<td>23%</td>
</tr>
<tr>
<td>Anderson (2004, experiment 1)</td>
<td>A cashier greeted every customer.</td>
<td>Off-line forced choice task of Inverse Paraphrase</td>
<td>19%</td>
</tr>
<tr>
<td>Anderson (2004: experiment 2)</td>
<td>An experienced climber scaled every cliff.</td>
<td>Off-line forced choice of “Several” with context</td>
<td>53%</td>
</tr>
<tr>
<td>Anderson (2004: experiment 4)</td>
<td>An experienced climber scaled every cliff.</td>
<td>Word-by-word self-paced reading with continuation and select “several”</td>
<td>41%</td>
</tr>
<tr>
<td>Anderson (2004: experiment 5)</td>
<td>An experienced climber scaled every cliff.</td>
<td>Sentence-by-sentence self-paced reading with continuation and context and select “several”</td>
<td>56%</td>
</tr>
</tbody>
</table>

Table 3. Previous Studies: Experimental Findings: Inverse scope response
A brief remark is necessary on the continuation method with definite description *the*, as the method has created some controversy in the literature. As noticed, continuation with *the* has been widely used as a tool to see whether readers interpreted the sentences with surface or inverse scope. Some literature notes that the singular continuation (*the boy*) does not unambiguously force surface scope, and therefore, the advantage for singular continuations does not necessarily reflect a strong preference for surface scope (Pylkkänen and McElree 2006: 533). It is reported that the singular continuation using *the* could be compatible with either surface (a > every) or inverse scope (every > a) in the quantified sentences (Pupa 2008: 424).  

Concluding this section, in psycholinguistic experimental research, inverse scope readings have repeatedly been shown to yield lower acceptance rates and/or higher processing loads relative to surface scope interpretations. The precise reasons for this limited access to inverse scope have not been articulated in a clear manner. Additionally, the manipulation of context was not performed systematically. In what follows, we briefly survey other factors (lexical, syntactic, pragmatic) that should be manipulated as part of the context before we finally lay out our research goals and questions.

---

9 Pupa (2008: 424) reports that, in a sequence like *Every doctor employs a receptionist. The receptionist has many responsibilities*, a receptionist in the first sentence takes narrow scope with respect to *every doctor*, and the receptionist in the second sentence can be anaphoric to the indefinite. According to Allan (2001), ambiguity arises between “every” and definite “the” as between “every” and indefinite “a”. A sentence like (a) *Every girl danced with the bearded sailor* is ambiguous between the distribution of one sailor per girl, and the same sailor for every girl, like *Every girl danced with a bearded sailor*. To illustrate, if a party of sailors were grouped into pairs, one of whom is bearded and the other isn’t, then (a) states that only the bearded sailors got to dance on the occasion referred to (Pupa 2008: 424).
2.4 Various factors that affect inverse scope accessibility

Linguists have acknowledged that quantificational phenomena involve the interplay of multiple levels of linguistic analysis (i.e., lexical, syntactic, semantic and pragmatic). This section shows that scope interpretations (the availability of inverse scope judgments) are indeed subject to lexical, syntactic, and pragmatic factors.

2.4.1 Lexical

Scope ambiguity (or the availability of inverse scope) is sensitive to the type of individual quantifiers (Ioup 1975; Liu 1990). For instance, each is more likely to take a wide scope reading than every, and someone is more likely to take a narrow scope than some N. Within existential quantifiers, the type of existential also matters: some N is reported to be less tolerant to narrow scope, as compared to other indefinites like a N or someone (Lasnik and Saito 1992; Kamp and Reyle 1993; Reinhart 1997; Szabolcsi 1997; Beghelli and Stowell 1997).

Additionally, indefinites with unmodified numerals (a, some, three, many, etc.) can take wide scope easily, as compared to indefinites with modified numerals (exactly three, at least three, less than three, etc.) or vague indefinites (two or three). The latter indefinites are often described as obligatorily narrow-scope taking quantifiers (Reinhart 1997: 383; Szabolcsi 2001: 626). A sentence like At least one student attended every seminar is indeed reported to strongly favor the every-wide (inverse scope) reading over the at least one-wide (surface scope) reading.

With this lexical variation in mind, in any study of quantifier scope, the precise quantifiers used is an important part of the research design. We selected some N – every N
pair in our study, a fairly conservative pair in terms of inverse scope possibility compared to other easy pairs like a N-every N or someone-every N. The reason was that the some – every difficult pair can be ideal for our purpose of manifesting contextual (not lexical or other) facilitation of inverse scope in a clearer and stronger manner. We will examine whether the accessibility of inverse scope is sensitive to discourse, holding two quantifiers the same.

2.4.2 Pragmatic

Scope ambiguity (or the availability of inverse scope) is also subject to world knowledge (pragmatic conditions). In the following examples (from Saba 1999: 8), the salient reading is gradually changed as the pragmatic situation changes.

(16) a. Every student submitted a paper.
    b. A paper was submitted by every student.
(17) a. Every student attended a seminar.
    b. A seminar was attended by every student.
(18) a. Every student speaks a language.
    b. A language is spoken by every student.

We have a paper-submitting situation in (16), a seminar-attending situation in (17) and a language-speaking situation in (18). For the active form in (16-18), ambiguity occurs in all three examples regardless of the kind of pragmatic situation. For the passive form, by contrast, the every>a inverse scope reading decreases from (16) to (18) (Saba 1999: 8). These examples point to the relevance of pragmatics on the availability of inverse scope.
2.4.3 Syntactic Constraints

Syntactic structure is another critical factor that determines scope ambiguity (or availability of inverse scope). With the same pairs of quantifiers, ambiguity differs relative to active versus passive structures (as seen in 16-18 above). Linguists agree to report that inverse scope is perceived more easily in the passive form (*A book was read by every boy*) than in the active form (*A boy read every book*).

Additionally, scope ambiguity differs relative to mono-clausal versus bi-clausal structures. A bi-clausal sentence like *someone thinks that everyone bought a book* is scopally unambiguous; it permits the (*someone > everyone*) surface scope reading alone. The example shows that the scope-taking property of the universal quantifier is syntactically restricted. Universals within an embedded clause cannot take scope out of its own embedded clause (May 1977).¹⁰

Caution is needed, as the restriction applies only when an embedded clause is finite. In a non-finite clause, *every* can take wide scope. In (19a), the inverse scope reading is available, whereas in (19b), no such reading is available:

(19)  
   a. A professor expects every student to pass the exam. (*a>every; every>a*)
   b. A professor expects that every student will pass the exam. (*a>every; *every>a*)

(Hornstein 1984, cited from Rakhlin 2007: 61-64)

¹⁰ Unlike universal quantifiers such as *every N* that cannot take wide scope out of its own tensed clause across the clausal boundary (May, 1977, among many others), existential quantifiers are known to take a wide scope out of its own embedded tense clause (known in the literature as indefinites’ exceptional wide scope taking). See that ambiguity can arise in sentence like *Every boy said that Jon loved some girl* when existential quantifiers are within an embedded clause and universals are out of it. Debates still continue in the literature on how to treat this indefinites’ exceptions in theory (see Fodor and Sag 1982; King 1988; Reinhart 1997; Kratzer 1998; Schwarzschild 2002; Winter 2001).
The restriction is generalized as the “clause-boundedness property of QR”. Put simply, the operation that drives inverse scope (QR) is not able to take place out of embedded tensed clauses (May 1977). To exemplify, in (20), the universal everyone cannot be raised higher than someone by QR at LF:

(20) a. \([\text{IP}_1 \text{Someone thinks } [\text{CP} \text{ that } [\text{IP}_2 \text{everyone bought a book.}]]]\]

b. *[\([\text{IP}_1 \text{everyone}_i \text{IP}_1 \text{someone}_j [\text{IP}_1 t_i \text{thinks } [\text{CP} \text{ that } [\text{IP}_2 t_j \text{bought a book.}]]]]]\]

Embedded tensed clauses are of various grammatical functions such as being the subject of a sentence, the object of a sentence, a relative clause, an adverbial clause, etc. For example, (21) and (22) from Rodman (1976: 168) show that the restriction is true of relative clauses. Sentences in (21a) and (21b) both are unambiguous.

(21) a. John dates every woman who loves a fish. (every-wide scope only)

b. John has dated a woman who loves every man. (every-narrow scope only)

Rodman found a sentence like (22) to be almost non-sensical (therefore marked by the asterisk *). It is because the every>a reading, grammatically unlicensed, conflicts with its pragmatically plausibility.

---

11 These embedded clauses are known as “syntactic islands” among linguists. Overt extraction out of them is prohibited. Whether those syntactic islands all are always scope islands is controversial - “a scope island is a syntactic constituent which confines the scope of quantifiers to that constituent,” but “which syntactic constituents really are scope islands is controversial” (King 1988: 429). The QR’s clause-boundedness phenomenon generally suggests that QR obeys syntactic (locality) constraints of movement in general (see Heim and Kratzer 1998 for a review), therefore taken as an important argument in favor of the movement theory of scope.
(22) * Guinevere has a bone that is in every corner of the house.
   (cf. Guinevere has a bone in every corner of the house.)
   * “for every corner of the house, Guinevere has a (different) bone in that corner”

The next section will further discuss this restriction, as it will be critically relevant when we design our experiments.

2.4.4 More on structural restrictions: Clause-boundedness of QR

A universal quantifier cannot affect the interpretation of expressions outside its clause. Importantly for us, there are exceptions to this generalization. There are cases where universals can scope out of a tensed clause, as in (23), in apparent violation of the QR’s locality constraints (example by Farkas and Giannakidou 1996; cited from Reinhart 2006: 62). In (23), every new patient in the embedded complement clause can take scope over the higher subject a doctor, meaning a different doctor for each patient.

(23) A doctor will make sure that we give every new patient a tranquilizer.

The example seems to show that QR seemingly applies across a clause boundary. However, the exact conditions under which it does so are not clear, perhaps occurring with a restricted set of verbs, like make sure (ibid., p. 62).

Furthermore, the restriction under consideration seems to be relative to the type of universal quantifier. The universal quantifier each, as compared to every, seems freer in its scope taking options. In examples in (24) by Ruys (2000: 525), “each soldier in (24a) may take scope over the entire sentence, whereas the scope of every soldier in (24b) is restricted to the adjunct clause in accordance with conditions on movement.”
(24) a. As each soldier appeared on the platform, a flag was hoisted and a gun went off.
   b. As every soldier appeared on the platform, a flag was hoisted and a gun went off.

Similarly, in (25) by Vanlehn (1978: 8), each can take scope beyond the clausal boundary, with the meaning of a different test for each drug.

(25) A quick test confirmed that each drug was psychoactive
    Summarizing, inverse scope availability is sensitive to syntactic structure; every can take a wide scope in the mono-clausal structure, but not in the bi-clausal structure. This is known as the constraint of the clause-boundedness of QR. However, caution is required with respect to this restriction, as the constraint seems to face some empirical problems. It may be the case that “universal quantifiers clearly obey island restrictions” (Reinhart 2006: 60), and the apparent violation cases could be reducible to a matter of other non-syntactic influence. One way or another, the subtlety of judgments motivates our thesis that our scope judgments are not exclusively syntax-based, but are subject to restrictions of discourse, too.  

---

12 Reinhart (2006: 62) remarks: “[u]nlike the existential quantifier that scopes out easily, it is sometimes easy and sometimes difficult for strong [universal] quantifiers to get scope wider than quantifiers that c-command them overtly, even inside their clause. Scoping strong [universal] quantifiers out of their clause seems even harder and, in fact, we do not know precisely when and why it is possible…. It appears that various factors affect the ease of scoping a strong quantifier out, rather than just a syntactic clause-boundedness restriction.”
2.5 Discourse Constraints

2.5.1 The necessity of discourse considerations in inverse scope

We have thus far shown that quantifier scope ambiguity (the availability of inverse scope) is indeed subject to lexical, pragmatic, and syntactic factors. Here we consider the question of whether quantifier scope is also subject to discourse factors – a widely held assumption amongst linguists (Kuno 1991; Erteschik-Shir 1999; Saba 1999; Kuno and Takami 2002; Szabolcsi 2001; Hayashishita 2000; Deguchi 2003; Reinhart 2006). For instance, Reinhart (2006) strongly appreciates the role of contextual factor. See what Reinhart writes (2006:79): “[i]n the specific area of relative quantifier scope, there may be further restrictions, or contextual strategies, that dictate scopal preferences and exclude options permitted by QR. Furthermore, … except for the case of existentials, non-overt [inverse] quantifier scope is a marked option: it is often very hard to obtain and require a strong discourse motivation.” See another statement by Reinhart (ibid., p.59): “as always with tasks involving quantifier interpretation, judgments of such readings may be subtle, and certainly depend on many contextual factors” (cf., Hayashishita 2004:70).

Despite this widely-held appreciation of contextual variable, contextual issues are left unexplored and have received little empirical scrutiny. The empirical investigation of contextual factors remains illusive. What discourse factors are relevant to the availability of

---

13 Hayashishita (2004) speculates that not all scope interpretations are generated from the grammar (i.e., on the basis of the structural relation of c-command at LF), and that there are scope phenomena that are from an extra-grammatical operation. Hayashishita (ibid., p.70) proposes, also speculatively, that “[s]urface scope readings may obtain through LF compositional computation while inverse scope readings do not. It thus follows that (i) there are (at least) two sources of inverse scope readings, LF compositional computation and an extra-grammatical operation, which I will call MINOR for convenience.”
inverse scope? We do not even know whether there are variations in acceptability from context to context. Next section considers which aspects of context might be relevant to inverse scope readings.

2.5.2 Focus and Wide Scope

The focus roughly is understood as “the most relevant to be conveyed by the speaker, i.e., what the speaker intends to convey” (contrasted to the background, what is not as important) (Molnár 1993 in Endriss 2009: 2; see also Wedgwood 2005: 8). The element focused is often manifested by means of heavy stress and perceptual salience. To exemplify, in “Dana [bought a HORSE]F”, ‘horse’ was stressed. The focus here is [bought a horse], whereas [Dana] builds the background.

Linguists in the formal tradition have noted that this focus has relevance on scope relations (Chomsky 1976; May 1977; Williams 1988; Reinhart 1996; Herburger 2000), in that focused (stressed) constituents likely get wide scope. For instance, according to Williams (1988:143), in examples like “Someone loves EVERYONE”, the universal quantifier that is stressed (thus focused) is likely taken as having wide scope. Similar ideas are found among linguists in the non-formal tradition (Erteschik-Shir 1999; Langacker 1991), although in a slightly different fashion. According to Langacker (1991 (vol.II); 132), “an element’s having wide scope is facilitated by various sorts of prominence, including linear precedence, heavy stress, and occurrence as part of the clausal subject.”

---

14 See Herburger (2000) for extensive discussion of the property of focus interacting with quantification in natural languages.

15 Langacker (1999 (vol.1): 132) states: “Naturally, prominent entities have the best chance of being selected as reference points for this purpose. It is no accident, therefore,
sequence like “Was only one of those chairs lifted by a boy? No, a boy lifted THREE of those chairs” (Langacker 1991 (Vol.II): 124), the object quantifier in the second sentence, *three of those chairs*, is stressed and can be read as wide scope, meaning that each chair was lifted by a different boy. To my knowledge, experimental evidence on this idea is unavailable.¹⁶

2.6 Research Goal:

Establishing contextual sensitivity of inverse scope accessibility

This dissertation systematically tests whether inverse scope accessibility in some-every sentences is context-sensitive, as is widely assumed amongst linguists. Two factors are manipulated: expectation and focus. The former is a discourse manipulation of what the reader expects – if the reader is expecting an inverse scope reading, we predict that inverse scope should be more accessible. The latter is a method of raising the salience of certain aspects of the inverse scope, thereby increasing the likelihood that inverse scope is accessed.

---

¹⁶ Some linguists note that *topicality*, another discourse relation, also has some effects on inverse scope. The basic idea is this: A subject quantifier is inherently inclined to be a topic (i.e. the default topic) and therefore take wide scope, but a non-subject quantifier construed as a topic likely takes a wide scope (Deguchi 2003: 123). There was one study that tested this idea; Catline and Micham (1975) (see Tunstall 1998: 33) showed that “topicality” can indeed affect which NP is chosen to take a wide scope. The results indicate that what participants thought to be a topic (corresponding to the noun in the quantified phrase) was likely given wide scope.
In sum, our research goal is to establish the contextual sensitivity of inverse scope accessibility. This investigation addresses two questions in the area of scope ambiguity in a native language:

1. Can discourse manipulations of focus facilitate the accessibility of inverse scope in *some-every* sentences in English?
2. Might the extent of discourse sensitivity vary relative to contextual types?
CHAPTER 3.
EXPERIMENT: EXPLORING THE EFFECT OF DISCOURSE
(4 EXPERIMENTS)

3.1. Methodology Overview

Our goal is to test the widely-held assumption that inverse scope accessibility is sensitive to various extra-grammatical factors, particularly discourse. To do so, four experiments in this chapter examine the extent to which inverse scope accessibility is sensitive to the two kinds of contextual information: expectation and focus. This section overviews the experimental design. The quantifiers were held constant (subject some N - object every N) while discourse and/or other factors alone were manipulated. We tested the relative power of each context type, twice with the presence or absence of an inverse-scope prime. We thus created four types of experiments. We compared inverse rates across the four experiments with four different population samples (therefore, between-groups design). The method and task were an off-line written survey involving a story-sentence verification task. Participants were tested as a group. Subjects read a story and judged whether the sentence was acceptable in the given story. Below we provide a brief outline of the four experiments. A complete description is provided in the following experimental sections.

Experiment 1 (expectation context) examines the effect of explicit mentioning of the speaker’s expectation (referred to henceforth as the expectation context). See section 3.2 for more details.

Experiment 2 (focal context) examines the effect of a stronger focal discourse context with contrastive focus (referred to henceforth as the focal context). In this focal context,
two sets were created for the object universal quantifier NP, and one set was contrastively focused through discourse. The test *some-every* sentence described what happened to the focused set. This focal context condition is expected to incur further increase in inverse scope readings compared to the relatively simple expectation context condition (experiment 1). Other features of the design and task of experiments 1 and 2 were exactly the same. The results from these two experiments would enable us to compare the extent to which each contextual manipulation, expectation versus focal, contributes to inverse scope accessibility.

**Experiments 3 and 4** retested the two discourse manipulations, this time with additional inverse primes, in an attempt to create maximally facilitating conditions for inverse scope. The prime here refers to an inverse scope context followed by a sentence that strongly favors an inverse scope reading (e.g., *some boy or other climbed every mountain*). Thus one prime is a full test item (context + test item) which strongly favors the inverse scope reading, and these prime items are then inter-mixed with experimental test items identical to experiments 1-2 (for experiments 3-4, respectively). Note that the term priming here is not being used in the standard sense of one item (the prime) being used to increase the likelihood of a particular response in the immediately subsequent item (the target). Rather, priming here refers to the effect that non-experimental items in the full item list have on the actual experimental items. The logic is that if the overall set of items that participants are tested on is ‘inverse scope heavy’, it should increase the likelihood of inverse scope responses on the experimental items. But if the overall list of items is ‘inverse scope light’, then it should reduce the likelihood of inverse scope responses on the experimental items.
No control was used to ensure that prime items immediately preceded test items, but the overall mix of inverse scope items in the test list was controlled for.

**Experiment 3 (expectation context & priming)** used the expectation context (like experiment 1), with prime items. **Experiment 4 (focal context & priming)** used the focal context (like experiment 2), with prime items. The prime items in experiments 3 and 4 were exactly the same. Except for the presence of prime items, other features of the design and task of experiments 3 and 4 were the same as those in experiments 1 and 2. We expect to find that inverse scope rates may increase further in the conditions with both support (contextual and prime) of experiments 3 and 4, as compared to the discourse-only conditions of experiments 1 and 2 (that is, *a prime advantage* in addition to a *discourse advantage*).

3.2. **Experiment Procedure**

Below are the details of the four experiments outlined above. Each experiment, an off-line written survey involving a story-sentence verification task, consists of four sections – instruction, practice (2 trials), main survey (47 trials), and post-experiment background survey. The entire session lasted approximately 45 minutes. Each section is detailed below.

(1) **Instructions**

Subjects were tested as a group. They were recruited from an undergraduate class at the University of Hawaii. The experiment was conducted in the classroom. Subjects were given a survey booklet. Written instructions informed the students that they were participating in an experiment on sentence comprehension. Subjects were instructed to read
stories carefully, and then asked to assess the truth-value of a target statement based on the events illustrated in the story. The exact instructions they received are shown below:

Please judge whether the sentence is a possible description of the provided story. The sentence need not be your preferred description, but do you think it is possibly true for the given story? Indicate your answer by checking one of the options – Possible description (although there may be a better way to describe the story) or Impossible description (you would never say the sentence to describe the story).

(2) Practice

A practice session with two trials was presented before the actual survey. Readers were guided to practice evaluating sentences with scope-taking operators. Two such trials were Not every kid made a big snowman as a possible description in the some-reading context; There was a certain Disney movie that all of the three guys were watching together as an impossible description in the reading of multiple movies (all>a certain N).

(3) Main survey

See sections 3.3 – 3.6 below for details on each experiment.

(4) Post-experiment survey

At the end, the post-experimental survey (5 minutes) was applied. As we shall see, our participants were mostly recruited from elementary-level mathematics classes. It is possible that the amount of experience with the mathematical English could have some bearing on the probability of ambiguity perception in some-every English (natural
language) sentences. We attempted to obtain a clue to our participants’ amount of math proficiency through surveying subjects for their mathematical education background (3 items) (The full list of survey items and results are presented in Appendix O).
3.3. Experiment 1: Expectation-context condition

3.3.1 Purpose

The purpose of Experiment 1 was to test whether the expectation context supporting the inverse-scope interpretation would facilitate the accessibility of inverse scope in English some-every sentences. The independent variable was context (surface-scope versus inverse-scope) and the dependent measure was judgment response (Possible or Impossible).

3.3.2 Materials: Expectation discourse

Twelve critical some-every sentences and contexts were constructed (and are listed in full in Appendix A). In the critical sentences, the subject was some NP and the object was every NP, all with action verbs in the past tense, for example, some child built every playhouse on the display. For each of the 12 test sentences, two stories were constructed: (i) an inverse-scope story in which the inverse scope reading of the test sentence was false and the surface scope reading was true, and (ii) a surface-scope story in which the inverse scope reading of the test sentence was true and the surface scope reading was false. Thus each experimental sentence had two story versions. The stories were controlled for of their length, 4 or 5 sentences.

The story proceeded as follows. There was a narrator (“I”) conveying a story to the reader, who first presented three entities as the domain of discourse for the object universal quantifier. For instance, for a sentence like some child built every playhouse on the display,
the story made sure that there were only three playhouses specifically named *Igloo, Rocket,* and *Playhouse* in the scene.

The narrator then described what he learned about who had built each of the playhouses. As for an indefinite subject (e.g., *some child*), the child’s or children’s identity was carefully kept unknown to the participant. For the surface scope context version, the narrator learned that it was the same child who built two out of the three objects. For the inverse scope context version, the narrator learned that it was two different children who did so.

Finally, when it comes to the last object, in the surface-scope context, the narrator expresses his expectation that the last thing would be done by a different child. In the inverse-scope context, the expectation was established that the last object would not have been built by a child. This expectation turns out to either be met or not. An example story context is given below.

**Sample of Target: Expectation context**

(1) **Inverse scope context (Expectation)**

An environmental activity was held at the school, and participants were making big playhouses out of cardboard. At last, three finished works were displayed. The *igloo* was the work of a 6th-grade boy, and the *rocket* was the work of a 5th-grade boy. When I saw the *doll house,* I thought it could not be a work of a child. However, I was surprised to discover that it was the work of a little 4th-grade girl.
Test Sentence: Some child built every playhouse on the display.

(2) Surface scope context (Expectation)
An environmental activity was held at the school, and participants were making big playhouses out of cardboard. At last, three finished works were displayed. The igloo and the rocket were both the works of a 6th-grade boy. When I saw the doll house, I thought it must be the work of a different child. However, I was surprised to discover that its creator was the same boy again.

Test Sentence: Some child built every playhouse on the display.
3.3.3 Fillers

We constructed 28 sentences and stories as fillers to control for participants’ attention and accuracy. 12 fillers were yes (possible)-answer items (i.e., Match items), potentially ambiguous sentences in the form of the subject universal quantifier (every NP) and negation. Half these every-not items occurred in a context favoring the every>not (none) reading, and half occurred in a context favoring the not>every (not all) reading. 16 fillers were no (impossible) -answer items (i.e., Mismatch items) where a story was incompatible with the filler sentence. The Mismatch fillers vary in structure, with one quantifier (e.g., numeral) in subject or object position. See examples of fillers in Appendix B.

3.3.4 Control items

In addition to 12 critical items and 28 fillers, we tested 7 “Control” items. The purpose was to test lexical and syntactic knowledge relevant for accessing inverse scope in our test items of the subject some N and the object every N.

3.3.4.1 Control 1: existential reading of some N in the subject position

The key idea important to us is that the wide scope of every over some (i.e., inverse scope) cannot obtain unless the indefinite some N is construed as an existential quantifier (see section 2.2.1). Readers’ problem with accessing inverse scope in the some.every sentences could be of a lexical nature, due to their idiosyncratic conception of a subject some N. With our goal being the investigation of the accessibility of inverse scope, it is important to make sure that readers first of all can access an existential reading of some N.
particularly in the subject position. If we were able to exclude this lexical confound, we would then be able to focus on the discourse factors in reader’s ability of inverse scope computation.

We tested readers for whether they access the subject some N’s variable (existential quantifier) reading under the influence of another operator, a universal quantifier, for the following three items (see Appendix C for the full list of Control 1 items and their contexts).

**Control 1 items (k=3)**

1. Some linguistics student visited my office every Monday during the workshop.
   (labeled as some-every temporal)
2. In the report, each teacher said that some student of mine did a great job.
   (labeled as each-some bi-clausal)
3. Some student failed in every math exam this month.
   (labeled as some-every locative)

These items (referred to henceforth as Control 1) were tested in the some-variable reading context. Structurally, these items all favor the variable reading of the subject some N taking a narrow scope under every or each. In (1) and (3), every N is used as a temporal and a locative adverbial phrase respectively. It is well-known that adverbial every N easily takes wide scope over subject indefinites. In (2), each N should easily take wide scope over some N, since the embedded subject some N lies in the c-command domain of the matrix subject each N in the surface syntax. Acceptance of at least two out of these three was taken as evidence that readers are able to read the subject some N existentially.
3.3.4.2 Control 2: syntactic restrictions of inverse scope with every

There are syntactic restrictions on the scope taking properties of universal quantifiers, as discussed in chapter 2 (2.4.4). Control 2 items tested whether readers have knowledge that some-every sentences have restrictions on when inverse scope is possible. We tested Control 2 items such as (1) and (2) in which inverse scope is supposedly impossible. The full contexts are available in Appendix D.

Control 2 items (k=2)
(1) His mother loved every boy at the show.
    (labeled as his mother-every type)
(2) Some girl said that every boy in the group made his debut as a teenager.
    (labeled as bi-clausal frozen scope type)

In (1), a mono-clausal sentence with the subject pronoun his NP and the object every N, the subject pronoun his mother cannot be variable-bound by the object quantifier every boy (e.g., known as a weak cross-over constraint) (see Heim 1982:209). His mother in (1) should refer to some third referent in discourse. In (2), the embedded subject every boy cannot take wide scope over the matrix subject some girl since this would require inverse scope to occur past a tensed clause boundary. Simply, the sentences (1) and (2) are unambiguous: they permit only surface scope reading.

Our Control 2 items were contextualized in the illicit inverse scope context. Therefore, readers are expected to reject inverse scope in these two illicit environments, while they should accept inverse scope for our target, some-every mono-clausal sentences.
3.3.4.3 Control 3: differential pairs of quantifiers than *some-every*

Scope ambiguity is sensitive to the type of individual quantifiers (see section 2.4.1). Important to us, the accessibility of inverse scope can be relative to the type of quantifiers tested. Our critical test items involved *some* N – *every* N pair. We tested two other pairs as Control 3 items. The first involved *some* N – *each* N, which we expect to be easily interpreted with inverse scope, and the second involved *someone* – *every* N, whose reports suggest that it should be favorable to inverse scope readings. The full contexts are available in Appendix E.

**Control 3 items (k=2)**

(1) Some student checked out each Davinci book in the library.
   (labeled *some* N– *each* N)
(2) Someone played every musician that I wanted to hear this morning.
   (labeled *someone* – *every* N)

Given the particular research question being pursued here (i.e., the effect of discourse on inverse scope), these Control 3 items have no bearing and are relatively uninformative. As such, henceforth, we will restrict all subsequent discussion of control items to Control 1 and 2 only. Results for Control 3 items throughout the experiments are summarized in Appendix M.

3.3.5 Materials: Summary

We had a total of 47 stimuli, 12 critical, 28 fillers and 7 Control items. We constructed two lists of stimuli, each containing all fillers and Controls and 12 critical
sentences (six in the surface scope context and the other six in the inverse scope context).

Stimuli in each list were semi-randomized, summarized in table 4.

<table>
<thead>
<tr>
<th>Type</th>
<th>Answer</th>
<th>Sentence</th>
<th>Context</th>
<th>Number of tokens in each list</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target (Some-Every)</td>
<td>yes/no</td>
<td>Some child built every playhouse.</td>
<td>Surface</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>yes</td>
<td>1. Some-Every (temporal) Some linguistics student visited my office every Monday during the workshop.</td>
<td>Inverse</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>yes</td>
<td>2. Each-Some (bi-clausal) In the report, each teacher said that some student of mind did a great job.</td>
<td>Some as a variable</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>yes</td>
<td>3. Each-Some (locative) Some student failed in every math exam this month.</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Control 1 (existential reading of subject some N)</td>
<td>yes</td>
<td>1. Some-Every (temporal) Some linguistics student visited my office every Monday during the workshop.</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>no</td>
<td>1. His mother-Every His mother loved every boy at the show.</td>
<td>Inverse</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>no</td>
<td>2. Bi-clausal frozen scope Some girl said that every member of the group made the debut as a teenager.</td>
<td>Inverse</td>
<td>1</td>
</tr>
<tr>
<td>Control 2 (syntactic restriction of inverse scope with every)</td>
<td>yes/no</td>
<td>1. Some-Each Some student checked out each Davinci book in the library.</td>
<td>Inverse</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>yes/no</td>
<td>2. Someone-Every Someone played every musician that I wanted to hear this morning.</td>
<td>Inverse</td>
<td>1</td>
</tr>
<tr>
<td>Control 3 (other quantifiers)</td>
<td>yes/no</td>
<td>Every-Not Every cook didn’t break an oven.</td>
<td>None</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Some</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No-answer (Mismatch) fillers</td>
<td>(not all)</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td></td>
<td>47</td>
</tr>
</tbody>
</table>

Table 4. Experiment 1: Materials
3.3.6 Design and Procedure

The experiment was conducted in the order of Instructions, Practice, Main survey, and Post-Experiment Background Survey. The task was an off-line pencil-and-paper survey. Participants were tested as a group. Participants were told that they were participating in a language comprehension task. See the section 3.2 for details.

3.3.7 Participants

Thirty-six native speakers of English participated in the experiment, all undergraduate students at the University of Hawaii. They were recruited from two classes, 22 from a basic-level mathematics class and 14 from a basic-level linguistics class. The two populations were tested as a group respectively. Data from all thirty-six participants were analyzed.

3.3.8 Results

Data analyses were conducted on the accuracy and proportions of Yes (possible description)/No (impossible description) judgment responses. The results from test items will be presented, followed by results on filler items. Because the same set of control items was tested in all four experiments, their results will be presented together at the end of this section, for the ease of comparison.

The results of the test items from Experiment 1 (expectation context) are presented in table 5 (k = number of tokens; N = number of participants; M = Mean number of items (out of 6) rated as a ‘possible’ description of the story; SD = Standard Deviation; M % = Percent acceptance out of all items (total = 216)).
Recall that Experiment 1 involved the expectation discourse. Given this discourse, participants \( n = 36 \) accepted \textit{some-every} sentences in the surface scope contexts 78\% of the time. The acceptance rate of the test sentences in the inverse scope contexts was a mere 27\%. This shows that the expectation discourse was not particularly effective in invoking the inverse scope reading.

Turning to filler items, we see that participants performed normally with filler items, as table 6 shows.

<table>
<thead>
<tr>
<th>Type</th>
<th>Sentence</th>
<th>Context (expectation)</th>
<th>N</th>
<th>M (SD, M %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target</td>
<td>Some-Every (k=6)</td>
<td>Surface</td>
<td>36</td>
<td>4.69 (1.06, 78.24)</td>
</tr>
<tr>
<td></td>
<td>Some-Every (k=6)</td>
<td>Inverse</td>
<td>36</td>
<td>1.61 (1.84, 26.85)</td>
</tr>
</tbody>
</table>

Table 5. Experiment 1: Results: Target

The accuracy rate with Mismatch filler items was 89\%. We can see that the participants were attentive, correctly rejecting what needs to be rejected. The tested group responded normally to Every-Not filler sentences, too. Every-Not sentences were accepted in the none-reading context 88\% of the time, and in the some-reading context only 56\% of the time. The \textit{some} (not > every) reading was not judged as good as linguists have taken for granted.\(^1\) It turns out that some native speakers judged the \textit{some} (not all) reading

\(^1\) Research in the area of child language acquisition has extensively examined children’s comprehension of scope ambiguity between negation and universal quantifier.
unacceptable in our task. The result was unexpected. But I argue that the response pattern was normal. S. Lee (2009) also showed, using a written survey similar to ours, that English native speakers accepted such not > every (some) readings around 50% of the time. Indeed, participants in the following experiments show imperfect responses for the some (not all) reading in every-not sentences. I therefore conclude that this group of participants, and the results of these fillers, were indeed normal.

3.3.9 Interim Conclusion

Inverse scope accessibility in some-every sentences was not sensitive to the expectation discourse. Placing speaker’s emphasis upon the set of the universal by means of mentioning the speaker’s expectation in the discourse did not markedly facilitate inverse scope.

Children were often found to be different from adults in their preferential pattern. In a sentence like every horse didn’t jump over the fence, children were biased toward the none (every>not) reading, whereas adults were biased toward the some (not>every) reading (Musolino et al. 2000; Lidz and Musolino 2002).
3.4 Experiment 2: Focal-context condition

3.4.1 Purpose

Experiment 2 explored the role of discourse in inverse scope accessibility by testing a stronger contrastive focus discourse. Using the same methodology as experiment 1, we examined to what extent this focal property may increase inverse scope.

3.4.2 Materials: focal context

We used the same set of 12 some-every test sentences as in Experiment 1, but we added a modifier at the end of sentences. These modifiers (relative clauses, temporal adverbials, locative adverbials, or a combination of thereof) were used to manipulate the focus of the context. See examples below. Our contexts were based upon those of experiment 1 – that is, we maintained the expectation context, but we added an additional element of focus. In the original expectation discourse, the restrictor set of the universal every N earned perceptual emphasis due to the story unfolding contra to the narrator’s expectation. In the focal version, the restrictor set of every N received stronger perceptual salience by being contrasted with another set of the universal.

The major difference between the expectation and focal versions is the number of sets available in the story context established as the domain of universal every N. The expectation version deals with only one set of objects (i.e., there were three playhouses named Igloo, Rocket, and Dollhouse). In the new focal version, on the other hand, another set was introduced later as the domain of the universal. Therefore, two sets are contrasted - one focused (i.e., there were three playhouses that I saw today), and the other defocused or backgrounded (i.e., there were four other playhouses that I didn’t see today). The every N
in the target sentence denoted referents in the focused set (e.g., *some child built every playhouse that I saw today*). See example item provided below (the full list of 12 sentences and their contexts is presented in Appendix F).

**Sample of Target (pictures are the same as in experiment 1)**

(1) **Inverse scope context (Focal context)**
An environmental activity was held at a school today, and participants were making big houses out of cardboard. At last, I saw three big playhouses finished and displayed. Surprisingly, the igloo was the work of a 6th-grade boy, and the rocket was the work of a 5th-grade boy. When I saw the doll house, I thought it could not be a work of a child. However, it was the work of a little child, this time a 4th-grade girl! After I left, I heard that four more houses were displayed, but none of them was a work of a child.

![Playhouses](image)

Test Sentence: Some child built every playhouse that I saw today.

(2) **Surface scope context (Focal context)**
An environmental activity was held at a school today, and participants were making big playhouses out of cardboard. At last, I saw three big playhouses finished and displayed.
Surprisingly, the igloo and the rocket were both the works of a 6th-grade boy. When I saw the doll house, I thought it must be the work of a different child. However, I was surprised to discover that its creator was the same boy again. After I left, I heard that four more houses were displayed, but none of them was a work of a child.

Test Sentence: Some child built every playhouse that I saw today.

3.4.3 Design and Procedure

The design and procedure were exactly the same as experiment 1 – Practice, Main survey and Post-Experiment Background Survey. The task was an off-line pencil-and-paper survey. Participants were tested as a group.

3.4.4 Participants

Twenty-seven native speakers of English participated in the experiment, all undergraduate students at the University of Hawaii. 14 were from a basic-level mathematics class, and the remaining 13 were from a basic linguistics class. The two populations were tested as a group respectively. Data from all twenty-seven participants were analyzed.
3.4.5 Results

Data analyses were conducted on the accuracy and proportions of Yes (possible description)/No (impossible description) judgment responses. The results of the test items from Experiment 2 (focal context) are presented in table 7 (k = number of tokens; N = number of participants; M = Mean number of items (out of 6) rated as a ‘possible’ description of the story; SD = Standard Deviation; M % = Percent acceptance out of all items (total = 162)).

<table>
<thead>
<tr>
<th>Type</th>
<th>Sentence</th>
<th>Context (focal)</th>
<th>N</th>
<th>M (SD, M %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target</td>
<td>Some-Every (k=6)</td>
<td>Surface</td>
<td>27</td>
<td>5.44 (0.80, 90.74)</td>
</tr>
<tr>
<td></td>
<td>Some-Every (k=6)</td>
<td>Inverse</td>
<td>27</td>
<td>3.70 (2.15, 61.73)</td>
</tr>
</tbody>
</table>

Table 7. Experiment 2: Results: Target

Given the focal discourse, participants (n = 27) accepted some-every sentences in the surface scope “focal” contexts 91% of the time. The acceptance rate of the test sentences in the inverse scope “focal” contexts was 62%. The inverse rate markedly increased with the focal discourse condition, as compared to the expectation discourse condition (62% versus 26%). The finding suggests that this stronger discourse with contrast focus contributed to inverse scope accessibility (henceforth referred to as the Focus Advantage). This is consistent with the hypothesis that inverse scope in some-every sentences is sensitive to discourse.

The participants performed well with filler items, as shown in table 8.

<table>
<thead>
<tr>
<th>Type</th>
<th>Sentence</th>
<th>Context</th>
<th>N</th>
<th>M (SD, M %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filler</td>
<td>Mismatch (no-answer) fillers (k=16)</td>
<td></td>
<td>27</td>
<td>14.37 (1.21, 89.81)</td>
</tr>
<tr>
<td></td>
<td>Every-Not (k=6)</td>
<td>None</td>
<td>27</td>
<td>5.15 (1.03, 85.80)</td>
</tr>
<tr>
<td></td>
<td>Every-Not (k=6)</td>
<td>Some (not all)</td>
<td>27</td>
<td>3.44 (1.89, 57.41)</td>
</tr>
</tbody>
</table>

Table 8. Experiment 2: Results: Fillers
Participants’ accuracy rate was 90%, indicating that the participants were attentive, and able to reject incorrect items. They were also normal with respect to Every-Not responses: Every-Not fillers were accepted in the none-reading context 86% of the time, and in the some-reading context 58% of the time, with similar rates as in Experiment 1 (88% for none; 56% for some). The participant groups in experiments 1 and 2 appear to be more or less similar in terms of their responses on every-not sentences: there was no statistical difference for the none reading rates ($t(60) = .3448, p = .7314$), nor the some reading rates ($t(60) = -.1566, p = .8761$).

3.4.6 Interim Conclusion

We found evidence that inverse scope accessibility in some-every sentences is sensitive to discourse, particularly to the focal discourse. Placing a stronger emphasis upon the set of the universal by means of the speaker’s expectation plus a contrastive focus facilitated inverse scope accessibility.
3.5.  **Experiment 3: Expectation context & priming**

3.5.1  **Purpose**

Experiments 3 and 4 investigated these same two discourse types in invoking inverse scope with the addition of a prime. This prime was added as another means of facilitating inverse scope. Studies have shown that inverse scope can be syntactically primed in scopally ambiguous sentences with universal *every N* and negation *not*.

Participants exposed to *Not every dog ate an apple* (unambiguously *not > every* (some) reading) were indeed more prone to accept *not > every* (some) inverse scope reading in *Every dog didn’t eat an apple* (Conroy and Lidz 2007; Viau et al. 2010).

Similarly, the *some N or other – every N* sentences are not unambiguous; but strongly biased towards inverse scope. We suppose that participants exposed to *some N or other* prime items are more likely to accept inverse scope in our target *some-every* items. We here use the term “prime items” to refer to “a context plus a prime sentence.” That is, one prime consisted of a context (favoring inverse scope) with a test item that was unambiguously compatible with this inverse scope. The experimental items (context plus test sentence) were considered the target item.

The primes were randomly interspersed into the lists of items, and so I acknowledge that this is not a traditional priming technique. What is being measured here is the effect of the non-experimental items on the actual experimental items. The difference between Experiment 1 and Experiment 3 is that the non-experimental items consist of more strongly inverse scope items in the latter experiment. The idea here is that the participants, over the course of the experiment, will be influenced into an inverse-scope mode of
thinking by the prime items, thereby facilitating inverse scope. If this is the case, we will be able to conclude that such priming effects are an additional factor which influences access to the inverse scope readings.

3.5.2 Design and Procedure

The design and procedure were exactly the same as experiment 1 – Practice, Main survey and Post-Experiment Background Survey. The task was an off-line pencil-and-paper survey.

3.5.3 Participants

Twenty-six native speakers of English participated in the experiment, all undergraduate students at the University of Hawaii. The participants were recruited from one basic mathematics class. One student was excluded due to a low accuracy rate (below 80%). Data from twenty-five participants (6 male, 19 female) were analyzed. The overall mean accuracy rate was 89%.

3.5.4 Materials

Experiment 3 used the same set of critical some-every sentences, in the expectation discourse, 16 fillers, and 7 Control items as in Experiments 1. The 12 every-not filler items in Experiment 1 were replaced with 12 new prime items: 6 were some N or other-every sentences in the inverse scope expectation context (e.g., some child or other invented every product) and 6 were the same N-every sentences in the surface scope expectation context (e.g., the same child invented every product) (the full list of items and contexts are
presented in Appendix G). These 12 prime items were randomly inter-mixed with the 12 test and other sentences. The prime and test sentences were made not adjacent to each other. See a sample prime provided below:

**Sample of prime:**

(1) **Inverse-scope prime (Expectation)**

Walmart sells *Needle Beetle, Crayon Holder, and Aim Fish* in their toy section, and these products were the winners of the Invention Competition. *Needle Beetle*, the 2005 winner, is a device invented by a 5th-grade boy to reduce anxiety when receiving injections, and *Crayon Holder*, the 2006 winner, is a device invented by a 7th-grade girl for grabbing small pieces of crayon. The 2007 winner, *Aim Fish*, is an easy-to-use fishing rod, and I thought this product might have been the invention of an adult. However, its inventor was a child, too, this time a 7th-grade boy.

![Winners of invention competitions](image)

Prime Sentence: Some child or other invented every product that was mentioned.
(2) Surface-scope prime (Expectation)

Walmart sells Needle Beetle, Crayon Holder, and Aim Fish in their toys section. These products were the best works in the Kids Invention Exhibition. According to the 7th-grade girl inventor, Needle Beetle was designed to reduce anxiety when receiving injections, and Crayon Holder was designed to grab small pieces of crayon. The Aim Fish was designed to be an easy-to-use fishing rod, and I thought this product might have been the invention of a different child. However, its inventor was that 7th-grade girl.

Winners of invention competitions

Prime Sentence: The same child invented every product that was mentioned.

3.5.5 Results

Data analyses were conducted on the accuracy and proportions of Yes (possible description)/No (impossible description) judgment responses. The results of target from Experiment 3 (expectation discourse and priming) are presented in table 9 (k = number of tokens; N = number of participants; M = Mean number of items (out of 6) rated as a ‘possible’ description of the story; SD = Standard Deviation; M % = Percent acceptance out of all items (total = 150)).
Given the expectation discourse and prime condition, participants \((n = 25)\) accepted some-every sentences in the surface scope expectation contexts 83% of the time. The acceptance rate of the test sentences in the inverse scope expectation contexts was 60%. The inverse scope rate substantially increased up to 60% when the prime items were added to the expectation discourse condition in Experiment 3, as compared to 27% in the expectation discourse alone in Experiment 1. This finding seems to suggest that the presence of the prime items contributed to inverse scope accessibility (henceforth referred to as the Prime Advantage).

Let us see whether the prime sentences, inverse-favoring but still scopally ambiguous, were read as inverse scope given the inverse-scope (expectation) context. Performance on the prime sentences was relatively successful, as expected, as shown in table 10.

![Table](https://example.com/table10.png)

The surface prime sentences, the same-every, were accepted in the surface scope expectation context 84% of the time. The inverse prime sentences, some N or other-every, were accepted in the inverse scope expectation context 77% of the time. There was no
statistical difference between the two conditions \( t (25) = 1.161, p = .251 \). Considering our inverse prime sentences are ambiguous, the inverse response rate of 77\%, although not perfect, can be taken to indicate that readers were mostly successful in accessing inverse scope. It is worth noting that some proportion of readers rejected the inverse scope reading of some \( N \) or other-every. We delay the discussion of individual variation until chapter 5.

The participants performed well with filler items, as shown in table 11.

<table>
<thead>
<tr>
<th>Type</th>
<th>Sentence</th>
<th>N</th>
<th>M (SD, M %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filler</td>
<td>Mismatch (no-answer) fillers</td>
<td>25</td>
<td>14.92 (1.22, 93.25)</td>
</tr>
</tbody>
</table>

Table 11. Experiment 3: Results: Fillers

The accuracy rate was 93 \%, indicating that the participants were attentive in their judgments, correctly rejecting what needs to be rejected.

### 3.5.6 Interim Conclusion

In Experiment 3 where the target some-every sentences in the expectation discourse were mixed with the prime items, inverse response rate increased up to 60 \%, compared to 27\% in the expectation discourse condition in Experiment 1. We found evidence that the Prime Advantage was present.
3.6 Experiment 4: Focal context & priming

3.6.1 Purpose

Experiment 4, similar to Experiment 3, examined the discourse sensitivity of inverse scope accessibility, this time with the focal discourse coupled with prime items. We examined to what further extent focal context and priming would increase inverse scope.

3.6.2 Design and Procedure

The design and procedure were exactly the same as experiment 1 – Practice, Main survey and Post-Experiment Background Survey. The task was an off-line pencil-and-paper survey. Participants were tested as a group.

3.6.3 Participants

Twenty-three native speakers of English participated as a group in the experiment, all undergraduate students at the University of Hawaii. They were recruited from one basic mathematics class. Two were excluded due to a low accuracy rate (below 80%). Data from twenty-one participants were analyzed. The overall mean accuracy was 92%.

3.6.4 Materials

Experiment 4 used the same set of critical *some-every* sentences embedded in the focal context as used in experiment 2. It also used the same set of *the same-every/some N or other-every* prime sentences embedded in the expectation context used in experiment 3. Other fillers and control sentences were the same as in all experiments so far.
3.6.5 Results

Data analyses were conducted on the accuracy and proportions of Yes (possible description)/No (impossible description) judgment responses. The results from Experiment 4 (focal context and priming) are presented in Table 12 (k = number of tokens; N = number of participants; M = Mean number of items (out of 6) rated as a ‘possible’ description of the story; SD = Standard Deviation; M % = Percent acceptance out of all items (total = 126)).

<table>
<thead>
<tr>
<th>Type</th>
<th>Sentence</th>
<th>Context (focal)</th>
<th>N</th>
<th>M (SD, M %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target</td>
<td>Some-Every (k=6)</td>
<td>Surface</td>
<td>21</td>
<td>5.52 (0.68, 92.06)</td>
</tr>
<tr>
<td></td>
<td>Some-Every (k=6)</td>
<td>Inverse</td>
<td>21</td>
<td>4.67 (1.74, 77.78)</td>
</tr>
</tbody>
</table>

Table 12. Experiment 4: Results: Target

Given the focal discourse and prime, participants (n = 21) accepted some-every sentences in the surface scope focal contexts 92 % of the time. The acceptance rate of the test sentences in the inverse scope focal contexts was 78 %. While this is numerically the highest inverse rate observed so far, it was far from perfect. Inverse rates were not substantially higher when the prime items were added to the focal discourse condition in Experiment 4 (78 %), compared to 62 % in the focal discourse alone in Experiment 2. The scores were not significantly different (p = .305). This difference might be attributed to the original focal context, or perhaps to the presence of the primes alone, or to a combination of the two. At this point, it is unclear.

Regarding prime items, this tested group performed more successfully than those in Experiment 3, as Table 13 shows.
The *same-every* sentences (surface prime) were accepted in the surface scope expectation context 84% of the time, and *some N or other-every* sentences (inverse prime) were accepted in the inverse scope expectation context with almost a perfect score of 92%. The two scores were not different ($t(21) = -1.644$, $p = .116$). It is reasonably inferred that the participants in the group in Experiment 4 appears to have more inverse-oriented people than the group in Experiment 3.

The participants performed well with filler items, as table 14 shows.

<table>
<thead>
<tr>
<th>Type</th>
<th>Sentence</th>
<th>Context (expectation)</th>
<th>N</th>
<th>M (SD, M %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prime</td>
<td>The Same-Every (k=6)</td>
<td>Surface scope</td>
<td>21</td>
<td>5.05 (1.20, 84.13)</td>
</tr>
<tr>
<td></td>
<td>Some N or other-Every (k=6)</td>
<td>Inverse scope</td>
<td>21</td>
<td>5.52 (0.6, 92.06)</td>
</tr>
</tbody>
</table>

Table 13. Experiment 4: Results: Prime

<table>
<thead>
<tr>
<th>Type</th>
<th>Sentence</th>
<th>N</th>
<th>M (SD, M %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filler</td>
<td>Mismatch (no-answer) fillers (k=16)</td>
<td>21</td>
<td>15.05 (0.97, 94.05)</td>
</tr>
</tbody>
</table>

Table 14. Experiment 4: Results: Fillers

The mean accuracy of the 16 filler items (no answer) was 94%, indicating that the readers were attentive and correctly rejected what must be rejected.

3.6.7 Interim Conclusion

In Experiment 4, where the prime support was available in addition to the focal discourse support, we found the highest rate of inverse scope acceptance for *some-every* sentences (78%). However, the nature of this high inverse rate remains uncertain. The contribution of the focal discourse was certainly present. But it could also be that this increased rate of inverse scope response was due to the Prime Advantage, or both. Further,
as hinted from the prime data, the possibility cannot be excluded that the population in
Experiment 4 consisted of more inverse-scope people – those who (for whatever reason)
are more flexible in their scope taking abilities and find it easier to access inverse scope.
However these data are interpreted, they add evidence that inverse scope accessibility is
sensitive to discourse, particularly the focal-type.

3.7 Further Results and analysis:

Experiment 1 to 4: Between-groups comparison

In what follows, we present a summary of target results from all four experiments,
followed by results from control items. We shall take a statistical look at the data,
conducting between-groups comparisons, using the Welch 1-Way Anova Test (variances
not assumed equal). Discussion and conclusion will then follow.

3.7.1 Results of target items: Group means

Table 1 and figure 1 below summarize results for the target some-every sentences
from the four experimental conditions. The surface-scope rates were 78 %, 90%, 83% and
92% respectively. The inverse-scope rate was lowest at 27 % in the expectation discourse
condition. The rate was 62 % in the focal discourse condition and similarly 60% in the
expectation discourse plus priming condition. Finally, inverse scope increased up to 78% in
the focal discourse plus priming condition.
Participants in Experiment 1 performed poorly for both surface and inverse scope. Participants in the other three experiments performed more or less similarly. Regarding the surface scope, the Welch 1-Way Anova Test found a between-experiments difference (F(3, 55.99) = 5.283, p = .003). According to the Tukey post-hoc analysis, the surface-score score for experiment 1 was significantly lower than in experiment 2 (p = .017) and in experiment 4 (p = .014), but not in experiment 3. Regarding the inverse scope, the Welch 1-Way Anova Test also found a between-experiments difference (F(3, 14.21) = 53.90, p < .0001). The Tukey post-hoc analysis indicated that the inverse-scope score for
participants in experiment 1 was significantly lower than all three other experiments, experiment 2 \((p = .001)\), experiment 3 \((p = .002)\), and experiment 4 \((p < .001)\). But among experiments 2, 3, and 4, there was no difference among the inverse-scope scores for any pairs \((2-3, p = .998; 2-4, p = .381; 3-4, p = .305)\). In summary, experiment 1 statistically differed from the other three experiments for surface scope and for inverse scope both. The three experiments \((2, 3, \text{and} 4)\) were similar to one another, for both surface and inverse scope.

Let us now discuss the implications of the experimental results. The crucial finding is that we found evidence for a discourse advantage. Inverse rates were high in the experimental conditions involving the focal discourse. By contrast, the role of the expectation discourse turns out to be unstable. It can be said that the focal discourse clearly facilitated inverse scope accessibility. Second, it appears that we found a Prime Advantage. With the expectation discourse, the presence of the prime made a difference to inverse score, compared to the absence of the prime. With the focal discourse condition, the difference was not statistically meaningful. One possible explanation of this is individual or group variation, as we shall see from the results from various controls. Given that, the high inverse acceptance rates observed in the experiments 2, 3, and 4 cannot directly be attributed to the effects of discourse and/or priming.

### 3.7.2 Results of Control items

This section reports results of control items. The same set of control items was repeatedly tested across four experiments. The data provide a clue to population variation.
3.7.2.1 Results of Control 1 items (*some N* as an existential quantifier)

The purpose of Control 1 items (three items with a “yes” answer) was to see if readers were able to read *some N* as an existential quantifier, construing the referent of *some* as a variable. See table 16 and figure2 for the results of Control 1 items from Experiments 1 to 4 (k = number of tokens; N = number of participants; M = Mean number of items (out of 1) rated as a ‘possible’ description of the story; SD = Standard Deviation).

<table>
<thead>
<tr>
<th>Experiment</th>
<th>1. some-every (temporal) <em>(some-variable) (k=1)</em></th>
<th>2. each-some (bi-clausal) <em>(some-variable) (k=1)</em></th>
<th>3. some-every (locative) <em>(some-variable) (k=1)</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (N=36)</td>
<td>M (SD) 0.83 (0.38)</td>
<td>M (SD) 0.81 (0.40)</td>
<td>M (SD) 0.42 (0.50)</td>
</tr>
<tr>
<td>2 (N=27)</td>
<td>M (SD) 0.85 (0.36)</td>
<td>M (SD) 0.89 (0.32)</td>
<td>M (SD) 0.59 (0.50)</td>
</tr>
<tr>
<td>3 (N=25)</td>
<td>M (SD) 0.92 (0.28)</td>
<td>M (SD) 0.88 (0.33)</td>
<td>M (SD) 0.80 (0.41)</td>
</tr>
<tr>
<td>4 (N=21)</td>
<td>M (SD) 0.76 (0.44)</td>
<td>M (SD) 1.00 (0.00)</td>
<td>M (SD) 0.86 (0.36)</td>
</tr>
</tbody>
</table>

Table 16. Experiments 1-4: Results: Control 1
1. Some linguistics student visited my office every Monday during the workshop.
2. In the report, each teacher reported that some student of mine did a great job.
3. Some student failed in every math quiz this month.
The *some*-variable reading with the first control item (1) was accepted with fairly high rates, 83%, 85%, 92%, and 76% respectively. Also, the *some*-variable reading with the second control 1 item (2) was accepted with high rates, 81%, 89%, 88%, and 100% respectively. For the *some*-variable reading with the third control 1 item (3), the acceptance rates were 42%, 59%, 80%, and 86%, respectively—low with participants in experiments 1 and 2, but high with participants in experiments 3 and 4.

The data provide three implications, as follows. First, most readers in all four experiments were capable of accessing *some* $N$ (in the subject position) as a scope-taking element (i.e., the referent of subject *some* $N$ varies by *every/each* $N$). The third item (*some-every*, locative) turned out to be difficult, and the scores were not perfect. But participants in all experiments accepted at least the first two items, consistently about 80% of the time. Therefore, we are able to eliminate the possibility that adult readers tend to mis-analyze
some \( N \) as a referential (not quantificational) expression. Second, important to us, our adults’ failure to access inverse scope is not necessarily of a lexical nature. The majority of the readers in experiment 1 were able to read some \( N \) as an existential quantifier, but they failed to access every-wide (inverse) scope over some in the expectation context. Third, we found a hint of group variation. The third “difficult” item (some student failed in every math quiz this month) made participants in experiments 1 and 2 stand out, possibly as populations less proficient with inverse scope compared to participants in experiments 3 and 4.

3.7.2.2 Results of Control 2 items (syntactic restrictions of inverse scope)

The purpose of Control 2 items (two items with a “no” answer) was to examine the knowledge of syntactic restrictions of inverse scope. One item was his mother-every type, and the other item was bi-clausal frozen scope type, both tested in the inverse-scope contexts. See table17 and figure 3 for their results (\( M = \) Mean number of items (out of 1) rated as a ‘possible’ description of the story; \( SD = \) Standard Deviation).

<table>
<thead>
<tr>
<th>Experiment</th>
<th>1. his mother-every (Inverse) (k=1)</th>
<th>2. bi-clausal frozen scope (Inverse) (k=1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( M ) (( SD ))</td>
<td>( M ) (( SD ))</td>
</tr>
<tr>
<td>1 (N=36)</td>
<td>0.19 (0.40)</td>
<td>0.39 (0.49)</td>
</tr>
<tr>
<td>2 (N=27)</td>
<td>0.37 (0.49)</td>
<td>0.48 (0.51)</td>
</tr>
<tr>
<td>3 (N=25)</td>
<td>0.40 (0.50)</td>
<td>0.60 (0.50)</td>
</tr>
<tr>
<td>4 (N=21)</td>
<td>0.33 (0.48)</td>
<td>0.76 (0.44)</td>
</tr>
</tbody>
</table>

Table 17. Experiments 1-4: Results: Control 2
1. His mother loved every boy.
2. Some girl said that every boy in the group made the debut as a teenager.
First, in the first item, the subject pronoun’s bound-variable reading by the object *every N* was incorrectly accepted 19\%, 37\%, 40\%, 33\% of the time respectively. These scores were not statistically different (Welch 1-way ANOVA test, F (3, 52.68) = 1.342, *p* = .271).

Second, the illicit inverse scope reading in the second frozen scope item was accepted with unexpectedly high rates: 39\%, 48\%, 60\%, 76\% of the time respectively. These scores were statistically different (The Welch 1-way ANOVA test, F (3, 55.03) = 3.091, *p* = .034), only between participants in experiments 1 and 4 (The Tukey Post-hoc test, *p* = .032). The frozen-scope scores were not different in the other three pairs of experiments.

The data from Control 2 items were not as clean as we predicted; the two items were not rejected outright, contrary to what has been claimed in the literature. The scores for the *pronoun-every N* example was relatively conservative and consistent across the four experiments, below 40\% of the time. But a concern for us was the bi-clausal frozen scope
item. The overall inverse-scope scores for the *some-every* bi-clausal item were higher than the mean inverse-scope scores for the target mono-clausal *some-every* items. Further, the scores for the frozen scope item were variable across the four experiments, particularly high in experiments 3 and 4, in the presence of the prime support. All we can say clearly here is that participants appear to be more proficient in dealing with the restriction associated with the subject pronoun’s bound-variable reading by object *every N*, than when it comes to the syntactic restriction associated with the universal’s long-distance scope taking.

As to the high acceptance scores for the *some-every* bi-clausal item, the following sources are possible. First, the item may happen to sound acceptable with the long-distance wide scope reading of *every* in our particular context. Second, it may be the case that the prime items in experiments 3 and 4 not only affected readers to accept target *some-every* items but also other items. If this is along the right track (and this seems reasonable, given the logic of experiments 3 and 4 overall), the high scores for the *some-every* bi-clausal item could partly be a by-product of the prime effect as was observed with the experimental items in experiments 3 and 4 - priming affects the so-called frozen scope items as well as the experimental items. Third, once again, individual/group variation may be a factor. Inverse scope should be impossible in the bi-clausal structure, but it appears to be readily available for some readers with flexible scope options, once contextually supported. Most probably, those flexible readers were influenced by the contextual information to access inverse scope in the bi-clausal structure, in active violation of the syntactic constraint that the universal’s scope taking is clause-bound.
3.7.3 Acceptance tendency

One potential factor that possibly influenced our data is a tendency to accept test items. From the results from target and control items, we found an interesting tendency: as inverse rates with our target *some-every* items increased, inverse rates with other control items tended to increase, too. That is, there is a tendency to accept items that involve inverse scope, licit or illicit. This tendency was shown stronger in the experimental environments manipulated to be more inverse-friendly, from experiment 1 through experiment 4.

Some might dismiss the tendency as a sign of merely a yes (possible) response bias. But it is not that simple. Participants' response on filler (Mismatch) items (k=16) was transparently clear (very reliable rejection of mismatch filler items). Furthermore, readers' responses on *his mother—every* control item (e.g., *His mother loved every boy*) were relatively conservative, across all of the four experiments. Therefore, the participants were not simply accepting items in a sloppy way.

Nevertheless, this tendency to accept is worrisome. Scope judgments were indeed unstable and subtle, being vulnerable to the presence of other scope items (controls, primes, or fillers). Participants seem to be swept toward rejection or acceptance, relative to the task environment or materials used. It interferes with our goal of evaluating the discourse contribution to inverse scope. Therefore, it becomes important to develop a best control for this tendency to accept.
3.7.4 Group variation

Another potential factor that possibly influenced our data is group variation. We here assumed that our four populations, all undergraduate students, were more or less homogeneous. We found some signs of group variation. Here point out that the group-related variation makes the data interpretation not straightforward. The lowest inverse rate was found in the expectation discourse condition. High inverse rates were found in the focal discourse condition. However, this could possibly be due to there simply being an unusual batch of people, not necessarily translatable into the limited role of the expectation discourse or the powerful role of the focal discourse. In other words, the high scores found with experimental groups 2, 3 and 4 could be the matter of group characteristics, more than they reflect discourse and/or prime effects.

In what follows, some signs of group variation are presented. First, Group 1 (participants in Experiment 1) in particular stood out as peculiar in their surface and inverse performance, as the statistical findings indicated. We conducted a histogram analysis of the four experiment groups on target inverse performance. See table 18 and figure 4. These data show the number of participants who accepted the six items in question in different proportions. For example, in experiment 1, 16 participants accepted 0 out of 6 inverse scope items, while 4 accepted 1 out of 6 inverse scope items, etc.

---

18 By ‘group variation’, I simply mean that the particular participants in each experiment (each group) may not have been homogeneous in their scope-taking preferences. Thus each group may have varied in their aggregate, and this is what (partially) created the results reported above. Henceforth, Group 1 refers to the participants in experiment 1; Group 2 refers to participants in experiment 2, etc.
With group 1 (experiment 1), a large proportion of participants totally rejected inverse items (zero inverse category) (44%, 16/36). It is striking that nearly half of the population in group 1 **entirely** rejected the target inverse items contextualized in the expectation discourse. This suggests that this group may have contained an inordinate number of inverse-scope-averse people.
Next, we compared groups 3 and 4 for their behavior on prime items. Recall that groups 3 and 4 were given the same set of prime items. See table 19 and figure 5, which shows the mean rates of acceptance of the prime items (surface scope and inverse scope).

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Condition</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>M %</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>The Same-Every</td>
<td>25</td>
<td>5.04</td>
<td>1.06</td>
<td>84.00</td>
</tr>
<tr>
<td></td>
<td>Some N or other-Every</td>
<td>25</td>
<td>4.60</td>
<td>1.78</td>
<td>76.67</td>
</tr>
<tr>
<td>4</td>
<td>The Same-Every</td>
<td>21</td>
<td>5.05</td>
<td>1.20</td>
<td>84.13</td>
</tr>
<tr>
<td></td>
<td>Some N or other-Every</td>
<td>21</td>
<td>5.52</td>
<td>0.60</td>
<td>92.06</td>
</tr>
</tbody>
</table>

Table 19. Experiments 3 and 4: Results: Prime

The responses on the *same* – *every* $N$ sentences in the surface scope context were not different: their acceptance rates were very similar (84 % acceptance in both experiment 3 and experiment 4, with no statistical difference ($t(40) = 0.026, p = .982$)). However, the two groups performed differently with the *some N or other* – *every* $N$ sentences in the inverse scope. Group 4 scored higher than group 3 did (92 % versus 77 %, with statistical difference ($t(30) = 2.435, p = .021$)). Recall that, with the target *some-every* sentences in
In the inverse-scope context, group 4 accepted the items at a numerically higher rate than group 3 did (78% vs. 60%, with no statistical difference).

In terms of target and prime responses, therefore, groups 3 and 4 seemed different in their basic capability of accessing inverse scope. Simply put, group 4 appears to be more proficient in inverse scope in general, compared with group 3. Group 4 indeed included more inverse-oriented people than group 3, as shown in the distribution of participants in figure 6.

Figure 6. Experiments 3 and 4: Results: Prime

The distribution was strikingly different. Group 4 displayed a skewed distribution towards acceptance, whereas group 3 had the frequency of responses spread all over the categories. All participants in group 4 (21/21, 100%) accepted the prime inverse for 4 trials and above (out of 6), whereas group 3 had some proportion of participants (6/25, 24%) that rejected prime inverse for 3 trials and above.
3.7.5 Prime effect

We are curious whether priming indeed occurred, that is, whether the prime response indeed affected the target response. We present a piece of evidence, taken to be consistent with the view that readers were truly being influenced by the prime in their judgment. The evidence is from a correlation analysis.

First, the performance on the target *every > some* inverse was positively and strongly correlated with the performance on the prime *every > some N or other* inverse responses, in experiment 3 (Pearson correlation coefficient = .698, *p* = .0001, *n* = 25), and in experiment 4 (Pearson correlation coefficient = .509, *p* = .018, *n* = 21). The correlation is in this particular direction - if one accepts target *some-every* sentences in the inverse scope context, s/he will likely accept prime *some N or other-every* sentences in the inverse scope context, but not the other way round. This was indeed the case. For both experiments, a majority of prime accepters did belong to target accepters. There were unprimed people who rejected target *some-every* sentences (difficult inverse items) while accepting prime *some N or other-every* sentences (easy inverse items). But few were found to reject the easy *some N or other-every* items, while accepting the difficult *some-every* items (one in experiment 3; zero in experiment 4). Therefore, I argue that priming indeed occurred, that is, the prime response affected the target response.
3.8 Summary of findings: Experiments 1 through 4

We carried out four experiments with English-speaking adults. Inverse scope responses increased some amount in the enriched experimental conditions 2, 3, and 4. Below is a summary of findings.

First, a contextual contribution to inverse scope was found. Inverse scope responses occurred at a higher rate in the presence of the focal discourse than the expectation discourse. It appears to be the case that speaker’s emphasis with the contrast focus can bring a much stronger prominence effect, facilitating inverse scope.

Second, a prime contribution to inverse rate was found. The rate of inverse scope responses was higher in the presence of prime sentences (26% to 60%), in the expectation discourse condition. The increase was in the same direction in the focal discourse condition. The prime effect was real, to the extent that response to the prime strongly correlated with the response to the target inverse item.

Third, knowledge of the syntactic restriction associated with universal quantifiers’ wide scope taking remains to be experimentally demonstrated in an independent task. The question will be whether it is the case that some native English speakers apply QR (quantifier raising) in a non-restricted manner.

Fourth, readers do have capability of reading a subject indefinite some N existentially (i.e., as an operator-like element). Our readers mostly did access the “existential” reading of some N in the subject position. This eliminates the possibility that adult readers mis-analyze some N as a referential expression and, for that reason, they fail to access inverse scope. Therefore, readers’ difficulty (or variation) with inverse scope, as far as some-every sentences are concerned, cannot be ascribed to lexical problems with
some. The primary source of difficulties in accessing inverse scope is not lexical but something else.

It is curious, then, why many readers still resist assigning inverse scope to some-every sentences. Most likely, lexical proficiency with quantifiers still seems to matter in accessing inverse scope. As our data suggest, not all the native speakers of English accessed the (scope-taking) operator meaning of a subject some N. The inverse-friendly subject some N or other instead of some N was not accepted in the scope contexts 100% of the time. There might be surface-scope adhering people, regardless of their lexical knowledge. Experiments in the following chapters, in the post-experiment questionnaire survey, will explore participant’s understanding of some N independent of scope assignment, for instance, by testing a sentence that does not involve another operator.

Fifth, a liberal tendency to accept was found, presumably due to the demands of the task. Readers tended to access inverse scope even in the illicit bi-clausal (frozen-scope) item, not only with licit mono-clausal (inverse-scope) items. The tendency got much stronger in the presence of prime sentences.

Sixth, some signs of group differences were found. Participants in experiment 1 looked far less inverse-oriented than participants in the other experiments 2, 3, and 4. And participants in experiment 4 looked basically much more inverse-oriented than participants in experiment 3. The discourse effect under investigation should be contingent upon individual variation. Some people might access inverse scope, without contextual help. Others may find inverse scope almost impossible, with contextual help. Controlling for group (or individual) differences becomes crucial to our goal, investigating the precise contributions of various discourse conditions to inverse scope accessibility. Otherwise, any
differences observed between groups might be largely due to differences between the groups.

3.9 Design implications

The issues mentioned shall be addressed in the following sets of experiments. The contribution of discourse and/or prime upon inverse scope shall continue to be our major question to investigate. In an effort to make our experiments better, we improve the design in terms of the following two major modifications.

First, we attempt to reduce readers’ liberal inverse scope judgment tendency in two ways. First, more of “surface-scope only” bi-clausal control items are included. Numerous some-every bi-clausal items were normed for their unavailability of inverse scope, before being introduced to the main experiments. Another source for liberal scope judgment seems to be in the task instruction that we used (Possible/Impossible). We investigate the role of task instructions in affecting rates of inverse responses.

Second, it is necessary to first examine the basic characteristics of selected groups empirically, a diagnosis for their default inverse-scope capability. We apply a separate task to each group, and measure the “baseline” capability of resolving scope problems (the baseline task).

3.10 Conclusion

This chapter examined whether and to what extent discourse factor (speaker’s emphasis) would facilitate the accessibility of inverse scope in some-every sentences. Some of our discourse conditions indeed helped readers to access inverse scope. There emerged
two confounds – a liberal tendency to accept and population variation. The two confounds were conflated with our discourse effects. Nonetheless, I argue that experimental data thus far show that in some contexts (i.e., the contrast focus context) inverse scope is easy to obtain and in others (i.e., the expectation context), inverse scope is less available. We found evidence that the discourse factor of the speaker’s emphasis is indeed relevant to facilitate inverse scope accessibility. In sum, we found evidence that inverse scope accessibility is indeed sensitive to discourse.

Having said that, the confounds that emerged require redress. In the next two chapters we attempt to do just this. The next chapter describes in great detail the development of a method to address these confounds, in particular the group variation confound. Chapter 5 then describes the implementation of this new method of testing on the exact same four experimental conditions.
CHAPTER 4. EXPERIMENT:
ADJUSTING DETAILS OF TASK DESIGN AND ITEMS
(5 EXPERIMENTS)

4.1. Motivation

The prior four experiments were a comparative investigation of two discourse
conditions and their contribution to the accessibility of inverse scope. The design compared
group means of four groups across the four experimental environments (referred to as a
between-groups design). Crucially, there emerged issues regarding methodology. The
present chapter will investigate the discourse-sensitivity of inverse scope accessibility by
implementing the same experimental manipulations but employing a task with much
improved design.

This chapter is generally concerned with the piloting and trial of various
experimental protocols, as well as the norming of various sentence types. It thus does not
directly contribute to the research questions of this dissertation, but are of vital relation to
the overall thrust of the dissertation – that such experimental details matter greatly in the
results obtained in quantifier experiments of this sort. The results of all of this piloting and
norming are then implemented in Chapter 5. The reader unconcerned with how the relevant
design and material were arrived at may thus wish to skip to Chapter 5.

This chapter deals with four specific goals. First, readers’ general tendency to
accept needed to be tightly controlled. To do so, numerous bi-clausal frozen scope items
were piloted for their acceptability/unacceptability, to ensure that only truly unacceptable
items were used. Second, it is widely appreciated that native speakers’ scope judgments are
subject to variability. There should be some manner in which the inter-subject variability is
controlled for. A separate task was devised and implemented to evaluate the “baseline”
inverse scope capability (referred to henceforth as the Baseline task). Third, we were concerned with the type of instruction used in the previous experiments which made reference to sentences being “possible/impossible”. In retrospect, such task instructions may have sounded too liberal, and this may have been responsible for readers’ liberal responses.\(^{(1)}\) It was necessary to determine the right type of instruction to be employed in the subsequent experiments. We here piloted two alternative wordings of instruction and answer choices. Lastly, in piloting these alternative instructions, we decided to pilot a two-step experiment design; one group is tested on the baseline task, and later, one of the four experimental tasks (This method is referred to henceforth as a within-group design).

It should be noted that this chapter contains descriptions and results from experiments which we ended up not using in subsequent experiments. One might ask why these are being presented in such detail. Our goal in doing so is two-fold. First, describing the details of how we arrived at our decision is important in evaluating the veracity and rigor of subsequent experiments. We therefore present all details as a way to establish our credibility going forward. Second, the variety in results in these piloting experiments adds to one of the final conclusions of this dissertation: the variability and unpredictability of scope in human language is utterly misunderstood and under-appreciated. If this dissertation is to have but one effect on the field of Linguistics, we hope it will be the

\(^{(1)}\) Readers likely respond differently relative to the type of instruction and answer choices, but little is known of this issue in the area of scope judgment. There can be multiple ways of formulating answer options to be used to capture subtle scope interpretative possibilities. Some examples are as follows.

- *Makes sense to you*
- *Acceptable*
- *Accurate*
- *Plausible*
- *Something you might hear*
acceptance of the fact that inverse scope accessibility is not a simple computational
procedure that can be calculated in a metronomic fashion.

Consequently, we conducted a total of six experiments, outlined below.

Experiment 5: Bi-clausal Frozen Control Items
Experiment 6A: Baseline with an Enumeration Context
Experiment 6B: Baseline with a Paraphrase Context
Experiment 7: Baseline-Focal Experiment with Yes, Okay
Experiment 8: Baseline-Focal Experiment with Yes, people might say this
Experiment 9: Focal Experiment-Baseline with Yes, people might say this

A brief outline of these experiments is presented below:

Experiments 5 piloted a variety of bi-clausal frozen scope items. The results found
extensive item variation – some were more acceptable, and others were not. Based on the
results, we selected 12 frozen scope items, the least-accepted ones, to be used in
subsequent two-step experiments. 6 out of 12 frozen items were included in the Baseline
task and the other six were included in the Experimental task.

Experiments 6A and 6B piloted two kinds of baseline discourse – an Enumeration
Context and a Paraphrase Context, respectively. The two versions made no difference to
inverse scope. The enumeration version was chosen to be used in the subsequent
experiments.

Experiments 7 and 8 piloted two types of instruction and answer choices (Yes,
Okay; Yes, people might say this) respectively, implementing the Baseline-Experimental
two-step experiment design. The “Yes, people might say this” instruction was selected to
be used in subsequent experiments. Finally, exposure to the Baseline task might influence
readers’ performance in the Experimental task. To see if this is the case, we conducted Experiment 9, the two-step experiment, in the reversed order, that is – first Experimental, and second, Baseline.
4.2 Experiment 5: Bi-clausal frozen scope items

4.2.1 Purpose

In experiment 5, we tested a variety of Control 2 items (some-every sentences in the bi-clausal structure in inverse scope contexts), attempting to find items which permit unambiguously surface scope readings only. Based on the results, a set of 12 “good” control bi-clausal frozen scope items (i.e., items that can be straightforwardly rejected) was selected to be used as Control 2 items in the subsequent experiments.

4.2.2 Design and Materials

Sixteen bi-clausal some-every sentences were constructed, all with subject “some N” in the matrix clause and object “every N” in the embedded clause. According to linguists’ informal reports on their intuition, acceptability worsens when every N is embedded in a relative clause (RC) as opposed to a complement clause. Acceptability also worsens when every N is an embedded object as opposed to when it is an embedded subject. Following this, we tested the unavailability of inverse scope in frozen scope items with the following three sentence types; (a) sentences with the matrix subject some N and embedded complement with subject every N (subject every N); (b) sentences with the matrix subject some N and an embedded complement with object every N (object every N); (c) sentences with matrix object some N and an embedded relative clause with every N (relative clause every N).
(1) frozen scope with matrix subject some – embedded subject every
(frozen subject; 6 items)
e.g., Some tourist wrote that every world famous bridge was beautiful.

(2) frozen scope with matrix subject some – embedded object every
(frozen object; 6 items)
e.g., Some doctor noticed that Paul kissed every new nurse.

(3) frozen scope with Relative Clause (RC; 4 items)
e.g., John interviewed some girl that won every award at the dance competition.

Sixteen frozen scope items were made from these three types. Acceptability was expected to worse in (2) relative to (1), and to be worst amongst in (3). These sentences were tested in inverse scope contexts only. The inverse scope context was simple, comparable to the baseline enumeration version. No such expectation or focus contextual manipulation was included. In each item, a story was followed by a picture and then a sentence.

Below is a sample item of the first type of frozen scope items (matrix some N with an embedded subject every). The full list of 16 frozen scope items and their contexts is presented in Appendix H.

**Sample of Frozen scope**

**(1) Inverse scope context**

Several parents volunteered as school book reviewers. One day, they were asked to review about whether three historically banned books would be acceptable as school books. The three books were *Adventures of Huckleberry Finn*, *Catcher in the Rye*, and *Fahrenheit 451*. Each book was assigned to a different parent reviewer. For *Adventures of Huckleberry Finn*, one reviewer thought that it was acceptable. For *Catcher in the Rye*, the other reviewer thought that it was acceptable, too. For the last, *Fahrenheit 451*, the third reviewer thought that it was also acceptable.
Frozen Sentence: Some reviewer thought that every book was readable.

4.2.3 Fillers

Five filler items (Match) were created. Fillers were mono-clausal or bi-clausal sentences. Four out of five were every/each – some sentences (mono-clausal or bi-clausal), which are scopally ambiguous but strongly favor surface scope (e.g., Every student decided to buy some coffee machine; Each reporter said that he visited some food factory). They were tested in the surface-scope contexts whose responses should be clearly yes answers. The five yes-items were taken as accuracy or attention-checkers, supposing that the target responses (frozen items) were expected to be responded with a no answer. Acceptance of at least 4 out of the 5 filler items was set as an accuracy criterion.

4.2.4 Procedure

The procedure was the same as the previous four experiments in chapter 3. The task was an off-line written survey involving a story-sentence verification task (instruction, practice and main survey). Participants were tested as a group. We changed the instruction
wording and answer choices, from with the ‘possible’ version into the version including ‘okay’. See the okay instruction below.

Please judge whether the sentence is Okay as a description of the provided story. The sentence need not be your preferred description, but do you think it is okay for the given story? Indicate your answer by checking one of the options
– Yes, okay or No, not okay.

4.2.5 Participants

Fifty-one participants participated as a group in the experiment, all undergraduate students at the University of Hawaii. They were distributed to list 1 (N=20), list 2 (N=14), and list 3 (N=17). A total of 13 participants were excluded due to their poor performance in the five accuracy-checking items (accepting less than 3 out of 5). Therefore, data from thirty-eight participants were analyzed (15 from list 1, 10 from list 2, 13 from list 3). Fillers were responded to at a rate of 91% accuracy, suggesting that informants’ judgments were reliable.

4.2.6 Results

Data analyses were conducted on the accuracy and proportions of Yes (okay)/No (not okay) judgment responses. The results of the target frozen items from Experiment 6 are presented in table 20 relative to the type (k = number of tokens; N = number of participants; M = Mean number of items (out of 4 or 6) rated as a ‘Okay’ description of the story; SD = Standard Deviation; M % = Percent acceptance out of all items).
The bi-clausal some-every frozen scope items were once again not rejected outright in the inverse scope context. Their overall acceptance rates were similar across the three categories, being accepted approximately 27% of the time. In the inverse scope context, category (1) items (frozen subject every) were accepted 29% of the time. Category (2) items (frozen object every) were accepted 26% of the time, and category (3) items (Relative Clause or RC) were accepted 27% of the time. It was not the case that the RC category items are worse than the other two categories; there was no difference among the three categories. Individual items, rather than structure, seem to matter more. We indeed found an extensive range of item variation, even in the same category. The acceptance rates ranged from 15 to 60% in category (1) (frozen subject every), and 7 to 46% in category (2) (frozen object every). The asymmetry found in category (3) (RC) was more striking – zero to 77%. See tables 21, 22, and 23 for data from individual items. An asterisk was marked in front of items to indicate items with low acceptance rates, later to be selected in the subsequent experiments.
(1) Frozen scope with matrix subject *some* – embedded subject *every*

<table>
<thead>
<tr>
<th>Item</th>
<th>Sentence (embedded subject <em>every</em> N)</th>
<th>List</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>Yes %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Some student made sure [that every invited speaker had a ride].</td>
<td>list1</td>
<td>15</td>
<td>0.60</td>
<td>0.51</td>
<td>60</td>
</tr>
<tr>
<td>2</td>
<td>Some boy was sure [that every monkey would pick a real banana].</td>
<td>list1</td>
<td>15</td>
<td>0.20</td>
<td>0.41</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td><em>Some</em> tourist wrote [that every world famous bridge was beautiful].</td>
<td>list2</td>
<td>10</td>
<td>0.30</td>
<td>0.48</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td><em>Some</em> tourist reported [that every tour to the Eiffel Tower was enjoyable].</td>
<td>list2</td>
<td>10</td>
<td>0.30</td>
<td>0.48</td>
<td>30</td>
</tr>
<tr>
<td>5</td>
<td><em>Some</em> boy claimed [that every apple was most delicious].</td>
<td>list3</td>
<td>13</td>
<td>0.15</td>
<td>0.38</td>
<td>15</td>
</tr>
<tr>
<td>6</td>
<td><em>Some</em> reviewer thought [that every book was acceptable].</td>
<td>list3</td>
<td>13</td>
<td>0.15</td>
<td>0.38</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>28.95</td>
</tr>
</tbody>
</table>

Table 21: Experiment 5: Results: Frozen scope items (frozen subject *every*)

(2) Frozen scope with matrix subject *some*– embedded object *every*

<table>
<thead>
<tr>
<th>Item</th>
<th>Sentence (embedded object <em>every</em> N)</th>
<th>List</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>Yes %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>Some</em> student knew [that the teacher read every book on the syllabus].</td>
<td>list1</td>
<td>15</td>
<td>0.13</td>
<td>0.35</td>
<td>13</td>
</tr>
<tr>
<td>2</td>
<td><em>Some</em> witness testified [that the man had robbed every bank in town].</td>
<td>list1</td>
<td>15</td>
<td>0.07</td>
<td>0.26</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td><em>Some</em> doctor noticed [that Paul kissed every new nurse].</td>
<td>list2</td>
<td>10</td>
<td>0.30</td>
<td>0.48</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td><em>Some</em> technician confessed [that John fixed every broken computer that I brought].</td>
<td>list2</td>
<td>10</td>
<td>0.30</td>
<td>0.48</td>
<td>30</td>
</tr>
<tr>
<td>5</td>
<td><em>Some</em> woman said [that Steven Spielberg directed every movie mentioned].</td>
<td>list3</td>
<td>13</td>
<td>0.38</td>
<td>0.51</td>
<td>38</td>
</tr>
<tr>
<td>6</td>
<td>Some guide remembered [that the old man loved every train mentioned].</td>
<td>list3</td>
<td>13</td>
<td>0.46</td>
<td>0.52</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>26.32</td>
</tr>
</tbody>
</table>

Table 22: Experiment 5: Results: Frozen scope items (frozen object *every*)
(3) Frozen scope with relative clause every

<table>
<thead>
<tr>
<th>Item</th>
<th>Sentence (Relative Clause)</th>
<th>List</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>Yes %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Some umbrella [that every child was carrying] was broken.</td>
<td>list3</td>
<td>13</td>
<td>0.77</td>
<td>0.44</td>
<td>77</td>
</tr>
<tr>
<td>2</td>
<td>*There was some horse [that every child was on].</td>
<td>list1</td>
<td>15</td>
<td>0.20</td>
<td>0.41</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>*John interviewed some girl [that won every award at the dance competition].</td>
<td>list2</td>
<td>10</td>
<td>0.00</td>
<td>0.00</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>*Some child [who was carrying every big balloon] was happy.</td>
<td>list2</td>
<td>10</td>
<td>0.00</td>
<td>0.00</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>27.08</td>
</tr>
</tbody>
</table>

Table 23: Experiment 5: Results: Frozen scope items (relative clause)

4.2.7 Discussion

The results showed three findings. First, the long-distance inverse scope in the some-every bi-clausal structures, given discourse, seemed to be generally disliked by readers, but not rejected outright. The frozen scope items were accepted on average 27% of the time.

Second, some degree of disagreement was expected, and item variability was indeed quite extensive regardless of structural category. Sentences like some student made sure that every invited speaker had a ride (embedded subject every) or some umbrella that every child was carrying was broken (RC) was found to sound quite acceptable (accepted 60% and 77% of the time respectively).

Third, the RC category was expected to score the lowest of the three conditions. It was not the case. Two factors seemed to affect performance on RC items. The first was the underlying order of two quantifiers, not the surface order. For instance, a remarkably high rate of acceptance was found with the item whose underlying structure involves a subject every and an object some, e.g., some umbrella [that every child was carrying ___] was
broken, accepted 77% of the time. In this object relative clause, the head of the relative clause, some umbrella, originates as the object of the relative clause (indicated by the underscore). By contrast, zero acceptance rate was found with the RC item whose underlying structure involves a subject some and an object every, e.g., some child [who __ was carrying every big balloon] was happy). In this subject relative clause, the head of the relative clause originates as the subject of the relative clause (indicated by the underscore).

4.2.8 12 frozen scope items selected:

6 for the Baseline task and 6 for the Experimental task

For subsequent experiments, we selected twelve frozen scope items (out of 16) with the lowest acceptance scores (less than 40 %). The selected 12 ones were the asterisk-marked ones in tables 21, 22, and 23 above - 4 items in category (1), 5 items in category (2), and 3 items in category (3). Some of these items were minimally modified to conform to the structural regularities discovered above. In subsequent two-step experiments, 6 out of the 12 frozen scope items were included in the Baseline task and the other six were included in the Experimental task (the full list of 12 frozen scope items and contexts are presented in Appendix I).
4.3. Experiment 6A: Baseline Context–Enumeration Version

4.3.1 Purpose

The purpose of experiment 6 was to establish a baseline context. We devised and tested two kinds of baseline context versions, one of which was subsequently selected.

4.3.2 Materials

Twelve some-every sentences and contexts were constructed (and are listed in full in Appendix J). The verbs used in the sentences were all action verbs in the past tense. For each of the 12 test sentences, two “baseline-type” stories were constructed: an inverse-scope story context and a surface-scope story context.

This “baseline” context was devised to be as simple and brief as possible. It had no such discourse manipulation as an expectation or contrast focus. In the baseline context, the story presented three entities as a domain restriction of the universal quantifier. For instance, a radio DJ was taking song requests, and introduced three classic pop artists named Elvis Presley, Louis Armstrong, and B. B. King. Then the story mentioned who requested each of the three songs – one man versus three men. Importantly, the story enumerated the mapping one by one (referred to henceforth as the enumeration version). In doing so, for an indefinite subject (e.g., some man), the story repeated a single referent (one man, and then he/she) or introduced multiple referents (one man, another man, a third man). Each story was accompanied by a picture scene with the three elements as the domain of the universal, to help readers’ understanding. An example story context is given below.
Sample of Target: Baseline (Enumeration)

(1) Inverse scope context (baseline context, enumeration)
A radio DJ had three favorite classic pop artists. They were Elvis Presley, Louis Armstrong, and B. B. King. One morning, he was taking song requests. One man requested a song by Elvis Presley and then another man requested a song by Louis Armstrong. Lastly, a third man called in and requested a song by B. B. King. The DJ was happy.

Test Sentence: Some man requested every pop artist that the DJ liked.

(2) Surface scope context (baseline context, enumeration)
A radio DJ had three favorite classic pop artists. They were Elvis Presley, Louis Armstrong, and B. B. King. One morning, he was taking song requests. One man requested a song by Elvis Presley and then requested a song by Louis Armstrong. He further requested a song by B. B. King. The DJ was happy.
Test Sentence: Some man requested every pop artist that the DJ liked.

4.3.3 Fillers

Fourteen fillers were created, four of which were no-answer (Mismatch) items, and the remaining ten were yes-answer (Match) items. This time, many yes-answer fillers were included to balance the overall number of match and mismatch items in the Baseline task, supposing that the target items were expected to be mostly responded with a no answer. Two of the yes-answer fillers were bi-clausal some-every sentences in the surface scope context.

Sample filler (Mismatch)
A group of us students went bicycle-riding around campus. John saw a male professor walking, and quickly avoided him. Students disliked that professor because he is always in a terrible mood. Carl also avoided him. Mike didn’t like the professor, either, but he approached and greeted him.
Filler Sentence: The three students avoided the professor

### 4.3.4 Control items

A total of 13 control items were included in the Baseline – 3 items for Control 1 (*some N* as an existential quantifier), 8 items for Control 2 (syntactic restrictions of inverse scope), and 2 items for Control 3 (other pairs of quantifiers).

Control 1 items were of the same type in experiment 1 in chapter 3. Control 3 items were exactly the same two items in experiment 1. For Control 2 items, unlike in previous experiments, we increased the number from 2 into 8; two items of the *his mother-every* type (*His mother loved every boy at the show; Her manager kissed every dancer on the stage*) and 6 items of the bi-clausal frozen scope type (2 embedded subject *every*; 3 embedded object *every*; 1 relative clause). The 6 frozen scope items were selected from

---

20 The bi-clausal frozen scope items (k=6) tested in the Baseline task were as follows.
(a) Some tourist reported that every tour to the Eiffel Tower was enjoyable.
(b) Some boy claimed that every apple was most delicious
(c) Some woman said that Steven Spielberg directed every movie mentioned.
(d) Some doctor noticed that Paul kissed every new nurse.
(e) Some witness testified that the man had robbed every bank in town.
(f) John interviewed some girl that won every award at the dance competition
the prior frozen scope norming experiment 5 (and are listed in full in Appendix I). All control items were contextualized in the “some”-variable reading.

4.3.5. Materials: Summary

The Baseline task consisted of a total of 41 stimuli -12 target, 16 filler, and 13 Control items. Two lists were constructed in a semi-randomized order. The stimuli in each list are summarized in table 24.

<table>
<thead>
<tr>
<th>Type</th>
<th>Answer</th>
<th>Sentence</th>
<th>Context</th>
<th>Number of tokens in each list</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target</td>
<td>yes/no</td>
<td>Some-Every</td>
<td>Surface (baseline)</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>yes/no</td>
<td>Some-Every</td>
<td>Inverse (baseline)</td>
<td>6</td>
</tr>
<tr>
<td>Control 1</td>
<td>yes</td>
<td>1. Some-Every (temporal)</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>(existential reading of subject some N)</td>
<td>yes</td>
<td>2. Each-Some (bi-clausal)</td>
<td>Some as a variable</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>yes</td>
<td>3. Each-Some (locative)</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Control 2</td>
<td>No</td>
<td>1. His mother-Every</td>
<td>Inverse</td>
<td>2</td>
</tr>
<tr>
<td>(syntactic restriction with inverse scope)</td>
<td>No</td>
<td>2. Bi-clausal frozen scope</td>
<td>Inverse</td>
<td>6</td>
</tr>
<tr>
<td>Control 3</td>
<td>yes/no</td>
<td>1. Some-Each</td>
<td>Inverse</td>
<td>1</td>
</tr>
<tr>
<td>(other quantifiers)</td>
<td>yes/no</td>
<td>2. Someone-Every</td>
<td>Inverse</td>
<td>1</td>
</tr>
<tr>
<td>Filler</td>
<td>No</td>
<td>No-answer (Mismatch)</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>Yes-answer (Match)</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>41</td>
</tr>
</tbody>
</table>

Table 24. Experiment 6A: Baseline task: Materials

4.3.6 Procedure

The method and task in this baseline experiment 6A were mostly the same as in the prior four experiments - instruction, practice, main survey. The task was an off-line written
survey involving a story-sentence verification task. Like in the frozen scope norming experiment 5, we changed the instruction wording and answer choices, from with the ‘possible’ version into the version including ‘okay’. See the okay instruction below.

Please judge whether the sentence is Okay as a description of the provided story. The sentence need not be your preferred description, but do you think it is okay for the given story? Indicate your answer by checking one of the options

– Yes, okay or No, not okay.

4.3.7 Participants

Twenty-one native speakers of English participated in the experiment, all undergraduate students at the University of Hawaii. Five were excluded due to low accuracy on fillers (below 70%). Data from sixteen participants were analyzed

4.3.8 Results of Target

Data analyses were conducted on the accuracy and proportions of Yes (okay) / No (not okay) judgment responses. Since the same set of control items was tested in another baseline experiment (6B, reported on below), their results will be presented together at the end of this section.

The results of the test items from Experiment 6A (baseline-enumeration context) are presented in table 25 (k = number of tokens; N = number of participants; M = Mean number of items (out of 6) rated as an ‘Okay’ description of the story; SD = Standard Deviation; M % = Percent acceptance out of all items (total = 96)).
Participants accepted *some-every* sentences in the surface scope baseline (enumeration) contexts 76% of the time. The acceptance rate of the test sentences in the inverse scope baseline (enumeration) contexts was 43%. We found that the inverse scope rate was relatively high in this baseline discourse (enumeration type), especially when compared to the rate of inverse scope responses in the focal discourse from experiment 1 in chapter 3 (43% versus 27%). The accuracy rate with filler items was 87%.

In addition to experiment 6A, we conducted experiment 6B in which we changed the context minimally by removing the enumeration portion of the context and replaced that with sentence at the end of the context which paraphrased the crucial components to the story. We ran this experiment in order to find the best baseline context. Additionally, we included the same control items as in experiment 6A. We ran this with fifteen participants, five of whom were excluded on the basis of low scores on the filler items, leaving ten participants. The results revealed a relatively minimal difference between the two contexts. We therefore selected the enumeration context (experiment 6A) as our baseline context. See Appendix K for the full experimental items from experiment 6B.

### 4.3.9 Results of Control items

Results on the three Control 1 items (with yes-answer) (*some N* as an existential quantifier), aggregated across experiments 6A and 6B, are presented in table 26.
1. Some linguistics student visited my office every Monday during the workshop.
2. In the report, each teacher reported that some student of mine did a great job.
3. In each math quiz this month, some student failed.

For experiments 6A and 6B, participants mostly did well with respect to the Control 1 items, interpreting the subject some N existentially in the three environments. The three items were accepted at high rate, 70-94% of the time.

Next, results on the eight Control 2 items (with no-answer) (syntactic restrictions of inverse scope), aggregated across experiments 6A and 6B, are presented in table 27.

These items were not rejected outright, as in the experiments in chapter 3. The his mother-every items in the inverse-scope contexts were successfully rejected at high rates, 85-90 % of the time. But the bi-clausal frozen scope items (unambiguously surface scope) in the inverse scope contexts were rejected at lower rates, 60-73 % of the time. The scores on the latter bi-clausal items in inverse contexts were, rather strikingly, just as high as the scores on the target mono-clausal items in inverse contexts.
4.4 Experiment 7: Baseline-Experimental (Focal discourse)

(with Okay instruction)

4.4.1 Purpose

In what follows in this chapter, we present three more experiments (7, 8, and 9) whose purpose was two-fold–first, to explore alternative versions of wording and answer choices; second, to explore a new design involving a two-step procedure (Baseline task, then Experimental task). As opposed to the “Possible/Impossible” version used in the experiments in chapter 3, we created two alternative versions; “Yes, Okay/ No, not Okay”; “Yes, people might say this/No, nobody would say this”. We tested the Okay version and the Yes, people version, in experiments 7 and 8, respectively. The full version of each answer choice is presented below.

3 versions of instruction:

(1) Possible/Impossible version

Please judge whether the sentence is a possible description of the provided story. The sentence need not be your preferred description. There may be a better way to say it that makes it clearer. But do you think the sentence is possibly true for the given story?

( ) possible description (although there may be a better way to say it)

( ) impossible description (you never say the sentence to describe the story)
(2) Yes, Okay version
Please judge whether the sentence is Okay as a description of the provided story. The sentence need not be your preferred description. There may be a better way to say it that makes it clearer. But do you think the sentence can be considered true for the given story?
Yes, Okay. No, not Okay.

(3) Yes, people might say this version
Please judge whether the sentence is something that people might say as a summary or description of the provided story. The sentence need not be your preferred way of speaking. There may be a better way to say it that makes it clearer. But do you think the sentence can be considered a possible way of expressing the situation?
Yes, people might say this No, nobody would say this

4.4.2 Design and Materials: Two-Step Procedure

Participants were tested on the Baseline task and then one week later, the Experimental task (focal discourse). This method is referred to as a two-step experiment. The idea was to gather baseline data and experimental data from the exact same set of individuals so as to compare judgments within the same individuals. This was to address the group variation that we observed in the experiments in Chapter 3. By testing the same individuals on the Baseline and the Experimental tasks, we can observe differences between the tasks without the fear of there being group differences.

The Baseline task used exactly the same set of materials and procedure as in experiment 6A. It had a total of 41 items, 12 target, 16 filler, and 13 control items, as table 28 shows.
Table 28. Experiment 7: Baseline Task: Materials (repeated from experiment 6A)

The Experimental task examined the facilitation of the focus discourse on inverse scope. The task was similar in design and materials to experiment 2 (focal discourse condition) in chapter 3, except the number and type of Control items. This Experimental task had the same set of 12 target items of *some-every* sentences contextualized in the focal context (6 in surface contexts; 6 in inverse contexts), the same set of 14 fillers for accuracy-checking (with “no” answer), and the same set of 12 Every-Not negation fillers (6 in *none*-reading contexts; 6 in *some*-reading contexts). As to Control items, this Experimental task included only the type of Control 2 (bi-clausal frozen scope), 6 items. The Experimental task had a total of 44 items, 12 targets, 12 negation fillers, 14 mismatch fillers, and 6 Control 2 (frozen-scope) items. See table 29 for materials in the Experimental task.
<table>
<thead>
<tr>
<th>Type</th>
<th>Answer</th>
<th>Sentence</th>
<th>Context</th>
<th>Number of tokens in each list</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target</td>
<td>yes/no</td>
<td>Some-Every</td>
<td>Surface (focal)</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>yes/no</td>
<td>Some-Every</td>
<td>Inverse (focal)</td>
<td>6</td>
</tr>
<tr>
<td>Control 2 (syntactic restriction</td>
<td>no</td>
<td>Bi-clausal frozen scope</td>
<td>Inverse</td>
<td>6</td>
</tr>
<tr>
<td>with inverse scope)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filler</td>
<td>yes/no</td>
<td>Every-Not</td>
<td>None</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>yes/no</td>
<td>Every-Not</td>
<td>Some (not all)</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>no</td>
<td>No-answer (Mismatch) fillers</td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>44</td>
</tr>
</tbody>
</table>

Table 29. Experiment 7: Experimental Task: Materials

4.4.4 Sample Materials: Baseline Task

The same as in experiment 6A (see section 4.3.2 - 4.3.4).

4.4.5 Sample Materials: Experimental Task (repeated from Experiment 2)

Here we repeat the materials from experiment 2 (see section 3.4.2 in chapter 3 for more details). Readers familiar with experiment 2 may wish to skip this section.

4.4.5.1 Sample of Target: Focal Context (repeated from Experiment 2 in chapter 3)

(1) Inverse scope context (Focal)

An environmental activity was held at a school today, and participants were making big houses out of cardboard. At last, I saw three big playhouses finished and displayed. Surprisingly, the igloo was the work of a 6th-grade boy, and the rocket was the work of a 5th-grade boy. When I saw the doll house, I thought it could not be a work of a child. However, it was the work of a little child, this time a 4th-grade girl! After I left, I heard that four more houses were displayed, but none of them was a work of a child.
(2) Surface scope context (Focal)
An environmental activity was held at a school today, and participants were making big playhouses out of cardboard. At last, I saw three big playhouses finished and displayed. Surprisingly, the igloo and the rocket were both the works of a 6th-grade boy. When I saw the doll house, I thought it must be the work of a different child. However, I was surprised to discover that its creator was the same boy again. After I left, I heard that four more houses were displayed, but none of them was a work of a child.
4.4.5.2 Sample of fillers and negation

Exactly the same set of 14 fillers for accuracy-checking (with “no” answer) and 12 negation (every-not) filler was used as in Experiment 2.

4.4.5.3 Control 2 items (bi-clausal frozen scope items)

A set (different items from the Baseline task) of six bi-clausal frozen scope sentences were tested in the inverse scope contexts. The six frozen-scope items in the Experimental task were the ones selected from the prior frozen scope norming experiment 5 (1 embedded subject every; 3 embedded every, and 3 RC; the items are listed in full in Appendix I) See a sample frozen scope item presented below.

Sample of Frozen Scope Item

(1) Inverse scope context
Mickey was looking for a delicious apple. There were three apples to choose from: one was red, one was green, and one was yellow. Mickey asked a group of boys to choose a delicious apple for him. First, one of the boys claimed “Only the red apple is delicious and the others are not” The other boy claimed, “The green apple is the only delicious one.” A third boy claimed, “The only delicious one is the yellow apple.” Three different boys chose three different apples, so Mickey could not decide which apple to choose.
Control Sentence: Some boy claimed that every apple was delicious.

4.4.6 Procedure of Two-Step Experiment

Experiment 7 relied on the same method as in previous experiments: an off-line written survey involving a story-sentence verification task. This time, the entire experiment consisted of two tasks (Baseline, Experimental), administered on separate days with a one-week interval. Each task consisted of three sections—instruction, practice (2 trials), and major survey. The post-experiment background survey followed the second Experimental task. Below are the details of the two-step experiment procedure.

(1) Instruction

Subjects were students of an undergraduate class at the University of Hawaii and tested as a group. The experiment was conducted in the classroom. Through written language, participants were instructed that they were participating in an experiment on sentence comprehension, involving a task of reading with a judgment component. Subjects were encouraged to read stories carefully, then asked to assess the truth-value of a target
statement based on the events illustrated in the story, and respond, using the given answer choices, Yes, Okay or No, not Okay. The exact instructions they received are shown below:

For each test item, you will see a written story and a picture. The picture will help you to understand the story.

Please read the story carefully. It provides the context for the main test sentence. At the end of the story and the picture, you will see a sentence in bold.

Please judge whether the sentence is Okay as a description of the provided story. The sentence need not be your preferred description. There may be a better way to say it that makes it clearer. But do you think the sentence can be considered true for the given story?

Indicate your answer by checking one of the options

Yes, Okay. ( ) No, not Okay. ( )

Please keep in mind the instructions above while you do the test. You will be given only two answer options in the test.

(2) Practice

A practice session with two trials was presented before the actual survey in each task. Readers were encouraged to practice evaluating sentences with scope-taking operators.

(3) Baseline Task

For the Baseline Task, we created four lists of the test items (41 trials), in the following manner. First, the 41 trials were semi-randomized into two different versions of lists. These two lists each were then reversed, presenting the items in the reverse order. We thus have four sub-lists, in other words, four different versions of the questionnaire. Having four lists this way, we can detect any effects of guessing or of judgmental fatigue. The first three items appearing in the questionnaire were fillers, to help participants to get
familiarized with the task. Participants as a group were distributed into one of the four lists or questionnaires. We made sure that each list was distributed to a group of roughly equal size in the pool of subjects. Before distributing them to informants, the sequence of questionnaire in each form of list was scrambled. The Baseline task lasted approximately 30 minutes.

(4) Experimental Task (Focal discourse) (one week later)

The same group of subjects participated in the Experimental task (focal discourse). In the Experimental task, too, four lists of test items (44 trials) were created and randomly distributed in the same manner as in the Baseline task. The Experimental task lasted approximately 40 minutes.

(5) Post-experiment background survey

At the end of the Experimental task, participants attended the post-experimental background survey (5 minutes) regarding their math or logic education background (3 items) (see the full list of survey items and their results in Appendix O).

4.4.7 Participants

Thirty-three native speakers of English participated in the experiment, all undergraduate students at the University of Hawaii. They were recruited from one basic mathematics class. Two participants were excluded due to their low accuracy rate (below 80%) on fillers. Data from thirty-one participants were analyzed.
4.4.8 Results

4.4.8.1 Results of Target from Baseline and Experimental (focal discourse)

Data analyses were conducted on the accuracy and proportions of Yes (okay)/No (not okay) judgment responses. The results from Baseline and Experimental (focal discourse) tasks were presented below, followed by results on filler items. Because the same set of control items was tested in the following two experiments, their results will be presented together at the end of this section, for ease of comparison.

The results of target from the Baseline task are presented in table 30 (k = number of tokens; N = number of participants; M = Mean number of items (out of 6) rated as an ‘Okay’ description of the story; SD = Standard Deviation; M % = Percent acceptance out of all items (total = 186)).

<table>
<thead>
<tr>
<th>Type</th>
<th>Sentence</th>
<th>Context (baseline)</th>
<th>N</th>
<th>M (SD, M %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target</td>
<td>Some-Every (k=6)</td>
<td>Surface scope</td>
<td>31</td>
<td>5.48 (0.77, 91.40)</td>
</tr>
<tr>
<td></td>
<td>Some-Every (k=6)</td>
<td>Inverse scope</td>
<td>31</td>
<td>1.13 (1.63, 18.82)</td>
</tr>
</tbody>
</table>

Table 30. Experiment 7: Results: Target in the Baseline task

Under the version of instruction Yes, Okay; No, not Okay, participants accepted some-every sentences in the baseline surface scope contexts 91% of the time. The acceptance rate of the test sentences in the baseline inverse scope contexts was a mere 19%.

Participants, as table 31 shows, were accurate on the items that measured general accuracy (88% correct) and were also generally correct on the bi-clausal some-every items in the surface scope context (76% correct).
We turn now to the results of the test items from the Experimental task (focal discourse). The results are presented in table 32.

<table>
<thead>
<tr>
<th>Type</th>
<th>Sentence</th>
<th>Context (Focal)</th>
<th>N</th>
<th>M (SD, M %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target</td>
<td>Some-Every (k=6)</td>
<td>Surface scope</td>
<td>31</td>
<td>5.16 (1.34, 86.02)</td>
</tr>
<tr>
<td></td>
<td>Some-Every (k=6)</td>
<td>Inverse scope</td>
<td>31</td>
<td>1.84 (2.53, 30.65)</td>
</tr>
</tbody>
</table>

Table 32. Experiment 7: Results: Target in the Experimental task

Under the version of instruction *Yes, Okay; No, not Okay*, the same participants accepted *some-every* sentences in the focal surface scope contexts 86 % of the time, much like in the Baseline task. The acceptance rate of the test sentences in the focal inverse scope contexts was only 31 %. The participants performed normally with filler items in the Experimental task, too.

With this two-step experiment under the *Yes, Okay* instruction, the inverse rate in the focal discourse was low, unlike the high rate in the Experiment 2. Importantly, the acceptance rate of inverse scope went up from 19% in the baseline discourse to 30% in the focal discourse. This increase was not nearly as great as we might expect, although statistically approaching significance.
4.4.8.2 Results of Control 1 items - Baseline

The results of Control 1 items (k=3) from the Baseline task are presented in table 33.

<table>
<thead>
<tr>
<th>Experiment (Baseline)</th>
<th>1. some-every (temporal) (some-variable) (k=1)</th>
<th>2. each-some (bi-clausal) (some-variable) (k=1)</th>
<th>3. each-some (locative) (some-variable) (k=1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M (%) (SD)</td>
<td>M (%) (SD)</td>
<td>M (%) (SD)</td>
<td></td>
</tr>
<tr>
<td>7 (N=31)</td>
<td>0.84 (0.37)</td>
<td>0.84 (0.37)</td>
<td>0.87 (0.34)</td>
</tr>
</tbody>
</table>

Table 33. Experiment 7: Results: Control 1 in the Baseline task
1. Some linguistics student visited my office every Monday during the workshop.
2. In the report, each teacher reported that some student of mine did a great job.
3. In each math quiz, some student failed.

Participants performed successfully with Control 1 items. Under the instruction Yes, Okay/No, not okay, readers accessed the subject some N as a variable for the three items, all above 80% of the time.

4.4.8.3 Results of Control 2 items – Baseline and Experimental

The results of Control 2 items from the Baseline task are presented in table 34.

<table>
<thead>
<tr>
<th>Experiment (Baseline)</th>
<th>1. his mother-every (Inverse) (k=2)</th>
<th>2. bi-clausal frozen scope (Inverse) (k=6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M (%) (SD)</td>
<td>M (%) (SD)</td>
<td>M (%) (SD)</td>
</tr>
<tr>
<td>7 (N=31)</td>
<td>0.06 (3.23)</td>
<td>1.42 (23.66)</td>
</tr>
</tbody>
</table>

Table 34. Experiment 7: Results: Control 2 in the Baseline task

Participants’ response to Control 2 items in the Baseline task was fairly conservative and thus successful. Under the version of instruction Yes, Okay; No, not Okay, the “no-answer” his mother-every N type sentences in the inverse scope contexts was largely rejected with
marginal acceptance rate, 3.23%. However, the bi-clausal frozen scope items in the inverse scope contexts were accepted to some extent, much like in previous experiments, about 24% of the time.

Next, see the results of Control 2 items (k=6) from the Experimental task (focal discourse) presented in table 35.

<table>
<thead>
<tr>
<th>Experiment (Experimental: Focal discourse)</th>
<th>bi-clausal frozen scope (Inverse) (k=6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 (N=31)</td>
<td>2.39 (39.78) (2.42)</td>
</tr>
</tbody>
</table>

Table 35. Experiment 7: Results: Control 2 in the Experimental task

In the Experimental task (focal discourse), the acceptance rate for the bi-clausal frozen-scope sentences in the inverse scope contexts was even higher, about 40%. It may have been suggested that acceptance of such items in previous experiments was just noise, or a yes-bias. However, it now appears that there genuinely are some speakers who perceive scope freezing items as being ambiguous.

4.4.9 Summary of Results and Discussion

The surface scope in the mono-clausal some-every test sentences was accepted at high rates regardless of the task - 91% in the Baseline task and 86% in the Experimental task (focal discourse). Important to us, within the same population, there was a significant increase in the inverse rate from the baseline discourse to the focus discourse. Inverse scope for mono-clausal test items was more often accepted in the focal discourse than in the baseline discourse, and the difference approached significance. Crucially, the increase
this time reflects the effect of the focus discourse upon inverse scope accessibility, and not
to group variation or other factors.

However, this discourse effect was conflated with increased acceptance of frozen-
scope items. Inverse scope for bi-clausal frozen scope items was significantly more often
accepted in the Experimental task than in the Baseline task (23.66 % in Baseline vs.
39.78 % in Experimental, t (30) = 3.09, p=.004, d =.556, $\eta^2 = .236$). This shows that
inverse scores, whether for mono-clausal test items or bi-clausal frozen scope items, tended
to increase together, from the Baseline to the Experimental tasks (focal discourse).

As to sources of this increase with frozen scope items, the increase cannot be
attributable to a discourse effect. It is because the discourse for scope freezing items was of
the same as the baseline type. Alternatively, it is possible, indeed likely, that priming plays
a role here. In the Experimental task, readers were primed to access inverse scope even for
scope unambiguous items, because inverse scope in general was facilitated due to the
presence of the enriched focal inverse-scope context. Correlation data provides support for
this priming idea. The two variables, inverse and frozen, were strongly correlated: readers
who were likely to find inverse scope acceptable for the scope-ambiguous (mono-clausal)
items, were likely to find inverse scope acceptable for the scope-freezing items as well

Strikingly, we found another interesting response pattern. The inverse scope scores
of the scope freezing control items were numerically higher than the scores of the scope
ambiguous test items. The difference was approaching significance in the Baseline task
(27 % for frozen vs. 19 % for target) ($t$ (30) = -1.79, $p=.083$, $d = -.322$, $\eta^2 = .094$), as well
as in the Experimental task (40 % for frozen vs. 31 % for target) ($t$ (30) = -3.07, $p =.005$, $d
= -.551$, $\eta^2 = .233$). The pattern is very counter-intuitive, in that some readers found inverse
scope in the scope freezing sentences (hard-to-accept ones) acceptable even more often than scope ambiguous items (easier-to-accept ones). We found few people who judged inverse scope acceptable in the scope-ambiguous structures alone. None of the 31 participants were found to distinguish mono-clausal from bi-clausal in terms of inverse scope possibility. Having said this, the pattern described above was not repeated in subsequent experiments; therefore we leave this for future research.
4.5  Experiment 8: Baseline-Experimental (Focal discourse)  
(with Yes, people instruction)

4.5.1  Purpose

Experiment 8 was exactly the same as Experiment 7 except the instruction tested was “yes, people might say this” type instruction, repeated below.

Yes, people might say this instruction
Please judge whether the sentence is something that people might say as a summary or description of the provided story. The sentence need not be your preferred way of speaking. There may be a better way to say it that makes it clearer. But do you think it can be considered a possible way of expressing the situation?

Yes, people might say this       No, nobody would say this

4.5.2  Participants and Procedure

Thirty-seven native speakers of English participated as a group in the in-class manner in the experiment, all undergraduate students at the University of Hawaii (all were from a general psychology class). Eight were excluded due to their low accuracy rate (below 80%) on fillers. Data from twenty-nine participants were analyzed. The procedure was exactly the same as in Experiment 7 – the same population was applied the Baseline task, and one week later, the Experimental task (focal discourse).
4.5.3 Results

4.5.3.1 Results of Target from Baseline and Experimental (focal discourse)

Data analyses were conducted on the accuracy and proportions of judgment responses based on Yes, people might say this or No, nobody would say this. The results of the test items from the Baseline Task are presented in table 36 (k = number of tokens; N = number of participants; M = Mean rate of acceptance; SD = Standard Deviation; M % = Mean percentage of acceptance) (k = number of tokens; N = number of participants; M = Mean number of items (out of 6) rated as a ‘People might say’ description of the story; SD = Standard Deviation; M % = Percent acceptance out of all items (total = 174)).

<table>
<thead>
<tr>
<th>Sentence</th>
<th>Context (baseline)</th>
<th>N</th>
<th>M (SD, M %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target</td>
<td>Some-Some (k=6)</td>
<td>29</td>
<td>5.34 (0.86, 89.08)</td>
</tr>
<tr>
<td>Some-Some (k=6) Inverse scope</td>
<td>29</td>
<td>1.21 (1.54, 20.12)</td>
<td></td>
</tr>
</tbody>
</table>

Table 36. Experiment 8: Results: Target items in the Baseline task

Under the instruction Yes, people might say this or No, nobody would say this, participants accepted some-every sentences in the baseline surface scope contexts 89% of the time. The acceptance rate of the test sentences in the baseline inverse scope contexts was 20%. The participants, as table 37 shows, were accurate on the items that measured general accuracy (97% correct) and were also generally correct on the bi-clausal some-every items in the surface scope context (71% correct).
The results of the test items from the Experimental task (Focal discourse) are presented in table 38.

<table>
<thead>
<tr>
<th>Type</th>
<th>Sentence</th>
<th>Context</th>
<th>N</th>
<th>M (SD, M %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target</td>
<td>Some-Every (k=6)</td>
<td>Surface scope</td>
<td>29</td>
<td>5.55 (0.78, 92.53)</td>
</tr>
<tr>
<td></td>
<td>Some-Every (k=6)</td>
<td>Inverse scope</td>
<td>29</td>
<td>1.97 (1.94, 32.76)</td>
</tr>
</tbody>
</table>

Table 38. Experiment 8: Results: Target items in the Experimental task

In the Experimental task (focal discourse) one week later, also under the instruction *Yes, people might say this or No, nobody would say this*, the same group of participants accepted *some-every* sentences in the focal surface scope contexts 93 % of the time. The acceptance rate of the test sentences in the focal inverse scope contexts was 33 %.

The participants, as table 39 shows, performed normally with universal-negation filler items (83 % versus 48%), and also with general accuracy filler items (97% accurate).

<table>
<thead>
<tr>
<th>Type</th>
<th>Sentence</th>
<th>Context</th>
<th>N</th>
<th>M (SD, M %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filler</td>
<td>No-answer (Mismatch) fillers (k=14)</td>
<td></td>
<td>29</td>
<td>13.55 (0.63, 96.80)</td>
</tr>
<tr>
<td></td>
<td>Every-Not (k=6)</td>
<td>None</td>
<td>29</td>
<td>4.97 (1.50, 82.76)</td>
</tr>
<tr>
<td></td>
<td>Every-Not (k=6)</td>
<td>Some (not all)</td>
<td>29</td>
<td>2.86 (2.15, 47.70)</td>
</tr>
</tbody>
</table>

Table 39. Experiment 8: Results: Fillers in the Experimental task

### 4.5.3.2 Results of Control items

The results from the Control items were much like previous experiments. Participants accepted *some*-variable reading in the Control 1 items in the Baseline task.
approximately 88% of the time, accepting inverse scope in the Control 2 items in the Baseline (his mother-every type and bi-clausal frozen scope items), 5% and 23% of the time, respectively. For the Control 2 bi-clausal frozen scope items in the Experimental task, the acceptance rate was 32%. The results are presented in the tables below, without further explanation.

The results of Control 1 items (k=3) from the Baseline task are presented in table 40.

<table>
<thead>
<tr>
<th>Experiment (Baseline)</th>
<th>1. some-every (temporal)</th>
<th>2. each-some (bi-clausal)</th>
<th>3. each-some (locative)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(some-variable) (k=1)</td>
<td>(some-variable) (k=1)</td>
<td>(some-variable) (k=1)</td>
</tr>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>8 (N=29)</td>
<td>0.93 (0.26)</td>
<td>0.90 (0.31)</td>
<td>0.83 (0.38)</td>
</tr>
</tbody>
</table>

Table 40. Experiment 8: Results: Control 1 in the Baseline task
1. Some linguistics student visited my office every Monday during the workshop.
2. In the report, each teacher reported that some student of mine did a great job.
3. In each math quiz, some student failed.

The results of Control 2 items (k=6) from the Baseline Task are presented in table 41.

<table>
<thead>
<tr>
<th>Experiment (Baseline)</th>
<th>1. his mother-every (Inverse) (k=2)</th>
<th>2. bi-clausal frozen scope (Inverse) (k=6)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (%) (SD)</td>
<td>M (%) (SD)</td>
</tr>
<tr>
<td>8 (N=29)</td>
<td>0.10 (5.17)</td>
<td>1.41 (23.56)</td>
</tr>
</tbody>
</table>

Table 41. Experiment 8: Results: Control 2 in the Baseline task

The results of Control 2 items (k=6) from the Experimental task (Focal discourse) are presented in table 42.
Experiment (Experimental: focal discourse) | bi-clausal frozen scope (Inverse) (k=6) | M (%) | (SD)
---|---|---|---
8 (N=29) | 1.93 (32.18) | (2.00)
Table 42. Experiment 8: Results: Control 2 in the Experimental task

4.5.3.3 Summary of Results and Discussion

The acceptance of inverse scope with *some-every* test items in the inverse scope contexts increased from 20.12 % in the Baseline task to 32.76 % in the Experimental (focal discourse) task. The increase, numerically small, was statistically meaningful (*t* (28) = 2.961, *p* = .006, *d* = .55, *η²* = .232). Importantly, the focal discourse advantage effect was demonstrated when readers were instructed to judge the sentences in terms of “yes, people might say this”. This can be compared to a marginal focal discourse effect that was found in the experiment 7 when readers were instructed with “yes, Okay” instruction.

Additionally, for frozen scope items, participants’ response patterns as follows, observed in experiment 7, were once again repeated in this experiment 8. First, within each task, similar acceptance rates were found between the target inverse and the control frozen scores in the Baseline (23.56 % vs. 20.12 %, *t* (28) = -1.03, *p* = .312) and also in the Experimental (32.18 % vs. 32.76 %, *t* (28) = .143, *p* = .887). Second, there was an increase of acceptance of inverse scope for frozen scope items from the Baseline task to the Experimental task, probably due to priming. The scope freezing items in the inverse scope contexts were accepted more often in the Experimental than in the Baseline (32.18 % vs. 23.56 %). The difference nearly approached significance (*t* (28) = 1.746, *p* = .092, *d* = .324, *η²* = .095). Third, like in experiment 7, we found so few participants in this experiment 8
that successfully distinguished some-every mono-clausal from some-every bi-clausal, either in the Baseline or the Experimental tasks.
4.6 Experiment 9: Experimental-Baseline Experiment

(with Yes, people instruction)

4.6.1 Purpose

The experimental findings so far show a focal discourse effect in inverse scope accessibility. A plausible suspicion, however, is that the effect, numerically small, might have to do with experimental design, not necessarily having to with discourse manipulation. One design aspect is that readers were repeatedly tested in two tasks whose design and material were similar. The task familiarity might have affected their performance on inverse scope at the second time of testing.

We conducted Experiment 9, exactly the same as Experiment 8 except the two tasks were conducted in the reversed order – first, the Experimental task was conducted, followed by the Baseline task with the same population one week later. The purpose was to see whether the order of two tasks could be a source of increasing inverse scope responses.

4.6.2 Participants and Procedure

Thirty-eight native speakers of English participated in the experiment, all undergraduate students at the University of Hawaii. They were recruited from a basic psychology class. Seven were excluded due to their low accuracy rate (below 80%) on fillers. Data from thirty-one participants were analyzed.

The procedure was exactly the same as in Experiment 8 except participants participated as a group first in the Experimental task (focal discourse), and then in the
Baseline Task (one-week interval). The instruction was the same “yes, people might say this” version as in Experiment 8.

4.6.3 Results

4.6.3.1 Results of Target from Experimental (focal discourse) and Baseline

Data analyses were conducted on the accuracy and proportions of judgment responses based on Yes, people might say this or No, nobody would say this. The results of the test items from the Experimental (Focal Discourse) Task are presented in table 43 (k = number of tokens; N = number of participants; M = Mean number of items (out of 6) rated as a ‘People might say’ description of the story; SD = Standard Deviation; M % = Percent acceptance out of all items (total = 186)).

<table>
<thead>
<tr>
<th>Type</th>
<th>Sentence</th>
<th>Context (focal)</th>
<th>N</th>
<th>M (SD, M %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target</td>
<td>Some-Ever (k=6)</td>
<td>Surface scope</td>
<td>31</td>
<td>5.35 (0.75, 89.25)</td>
</tr>
<tr>
<td></td>
<td>Some-Ever (k=6)</td>
<td>Inverse scope</td>
<td>31</td>
<td>2.39 (2.32, 39.79)</td>
</tr>
</tbody>
</table>

Table 43. Experiment 9: Results: Target items in the Experimental task

In the Experimental task (focal discourse), participants accepted some-every sentences in the focal surface scope contexts 89 % of the time. The acceptance rate of the test sentences in the focal inverse scope contexts was 40 %.

The participants, as table 44 shows, performed normally with universal-negation filler items (76 % versus 46%), and also with general accuracy filler items (97% accurate).
Type | Sentence | Context | N | M (SD, M %) \\
--- | --- | --- | --- | --- \\
Filler | No-answer (Mismatch) fillers (k=14) | 31 | 13.55 (0.81, 96.77) \\
| Every-Not (k=6) | None | 31 | 4.58 (1.77, 76.34) \\
| Every-Not (k=6) | Some (not all) | 31 | 2.74 (2.32, 45.70) \\

Table 44. Experiment 9: Results: Fillers in the Experimental task

The results of the test items from the Baseline are presented in table 45.

Type | Sentence | Context (baseline) | N | M (SD, M %) \\
--- | --- | --- | --- | --- \\
Target | Some-Every (k=6) | Surface scope | 31 | 5.58 (0.67, 93.01) \\
| Some-Every (k=6) | Inverse scope | 31 | 1.77 (2.11, 29.57) \\

Table 45. Experiment 9: Results: Target items in the Baseline task

Given the baseline discourse, the same group of participants accepted the test *some-every* sentences in the baseline surface scope contexts 93 % of the time. The acceptance rate of the test sentences in the baseline inverse scope contexts was 30 %.

Regarding fillers, as table 46 shows, participants were accurate on the items that measured general accuracy (91% correct) and were also generally correct on the bi-clausal some-every items in the surface scope context (82 % correct).

| Type | Sentence | Context | N | M (SD, M %) \\
--- | --- | --- | --- | --- \\
Filler | Yes-answer (Match) fillers (k=14) | 31 | 12.81 (1.17, 91.48 %) \\
| Bi-clausal *some-every* (k=2) | Surface scope | 31 | 1.65 (0.49, 82.26 %) \\

Table 46. Experiment 9: Results: Fillers in the Baseline task

### 4.6.3.2 Results of Control items

Results from the Control items were not significantly different from previous experiments, and are therefore omitted here.
4.6.3.3 Summary of Results and Discussion

We found that the order of two tasks did not make a much difference to the extent of the increase in inverse scores from the Baseline task to the Experimental task. Target inverse scope response scores were numerically higher in the Experimental task (focal discourse) than in the Baseline task (40 % in Experimental, 30 % in Baseline), and the difference approached significance \( t(30) = 1.771, p = .087, d = .318, \eta^2 = .092 \). Also frozen scores were numerically higher in the Experimental task than in the Baseline task (38 % in Experimental, 23 % in Baseline), with statistical difference \( t(30) = 2.827, p = .008, d = .508, \eta^2 = .205 \). Importantly, this seems to be the case regardless of the order in which the Baseline and Experimental Tasks are performed. Thus the increase in acceptance of inverse scope sentences in the focal discourse is not attributable to the order of tasks.

Regarding the bi-clausal control sentence, the participants accepted the frozen scope items to some extent, much like in previous experiments, also showing that the order of tasks is not a determining factor. Also like in previous experiments, within each task, readers accepted target inverse-scope items and control frozen-scope items to a similar extent: in the Experimental task (at the first time of taking), 40 % for target and 38 % for frozen, without significant difference \( t(30) = 0.329, p = .745 \), and in the Baseline (at the second time of taking), 30 % in the mono-clausal structure and 23 % in the bi-clausal structure, without significant difference \( t(30) = 1.434, p = .162 \).

In sum, then, with the “yes, people might say this” instruction, the focal discourse effect (increase of inverse scores in the focus discourse, compared to the baseline discourse) was demonstrated with statistical significance, in the Baseline-Experimental
order (in Experiment 8). In the reversed Experimental-Baseline order (in Experiment 9),
the focal discourse effect was marginal but in the same direction.

4.7 Summary of findings: 5 Experiments in Chapter 4

(1) The acceptance rate of the test sentences in the inverse scope baseline (enumeration)
contexts was 43% (N=16). The acceptance rate of the test sentences in the inverse scope
baseline (paraphrase) contexts was 37% (N=10). There was no difference between these
two contexts, and so the enumeration context was selected for experiments in Chapter 5.

(2) We tested some-every bi-clausal (frozen scope) items, for their
acceptability/unacceptability of inverse scope. The bi-clausal frozen scope items were not
straightforwardly rejected in the inverse scope context, being accepted on average 27 % of
the time. There was no difference across the three categories: 29 % for [frozen subject
every], 26% for [frozen object every], and 27% for [Relative Clause or RC]. Individual
items, rather than structure, seem to matter more. For subsequent experiments, we selected
twelve frozen scope items (out of 16) with the lowest acceptance scores (less than 40 %).

(3) With the new Baseline-Experimental design, we found lower mean acceptance rates of
inverse accessibility, as table 47 and figure 7 show; the maximum extent that the focal
context enabled readers to access inverse scope was only about 40 percent (Experiment 9:
Experimental-Baseline order under yes people instruction, N=31).
Experiment 7: Baseline-Experimental (focal) / Yes, Okay
Experiment 8: Baseline-Experimental (focal) / Yes, people might say this
Experiment 9: Experimental (focal) -Baseline / Yes, people might say this

Despite the overall low inverse response rates with this new Baseline-Experimental design, the focal discourse effect was once again demonstrated consistently across the three experiments in this chapter 4. Importantly, the effect was demonstrated, regardless of group variations, regardless of task instruction types, and regardless of the task ordering. The data thus add evidence in support of the thesis that inverse scope accessibility is sensitive to discourse.
The results from figure 8 show that the order of two tasks did not make a much difference.

We aimed to see whether the order of two tasks made any difference to the extent of the increase in inverse scores from the Baseline task to the Experimental task. To do so, we conducted independent samples t-tests with “difference in scores from Experimental to Baseline” as the dependent measure, for inverse and frozen categories separately. For the inverse category, the amount of difference as an indication of discourse effect was not different between the two orders ($t(58) = .335, p = .739$). So was for frozen ($t(58) = -.937, p = .353$).

The results also show that both inverse and frozen scope sentences increase in their availability of inverse scope in the focal discourse context. Acceptance of the (mono-
clausal) inverse scope items increased to the same extent that frozen scope items were accepted. In other words, performance on the inverse scope items co-varied with the performance on the frozen scope items. People perceived frozen scope items to sound better when they were presented with (better-sounding) inverse items in the focal context than when presented with the baseline inverse items.

(6) Finally, the results from figure 9 show that there was no instruction-type effect on the inverse scope responses.

![Figure 9. Experiments 8 and 9: Results: No instruction-type effect](image)

We conducted one sample t-tests in order to see if there were discourse effects under either of the two instruction types tested in experiment 8 versus experiment 9. There was indeed found to be a statistically significant discourse effect under both instructions. For the *Okay* instructions (Baseline – Experimental order), the difference in scores from the Experimental
task to the Baseline task was positive for inverse ($t(30) = 2.10$, $p = .054$) and also for frozen ($t(30) = 3.09$, $p = .004$). For the People instructions (Baseline-Experimental order), the difference in scores from the Experimental task to the Baseline task was strongly positive for inverse ($t(28) = 2.96$, $p = .006$), and weakly positive for frozen ($t(28) = .92$, $p = .092$).

We then aimed to see whether the type of instructions made any difference to the extent of the increase in inverse scores from the Baseline task to the Experimental task. To do so, we conducted independent samples t-tests with “difference in scores from Experimental to Baseline” as the dependent measure, for inverse and frozen categories separately. For the inverse category, the amount of difference as an indication of discourse effect was not different between the two instruction types (Okay versus People) ($t(58) = -0.11$, $p = .912$). So was for frozen ($t(58) = 1.04$, $p = .301$).

Therefore, the two types of instruction wording (Yes, okay; Yes, people might say this) did not substantially affect the rate of inverse scope responses. Nonetheless, with a group analysis, we found some signs towards the fact that the “yes, people might say this” type of instruction was more amenable to inverse scope readings as compared to when the “yes, okay” instruction type was given. As such, we decided to pick the “yes, people might say this” instruction to be used in the subsequent experiments.
4.8 Moving on to Chapter 5

This chapter tested a new two-step experiment design in order to detect the precise extent of the focal contextual manipulation in a more rigorous fashion. We manipulated the number of mismatch-answer frozen scope items and the precise wording of the instructions. With these manipulations, a modest amount of inverse scope accessibility increase was observed in relation to the change in discourse type.

The experimental findings so far suggest that discourse (particularly, the focus-type discourse) indeed contributes to the accessibility of inverse scope. But this effect was not powerful enough. Under close scrutiny of individual responses, we discovered some signs that discourse contribution was indeed limited. Relatively few of the participants were genuinely affected by the discourse to accept inverse scope items more often in the focal discourse. More than half of the participants (about 70%) stayed strongly resistant to the inverse scope reading, regardless of the structure (either with the mono-clausal or with the bi-clausal) or regardless of the task (either in the Baseline task or in the Experimental task). And some proportion of the participants tended to accept inverse-scope items, regardless of the structure or the task. Therefore, we are faced with a question of why a majority of readers failed to access the inverse scope reading, given this particular design and task. This issue of individual variation, although not our major concern, will be revisited in later chapters.

In the following series of experiments, we further investigate the role of discourse by implementing the new two-step experiment design to our four major experimental manipulations (expectation, expectation with prime, focal, and focal with prime), this time, with larger-size population samples.
CHAPTER 5.
EXPERIMENT: INVESTIGATION OF THE ROLE OF DISCOURSE
(4 EXPERIMENTS)

5.1 Motivation

This last set of four experiments (Experiments 10 to 13) re-examined the discourse-sensitivity of inverse scope accessibility in a more rigorous fashion, by implementing a full-fledged two-step method with a large number of informants. We tested the four discourse manipulations in the frame of a two-step task—(a) expectation context; (b) focal context; (c) expectation context with prime; (d) focal context with prime. This time, each sub-experiment engages a separate group of readers; but the new design helps us ensure that the groups are homogeneous in terms of their baseline scope capability.

5.2 Methodology Overview: two-step experiment
(repeated from section 4.4.6, Experiment 7)

The design was the two-step experiment consisting of the Baseline and the Experimental tasks separated by a one-week interval as in Experiments 7-9. The Baseline task examined participants’ baseline capability of accessing inverse scope. In the Baseline task, materials and procedure were exactly the same as in experiment 7. A total of 41 items included 12 target, 16 filler, and 13 Control items.

The Experimental task examined the facilitation of two kinds of discourse (expectation and focus) and priming on inverse scope. The Experimental task in the previous pilot experiments in chapter 4 (Experiments 7, 8 and 9) had examined the focal discourse. In the set of four experiments discussed here, the Experimental task in each experiment examined one of our four possible permutations of discourse and priming: (i)
expectation discourse, no prime; (ii) focal discourse, no prime; (iii) expectation with prime; (iv) focal discourse with prime. The set of stimuli types tested in each Experimental task is summarized below in table _. The four Experimental tasks were similar in design and materials to Experiments 1, 2, 3 and 4 from chapter 3 respectively: 12 target items of some- every sentences contextualized in the expectation or focal context (6 in surface; 6 in inverse), 14 fillers for accuracy-checking (with “no” answer), every-not negation fillers or some N or other-every prime.

The four Experimental tasks, unlike Experiment 1 to 4, included bi-clausal frozen (control 2) as control items. Control 1 (the existential reading of some N) and Control 3 (other quantifiers) were tested in the Baseline task. The 6 frozen-scope items in the Experimental task were a different set than the frozen-scope items in the Baseline task.

5.3 Experiment Procedure

The procedure of the four (Baseline-Experimental) experiments was similar to the procedure in experiment 7(see section 4.5.5). The task was the same off-line written survey involving a story-sentence verification task. Each experiment consisted of two tasks, administered on separate days with a one-week interval. Each task consisted of three sections – instruction, practice (2 trials), and survey. The experimental task had the additional post-experiment background survey at the end. The details are repeated below.

(1) Instruction

Subjects were students of an undergraduate class at the University of Hawaii. The four experiments were conducted in the classroom at the same time, and subjects
were tested as a group. Written instructions informed the students that they are participating in an experiment on sentence comprehension, involving a task of reading with a truth-value judgment component. Subjects were first instructed to read stories carefully, then asked to assess the truth-value of a target statement based on *Yes, people might say this / No, nobody would say this*. The exact instructions they received in both sessions are shown below:

For each test item, you will see a written story and a picture. The picture will help you to understand the story.

Please read the story carefully. It provides the context for the main test sentence. At the end of the story and the picture, you will see a sentence in bold.

Please judge whether the sentence is something that people might say as a summary or description of the provided story. The sentence need not be your preferred way of speaking. There may be a better way to say it that makes it clearer. But answer according to whether you think it can be considered as possible way of expressing the situation or not.

Indicate your answer by checking one of the options

*Yes, people might say this ( )  No, nobody would say this ( )*

Please keep in mind the instructions above while you do the test. You will be given only two answer options in the main test.

The survey in both of the sessions also included the prompt (Take a break now) occasionally at three different points of trials. Participants, when they meet prompts, were asked to stop and take a short break for 2 or 3 minutes.
(2) **Practice**

A practice session with two trials was presented before the actual survey in each session. Readers were guided to practice evaluating sentences with scope-taking operators.

(3) **Baseline Task**

In the Baseline Task, four lists of the test items (41 trials) were created the same manner as we did in the previous experiments. The Baseline task lasted approximately 30 minutes.

(4) **Experimental Task (one week later)**

The same group of subjects participated in the Experimental task one week later. Four lists of test items (44 trials) were created and randomly distributed in the same manner as in the Baseline. The four tasks were randomly distributed to participants. The main survey lasted approximately 40 minutes.

(5) **Post-experiment background survey**

At the end of the Experimental task, participants responded to a post-experimental background survey (5 minutes). It was the same as in the experiments in chapter 4 (see the full list of background survey items and their results in Appendix O). This time, subjects were additionally surveyed for their conception of the indefinite *some N* (2 items) (the list of *some N* items and their results are presented in Appendix N).
5.4 Participants

A total of 412 native speakers of English participated in five sets of Baseline-Experimental experiments (see table 45), all undergraduate students at the University of Hawaii (259 female and 161 males). They were recruited from two large classes in the Mathematics Department (two basic mathematics classes taken by undergraduate freshmen students, Math 1 and Math 2). In each group, the Baseline task was conducted in class on separate days. Then, exactly one week later, each group was tested on the Experimental task in class.

Data from 49 participants were excluded due to their low accuracy rate (less than 70% in either task). Data from 363 participants were analyzed. Among the 363 that had participated in the Baseline task, 78 subjects were given the Expectation version of the Experimental task (Experiment 10), 83 subjects were given the Focal version (Experiment 11), 82 subjects were given the Expectation with Prime version (Experiment 12), and 84 subjects were given the Focal with Prime version (Experiment 13). See table 48 for a summary of distribution of participants.

<table>
<thead>
<tr>
<th>Experimental Task Type</th>
<th>Number of Participants</th>
<th>Experiment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expectation, no prime</td>
<td>78</td>
<td>10</td>
</tr>
<tr>
<td>Focal, no prime</td>
<td>83</td>
<td>11</td>
</tr>
<tr>
<td>Expectation, prime</td>
<td>82</td>
<td>12</td>
</tr>
<tr>
<td>Focal, prime</td>
<td>84</td>
<td>13</td>
</tr>
<tr>
<td>Baseline, prime</td>
<td>36</td>
<td>14</td>
</tr>
</tbody>
</table>

Table 48. Summary of distribution of participants into Task Types.

The remaining 36 were given another separate version that we created, “Baseline with Prime,” (Experiment 14). In this last experiment, subjects were tested for 12 inverse
scope baseline items, in the Baseline task. The same subjects, after 7 days, were re-tested for the same baseline target items, this time in the Baseline with Prime task where prime items were present as a replacement of fillers. The purpose was to see if the prime effect emerges in the baseline discourse.

5.5 Prediction and analysis method

We had one within-subjects factor with two levels (inverse scope; baseline versus experimental) that was repeatedly measured through two tasks, baseline and experimental. First, we expected to have a within-subjects effect for discourse manipulation (baseline vs. experimental). Thus, comparisons were made between the means of inverse scope in the baseline compared to the experimental, using paired samples t-test.

We also had another within-subjects factor repeatedly measured in each task of baseline and experimental, which is frozen scope. No treatment or manipulation was applied for the frozen items in either task. We tested the frozen scope items to check whether participants were careful enough to resist accepting inverse scope in the *some-every* bi-clausal structure in either task. Therefore, we expected to have a within-subjects effect for scope (frozen vs. inverse), inverse scope being substantially higher than frozen scope. Thus, comparisons were made between the means of inverse scope in the target mono-clausal structure compared to the control bi-clausal structure, using paired samples t-test.

Most importantly, we had one between-subjects factor with four levels (discourse manipulation; 1, 2, 3 and 4) to determine the relative contribution of each discourse manipulation to the combined result. The Welch 1-Way Anova Test (variances not
assumed equal) was conducted to discover whether there is any between-groups difference between the four discourse categories.
5.6  Experiment 10 (Baseline-Experimental: Expectation context)

5.6.1  Purpose

The purpose of Experiment 10 was to test to what extent the expectation context supporting the inverse scope would affect the accessibility of inverse scope, compared to the baseline context supporting the inverse scope.

5.6.2  Design and Procedure

The design and procedure was two-step experiments (Baseline-Experimental) (see section 5.2 for details).

5.6.3  Materials: Baseline

The material in the Baseline task was the same set of 41 stimuli (target, filler, and control) as in experiment 7. 12 target some-every items were contextualized in the baseline (enumeration) discourse - six in surface scope and six in inverse scope.

Sample of Baseline (repeated from Section 4.4.2, Experiment 7)

(1)  Inverse scope context (baseline context, enumeration)
A radio DJ had three favorite classic pop artists. They were Elvis Presley, Louis Armstrong, and B. B. King. One morning, he was taking song requests. One man requested a song by Elvis Presley and then another man requested a song by Louis Armstrong. Lastly, a third man called in and requested a song by B. B. King. The DJ was happy.
Test Sentence: Some man requested every pop artist that the DJ liked.

(2) Surface scope context (baseline context, enumeration)
Context: A radio DJ had three favorite classic pop artists. They were Elvis Presley, Louis Armstrong, and B. B. King. One morning, he was taking song requests. One man requested a song by Elvis Presley and then requested a song by Louis Armstrong. He further requested a song by B. B. King. The DJ was happy.

Test Sentence: Some man requested every pop artist that the DJ liked.
5.6.4 Fillers

The Baseline task had 14 filler (no-answer, mismatch) items, and 10 filler (yes-answer, match) items. The overall number of match and mismatch items was balanced. Two of the yes-answer fillers were bi-clausal *some-every* sentences in the surface scope context.

5.6.5 Control items

The same three kinds of Control items were used as in experiment 7 (Control 1, 2, and 3). However, the previous experiments (7-9) found a massive priming effect upon frozen items. We therefore decided to select more Control 2 items that were particularly difficult to obtain in inverse scope. We therefore needed more RC items for Control 2 type items, and so three out of twelve items were modified into RC type. The remaining nine frozen items were repeated. In the Baseline task, therefore, the frozen-scope items consisted of Embedded subject *every N* (1 item), Embedded object *every N* (2 item), and Relative Clause *every N* (3 items).

We also modified the contexts so as to strengthen the ungrammaticality of the inverse reading of these items. We added one final statement to the given story at the end, like “there was no single person who did all, but it was three different people” (sample is presented below). The sentence added was underlined (the entire set of the modified versions of frozen scope discourse is presented in Appendix L). For the other Control 2, *his mother-every* type, the same two items were repeated as in previous experiment 7.
Sample of Control 2: bi-clausal frozen scope in the Baseline task

I brought my niece and her friends to the theatre. The theater was showing three movies: *Catch Me If You Can, The Terminal,* and *A.I.* While we waited, I quizzed them about which of these movies had been directed by Steven Spielberg. Each girl guessed about a different movie: One girl guessed that Spielberg directed *Catch Me If You Can.* Another girl then guessed that he directed *The Terminal.* Finally, a third girl guessed that *A.I.* was directed by Steven Spielberg. Yet, no single girl guessed he directed all of the movies.

Control Sentence: Some girl guessed that Spielberg directed every movie mentioned.

5.6.6 Materials: Experimental Task – Expectation Discourse

The same set of twelve target sentences in experiment 1 (expectation discourse) was tested. Each of the 12 test sentences was contextualized in the expectation inverse-scope story context, and the expectation surface-scope story context.
Sample of Target (repeated from Experiment 1 in chapter 3)

(1) **Inverse scope context (expectation)**
An environmental activity was held at the school, and participants were making big playhouses out of cardboard. At last, three finished works were displayed. The *igloo* was the work of a 6th-grade boy, and the *rocket* was the work of a 5th-grade boy. When I saw the *doll house*, I thought it could not be a work of a child. However, I was surprised to discover that it was the work of a little 4th-grade girl.

Test Sentence: Some child built every playhouse on the display.

(2) **Surface scope context (expectation)**
An environmental activity was held at the school, and participants were making big playhouses out of cardboard. At last, three finished works were displayed. The *igloo* and the *rocket* were both the works of a 6th-grade boy. When I saw the *doll house*, I thought it must be the work of a different child. However, I was surprised to discover that its creator was the same boy again.
Test Sentence: Some child built every playhouse on the display.

5.6.7 Fillers

Fillers were repeated from experiment 1 (12 every-not sentences and 16 no-answer mismatch fillers).

5.6.8 Control 2 items (Frozen-scope)

We used revised frozen-scope items for the Experimental task, as well. Like in the Baseline task, the frozen-scope items consisted of Embedded subject every $N$ (1 item), Embedded object every $N$ (2 item), and Relative Clause every $N$ (3 items). The discourse was clarified in a crystal-clear inverse-scope manner, excluding the surface-scope reading circumstance by adding a sentence at the end (the added sentence is underlined).
Sample of Control 2: bi-clausal frozen scope in the Experimental task

Our town was small and there were only three banks – Central, Hawaii, and Pacific. A man was arrested for robbing all three banks. The prosecutor was looking for witnesses. Before long, three witnesses came forward to testify: One witness testified that the man had robbed Central Bank. Another witness testified that the man had robbed the Hawaii Bank. A third witness testified that the man had robbed the Pacific Bank. Three different witnesses testified about different banks, and none of them saw the man robbing all the banks.

Control Sentence: Some witness testified that the man had robbed every bank in town.

5.6.9 Results: Experiment 10 (Baseline-Experimental: Expectation)

Data analyses were conducted on the accuracy and proportions of Yes (people might say this)/No (nobody would say this) judgment responses. The results from the Baseline and then Experimental tasks are presented below. Because the same set of Control items was tested in the following three experiments, their results will be presented together at the end of this section, for ease of comparison.
The results of the Baseline task are presented in table 49 (k = number of tokens; N = number of participants; M = Mean number of items (out of 6) rated as a ‘People might say’ description of the story; SD = Standard Deviation; M % = Percent acceptance out of all items (total = 468)).

<table>
<thead>
<tr>
<th>Type</th>
<th>Sentence</th>
<th>Context (baseline)</th>
<th>N</th>
<th>M  (SD, M %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target</td>
<td>Some-Every (k=6)</td>
<td>Surface scope</td>
<td>78</td>
<td>5.53 (0.85, 92.09)</td>
</tr>
<tr>
<td></td>
<td>Some-Every (k=6)</td>
<td>Inverse scope</td>
<td>78</td>
<td>1.55 (1.78, 25.86)</td>
</tr>
</tbody>
</table>

Table 49. Experiment 10: Results: Target in the Baseline task

Given the baseline discourse, under the instruction Yes, people might say this/ No, nobody would say this, participants (n = 78) accepted some-every sentences in the baseline surface scope contexts 92% of the time. The acceptance rate of the test sentences in the baseline inverse scope contexts was 26%. The participants performed well on filler items in the Baseline task, accurate 91% of the time.

The results of the test items from the Experimental task are presented in table 50.

<table>
<thead>
<tr>
<th>Type</th>
<th>Sentence</th>
<th>Context (expectation)</th>
<th>N</th>
<th>M  (SD, M %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target</td>
<td>Some-Every (k=6)</td>
<td>Surface scope</td>
<td>78</td>
<td>5.44 (0.88, 90.60)</td>
</tr>
<tr>
<td></td>
<td>Some-Every (k=6)</td>
<td>Inverse scope</td>
<td>78</td>
<td>1.86 (2.11, 30.98)</td>
</tr>
</tbody>
</table>

Table 50. Experiment 10: Results: Target in the Experimental (Expectation) task

Given the expectation discourse, under the instruction Yes, people might say this/ No, nobody would say this, the same participants (n = 78) accepted some-every sentences in the expectation surface scope contexts 91% of the time, much like in the Baseline task. The acceptance rate of the test sentences in the expectation inverse scope contexts was only
31 %, not much different from 26 % in the baseline inverse scope discourse. Participants were accurate on the filler items, 94 % of the time.

Like the results obtained in experiment 1 in chapter 3, the effect of the Expectation context was minimal. The rate of acceptance of inverse scope went up from 26 % in the Baseline task only to 31 % in the Experimental (Expectation) task.
5.7  Experiment 11 (Focal Context)

5.7.1  Purpose

The purpose of experiment 11 was to test the extent to which the focal context supporting the inverse scope would affect inverse scope accessibility, compared to the baseline context supporting the inverse scope. Experiment 11 was exactly the same as experiment 10 except that the type of the Experimental task this time was Focal context.

5.7.2  Design and Procedure

The design and procedure were the same two-step experiments (Baseline-Experimental) as in experiment 10.

5.7.3  Materials: Baseline Task

The same set of materials in the Baseline as in experiment 10 was repeated.

5.7.4  Materials: Experimental Task – Focal Discourse

The same set of twelve critical sentences in Experiment 2 (focal discourse) was tested. Each of the 12 test sentences was contextualized in the focal inverse-scope story context, and the focal surface-scope story context.
Sample of Target (repeated)

(1) Inverse scope context (focal context)
An environmental activity was held at a school today, and participants were making big houses out of cardboard. At last, I saw three big playhouses finished and displayed. Surprisingly, the igloo was the work of a 6th-grade boy, and the rocket was the work of a 5th-grade boy. When I saw the doll house, I thought it could not be a work of a child. However, it was the work of a little child, this time a 4th-grade girl! After I left, I heard that four more houses were displayed, but none of them was a work of a child.

Test Sentence: Some child built every playhouse that I saw today.

(2) Surface scope context (focal context)
An environmental activity was held at a school today, and participants were making big playhouses out of cardboard. At last, I saw three big playhouses finished and displayed. Surprisingly, the igloo and the rocket were both the works of a 6th-grade boy. When I saw the doll house, I thought it must be the work of a different child. However, I was surprised to discover that its creator was the same boy again. After I left, I heard that four more houses were displayed, but none of them was a work of a child.
Test Sentence: Some child built every playhouse that I saw today.

5.7.5 Fillers and Controls: Experimental Task

The same set of fillers and control items were repeated from experiment 10, the Experimental task.

5.7.6 Results: Experiment 11 (Baseline-Experimental: Focal)

Data analyses were conducted on the accuracy and proportions of judgment responses based on Yes, people might say this or No, nobody would say this. The results of the test items from the Baseline Task are presented in table 51 (k = number of tokens; N = number of participants; M = Mean number of items (out of 6) rated as a ‘People might say’ description of the story; SD = Standard Deviation; M % = Percent acceptance out of all items (total = 438)).
Given the baseline discourse, under the instruction *Yes, people might say this or No, nobody would say this*, participants \((n = 83)\) accepted *some-every* sentences in the baseline surface scope contexts 92 % of the time. The acceptance rate of the test sentences in the baseline inverse scope contexts was 29 %. The participants performed well on filler items in the Baseline task, accurate 91% of the time.

The results of the test items from the Experimental task are presented in table 52.

<table>
<thead>
<tr>
<th>Type</th>
<th>Sentence</th>
<th>Context (baseline)</th>
<th>N</th>
<th>M (SD, M %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target</td>
<td>Some-Every (k=6)</td>
<td>Surface scope</td>
<td>83</td>
<td>5.53 (0.87, 92.17)</td>
</tr>
<tr>
<td></td>
<td>Some-Every (k=6)</td>
<td>Inverse scope</td>
<td>83</td>
<td>1.75 (1.67, 29.12)</td>
</tr>
</tbody>
</table>

Table 51. Experiment 11: Results: Target in the Baseline task

Given the focal discourse, also under the instruction *Yes, people might say this or No, nobody would say this*, the same group of participants \((n = 83)\) accepted *some-every* sentences in the focal surface scope contexts 88 % of the time. The acceptance rate of the test sentences in the focal inverse scope contexts was 36 %. The participants performed well on filler items in the Baseline task, accurate 91% of the time. Unlike the high inverse rates obtained in chapter 3, the effect of the focal context in this experiment 11 turns out to be minimal. The rate of acceptance of inverse scope went up from 29 % in the Baseline task only to 35 % in the Experimental task.

<table>
<thead>
<tr>
<th>Type</th>
<th>Sentence</th>
<th>Context (focal)</th>
<th>N</th>
<th>M (SD, M %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target</td>
<td>Some-Every (k=6)</td>
<td>Surface scope</td>
<td>83</td>
<td>5.25 (1.08, 87.55)</td>
</tr>
<tr>
<td></td>
<td>Some-Every (k=6)</td>
<td>Inverse scope</td>
<td>83</td>
<td>2.11 (2.06, 35.14)</td>
</tr>
</tbody>
</table>

Table 52. Experiment 11: Results: Target in the Experimental (Focal) task
5.8 Experiment 12 (Expectation Context with Priming)

5.8.1 Purpose

The purpose of experiment 12 was to test to what extent the expectation context, with priming support, would affect inverse scope accessibility, compared to the baseline context. Experiment 12 was exactly the same as experiment 10 except that the type of the Experimental task tested this time was the Expectation with Prime task.

5.8.2 Design and Procedure

The design and procedure were the same two-step experiments (Baseline-Experimental) as in experiment 10.

5.8.3 Materials: Baseline Task

The same set of materials in the Baseline as in experiment 10 was repeated.

5.8.4 Materials: Experimental Task – Expectation Discourse

Experiment 12 in the Experimental task used the same set of target *some-every* sentences (in the expectation discourse), 16 fillers, and 7 control items as in experiments 10. Each of the 12 test sentences was contextualized in the expectation inverse-scope story context, and the expectation surface-scope story context.

Also, experiment 12 used the same set of 12 prime items as in Experiment 3: 6 were *some N or other-every* sentences in the inverse scope expectation context (e.g., *some*
child or other invented every product) and 6 were the same N-every sentences in the surface scope expectation context (e.g., the same child invented every product).

Sample prime (repeated)

(1) Inverse scope prime (expectation)
Walmart sells Needle Beetle, Crayon Holder, and Aim Fish in their toy section, and these products were the winners of the Invention Competition. Needle Beetle, the 2005 winner, is a device invented by a 5th-grade boy to reduce anxiety when receiving injections, and Crayon Holder, the 2006 winner, is a device invented by a 7th-grade girl for grabbing small pieces of crayon. The 2007 winner, Aim Fish, is an easy-to-use fishing rod, and I thought this product might have been the invention of an adult. However, its inventor was a child, too, this time a 7th-grade boy.

Prime Sentence: Some child or other invented every product that was mentioned.

(2) Surface scope prime (expectation)
Walmart sells Needle Beetle, Crayon Holder, and Aim Fish in their toys section. These products were the best works in the Kids Invention Exhibition. According to the 7th-grade girl inventor, Needle Beetle was designed to reduce anxiety when receiving injections, and
Crayon Holder was designed to grab small pieces of crayon. The Aim Fish was designed to be an easy-to-use fishing rod, and I thought this product might have been the invention of a different child. However, its inventor was that 7th-grade girl.

Prime Sentence: The same child invented every product that was mentioned.

### 5.8.5 Fillers and Controls: Experimental Task

The same set of fillers and control items were repeated from experiment 10, the Experimental task.

### 5.8.6 Results: Experiment 12 (Baseline-Experimental: Expectation with Prime)

Data analyses were conducted on the accuracy and proportions of judgment responses based on Yes, people might say this or No, nobody would say this. The results of the test items from the Baseline task are presented in table 53 (k = number of tokens; N = number of participants; M = Mean number of items (out of 6) rated as a ‘People might say’ description of the story; SD = Standard Deviation; M % = Percent acceptance out of all items (total = 492)).
Given the baseline discourse, under the instruction *Yes, people might say this or No, nobody would say this*, participants ($n = 82$) accepted *some-every* sentences in the baseline surface scope contexts 92% of the time. The acceptance rate of the test sentences in the baseline inverse scope contexts was 28%. The participants’ performance on fillers in the Baseline task was good, with their accuracy rate at 90%.

The results of the test items from the Experimental task (Expectation with Prime) are presented in table 54.

<table>
<thead>
<tr>
<th>Type</th>
<th>Sentence</th>
<th>Context (expectation)</th>
<th>N</th>
<th>M (SD, M %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target</td>
<td>Some-Every (k=6)</td>
<td>Surface scope</td>
<td>82</td>
<td>5.56 (0.79, 92.68)</td>
</tr>
<tr>
<td></td>
<td>Some-Every (k=6)</td>
<td>Inverse scope</td>
<td>82</td>
<td>2.15 (2.19, 35.77)</td>
</tr>
</tbody>
</table>

Table 54. Experiment 12: Results: Target in the Experimental task

Given the expectation discourse with prime support, also under the instruction *Yes, people might say this or No, nobody would say this*, the same group of participants ($n = 82$) accepted *some-every* sentences in the expectation surface scope contexts 93% of the time. The acceptance rate of the test sentences in the expectation inverse scope contexts was 36%. The participants performed well on filler items in the Baseline task, accurate 93% of the time.

In the Experimental task (Expectation with Prime), the participants’ response to the prime items is presented in table 55.

<table>
<thead>
<tr>
<th>Type</th>
<th>Sentence</th>
<th>Context (baseline)</th>
<th>N</th>
<th>M (SD, M %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target</td>
<td>Some-Every (k=6)</td>
<td>Surface scope</td>
<td>82</td>
<td>5.54 (0.82, 92.28)</td>
</tr>
<tr>
<td></td>
<td>Some-Every (k=6)</td>
<td>Inverse scope</td>
<td>82</td>
<td>1.68 (1.72, 28.05)</td>
</tr>
</tbody>
</table>

Table 53. Experiment 12: Results: Target in the Baseline task
Type | Sentence | Context | N  | M ($SD, M \%) |
--- | --- | --- | --- | --- |
Prime | The Same-Every (k=6) | Surface scope | 82 | 5.24 (1.00, 87.40) |
Some N or other-Every (k=6) | Inverse scope | 82 | 3.85 (1.90, 64.23) |

Table 55. Experiment 12: Results: Prime in the Experimental task

Under the instruction *Yes, people might say this or No, nobody would say this*, the same group of participants ($n = 82$) accepted the surface prime *the same-every* sentences in the surface scope (expectation) contexts 87 % of the time. The acceptance rate of the inverse prime *some N or other-every* sentences in the inverse scope (expectation) contexts was 64 %.

Again, unlike the high inverse rates obtained in chapter 3, the effect of the Expectation context with Prime was minimal. The rate of acceptance of inverse scope went up from 28 % in the Baseline task only to 36 % in the Experimental (Expectation with Prime) task.
5.9 Experiment 13 (Focal Context with Priming)

5.9.1 Purpose

The purpose of experiment 13 was to test to what extent the focal context, with prime support, would affect inverse scope accessibility, compared to the baseline context. Experiment 13 was exactly the same as experiment 10 except that the type of the Experimental task tested this time was the Focal context with Prime.

5.9.2 Design and Procedure

The design and procedure were the same two-step experiments (Baseline-Experimental) as in Experiment 10.

5.9.3 Materials: Baseline Task

The same set of materials in the Baseline as in Experiment 10 was repeated.

5.9.4 Materials: Experimental Task – Focal Discourse

Experiment 13 used the same set of target some-every sentences (in the focal discourse), 16 fillers, and 7 control items as in Experiments 10. Each of the 12 test sentences was contextualized in the focal inverse-scope story context, and the focal surface-scope story context.

Also, experiment 13 used the same set of 12 prime items as in experiment 3: 6 were some N or other-every sentences in the inverse scope expectation context (e.g., some
child or other invented every product) and 6 were the same N-every sentences in the surface scope expectation context (e.g., the same child invented every product).

5.9.5 Results: Experiment 13 (Baseline-Experimental: Focal with Prime)

Data analyses were conducted on the accuracy and proportions of judgment responses based on Yes, people might say this or No, nobody would say this. The results of the test items from the Baseline Task are presented in table 56 (k = number of tokens; N = number of participants; M = Mean number of items (out of 6) rated as a ‘what People might say’ description of the story; SD = Standard Deviation; M % = Percent acceptance out of all items (total = 504)).

<table>
<thead>
<tr>
<th>Type</th>
<th>Sentence</th>
<th>Context (baseline)</th>
<th>N</th>
<th>M (SD, M %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target</td>
<td>Some-Every (k=6)</td>
<td>Surface scope</td>
<td>84</td>
<td>5.30 (1.05, 88.29)</td>
</tr>
<tr>
<td></td>
<td>Some-Every (k=6)</td>
<td>Inverse scope</td>
<td>84</td>
<td>1.52 (1.75, 25.40)</td>
</tr>
</tbody>
</table>

Table 56. Experiment 13: Results: Target in the Baseline task

Given the baseline discourse, under the instruction Yes, people might say this or No, nobody would say this, participants (n = 84) accepted some-every sentences in the baseline surface scope contexts 88 % of the time. The acceptance rate of the test sentences in the baseline inverse scope contexts was 25 %. The participants performed well with filler items in the Baseline task, with their accuracy rate at 92 %.

The results of the test items from the Experimental task (Focal with Prime) are presented in table 57.
In the Experimental task (Focal with Prime) one week later, also under the instruction *Yes, people might say this or No, nobody would say this*, the same group of participants \((n = 84)\) accepted *some-every* sentences in the focal surface scope contexts 89 \% of the time. The acceptance rate of the test sentences in the focal inverse scope contexts was 29 \%. The participants’ performance on filler items in the Experimental task was as normal as in the previous experiments, being accurate 93 \% of the time.

The participants’ performance on the prime items in the Experimental task was of a similar contrast as in the previous experiments – 86 \% for the surface prime *the same-every* sentences in the surface scope context and 57 \% for the inverse prime *some N or other-every* sentences in the inverse scope context. See table 58.

<table>
<thead>
<tr>
<th>Type</th>
<th>Sentence</th>
<th>Context (focal)</th>
<th>N</th>
<th>M (SD, M %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target</td>
<td>Some-Every (k=6)</td>
<td>Surface scope</td>
<td>84</td>
<td>5.33 (1.10, 88.89)</td>
</tr>
<tr>
<td></td>
<td>Some-Every (k=6)</td>
<td>Inverse scope</td>
<td>84</td>
<td>1.74 (1.96, 28.97)</td>
</tr>
</tbody>
</table>

Table 57. Experiment 13: Results: Target in the Experimental task

Under the instruction *Yes, people might say this or No, nobody would say this*, the same group of participants \((n = 84)\) accepted the surface prime *the same-every* sentences in the surface scope contexts 86 \% of the time. The acceptance rate of the inverse prime *some N or other-every* sentences in the inverse scope contexts was a mere 57 \%.
Unlike the results obtained in chapter 3, the effect of the Focal Context with Prime was relatively minimal. The rate of acceptance of inverse scope went up from 25% in the Baseline Task only to 29% in the Focal with Prime Task.
5.10 Experiment 14 (Baseline with Priming)

5.10.1 Purpose

We conducted an additional small-scale experiment, Experiment 14, while conducting the series of four large-scale experiments discussed in this chapter. We were interested in two issues – first, to further explore whether the prime plays any role in facilitating inverse scope accessibility, and second, to see if the prime effect, if any, would be relative to the discourse factors we manipulated, expectation or focus. If it is the case, we expect that the prime advantage effect does not emerge in the Baseline with Prime task, where the prime items were mixed with the inverse items in the baseline-type discourse.

5.10.2 Design and Procedure

The design and procedure were the same two-step experiment (Baseline-Experimental) as in experiment 10. Participants (n=36) were tested first on the Baseline task and one week later on the Experimental task (Baseline with Prime).

5.10.3 Results: Experiment 14 (Baseline-Experimental: Baseline with Priming)

Data analyses were conducted on the accuracy and proportions of judgment responses based on Yes, people might say this or No, nobody would say this. The results of the test items from the Baseline task are presented in table 59 (k = number of tokens; N = number of participants; M = Mean number of items (out of 6) rated as a ‘People might say’ description of the story; SD = Standard Deviation; M % = Percent acceptance out of all items (total = 216)).
Given the baseline discourse, under the instruction *Yes, people might say this or No, nobody would say this*, participants \(n = 36\) accepted *some-every* sentences in the baseline surface scope contexts 90% of the time. The acceptance rate of the test sentences in the baseline inverse scope contexts was 33%. The participants’ performance on filler items was good, accurate 89% of the time.

In the Experimental task, the exact same baseline test items were tested, this time in the presence of prime items. Results are presented in table 60.

<table>
<thead>
<tr>
<th>Type</th>
<th>Sentence</th>
<th>Context (baseline)</th>
<th>N</th>
<th>M (SD, M %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target</td>
<td>Some-Every (k=6)</td>
<td>Surface scope</td>
<td>36</td>
<td>5.39 (1.08, 89.81 %)</td>
</tr>
<tr>
<td></td>
<td>Some-Every (k=6)</td>
<td>Inverse scope</td>
<td>36</td>
<td>1.97 (1.76, 32.87 %)</td>
</tr>
</tbody>
</table>

Table 59. Experiment 14: Results: Target in the Baseline task

Given the baseline discourse with prime support, also under the instruction *Yes, people might say this or No, nobody would say this*, the same group of participants \(n = 36\) accepted *some-every* sentences in the baseline surface scope contexts 95% of the time. The acceptance rate of the test sentences in the baseline inverse scope contexts was 27%. The participants’ performance on filler items in the Experimental task was good, with participants accurately responding 95% of the time.

Regarding the prime items, the results are presented in table 61. The participants displayed a similar contrast between the two readings as in the previous experiments so far.
Table 61. Experiment 14: Results: Prime in the Experimental task

<table>
<thead>
<tr>
<th>Type</th>
<th>Sentence</th>
<th>Context</th>
<th>N</th>
<th>M (SD, M %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prime</td>
<td>The Same-Every (k=6)</td>
<td>Surface scope</td>
<td>36</td>
<td>5.33 (0.86, 88.89 %)</td>
</tr>
<tr>
<td></td>
<td>Some N or other-Every (k=6)</td>
<td>Inverse scope</td>
<td>36</td>
<td>3.89 (1.77, 64.81 %)</td>
</tr>
</tbody>
</table>

Under the instruction *Yes, people might say this or No, nobody would say this*, the same group of participants ($n = 36$) accepted the surface prime *the same-every* sentences in the surface scope contexts 89% of the time. The acceptance rate of the inverse prime *some N or other-every* sentences in the inverse scope contexts was 65%.

Important to us, we discovered that the rate of acceptance of inverse scope numerically (though not significantly) decreased from the Baseline task to the Experimental task (Baseline with Prime) – 33% to 27%. Obviously, the data provide evidence that the prime items alone cannot facilitate inverse scope accessibility. The contribution of our prime items appears to be manifested relative to stronger discourse manipulations.
5.11 Results of Experiments 10-13: Control Items

This section presents results from Control items from the four experiments in this chapter.

5.11.1 Results of Control 1 items (some N as an existential quantifier) - Baseline

Control 1 items tested readers’ knowledge of some N as existential quantifiers. The same set of Control 1 items (k=3) was tested across the four Baseline task groups. Therefore, we presented their results, aggregated across the four Baseline groups, as table 62 shows (for results broken by each group, see table 63 in footnote 20).²¹

<table>
<thead>
<tr>
<th>Experiment (Baseline)</th>
<th>1. some-every (temporal) (some-variable) (k=1)</th>
<th>2. each-some (bi-clausal) (some-variable) (k=1)</th>
<th>3. each-some (locative) (some-variable) (k=1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>10-13 (N=327)</td>
<td>0.89 (0.31)</td>
<td>0.91 (0.28)</td>
<td>0.84 (0.36)</td>
</tr>
</tbody>
</table>

Table 62. Experiments 10-13: Results: Control 1 in the Baseline task
1. Some linguistics student visited my office every Monday during the workshop.
2. In the report, each teacher reported that some student of mine did a great job.
3. In each math quiz, some student failed.

²¹ Results on the Control 1 items are broken down by individual groups in table 63.

<table>
<thead>
<tr>
<th>Experiment (Baseline)</th>
<th>1. some-every (temporal) (some-variable) (k=1)</th>
<th>2. each-some (bi-clausal) (some-variable) (k=1)</th>
<th>3. each-some (locative) (some-variable) (k=1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>10 (N=78)</td>
<td>0.86 (0.35)</td>
<td>0.88 (0.32)</td>
<td>0.86 (0.35)</td>
</tr>
<tr>
<td>11 (N=83)</td>
<td>0.90 (0.30)</td>
<td>0.90 (0.30)</td>
<td>0.80 (0.41)</td>
</tr>
<tr>
<td>12 (N=82)</td>
<td>0.93 (0.26)</td>
<td>0.93 (0.26)</td>
<td>0.88 (0.33)</td>
</tr>
<tr>
<td>13 (N=84)</td>
<td>0.87 (0.34)</td>
<td>0.93 (0.26)</td>
<td>0.85 (0.36)</td>
</tr>
</tbody>
</table>

Table 63. Experiments 10-13: Results: Control 1 in the Baseline task broken by Individual Groups
Participants performed successfully with Control 1 items. The participants accepted the existential reading of a subject *some N* across the three items, above 80% of the time on average - 89 % in the *some-every* (temporal) item; 91% in the *each-some* (bi-clausal) item; 84 % in the *each-some* (locative) item. The results confirm that the participants across the four groups were capable of accessing the existential quantifier meaning of a subject *some N*.

### 5.11.2 Results of Control 2 (frozen scope) items – Baseline and Experimental

Control 2 items tested readers’ knowledge of syntactic restriction of inverse scope with *every*. The same set of Control 2 items was tested across the four Baseline task groups – 2 items for *his mother-every* type, and 6 items for *some-every* bi-clausal frozen scope type. Their results are presented in table 64, aggregated across the four Baseline groups (for results broken by each group, see table 65 in footnote 21).

---

Results on the Control 2 items are broken down by individual groups in table 65.

<table>
<thead>
<tr>
<th>Experiment (Baseline)</th>
<th>1. his mother-every (Inverse) (k=2)</th>
<th>2. bi-clausal frozen scope (Inverse) (k=6)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (%) (SD)</td>
<td>M (%) (SD)</td>
</tr>
<tr>
<td>10 (N=78)</td>
<td>0.21 (10.26)</td>
<td>1.19 (19.87)</td>
</tr>
<tr>
<td>11 (N=83)</td>
<td>0.33 (16.27)</td>
<td>1.46 (24.30)</td>
</tr>
<tr>
<td>12 (N=82)</td>
<td>0.23 (11.59)</td>
<td>1.39 (23.17)</td>
</tr>
<tr>
<td>13 (N=84)</td>
<td>0.19 (9.52)</td>
<td>1.29 (21.43)</td>
</tr>
</tbody>
</table>

Table 65. Experiments 10-13: Results: Control 2 in the Baseline task broken by Individual Groups
In this Baseline task, unlike the results obtained in the experiments so far, participants performed fairly conservatively. The rejection rates of Control 2 items were generally higher. The his mother-every sentences in the inverse scope contexts were rejected 88% of the time on average. While the frozen-scope sentences in the inverse scope contexts were accepted to some extent, their acceptance rates were marginal, 22% of the time on average.

In the Experimental tasks, the same set of six frozen scope items were tested across the four Experimental task groups. Their results are presented in table 66, aggregated across the four Experimental groups (for results broken by each group, see table 67 in footnote 22).

---

<table>
<thead>
<tr>
<th>Experiment (Baseline)</th>
<th>1. his mother-every (Inverse) (k=2)</th>
<th>2. bi-clausal frozen scope (Inverse) (k=6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-13 (N=327)</td>
<td>M (%) (SD)</td>
<td>M (%) (SD)</td>
</tr>
<tr>
<td></td>
<td>0.2 (11.93)</td>
<td>1.3 (22.22)</td>
</tr>
</tbody>
</table>

Table 64. Experiments 10-13: Results: Control 2 in the Baseline task

---

Results on the Control 2 items in the Experimental tasks are broken down by individual groups in table 67.

<table>
<thead>
<tr>
<th>Experiment (Experimental)</th>
<th>Some-every bi-clausal frozen (Inverse) (k=6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 (N=78)</td>
<td>M (%) (SD)</td>
</tr>
<tr>
<td>11 (N=83)</td>
<td>1.08 (17.95) 1.42</td>
</tr>
<tr>
<td>12 (N=82)</td>
<td>1.13 (18.88) 1.32</td>
</tr>
<tr>
<td>13 (N=84)</td>
<td>1.49 (24.80) 1.83</td>
</tr>
</tbody>
</table>

Table 67. Experiment 10-13: Results: Control 2 in the Experimental task broken by Individual Groups

169
As for the frozen scope items in the Experimental tasks, participants across the four groups performed as conservatively as they did for the frozen scope items in the Baseline task. The acceptance rate of the frozen scope items in the Experimental tasks was low at 20% on average across the four groups, much lower than the rates observed in the previous experiments. The performance with frozen-scope items in the two tasks was not statistically different. In sum, the set of frozen scope items in the Experimental tasks were largely rejected as much as the other set of frozen scope items in the Baseline tasks were.

5.11.3 Results of Prime

The same set of prime items was tested in two experiments 12 and 13. The results are summarized in table 68.

<table>
<thead>
<tr>
<th>Experiment (Experimental)</th>
<th>bi-clausal frozen scope (Inverse) (k=6)</th>
<th>M (%)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-13 (N=327)</td>
<td>1.2 (20.30%)</td>
<td>(1.5)</td>
<td></td>
</tr>
</tbody>
</table>

Table 66. Experiment 10-13: Results: Control 2 in the Experimental task

The acceptance contrasts between the inverse and surface prime items look similar in the two experiments. Indeed, no between-experiments difference was found for the inverse prime, and for the surface prime, too.
5.12 Results of Target versus Frozen: Within-experiment comparison

Overall, the acceptance rates were lower, for inverse scope items and frozen scope items, across the four experiments with this Baseline-Experimental design. Here, we evaluate two issues – (i) whether participants in each experiment were at least able to distinguish legitimate inverse scope from illegitimate long-distance inverse scope (frozen scope), and (ii) whether our four discourse manipulations were influential as compared to the baseline discourse condition.

Within each experiment, we conducted three within-experiment comparisons as follows – (i) Within each task (Baseline and Experimental), inverse scope versus frozen performance; (ii) frozen scope responses in the Baseline task versus the Experimental task, and (iii) inverse scope responses in the Baseline task versus the Experimental task.

In the end, we shall see the following pattern emerging in each experiment. Participants in general gave a low acceptance rate not only for frozen scope items but also for inverse scope items across the four discourse environments, unlike what was found in the earlier studies. The four groups of participants displayed a strong rejection tendency towards items, regardless of the tasks (Baseline or Experimental) and regardless of the structure (mono-clausal or bi-clausal). Important to us, the discourse advantage effect was not manifested as clearly and consistently as in the previous experiments in chapter 3. Nonetheless, we found a meaningful sign that participants made a distinction between the bi-clausal and the mono-clausal scope items.
5.12.1 Experiment 10 (Baseline–Expectation)

The results from Experiment 10 (Baseline-Expectation) are illustrated in figure 10.

Figure 10. Experiment 10: Results from Inverse and Frozen in Baseline-Expectation

In Experiment 10, participants accepted target inverse scope items substantially more often than frozen control items on both tasks. Paired t-tests indicated significant differences between inverse and frozen variables on both tasks, with a small effect size in the Baseline task (1.55 for inverse versus 1.19 for frozen, \( t = 2.12, df = 77, p = .04, d = .240, \eta^2 = .054 \)) and with a medium effect size in the Experimental (Expectation) task (1.86 for inverse versus 1.08 for frozen, \( t = 4.04, df = 77, p < .001, d = .457, \eta^2 = .173 \)).

Also, the type of task (Baseline versus Experimental) made no difference regarding frozen scope, consistent with our prediction. Paired t-tests indicated that participants responded to frozen control items with similarly low rates in the two tasks (\( t = -.68, df = 77, p = .50 \)).

Lastly, and most importantly, contra to our prediction, there was no reliable Baseline-Experimental difference on participants’ responses to the inverse test items (\( M = \))
1.55 in the Baseline task versus $M = 1.86$ in the Experimental (Expectation) task, $t = 1.57$, $df = 77$, $p = .121$).

In sum, in Experiment 10, participants successfully made a distinction between mono-clausal and bi-clausal structures, across the two tasks. Yet we found no evidence for an expectation discourse effect. The expectation discourse failed to facilitate inverse scope accessibility, compared to the baseline discourse.

5.12.2 Results of Experiment 11 (Baseline–Focal)

The results from Experiment 11 (Baseline–Focal) are illustrated in figure 11.

![Figure 11. Experiment 11: Results from Inverse and Frozen in Baseline-Focal](image)

In Experiment 11, the participants also exhibited sensitivity to sentence type by accepting inverse scope items substantially more often than frozen scope items in both tasks. In the Baseline task, the distinction was small but approaching significance (1.75 for inverse versus 1.46 for frozen, $t = 1.94$, $df = 82$, $p = .056$, $d = .213$, $g^2 = 0.043$). In the Experimental task, the distinction was larger and very significant (2.11 for inverse vs. 1.13 for frozen, $t = 6.41$, $df = 82$, $p < .001$, $d = .703$, $g^2 = .331$).
In Experiment 11, unlike in Experiment 10, the type of task (Baseline versus Experimental (focal)) made a difference regarding the frozen and inverse responses. Participants accepted the frozen control items more often in the Baseline than in the Experimental (focal) task (1.46 in baseline versus 1.13 in experimental, \(t = -2.33, df = 82, p = .022, d = -0.256, \eta^2 = .062\)). Importantly in this Experiment 11 (Baseline-Focal), inverse scope items were accepted more often in the Experimental task than in the Baseline task (1.75 in baseline versus 2.11 in focal, \(t = 1.94, df = 82, p = .056, d = .213, \eta^2 = .043\)).

In sum, in Experiment 11 like in Experiment 10, participants successfully made a distinction between mono-clausal and bi-clausal *some-every* structures, across the two tasks. Also we found some sign of the focal discourse advantage effect, although it was small: our focal discourse seems to facilitate inverse scope accessibility, compared to the baseline context.
5.12.3 Experiment 12 (Baseline–Expectation with priming)

The results from Experiment 12 (Baseline–Expectation with priming) are illustrated in figure 12.

![Figure 12. Experiment 12: Results from Inverse and Frozen in Baseline - Expectation with Prime](image)

First, this group in Experiment 12, like the two previous groups, exhibited sensitivity to the difference between legitimate inverse scope and illegitimate frozen scope, in both tasks. Paired t-tests indicated that participants accepted inverse scope items substantially more often than frozen scope items in the Baseline task (1.68 for inverse versus 1.39 for frozen, \( t = 2.19, df = 81, p = .032, d = .241, \eta^2 = 0.055 \)). The distinction was larger in the Experimental task (2.15 for inverse versus 1.49 for frozen, \( t = 4.14, df = 81, p < .001, d = .457, \eta^2 = 0.173 \)).

Second, the type of task (Baseline versus Experimental) did not make a difference regarding frozen scope (1.39 in experimental versus 1.49 in baseline, \( t = 0.6, df = 81, p = .552 \)). Importantly, in this Experiment 12, there was a reliable Baseline-Experimental
difference for inverse scope items (1.68 in Baseline vs. 2.15 in Experimental (Expectation with priming), $t = 2.62, df = 81, p = .01, d = .289, g^2 = 0.077$). In other words, participants accepted inverse scope items substantially more often in the Experimental (Expectation with priming) task than in the Baseline task. Therefore, we seem to have evidence that the Expectation discourse, in the presence of priming (Experiment 12), facilitated inverse scope accessibility, but that it did not do so in the absence of priming (Experiment 10).

5.12.4 Experiment 13 (Baseline–Focal with priming)

The results from Experiment 13 (Baseline–Focal with priming) are illustrated in figure 13.

![Figure 13. Experiment 13: Results from Inverse and Frozen in Baseline–Focal with Prime](image)

This group stood out as less willing to accept inverse scope in general, compared to the other three groups. The last group in Experiment 13 had the lowest rates of inverse acceptance in both tasks (1.52 in Baseline; 1.74 in Experimental). Due to the low inverse rate in the Baseline task, this group, unlike the other three groups, even failed to exhibit
sensitivity to the difference between mono-clausal and bi-clausal sentences in the Baseline task – participants accepted frozen and inverse scope items, at similar rates (approximately one item out of six -1.52 for inverse versus 1.29 for frozen, $t = 1.5$, $df = 83$, $p = .139$). In the Experimental (Focal with priming) task, however, participants successfully made a structural distinction, accepting inverse scope items substantially more often than frozen scope items, with a medium effect size ($1.74$ for inverse versus $1.19$ for frozen, $t = 3.52$, $df = 83$, $p < .001$, $d = .384$, $\eta^2 = .129$).

Second, like other groups, this group did not exhibit a distinction on frozen scope items between the Baseline and the Experimental tasks ($1.29$ in baseline versus $1.19$ in experimental, $t = -0.70$, $df = 83$, $p = .490$). However, contra to our prediction, despite the strongest discourse manipulation provided (Focal with priming), inverse scope response rates were not different in the Baseline and Experimental task (Focal with priming). Participants were simply accepting inverse scope items, only about one and a half items out of six, whether they were exposed to the baseline context or to the focal discourse with priming ($1.52$ in baseline versus $1.74$ in experimental, $t = 1.04$, $df = 83$, $p = .302$).

The findings are puzzling. The focal discourse effect has been found so far consistently throughout the previous experiments in chapters 3 and 4, every time the experiments engaged the focus discourse. This last experiment provides abnormal results.

5.13 Results of Target: Between-experiments comparison

We conducted between-experiments comparisons from the four experiments, in the Baseline and Experimental tasks. The purpose was to compare our four types of discourse manipulations. There was no such between-experiments difference for two major variables
(inverse and frozen); this was expected from the overall low rates of inverse scope across the four manipulations.

We summarize the results of three variables (surface, inverse, and frozen scope items) in the four experiments in table 69 (% = Percent of acceptance out of all items).

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Baseline (k=6)</th>
<th>Experimental (k=6)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Surface</td>
<td>Inverse</td>
</tr>
<tr>
<td>10 (N=78)</td>
<td>92 %</td>
<td>26 %</td>
</tr>
<tr>
<td>11 (N=83)</td>
<td>92 %</td>
<td>29 %</td>
</tr>
<tr>
<td>12 (N=82)</td>
<td>92 %</td>
<td>28 %</td>
</tr>
<tr>
<td>13 (N=84)</td>
<td>88 %</td>
<td>25 %</td>
</tr>
</tbody>
</table>

Table 69. Experiments 10-13: Results: Baseline and Experimental tasks

The results of surface and inverse scope items from two tasks across the four experiments, along with results from frozen scope items, are illustrated in figure 14, for ease of comparison.

Figure 14. Experiments 10-13: Results in the Baseline and Experimental tasks
The Welch 1-Way Anova Test (variances not assumed equal) found no between-experiments difference in any pair of the four experiments, for either inverse or frozen conditions, in either the Baseline or the Experimental tasks. For the frozen condition, participants from the four experiments performed similarly in the Baseline (F(3, 179.068) = .605, p = .612) and also in the Experimental tasks (F(3, 178.315) = .936, p = .425). No between-experiments difference was found for the surface scope condition in the Baseline (F(3, 179.022) = 1.123, p = .341) and in the Experimental tasks (F(3, 178.211) = 1.702, p = .168). Important to us, for the inverse scope condition, too, no between-experiments difference was found in the Baseline (F(3, 179.008) = .313, p = .816) and in the Experimental task (F(3, 178.864) = .753, p = .522).

Summarizing, we discovered that the four groups were indeed very similar to one another. The groups did not differ at all, in terms of their potential to access inverse scope in the Baseline or the Experimental tasks. We had expected that our groups would be similar in their performance in the Baseline task. However, it was unexpected that our four discourse manipulations did not make any difference to inverse scope accessibility.

5.14 Summary of Findings, Discussion, and Interim Conclusion

In what follows, we summarize experimental findings from the last series of four experiments in this chapter.

5.14.1 Similarity of the four groups in the Baseline

Regarding the some-every mono-clausal target sentences, our groups accessed inverse scope 25-29% of the time (an average of 1.52-1.75 points on a 6-point scale) in the
baseline discourse (26%, 29%, 28%, and 25% respectively). The four groups did not perform differently in the baseline inverse condition. It confirms that our four sub-groups were more or less homogeneous, as was predicted. Establishing the similarity of the four groups in the Baseline task enables us to safely compare the discourse contributions in the Experimental task.

5.14.2 No robust discourse effect

Inverse scope responses in the Experimental task were unexpectedly low across the four experiments. Regarding the *some-every* mono-clausal target sentences, four groups accessed inverse scope only 29-35% of the time (an average of 1.74-2.15 points on a 6-point scale) in the Experimental discourse conditions (31 % in (i) Expectation; 35 % in (ii) Focal; 36 % in (iii) Expectation with priming; 29 % in (iv) Focal with priming). There was a small increase of inverse scope responses; the difference was statistically meaningful in Experiment 11 (Focal) and Experiment 12 (Expectation with priming) discourse manipulations only. No such contextual facilitation was found in Experiment 10 (Expectation) and Experiment 13 (Focal with priming).

The results were less than convincing, since the increase in discourse effect did not run in the direction expected. That is, we expected the effect of discourse to increase from Experiment 10 to Experiment 11 (with the addition of priming), to increase from Experiment 10 to Experiment 12 (with the change in discourse type), and to increase from Experiment 12 to Experiment 13 (with the addition of priming). We did not see this pattern.

The set of data here may be a challenge to the implicit belief among linguists that discourse plays any “substantial” role in facilitating the accessibility of inverse scope.
Discourse should no doubt be just one of many factors. Obviously, our discourse explained such a low portion of the variation involved in accessing inverse scope. What other factors, probably more critical than discourse, might be at play is left for a future research.

5.14.3 No robust prime effect

The prime response rates observed were strikingly low, compared to the remarkably high prime response rates found in the previous experiments in chapter 3 - for the inverse-prime some N or other-every sentences in the inverse scope contexts. 77% in experiment 3 (n=25) and 92% in experiment 4 (n=21). It appears that the participants in this sample were very much restricted in their scope judgment even with the some N or other-every prime items.

Every-Not filler data are also slightly suggestive of the sample’s restrictedness, compared to the groups in chapter 3 or 4. Regarding some (not>every) reading, the sample scored an average of 2.28 (38 %) and 3.11 (52 %) (in Experiments 10 and 11 respectively). The acceptance rates of the some reading in the experiments in chapter 4 were more or less similar at 46-56% (3.35 (56 %) in experiment 7; 2.86 (48 %) in experiment 8; and 2.74 (46 %) in experiment 9). By contrast, the groups in the experiments in chapter 3 had scored higher some reading rates (3.36 (56 %) in experiment 1 and 3.44 (57 %) in experiment 2). This suggests that there may be something about the population tested in Experiments 10-13 that makes them somehow averse to inverse scope.
5.14.4 **Strong evidence was found of structural sensitivity for inverse scope with every**

In this last set of experiments, we finally found evidence of participants’ structural sensitivity for inverse scope with *every*. This result was a remarkable one, because in the previous experiments no such distinction was made between bi-clausal structures (frozen scope) and mono-clausal structures (inverse scope).  

The contingency table 70, as will be explained, illustrates the higher likelihood of accepting inverse scope items than frozen scope items in a more obvious manner. We collapsed all participants from the four experiments (a total of 327). We then constructed a 7 x 7 contingency table for (total # of ‘yes’ responses to frozen, a number between 0 and 6) x (total # of ‘yes’ responses to target inverse, also a number between 0 and 6), in each task.

<table>
<thead>
<tr>
<th>Experimental Inverse * Experimental Frozen Cross-tabulation</th>
<th>Count</th>
<th>Total 1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Experimental 0</td>
<td>101</td>
<td>17</td>
</tr>
<tr>
<td>Inverse 1</td>
<td>19</td>
<td>24</td>
</tr>
<tr>
<td>Experiments 2</td>
<td>17</td>
<td>7</td>
</tr>
<tr>
<td>Experiments 3</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>Inverse 4</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Experiments 5</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Experiments 6</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

| Total                                                      | 149 | 74 | 44 | 29 | 12 | 11 | 8  | 327    |

Table 70. Results: Experiments 10-13: Frequency of participants

The highest number of participants (n=101) was in the (0, 0) category: complete rejecters of both item types. The second highest number of participants (n=24) was in the (1, 1)

24 We assumed that the devices QR and QR clausal boundedness and c-command are part of English grammar. One need not claim that the observed inverse-frozen difference reflects evidence for QR. An alternative way of deriving the constructions (other than QR) is always conceivable and may be consistent with the given data set.
Beyond that, the preponderance of numbers tends to skew away from the diagonal and towards accepting of the experimental inverse sentences. That is, if there was a tendency, participants tended to accept inverse scope items more than frozen scope items. Importantly, fewer participants (n=42) accepted more frozen scope items than inverse scope items, and a lot more participants (n=138) accepted more inverse scope items than frozen scope items.

We conducted the same contingency table analysis for a total of 327 participants, regarding performance on inverse and frozen variables in the Baseline task (see table 71), finding essentially the same thing, although to a slightly lesser degree.

<table>
<thead>
<tr>
<th>Baseline Inverse</th>
<th>Baseline Frozen</th>
<th>Count</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Baseline</td>
<td>0</td>
<td>25</td>
<td>17</td>
</tr>
<tr>
<td>Inverse</td>
<td>1</td>
<td>73</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>37</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>10</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>121</td>
<td>80</td>
<td>68</td>
</tr>
</tbody>
</table>

In sum, the contingency table analysis in terms of the frequency of population shows clearly that acceptance of inverse scope sentences was greater than that of frozen scope items in a systematic and consistent fashion.
5.14.5 Frozen item variability: their marginal acceptance is meaningful

Here, we analyzed differential probability of yes responses across the 12 frozen scope items (6 from the Baseline task; 6 from the Experimental task) (the 12 frozen scope sentences and their mean rates are presented in Appendix L). The item analysis in figure 15 shows that some frozen scope items were apparently acceptable.

As seen in figure 15, two baseline frozen items (1st and last) obtained exceptionally high rates, above 35% (*some tourist reported that every tour that I guided was enjoyable* (M = .36); *The father watched some horse that every child wanted to ride* (M = .38)). In other words, these two baseline frozen items happened to sound better. If participants were not randomly responding to frozen scope items, we expect that those who accepted only one or two frozen scope items in the Baseline task likely to accept frozen scope items 1 and/or 6. This was indeed the case. Among the participants who accepted a single frozen
item in the Baseline task (n=80), a majority of them (80%) accepted item 1 or 6 (35 % for item 1 (28/80), 34 % for item 6 (43 %)).

In the Experimental task, two items (item 3 and 4) stood out as relatively good-sounding ones in inverse scope (Some student found that Jackson had read every book assigned (M=.28); The school had some reviewer that found every book acceptable (M=.24)). One may expect that participants likely accepted the two “good-sounding” frozen scope items, if they accepted only one or two. This was very much the case. Among the participants who affirmed a single frozen scope item in the Experimental task, the greatest number of them (24/74, 33 %) affirmed item 3. Among the participants who affirmed exactly two frozen scope items, the largest proportion (9/44, 21 %) accepted items 3 and 4 only.

In conclusion, we discovered that participants’ variable responses to frozen scope items were not random, but more or less consistent and systematic. There was remarkable agreement in the ratings. It turned out that some frozen items were indeed relatively better than others.

5.14.6 Frozen response rates increased as Inverse response rates increased

It is already clear that responses to inverse scope items affect responses to frozen scope items. More generally, it can be said that responses to potentially scope-ambiguous items tended to affect one another. Pearson correlations were calculated between participants’ ratings on each of the four major subcategories involving potentially inverse scope computation. The results can be seen in table 72.
The results indicate that participants’ responses to inverse and frozen scope items were highly correlated within and across the two tasks. All four variables were strongly and positively correlated with one another. For instance, inverse scope responses in the Baseline task were strongly correlated with frozen scope responses in the Baseline ($\rho = 63$, $p < .05$), also with inverse scope responses in the Experimental task ($\rho = 60$, $p < .05$), and also with frozen scope responses in the Experimental task ($\rho = 70$, $p < .05$).

5.14.7 A strong rejection tendency towards inverse and frozen scope items both

We found an overwhelming tendency to reject both inverse and frozen scope items. For a total of all the participants (n=327) in the last set of experiments, we collapsed the number of acceptance responses from the Baseline and Experimental tasks, for each variable, inverse and frozen. There were a total of 12 items for inverse and frozen respectively. We divided the participants into two categories based on their performance on
the two variables – Reject Category (accepted zero to 6 items) and Accept Category (accepted 7 to 12 items), for each variable. The frequency results are presented in table 73.

<table>
<thead>
<tr>
<th>Experiments 10-13 (N=327)</th>
<th>Frozen scope</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Inverse scope</td>
<td>Reject</td>
<td>Accept</td>
</tr>
<tr>
<td></td>
<td>255 (78%)</td>
<td>7 (2%)</td>
</tr>
<tr>
<td></td>
<td>41 (13%)</td>
<td>24 (7%)</td>
</tr>
</tbody>
</table>

Table 73. Results: Experiments 10-13: Response patterns to Inverse and Frozen (frequency of participants)

The sample had three sub-groups. First, a majority of participants (255 out of 327, 78%) belonged to rejecters of inverse scope regardless of the structure. They seemed to be restricted in their operation of QR, or even seemed to lack QR, unwilling to accept inverse scope within or beyond the clausal boundary (called under-use of QR). Second, a minority of people (41 out of 327, 13%) belonged to the normative linguist-like pattern, accepting inverse scope in the mono-clausal structure only while rejecting it in the bi-clausal structure (called linguist-like use of QR). Third, it turned out that fewer people (24 out of 327, 7%) were lenient acceptors of inverse scope, either mono-clausal or bi-clausal (called over-use of QR).

5.14.8 Individual analysis regarding Inverse scope

So far we have seen results from the four experiments that are less than satisfying. Here we consider the possibility that these weak results are due to differences amongst individuals in our population. That is, it may be that there are some individuals who very easily accept inverse scope, but others who are resistant to it (but still accept it sometimes), and yet others who strongly reject inverse scope. Importantly for us, if this turns out to be
the case, then it may also be that for one (or more) of these groups, our discourse manipulation does indeed have an effect. If this is the case, then the weak results observed above may be attributed to certain individuals weakening our results, and not to the inefficacy of discourse manipulation per se.

We collapsed all the data from 327 participants from the four experiments. With the data, the 7 by 7 contingency table (table 74) was constructed for (total # of 'yes' responses to inverse scope items in the Baseline task, a number between 0 and 6) x (total # of 'yes' responses to inverse scope items in the Experimental task, also a number between 0 and 6).

<table>
<thead>
<tr>
<th>Baseline Inverse * Experimental Inverse Cross-tabulation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Baseline Inverse 0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>24</td>
</tr>
<tr>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>125</td>
</tr>
</tbody>
</table>

Table 74. Results: Experiments 10-13: Frequency of participants

Below we summarize four observations based on the contingency table 74.

- About 24 percent of the participants were not influenced by discourse at all, entirely rejecting all the inverse scope items in both the Baseline and Experimental tasks (79/327).
- About 40 percent of the participants were indeed influenced by discourse, accepting
inverse scope more often in the Experimental than in the Baseline (130/327) task.

- About 11 percent of the participants remained the same, accepting exactly the same number of inverse scope items in the Baseline and Experimental (36/321) tasks.
- About 25 percent of the participants shifted backward, somewhat unexpectedly – accepting inverse scope less often in the Experimental than in the Baseline (82/327) task.

Thus there were indeed discourse-influenced people, as much as 40 percent of the population.

5.15 Individual Analysis: Low, Medium, and High Inverse Scope Participants

5.15.1 Purpose

Here we show once again that discourse effects clearly exist for a small portion of the sample population, although the majority of the sample remained uninfluenced by discourse. Furthermore, the data inform the question - if some adults were influenced by discourse, then who were they? Who might most likely get influenced by changes in discourse and items? Simply, we were interested in finding which category of participants would be most amenable to shifting from the Baseline to the Experimental task.

5.15.2 Grouping criterion

We divided each sample into three sub-categories – low, medium, and high inverse people. In grouping people, we decided to apply a criterion with the cut-off points
arbitrarily set as two and four. That is, we take 0 or 1 yes responses to inverse scope items as an indication of ‘low inverse’, and 2 or 3 yes responses as an indication of ‘medium inverse’, and 4 through 6 yes responses to inverse scope items as a sufficient indication of ‘high inverse’. The grouping method is summarized as follows.

(i) **Low-Inverse scope people:**
those who accept the inverse scope reading of the test items less than 30% of the time (0 or 1 out of 6 items)

(ii) **Medium-Inverse scope people:**
those who accept the inverse scope reading of the test items between 30% and 60% of the time (2 or 3 out of 6 items)

(iii) **High-Inverse scope people:**
those who accept the inverse scope reading of the test items more than, 60% of the time (4 through 6 out of 6 items)

Next, we were interested in establishing how each group changed from the Baseline to the Experimental tasks. We applied this three-way categorization, to inverse performance in the Baseline and then in the Experimental tasks. Lastly, we simply counted how many participants shifted up or down or stayed the same, from the Baseline to the Experimental task. The same procedure was applied across the four experimental samples. The shift method is summarized as follows:

(a) **Shift Up** (e.g., low/medium to high, medium to high)
: Accepting inverse scope more often in the Experimental than in the Baseline task

(b) **Shift Down** (e.g., medium/high to low, high to medium/low)
: Accepting inverse scope less often in the Experimental than in the Baseline task

(c) **Stay the same**
Before presenting the group/shift analysis within each sample, we present the overall breakdown of groups by experiment, in Table 75.

<table>
<thead>
<tr>
<th>Baseline inverse</th>
<th>Experiment 10</th>
<th>Experiment 11</th>
<th>Experiment 12</th>
<th>Experiment 13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (0 or 1)</td>
<td>47 (60 %)</td>
<td>43 (52 %)</td>
<td>44 (54 %)</td>
<td>47 (56 %)</td>
</tr>
<tr>
<td>Medium (2 or 3)</td>
<td>17 (22 %)</td>
<td>28 (34 %)</td>
<td>23 (28 %)</td>
<td>27 (32 %)</td>
</tr>
<tr>
<td>High (4, 5, or 6)</td>
<td>14 (18 %)</td>
<td>12 (14 %)</td>
<td>15 (18 %)</td>
<td>10 (12 %)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>78</strong></td>
<td><strong>83</strong></td>
<td><strong>82</strong></td>
<td><strong>84</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Experimental inverse</th>
<th>Expectation</th>
<th>Focal</th>
<th>Expectation with Priming</th>
<th>Focal with Priming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (0 or 1)</td>
<td>46 (59 %)</td>
<td>41 (49 %)</td>
<td>38 (46 %)</td>
<td>48 (57 %)</td>
</tr>
<tr>
<td>Medium (2 or 3)</td>
<td>9 (12 %)</td>
<td>19 (23 %)</td>
<td>22 (27 %)</td>
<td>19 (23 %)</td>
</tr>
<tr>
<td>High (4, 5, or 6)</td>
<td>23 (29 %)</td>
<td>23 (28 %)</td>
<td>22 (22 %)</td>
<td>17 (20 %)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>78</strong></td>
<td><strong>83</strong></td>
<td><strong>82</strong></td>
<td><strong>84</strong></td>
</tr>
</tbody>
</table>

Table 75. Results: Experiments 10-13: Low, Medium and High groups in each experiment.

We had found that the four population samples looked similar in terms of their mean inverse scores in the Baseline task. But the samples actually looked different, even slightly, under this group analysis. The ratios of low, medium versus high in the Baseline task were variable across the four samples. The overall ratios in the Baseline task were roughly 5:3:2. But the Expectation sample stood out; compared to other sample groups, the Expectation sample had the largest portion of low-inverse and high-inverse, and the smallest portion of medium-inverse.

5.15.3 Experiment 10: Expectation sample

Table 76 shows the number of participants who were in each group (low, medium, high inverse scope) in the Baseline task, crossed with those in each group (low, medium, high inverse scope) in the Experimental task.
Based on this table, we calculated how many participants shifted up or down or stayed the same from the Baseline to the Experimental task. The shift results from the Expectation sample are presented in table 77.

<table>
<thead>
<tr>
<th>Experiment 10</th>
<th>Experimental Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>low</td>
</tr>
<tr>
<td>Baseline Group</td>
<td>low</td>
</tr>
<tr>
<td></td>
<td>medium</td>
</tr>
<tr>
<td></td>
<td>high</td>
</tr>
</tbody>
</table>

|               | low     | 46     | 9    | 23   | 78    |

Table 76. Experiment 10: Grouping of participants into Low, Medium and High inverse people

Table 77. Results: Experiment 10: Shift Pattern

<table>
<thead>
<tr>
<th>Experiment 10</th>
<th>1.Baseline Low (n=47)</th>
<th>2.Baseline Medium (n=17)</th>
<th>3. Baseline High (n=14)</th>
<th>Total (n=78)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shift UP</td>
<td>8 (17%)</td>
<td>8(47%)</td>
<td>n/a</td>
<td>16 (21%)</td>
</tr>
<tr>
<td>Shift DOWN</td>
<td>n/a</td>
<td>5 (29%)</td>
<td>3 (21%)</td>
<td>8 (10%)</td>
</tr>
<tr>
<td>Stay</td>
<td>39 (83%)</td>
<td>4 (24%)</td>
<td>11 (79%)</td>
<td>54 (69%)</td>
</tr>
</tbody>
</table>

In the Experiment 10, 16 participants (21%) shifted up (accepting inverse scope more often in the Experimental than in the Baseline task), 8 participants (10%) shifted down (accepting inverse scope rather less often in the Experimental than in the Baseline task). The remaining 54 participants (69%) remained the same, uninfluenced by the expectation discourse.

In what follows, we analyze the remaining three experiments, following exactly the same procedure.
5.15.4 Experiment 11: Focal sample

The second Focal experiment population was grouped and analyzed with the same procedure as above, as table 78 shows.

<table>
<thead>
<tr>
<th>Experiment 11</th>
<th>Experimental Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Baseline Group</td>
<td>1 31</td>
</tr>
<tr>
<td></td>
<td>2 8</td>
</tr>
<tr>
<td></td>
<td>3 2</td>
</tr>
<tr>
<td>Total</td>
<td>41</td>
</tr>
</tbody>
</table>

Table 78. Experiment 11: Grouping of participants into Low, Medium and High inverse people

Based on the table above, we calculated how many participants shifted up or down or stayed the same from the Baseline to the Experimental task. The shift results from the Focal sample are presented in table 79.

<table>
<thead>
<tr>
<th>Experiment 11 (Focal)</th>
<th>1.Baseline Low (n=43)</th>
<th>2.Baseline Medium (n=28)</th>
<th>3. Baseline High (n=12)</th>
<th>Total (n=83)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shift UP</td>
<td>12 (28%)</td>
<td>9 (32%)</td>
<td>n/a</td>
<td>21 (25%)</td>
</tr>
<tr>
<td>Shift DOWN</td>
<td>n/a</td>
<td>8 (29%)</td>
<td>2 (17%)</td>
<td>10 (12%)</td>
</tr>
<tr>
<td>Stay</td>
<td>31 (72%)</td>
<td>11 (39%)</td>
<td>10 (83%)</td>
<td>52 (63%)</td>
</tr>
</tbody>
</table>

Table 79. Results: Experiment 11: Shift Pattern

In the second Focal sample, 21 participants (25%) shifted up, 10 participants (12%) shifted down, and the remaining 52 participants (63%) stayed the same.
5.15.5 Experiment 12: Expectation with priming sample

The third population who received the Expectation discourse plus priming was analyzed with the same procedure as above, in table 80.

<table>
<thead>
<tr>
<th>Experiment 12 (Expectation with priming)</th>
<th>Experimental Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Baseline Group</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>38</td>
</tr>
</tbody>
</table>

Table 80. Experiment 12: Grouping of participants into Low, Medium and High inverse people

Based on the table above, we calculated how many participants shifted up or down or stayed the same from the Baseline to the Experimental task. The shift results from the Expectation plus priming are presented in table 81.

<table>
<thead>
<tr>
<th>Experiment 12 (Expectation with priming)</th>
<th>1. Baseline Low (n=44)</th>
<th>2. Baseline Medium (n=23)</th>
<th>3. Baseline High (n=15)</th>
<th>Total (n=82)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shift UP</td>
<td>12 (27%)</td>
<td>9 (39%)</td>
<td>0</td>
<td>21 (26%)</td>
</tr>
<tr>
<td>Shift DOWN</td>
<td>0</td>
<td>6 (26%)</td>
<td>4 (27%)</td>
<td>10 (12%)</td>
</tr>
<tr>
<td>Stay</td>
<td>32 (73%)</td>
<td>8 (35%)</td>
<td>11 (73%)</td>
<td>51 (62%)</td>
</tr>
</tbody>
</table>

Table 81. Results: Experiment 12: Shift Pattern

In the third Expectation discourse with priming population sample, 21 participants (26%) shifted up, 10 participants (12%) shifted down, and the remaining 51 participants (62%) stayed the same.
5.15.6 Experiment 13: Focal with priming sample

The fourth Focal discourse plus priming sample was analyzed with the same procedure as above, in table 82.

<table>
<thead>
<tr>
<th>Experiment 13</th>
<th>Experimental Group</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Base Group</td>
<td>1</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>48</td>
<td>19</td>
</tr>
</tbody>
</table>

Table 82. Experiment 13: Grouping of participants into Low, Medium and High inverse people

Based on this table, we calculated how many participants shifted up or down or stayed the same from the Baseline to the Experimental task. The shift results from the Focal discourse plus priming sample are presented in table 83.

<table>
<thead>
<tr>
<th>Experiment 13 (Focal with priming)</th>
<th>1. Baseline Low (n=47)</th>
<th>2. Baseline Medium (n=27)</th>
<th>3. Baseline High (n=10)</th>
<th>Total (n=84)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shift UP</td>
<td>13 (28%)</td>
<td>6 (22%)</td>
<td>0</td>
<td>19 (23%)</td>
</tr>
<tr>
<td>Shift DOWN</td>
<td>0</td>
<td>11 (41%)</td>
<td>4 (40%)</td>
<td>15 (18%)</td>
</tr>
<tr>
<td>Stay</td>
<td>34 (72%)</td>
<td>10 (37%)</td>
<td>6 (60%)</td>
<td>50 (60%)</td>
</tr>
</tbody>
</table>

Table 83. Results: Experiment 13: Shift Pattern

In the fourth Focal discourse plus priming sample, 19 participants (23%) shifted up, 15 participants (18%) shifted down, and 50 participants (60%) stayed the same.
5.15.7 Central observations

Here are four central observations from these groups and the shift data.

(1) Across all four experiments, the aggregated number of participants who shifted up was 77 and the aggregated number of participants who shifted down was 43. Furthermore, within every experiment, the total number of participants who shifted up was greater than the total number of participants who shifted down (Experiment 10: 16 versus 8; Experiment 11: 21 versus 10; Experiment 12: 21 versus 10; Experiment 13: 19 versus 15).

(2) The low inverse group of participants was generally non-shifters, hardly influenced by discourse manipulations. In every experiment, only one third of the low inverse participants shifted up, influenced by discourse manipulations (17%, 28%, 27%, 28% respectively). In every experiment, the majority of the low participants stayed low (83%, 72%, 73%, 72%, respectively). In every experiment, about half of the low inverse scope people belonged to complete rejectors of inverse scope, the category who accepted no inverse scope items in either the Baseline or the Experimental task.

(3) The high inverse scope participants were also non-shifters. The majority of the high inverse scope participants remained high (79%, 83%, 73%, respectively), in every experiment except the last one, where half (40%) of the high inverse scope participants unexpectedly shifted down.
(4) The medium inverse scope participants were the most likely to shift, unsurprisingly. The medium inverse group more or less tended to shift up more than they shifted down, although the pattern was not consistent in every experiment. First, among the medium inverse scope people in Experiment 10, there was more that shifted up than down (the ratio of shift up versus down was 47% versus 29%). Among the medium inverse scope people in Experiment 11, however, shift-up people were slightly lesser than shift-down people (the ratio of shift up versus down was 32% versus 39%). Among the medium inverse scope people in Experiment 12, there were much more that shifted up than shifted down (the ratio of shift up versus shift down was 39% versus 35%). Lastly, the last sample was an exception; it had more medium inverse scope people who shifted down than shifted up (the ratio of shift up versus shift down was 22% versus 37%).

So here is what we can conclude from this. This shows that each of the discourse manipulations does seem to have an effect, but the segment of the population that is affected by this manipulation is the people who are neutral in terms of their inverse scope preferences. If you are amenable to inverse scope, you will not become more open to inverse scope because of discourse, and if you are averse to inverse scope, you will not become less open to inverse scope because of discourse. Generally, if you are in one of these groups, you will remain in one of these groups. But if you are in the middle - open to inverse scope, but not overly so - then you are likely to be swayed by discourse manipulations.

The take-home message for all of this would be that as experimenters, we need to analyze our populations and investigate whether they are (at the outset) inherently low,
medium or high inverse scope people before we introduce some kind of manipulation (no matter what it is - discourse or otherwise). This is because if your population consists of entirely low-inverse or high-inverse scope people, the manipulation will simply not work. A population with a sufficient number of the medium inverse scope people would have more probability of shifting up, and therefore an experimental effect will emerge. We failed to find a robust expectation discourse effect with the first experimental population (experiment 10). One source seems to be in the small number of the medium inverse scope people (17, as opposed to 28, 23, and 27, in other experiments). The last experiment 13 did not find a robust focal discourse effect, either. This last group had a sufficient number of the medium people, but many of them behaved in an unpredicted manner, shifting downwards from the Baseline to the Experimental task.

5.16 Conclusion: on the role of discourse

This section revisits the central issue in our research, whether inverse scope accessibility can be shown to be sensitive to discourse factors. The last set of experiments found a robust bias for the surface scope interpretation despite the discourse support. In terms of group mean scores, the baseline-experimental differences were not much larger numerically. The data from group means show that inverse scope for some-every sentences, given enriched discourse contexts, is accessed only sparingly, roughly 25-29% of the time. The discourse influence seemed undeniably real, but its actual effect surfaced extremely minimally (that is, far less powerful than have been observed).

Interestingly, a close look at the individual behavior provided two key findings. There were some people who accessed inverse scope without the influence of discourse.
Also there were some people (a large proportion of the sample) who failed to access inverse scope even with the influence of discourse. Importantly, there were indeed people, although a small proportion, whose inverse scope was substantially facilitated due to our discourse manipulations. That is, the discourse effect was in fact demonstrated only for a small proportion of English speakers. When we examined the kind of people who were subject to change due to discourse (discourse-influenced people), we found that many of them belonged to people in the Baseline task who were fluctuating in their preferences, people who were more or less open to inverse scope from the beginning. This shows that one is to be more or less open to inverse scope, to be able to get influenced by discourse to access inverse scope more often.

Finally, let us discuss the role of discourse in inverse scope accessibility, the central question in our investigation. Our discourse did not affect the majority of people for the inverse scope acceptability judgments. It is striking that that much sufficient amount of discourse information was not being influential at all for the majority of the sample in our experiments. One thus cannot avoid being skeptical of contextual variables to what extent they are plausibly determinative of scope interpretations. Many linguists posit that discourse information is in principle crucial to the comprehension system engaging ambiguous sentences. We thus have implicitly assumed that ordinary speakers invoke performance systems that do take advantage of contextual information in deciding whether some-every sentences are interpreted as surface scope or as inverse scope. The data here may challenge these strong assumptions on the role of discourse in inverse scope accessibility.
We found it was unrealistically naïve to expect that most native English speakers would be able to benefit from sufficient contextual support in their scope interpretations. A reasonable way to evaluate the role of discourse, therefore, is that the richness of linguistic context is just one of various predictors of adults’ success with resolving *some-every* quantified sentences in the inverse-scope manner. The point gets clear from the evidence that I have assembled so far; neither the enriched discourse nor the presence of prime can provide the complete explanation of the phenomenon and its variability. The phenomenon is indeed subject to many other factors, too, for which more research is needed. Obviously, linguistic factors (grammar, lexical, discourse, etc.), although primary, cannot explain all the variation: other cognitive or even societal or task factors are perhaps crucially relevant.

Given our data, it is possible that some cognitive variable (mental flexibility) looks like a very critical factor to inverse scope recognition, perhaps far more so than discourse is. It appears as if some people are cognitively more inclined towards the potential alternative interpretation of ambiguous sentences. The difference between “surface responders” and “inverse responders” somehow relates to these differences in the participants’ mental flexibility. The reason for this is that we have observed throughout the data that participants’ responses to potentially ambiguous items actually moved quite closely together (as shown by the results from the correlation analysis and also the contingency table analysis). Once participants accepted inverse scope for mono-clausal items, they were also likely to accept inverse scope for bi-clausal frozen scope items. Inverse scope responses were strongly related among test items and other scope-involving control conditions. In some way, an inclination like “how well they can switch” (e.g., mental
flexibility) could be one relevant cognitive factor involved in the mechanism of dealing
with ambiguity in general, scope ambiguity included.
CHAPTER 6. CONCLUSION

6.1 Conclusion

Inverse scope (in some-every expressions) engages a formal (syntactic) process which reverses the scope relations. The actual interpretation, however, involves multiple levels of information beyond syntax, demanding the integration of syntax with other aspects of language (e.g. pragmatic, discourse, prosodic, etc.). Linguists have indeed assumed that extra-grammatical domains are of some significance for the theory of scope. However, the ‘external’ factors of inverse scope have received little empirical investigation. No systematic account is available particularly on the role of discourse factors in scope interpretations.

The present study was a systematic investigation of discourse factors in the accessibility of inverse scope in some-every sentences. Logically, in a sentence some boy climbed every mountain, its inverse scope reading, represented as $\forall y [\exists x [Cx, y]]$, means that ‘for every individual y, there exists some individual x such that x climbed y’ (i.e. every mountain has at least one boy who climbed it).

We knew going into this dissertation that the surface scope reading is the dominant reading, and that the inverse scope reading is strongly dis-preferred. Our thesis was what linguists have assumed: contextual variables would facilitate people’s logical (syntactic) computation of inverse scope, and therefore make inverse scope easier and more likely. We empirically tested this general thesis.

In addition to discourse, we also hypothesized that the nature of the experiment would affect responses to inverse scope sentences. Specifically, we hypothesized that the
nature of the non-test items might facilitate access to inverse scope. We refer to this as priming, although as noted earlier, the specific version of priming that we are using involves task-level priming, and not sentence-level priming per se. That is, for us, the notion of priming is not that one sentence (a prime) precedes the test sentence (target), and a specific outcome is predicted. Rather, our notion of priming is a measure of how many other sentences within the overall task involve inverse scope. The idea is that if many other, unambiguously inverse scope items occur in the task, the likelihood of inverse scope in the test sentence increases.

We developed a specific hypothesis that contextual information related to speaker’s emphasis (via the manipulation of speaker’s expectation or contrastive focus) and the level of priming in each task would be relevant to inverse scope interpretation. The two discourse manipulations were experimentally manipulated to guide readers to focalize their attention upon “every element of y”, by mentioning expectation or by contrasting the set of every with another set of every. These two discourse manipulations were crossed with a prime and non-prime condition, in which unambiguously inverse scope sentences were manipulated within the rest of each item list.

We conducted a total of 13 experiments, the results of which are summarized in table 84.
### Table 84. Results: Experiments 1-13: Test items in the Baseline and the Experimental tasks

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Baseline M (SD, %)</th>
<th>Experimental M (SD, %)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Surface (k=6)</td>
<td>Inverse (k=6)</td>
</tr>
<tr>
<td>1 (N=36)</td>
<td></td>
<td>4.69 (1.06, 78)</td>
</tr>
<tr>
<td>2 (N=27)</td>
<td></td>
<td>5.44 (0.80, 91)</td>
</tr>
<tr>
<td>3 (N=25)</td>
<td></td>
<td>4.96 (1.21, 83)</td>
</tr>
<tr>
<td>4 (N=21)</td>
<td></td>
<td>5.52 (0.68, 92)</td>
</tr>
<tr>
<td>7 (N=31)</td>
<td>5.48 (0.77, 91)</td>
<td>1.13 (1.63, 19)</td>
</tr>
<tr>
<td>8 (N=29)</td>
<td>5.34 (0.86, 89)</td>
<td>1.21 (1.54, 20)</td>
</tr>
<tr>
<td>9 (N=31)</td>
<td>5.58 (0.67, 93)</td>
<td>1.77 (2.11, 30)</td>
</tr>
<tr>
<td>10 (N=78)</td>
<td>5.53 (0.85, 92)</td>
<td>1.55 (1.78, 26)</td>
</tr>
<tr>
<td>11 (N=83)</td>
<td>5.53 (0.87, 92)</td>
<td>1.75 (1.67, 29)</td>
</tr>
<tr>
<td>12 (N=82)</td>
<td>5.54 (0.82, 92)</td>
<td>1.68 (1.72, 28)</td>
</tr>
<tr>
<td>13 (N=84)</td>
<td>5.30 (1.05, 88)</td>
<td>1.52 (1.75, 25)</td>
</tr>
</tbody>
</table>

A brief description of each experiment is summarized below.

**Chapter 3:**
- Experiment 1: Expectation / Yes, possible
- Experiment 2: Focal / the same
- Experiment 3: Expectation with priming / the same
- Experiment 4: Focal with priming / the same

**Chapter 4:**
- Experiment 7: Baseline - Focal / Yes, Okay
- Experiment 8: Baseline - Focal / Yes, people might say this
- Experiment 9: Focal - Baseline / Yes, people might say this

**Chapter 5:**
- Experiment 10: Baseline - Expectation / Yes, people might say this
- Experiment 11: Baseline - Focal / the same
- Experiment 12: Baseline - Expectation with priming / the same
- Experiment 13: Baseline - Focal with priming / the same

One overall finding is that acceptability varied dramatically with the population and the task. Despite this variability, the focus discourse condition consistently showed increased inverse scope responses (sometimes small, sometimes large), in all cases in
which this was tested, with the exception of experiment 13. It can be safely said that our focal discourse condition facilitated inverse scope accessibility to some extent. The finding provides evidence for the relevance of linguistic “focus (prominence)” on the universal quantifier’s wide scope possibility. No such evidence was found for the expectation-type discourse. We do not have an explanation of why.

The results of this investigation yielded empirical and rigorous evidence that context is indeed of some relevance to inverse scope performance in some-every sentences. Therefore, the general thesis was confirmed: accessing inverse scope in some-every sentences is subject to restrictions of discourse.

However, the contribution by our focal context was shown to be limited. This discourse effect cannot be generalized to the entire population. In the last set of experiments with the most rigorous method, the focal contextual variable impacted very few participants. Only about one third of the sample (n=327) (or even less than that) were affected such that they increased the rate of inverse scope in the Experimental task (discourse manipulation), compared to the Baseline task (no discourse manipulation). More than half of the sample (about 60%) remained strictly resistant to inverse scope readings. Therefore, we cannot say that discourse is a decisive variable; it certainly does not seem to be the case that discourse-embedded quantified sentences resolve all difficulty associated with computing inverse scope.

Also, the manner in which the discourse effect was manifested was not as simple as we had expected. There appeared to be several confounding issues that were not suspected at the outset, complicating the data interpretation. One confound to our discourse effect was that the clause-bound property of quantifier scope was frequently violated. That is,
inverse scope is supposed to be impossible across a clause boundary, but many of our participants violated this principle. It appears that the contextual manipulations were so over-arching that those individuals who were amenable to inverse scope got inverse scope even out of bi-clausal sentences, in violation of this syntactic constraint.

A second confound to this discourse effect was the nature of the population. Discourse effects seem to be relative to or even dependent on the character of a selected sample population. It appears that discourse of whatever kind would not facilitate access to inverse scope at all for at least some people (those who reject inverse scope under all circumstances), for reasons that we do not know yet. The effect of discourse might emerge more clearly once a better understanding of these sub-group characteristics is reached.

6.2 Future research

The results present an opportunity for further research. We are drawn to this question, more than anything else. Why is it the case that about two thirds of people (about 60 percent in the last set of experiments) reject inverse scope reading consistently? We are forced to re-visit the sources of the surface-scope bias. It is at least suggested in our data that the problem of the strong surface-bias is not in discourse. In other words, the surface scope bias is not the kind of bias that disappears simply because enriched context is provided. If it is not discourse, what other factors account for the majority of non-inverse people?
Among factors impeding inverse scope behavior are: lexical uncertainty associated with indefinite some \( N \), or a different degree of mental flexibility or working-memory limitations. Below is a brief discussion of the two factors.

First, the lexical uncertainty of “some” could be one factor.\(^2^6\) We showed that people’s understanding of some \( N \) as an existential quantifier is generally okay throughout the experiments. We still cannot entirely exclude the possibility that vulnerability in inverse scope performance could be due to the misinterpretation of lexical quantifiers, especially indefinites. The surface-biased adults may experience “difficulty” or “lesser proficiency” with the quantifying function of the term some \( N \), which may bias them towards mistakenly identifying some \( N \) with a referential expression, or even associating some \( N \) with pragmatic implicature (some but not all). One may seek to re-examine contextual influence upon inverse scope accessibility with other combination of quantifiers. The use of logically clarified quantifiers \((\text{at least one}, \text{instead of some})\) may remove the lexical uncertainty associated with some \( N \) and increase the probability that readers interpret the at least one-every sentences as inverse scope.

In fact, in the last set of experiments (a post-experiment survey), we directly tested whether our native English adults’ interpretation of some conforms to classical logic, interpreting ‘some’ as ‘at least one and possibly all’ (the detailed method and results are presented in Appendix N). We found that the majority of the participants (in the last set of experiments) endorsed the logical meaning of some \( N \) as at least one \( N \), and only a few interpreted some referentially, and fewer interpreted some pragmatically. First of all,

\(^{26}\) It is agreed that “some” is indeed a difficult quantifier. The studies of deductive inferences suggest that existential pose further difficulty than universals upon syllogistic reasoning; syllogisms with I (Some A are B) and O (Some A are not B) premises are more difficult to solve than those with A (All A are B) and E (No A are B) premises.
important for us, the data suggest that the pragmatic implicature associated with *some* is not directly responsible for inverse scope difficulty in *some-every* sentences. The curious fact, however, is that most people were lexically okay (logical) but strongly resisted interpreting *some* as taking a narrow scope under *every*. I strongly suspect that the degree of proficiency with lexical quantifiers (particularly, indefinites) still matters. Indeed, it is hinted in the data that poor proficiency with dealing with logical concepts of lexical quantifiers may have to do with poor inverse-scope performance.

Another possible factor for surface-scope bias is mental flexibility. The problem of surface-scope biased people might be partly due to a “non-linguistic” reason known as ‘a re-analysis difficulty in language parsing’. The gist is that people, in comprehending an ambiguous assertion, first establish one reading and then have to undo it, creating the other reading, but they often fail to do so. That said, the difficulty of inverse scope may have to do with the cognitive (not linguistic) difficulty of rejecting the first analysis and looking for an alternative one. In our case, surface scope people may have got stuck in the first established surface scope reading, without recognizing an alternative inverse scope reading in *some-every* sentences. It is hard to think that the “majority” of the surface-biased people in the last set of experiments were having a parsing (reanalysis) difficulty. Adults, unlike children, are generally agreed to have full-blown computational resources. However, there may be some adults, like children, who are limited in their parsing flexibility (working memory capacity), having trouble switching from one reading to another.²⁷ If the majority of the surface-biased people in the last set of experiments were indeed having a parsing difficulty

²⁷ See Rakhlin (2007: 72): “adults switch from one reading to another more easily compared with children, who may have difficulty revising their initial parse because they lack computational resources to evaluate multiple options. As a result, children select the first grammatical interpretation that they access and stay with it (cf. Lid, 2007).”
(reanalysis) difficulty, it is at least certain given our data that discourse does not help them to get this parsing difficulty over. The precise nature of parsing or computational difficulty remains to be clarified, therefore requiring empirical investigation.

6.3 Method implication

I believe that the most critical contribution in this area of research is in expanding descriptive facts, precisely describing what actually happens, what subjects actually do, and asking what the interpretational strategies are that underlie inconsistent judgments. In the present study, I have managed to describe the facts as meticulously as possible. Future study can expand data further, replicating experiments that have been fully described, and applying the method to other quantifiers and other languages.

The present inquiry was a preliminary assessment of contextual variables that seem to have a bearing on inverse scope. There is a further empirical demand to re-examine contextual sensitivity of this formal operation, inverse scope, discovering a better method. We had hoped to find out the best experimental condition(s) that can manifest knowledge of scope ambiguity for naïve people. If both scope readings are legitimate results of a grammatical operation in English, we expect them to be evident under some experimental conditions. The knowledge of inverse scope among native speakers of English remains to be experimentally demonstrated and thus established.

The present method used at least showed its effectiveness in that the enhanced level of accessing inverse scope, as distinct from the baseline level, can be calculated. The need for a ‘baseline measure’ in studying people’s scope interpretations has become fairly
obvious, as without one there is no basis against which any linguistic (discourse) effect can be properly measured.

However, we admit that our task has limitations in some fashion or other. One limitation is that many scope-involving items, similar in lexical and structural aspects, were mixed in one task setting, although it was inevitable for the purpose of an efficient design and analysis. For another limitation, the present task may have involved meta-linguistic processing. One piece of evidence is that judgments on scope possibility were sensitive to the kind of instruction put to the participants (possible/impossible versus okay or yes, people might say this). The overwhelming surface scope bias could partly be attributable to strategic response such that participants might have spontaneously adopted an inverse scope interpretation, but simply be more cautious. It is an empirical question whether any difference in task design or instructions would affect response pattern. The component of the meta-linguistic processing in scope judgments is worth an empirical examination.

One may claim that the present data from a group of native speakers may not represent a real one but represents a mere experimental artifact enforced by a specific task (simply a task effect). One may criticize that the limited power of discourse has to do with the deficiency of the discourse under investigation. It is valuable to inquire whether or not there is any better discourse or method by which we can assure ourselves that inverse scope knowledge is manifested given a good discourse or method or task. What is also valuable is to make a systematic examination into the irregularity and variation as observed by the present task and design, and endeavor to “understand” (not ignore) the results that have been obtained. Efforts in either direction will enhance our understanding of this formal phenomenon and its interface with non-formal information.
6.4 Teaching Implication

The results of the investigation can present a practical implication to the teaching of quantifiers and their scope in the area of formal logic. It is often recognized among teachers that quantified sentences and representing them in a proper format pose difficulty for students. The nature of students’ difficulty needs to be understood. Teaching implications can come from understanding the sources of why logically-untrained ordinary people have a trouble with dealing with quantifiers and their scope. This was part of our endeavor in the present study. So the results should have direct relevance to the effective teaching of the phenomenon. Regarding the difficulty associated with quantifiers and their scope, there could be many known or unknown sources, as we have discussed. Our finding particularly informs teachers that contextual variable is one factor for inverse scope difficulty. Therefore, the major implication for teachers will be that contextual information can be used to facilitate accessing inverse scope at least for some portion of ordinary people.

Contextual facilitation of logical reasoning has been demonstrated in other areas of logical reasoning, as well. Deductive reasoning studies have dealt with the same issue as ours, how pragmatics influences or interacts with conditional or syllogistic reasoning. Their observation, like ours, has been that participants’ actual judgments on conditional or syllogistic reasoning often deviate from standard logic. Empirical findings from these reasoning studies show that context “facilitates” reasoning with disjunctive operators (Newstead, Griggs and Chrostowski 1984). Similarly, if-conditional judgments tended to be facilitated by contextual examples (see references in Evans 1989, Chapter 4, p. 89).\(^{28}\)

\(^{28}\) Studies found that If-conditional reasoning was facilitated in Watson Selection Task
Given what we presented so far, it may appear as if context influences logical reasoning in the positive (facilitative) direction. Caution is needed, as it could be the opposite case. Contexts could bias formal reasoning, particularly in the area of syllogistic reasoning: realistic contexts, personal knowledge or belief were found to “inhibit” syllogistic reasoning (known as belief bias) (see references in Revlis 1975). In this latter case, ordinary people are encouraged not to use contextual information and “de-bias” any contextual influence, in order to acquire what is supposed to be acquired. In one way or another, these results, along with ours, critically inform teachers that context indeed matters in formal reasoning.

Lastly but most importantly, quantifier scope ambiguity and its actual perception primarily engage a logical understanding of individual quantifiers. It is well-appreciated that quantifiers in natural languages (‘all’, ‘some’, ‘each’, ‘every’ and ‘any’) do not always behave like quantifiers in the formal language (ENGLISH) (Stedmon 1986; 118-9). It probably is the case that lexical knowledge is determinative of success with quantifiers and their scope shifting, much more than contextual variable is. In dealing with scope ambiguity phenomenon, teachers and students both need to attend to individual quantifiers and their semantics in classical logic tradition, how the tradition is different from or similar to the actual way natural language quantifiers work in their mind.

Unfortunately, little “empirical” research has been done on the comprehension of quantifier phrases. Only a couple of studies attempted to examine how quantificational expressions engage differential processing from that of non-quantificational expressions in natural language comprehension (Warren and Gibson 2002; Warren 2003; Wijnen and Kaan 2006; Frazier, Clifton, Rayner, Deevy, Koh and Bader 2005).
APPENDIX A.
12 TARGET SOME-EVERY SENTENCES: EXPECTATION CONTEXT

Item 1: Some child built every playhouse on the display.

(1) Inverse scope context (Expectation)
An environmental activity was held at the school, and participants were making big playhouses out of cardboard. At last, three finished works were displayed. The igloo was the work of a 6th-grade boy, and the rocket was the work of a 5th-grade boy. When I saw the doll house, I thought it could not be a work of a child. However, I was surprised to discover that it was the work of a little 4th-grade girl.

Test Sentence: Some child built every playhouse on the display.

(2) Surface scope context (Expectation)
An environmental activity was held at the school, and participants were making big playhouses out of cardboard. At last, three finished works were displayed. The igloo and the rocket were both the works of a 6th-grade boy. When I saw the doll house, I thought it must be the work of a different child. However, I was surprised to discover that its creator was the same boy again.

Test Sentence: Some child built every playhouse on the display.

Item 2: Some student wrote every video game paper that I read today.

(1) Inverse scope context (Expectation)
I am a professor of visual arts. Today, I was reading the three best papers on video games selected for the Video Game Writing Contest. Each paper analyzed a different game; Tetris, SimCity, and Spacewar. I was impressed to learn that the author of the Tetris paper was a college student from Harvard, and the author of the SimCity paper was a student from Stanford. When I read the Spacewar paper, I thought it must have been written by a
professor. But even the author of the Spacewar paper was a college student, this one from MIT.

Test Sentence: Some student wrote every video game paper that I read today.

(2) Surface scope context (Expectation)
I am a professor of visual arts. Today, I was reading the three best papers on video games published in the Video Game journal. Each paper analyzed a different game; Tetris, SimCity and Spacewar. I was impressed to learn that the author of the Tetris and SimCity papers was a female student majoring in Art. When I read the Spacewar paper, I thought it must have been written by a professor. But the author of the Spacewar paper was the same female art student.

Test Sentence: Some student wrote every video game paper that I read today.

Item 3: Some amateur won every award at the art competition this year.
(1) Inverse scope context (Expectation)
This year, an art competition had to award three prizes in the areas of design, painting and sculpture. First, the design award was presented to an amateur. Still, people expected that the winners in the other two categories would be professionals. To everyone’s surprise, however, the winner of the painting award this year was another amateur. Then, winding up the awards, the audience was shocked to see a very young student amateur chosen as the winner for sculpture as well.
Test Sentence: Some amateur won every award at the art competition this year.

(2) Surface scope context (Expectation)
This year, an art competition had to award three prizes in the areas of design, painting and sculpture. First, the design award was presented to a young female amateur. Still, people expected that the winners in the other two categories would be professionals. To everyone’s surprise, however, the same female amateur was the winner of the painting award this year, and of the sculpture award, too.

Test Sentence: Some amateur won every award at the art competition this year.

Item 4: Some company delivered every piano that Granma bought for us this year.
(1) Inverse scope context (Expectation)
My Grandma, a retired musician, always wanted her grandchildren to study the piano like she had. This year, she decided to buy pianos for us all and surprise us by having them delivered on our birthdays. She bought all three pianos and for my older cousin’s birthday, she called a moving company and had one delivered to him. Unfortunately, they weren’t very careful with it so for my younger cousin’s birthday, she called another company and had them deliver one to her. My birthday is last and since I live in a different state, Grandma had to hire yet another moving company to deliver my piano to me.
Test Sentence: Some company delivered every piano that Granma bought for us this year.

(2) Surface scope context (Expectation)
My Grandma, a retired musician, always wanted her grandchildren to study the piano like she had. This year, she decided to buy pianos for us all and surprise us by having them delivered on our birthdays. She bought all three pianos and for my older cousin’s birthday, she called a moving company and had one delivered to him. They were very careful with it, so for my younger cousin’s birthday, she called the same company and had them deliver one to her. My birthday is last and Grandma again hired the same moving company to deliver my piano to me.

Item 5: Some scientist reviewed every sci-fi movie that I read about today.
(1) Inverse scope context (Expectation)
I am a sci-fi movie critic. Today, I was reading three science articles and each of them discussed one of three sci-fi movies: Spiderman, Superman and X-men. When I read about Spiderman and Superman, I was surprised to see that the reviewers of the two movies were real scientists -- the Spiderman one was by an animal scientist, and the Superman one by a physicist. As for X-men, I expected at least its reviewer to be a movie critic. However, I was amazed that it was actually a third scientist who reviewed X-men, a physiologist this time.
Test Sentence: Some scientist reviewed every sci-fi movie that I read about today.

(2) Surface scope context (Expectation)
I am a sci-fi movie critic. Today, I was reading three science articles and each of them discussed one of three sci-fi movies: Spiderman, Superman and X-men. When I read about Spiderman and Superman, I was surprised to see that the reviewer of the two movies was a real scientist – a knowledgeable physicist. As for X-men, I expected at least its reviewer to be a movie critic. However, I was amazed that it was actually the same scientist who reviewed X-men.

Test Sentence: Some scientist reviewed every sci-fi movie that I read about today.

Item 6: Some participant took every poster that Jane brought today.

(1) Inverse scope context (Expectation)
Jane was doing a survey and, as compensation, she gave each participant $5 in cash. She also prepared pictures of celebrities, thinking that participants might want a gift instead. Today, she prepared three pictures - Will Smith, George Clooney and Britney Spears. This morning, she had a female participant who wanted the poster of Will Smith. She continued her survey, but didn’t expect the remaining two posters would be very popular. This afternoon however, she had another woman participant who took the George Clooney poster, and at the end of the day, she had a third participant who wanted the last Britney Spears poster.
Test Sentence: Some participant took every poster that Jane brought today.

(2) **Surface scope context (Expectation)**
Jane was doing a survey and, as compensation, she gave each participant $5 in cash. She also brought posters of celebrities, thinking that participants might want a gift instead of money. Today, Jane brought three posters - Will Smith, George Clooney and Britney Spears. This morning, she had two female participants and they wanted money. She continued her survey, but didn’t expect the three pictures would suddenly become popular. At the end of the day, however, she had a male participant who loved celebrity posters. So, all three posters went to the male participant.

Test Sentence: Some participant took every poster that Jane brought today.

Item 7: **Some student criticized every professor at the café this morning.**

(1) **Inverse scope context (Expectation)**
I am a professor at this university. This morning, I was at the campus café with two of my colleagues, Dr. Johnson and Dr. Drew. We were the only three faculty members at the café this morning. Suddenly, we noticed some students nearby and heard them criticizing us. According to a psychology student, Dr. Johnson was never available to his students, and according to another philosophy student, Dr. Drew wasn’t either. I wasn’t really worried since I’m always very generous with my time. This made it all the worse when I heard one of my linguistics students criticizing me, too.
Professors at the cafe
Dr. Drew
Dr. Johnson
Me

Test Sentence: Some student criticized every professor at the café this morning.

(2) **Surface scope context (Expectation)**
I am a professor at this university. This morning, I was at the campus café with two of my colleagues, Dr. Johnson and Dr. Drew. We were the only three faculty members at the café this morning. Suddenly, we noticed some students nearby and heard them criticizing us. According to a female student, my companions, Dr. Johnson and Dr. Drew were never available to students. As for me, I wasn’t worried since I’m always very generous with my time. But I felt terrible when I heard the same student criticizing me, too.

Test Sentence: Some student criticized every professor at the café this morning.

Item 8: **Some student designed every logo that the newspaper featured today.**

(1) **Inverse scope context (Expectation)**
I’ve always been interested in advertising and tend to notice catchy logos. Today, the design column of our local newspaper featured three logos that had each won an award in logo design contests. To my surprise, the Art logo had been created by an art undergraduate art student, and the Technoworks logo was another art student’s work. I learned that college students often win logo design competitions. Still, I thought the last one, the Hilton logo was really remarkable and must have been designed by a professional. I couldn’t believe it when I saw that the Hilton logo was the work of a third student, this time a high school senior.
Test Sentence: Some student designed every logo that the newspaper featured today.

(2) Surface scope context (Expectation)
I’ve always been interested in advertising and tend to notice catchy logos. Today, the design column of our local newspaper featured three logos that had each won an award in logo design contests. To my surprise, the Art logo and the Technoworks logo had been designed by a college art major student. Still, I thought the last one, the Hilton logo, was really remarkable and must have been designed by a professional. I couldn’t believe it when I saw that the Hilton logo too was designed by the same art student.

Test Sentence: Some student designed every logo that the newspaper featured today.

Item 9: Some doctor hired every new lawyer in my legal firm this year.
(1) Inverse scope context (Expectation)
I run a legal firm. This year, my legal firm hired exactly three new lawyers specializing in medical cases, John, Bill and Mary. Bill immediately got a client from the City Hospital and then Mary got a client from the Central Hospital. But, John was without any clients of his own for a while and he was worried about losing his job. Luckily, John was finally retained by a female surgeon from the Public Hospital.
Test Sentence: Some doctor hired every new lawyer in my legal firm this year.

(2) Surface scope context (Expectation)
I run a legal firm. This year, my legal firm hired exactly three new lawyers specializing in medical cases, John, Bill and Mary. My office was going to handle a big medical issue that one female doctor had brought to us. Bill and Mary immediately got hired by that doctor and became involved in this big case. But, John was busy with something else and I was worried that he might not get any client. However, John finally got hired by the female doctor and joined the team.

Item 10: Some boy painted every old bench that I recently brought.
(1) Inverse scope context (Expectation)
I love wooden benches. Recently, I brought home three old benches from a garage sale. The benches were pretty weather-beaten and my wife didn’t like the way any of them looked. One day, she asked some boys in the neighborhood to come by and paint them for her. That morning, a boy came and painted the smallest bench of the three. I was a little disappointed when I saw it and hoped that no more benches would be painted. To my surprise however, another boy came and painted one of the two bigger benches while I was out, and not long after, a third boy came and painted the last bench.
(2) **Surface scope context (Expectation)**
I love wooden benches. Recently, I brought home three old benches from a garage sale. The benches were pretty weather-beaten and my wife didn’t like the way any of them looked. One day, she asked some boys in the neighborhood to come by and paint them for her. That morning, a young boy came and painted one of those three benches. I was a little disappointed when I saw it and hoped that no more benches would be painted. To my surprise however, the young boy enjoyed doing that painting job, so he painted the remaining two benches.

Test Sentence: Some boy painted every old bench that I recently brought.

*Item 11: Some couple ordered every cake that the hotel prepared this Sunday.*
(1) **Inverse scope context (Expectation)**
This Sunday, the hotel where I work decided to provide, upon request, a free cake to newlywed couples staying with us. The hotel prepared three fresh cakes - a chocolate cake, a vanilla cake and a cheesecake. They didn’t expect all of the cakes to be gone, since the hotel usually has few honeymooners. In the morning, however, the hotel got an order for the chocolate cake from one couple from Washington. They thought that would be the only one for the day. However, that afternoon, they got another order for the vanilla cake from a couple from California. Then, later in the day, the bakery was surprised to have a couple from Hawai’i come and order the last remaining cake.
Test Sentence: Some couple ordered every cake that the hotel prepared this Sunday.

(2) Surface scope context (Expectation)
This Sunday, the hotel where I work decided to provide, upon request, a free cake to newlywed couples staying with us. The hotel prepared three fresh cakes- a chocolate cake, a vanilla cake and a cheesecake. They didn’t expect all of the cakes to be gone, since the hotel usually has few honeymooners. In the morning, the hotel happened to have a couple who really loves cakes. The hotel immediately got an order for the chocolate cake from the couple. Still, they didn’t expect the remaining two cakes to be gone. They were surprised to get another order for the two remaining cakes from the same couple.

Test Sentence: Some couple ordered every cake that the hotel prepared this Sunday.

Item 12: Some passenger found every bottle in the plane for New York this morning.
(1) Inverse scope context (Expectation)
Just this morning, an anonymous call again alerted the company that there were three small bottles with explosives hidden somewhere in the cabin of a plane leaving for New York. Luckily, things worked out okay. Surprisingly, a woman passenger found one suspicious bottle under her seat. Everyone was worried that the other two bottles wouldn’t be found by passengers. Soon, however, a male passenger found the second bottle in the seat pocket in front of him, and the last bottle was found by a third passenger in the business-class section.
(2) Surface scope context (Expectation)
Just this morning, an anonymous call again alerted the company that there were three small bottles with explosives hidden somewhere in the cabin of a plane leaving for New York. Luckily, things worked out okay. Surprisingly, a brave woman passenger found a suspicious blue bottle in her seat pocket. Everyone was worried that the other two bottles wouldn’t be found by passengers. To everyone’s surprise, however, this brave female passenger found the other two bottles, too.

Test Sentence: Some passenger found every bottle in the plane for New York this morning.

Test Sentence: Some passenger found every bottle in the plane for New York this morning.
APPENDIX B.
FILLERS:
12 EVERY-NOT FILLERS, AND 16 NO-ANSWER FILLERS

Sample negation filler:

(1) none-reading context (surface-scope)
Three kids were participating in a fun Halloween activity as a team. The activity was to carve a Halloween pumpkin. Each kid grabbed a pumpkin. The kids were talented decorators, and I assumed they were all going to carve their pumpkin. But I was wrong. The kids all forgot to bring carving tools, so they had to leave their pumpkins uncarved.

Filler Sentence: Every kid didn’t carve a pumpkin.

(2) some (not all)-reading context (inverse-scope)
Three kids were participating in a fun Halloween activity as a team. The activity was to carve a Halloween pumpkin. Each kid was grabbing a pumpkin. The kids were talented decorators, and I assumed they were all going to carve their pumpkin. But I was not completely right. One kid forgot to bring a carving tool, and was unable to carve, so only the other two kids carved a pumpkin.

Filler Sentence: Every kid didn’t carve a pumpkin.

Sample “no-answer” (Mismatch) fillers
(1) John sells hats. One day, he received a small group of male customers. They wondered what color of hat would match their clothing style. To the guy wearing a brown suit, John recommended a brown hat. To the guy with a black suit, he recommended a green hat. To the guy with a gray suit, he also recommended a green hat. The customers all followed John’s advice.
Every customer selected the same color hat.

(2) Where is the best place to meet people? According to a recent survey, coffee places like Starbucks are the best place to initially meet someone, whether you're a coffee drinker yourself or not. It’s because these cafes are all over town and people are constantly coming and going. Also, you are able to grab a cup of coffee and relax while you wait for someone.

Only coffee drinkers like to meet people at coffee places.
APPENDIX C.
CONTROL 1 ITEMS (EXISTENTIAL READING OF SOME N)

Item 1: some-every temporal
(1) some-variable reading context:
I am a math professor, and I recently offered a workshop on “Language and Math” for one month. I had special office-hours every Monday during that month. I noticed more linguistics students visited my office. The first Monday that month, I had three students in my office and one of them was from linguistics. The second Monday, I met with two students, including an MA student in linguistics. I expected that such enthusiasm wouldn’t last throughout the workshop. Surprisingly however, the third Monday, I had a linguistics undergraduate visit my office, and on the last Monday, I had an entirely new student, also from linguistics.

Control Sentence: Some linguistics student visited my office every Monday during the workshop.

Items 2: each-some bi-clausal
(1) some-variable reading context:
I am a middle school teacher, and I make a point of emphasizing the importance of the three areas of math, art and music in my students’ education. Yesterday, a teacher in each of the three areas gave me a report about my students. The math teacher reported that one of my students was excelling on math quizzes. I knew that several students in my school were pretty smart, but had remained a bit modest. However, the art teacher also reported that another student of mine had done a great job in a recent art competition. Surprisingly, the music teacher had a similar report about a new student who had just been admitted to my class.
Control Sentence: In the report, each teacher said that some student of mine did a great job.

**Item 3: some-every locative**

(1) **some-variable reading context:**
I am a math teacher in an elementary school, and I have been using a particular method of teaching math that I developed. To see if this method works, I have been testing my students by giving them a quiz three times every month. No student had failed any of the quizzes so far. This month however, I had one student who failed in the first quiz, and another student who failed in the following quiz. I realized I was overly confident in my method. In the last quiz this month, there was one student who failed, and it was a student who used to be very good at math.

Control Sentence: Some student failed in every math exam this month.
APPENDIX D.
CONTROL 2 ITEMS
(SYNTACTIC RESTRICTION OF INVERSE SCOPE WITH EVERY)

Item 1: his mother-every type
(1) Inverse scope context:
I often wonder whether working moms really love their children. One day, I was watching a TV show where three young boys were featured. Their names were Tom, Jim and Paul. These boys kept complaining about their mothers always being too busy with their work. A while later, the interviewer called their mothers up to the stage, and got them to express how much they love their kids. In fact, I could tell by watching them that John’s mother loved John and Jim’s mother loved Jim. As for Paul, his mother didn’t look very affectionate at first. Finally however, I could tell that Paul’s mother also loved Paul.

Control Sentence: His mother loved every boy at the show.

Item 2: bi-clausal frozen scope type
(1) Inverse scope context:
I was at the concert of Westlife, a group of 4 singers, Shane, Mark, Nicky and Kian. I was quite surprised to see them all grown up. Interestingly, I overheard a group of girls seated nearby talking about how old each member had been at the time of the debut. One girl seated next to me said Shane was 18 years old and the other girl said Nicky was only 19 years old. I was quite surprised these two were so young. To my further surprise, a different girl far from me said that Kian was only 17 years old then. And so was the last member, Mark, according to a girl next to her.
Four singers of *Westlife*

Shane  
Nicky  
Mark  
Kian

Control Sentence: Some girl said that every boy in the group made his debut as a teenager.
APPENDIX E.
CONTROL 3 ITEMS (OTHER QUANTIFIER PAIRS)

Item 1: Some N – Each N
(1) Inverse scope context:
The novel *The Da Vinci Code* was being hotly debated among students at my school, so I ran to the library to check out a copy of the book. However, the library only had three copies, and they had all been checked out. According to the librarian, a philosophy student took one copy in the morning, and a history student took the second copy in the afternoon. I expected at least one copy to still be there this morning. Regretfully, the last remaining copy had been checked out by an art student just before I arrived. I should have come earlier!

Control Sentence: Some student checked out each *Da Vinci Code* book in the library.

Item 2: Someone – Every N
(1) Inverse scope context:
While driving to work, I was listening to the radio, and I wanted to hear new age songs from three of my favorite musicians *Enya, Yanni* and *Vangelis*. Luckily, I heard a woman DJ playing an *Enya* song, and then I moved to another program, and there heard another DJ playing some of *Yanni’s* music. *Vangelis* is not so popular, so I thought I had no chance of hearing his music. Just before I got to work however, I tried several stations and finally found a movie star DJ playing *Vangelis* music, too. I was so happy.
3 new age musicians

Control Sentence: Someone played every musician that I wanted to hear this morning.
APPENDIX F.
12 TARGET SOME-EVERY SENTENCES: FOCAL CONTEXT
(Pictures were the same as in Expectation context)

Item 1: Some child built every playhouse that was on display this year.
(1) Inverse scope context (Focal)
An environmental activity is held at a local school every year where participants make big playhouses out of cardboard to support recycling. Last year, I remember that several houses in various shapes had been completed and were on display, and that none of them had been made by a child. Today, I went to see this year’s event and only three best playhouses were on display. Surprisingly, the Igloo was the work of a 6th-grade boy, and the Rocket was the work of a 5th-grade boy. When I saw the last playhouse, the Doll House, I thought it could not possibly be the work of a child. However, it turned out that this one, too, was the work of a little child, a 4th-grade girl.

Test Sentence: Some child built every playhouse that was on display this year.

(2) Surface scope context (Focal)
An environmental activity is held at a local school every year where participants make big playhouses out of cardboard to support recycling. Last year, I remember that several houses in various shapes had been completed and were on display, and that none of them had been made by a child. Today, I went to see this year’s event and only three best playhouses were on display. Surprisingly, the Igloo and the Rocket were both the works of a 6th-grade boy. When I saw the last playhouse, the Doll House, I thought it must be the work of a different child. However, it turned out that its creator was the same boy again.

Test Sentence: Some child built every playhouse that was on display this year.

Item 2: Some student wrote every video game paper that I read today.
(1) Inverse scope context (Focal)
I am a professor of visual arts. In the past few years, I have read many papers about movies or video games, and none of them have ever been written by students. Today, however, while browsing online, I found a few new papers written by students. I was reading the three best papers on video games selected for a Video Game Writing Contest. Each paper analyzed a different game: Tetris, SimCity, and Spacewar. I was impressed to learn that the author of the Tetris paper was a college student from Harvard, and the author of the SimCity paper was a student from Stanford. When I read the Spacewar paper, I thought it must have been written by a professor. But even the author of the Spacewar paper was a college student, this one from MIT.

Test Sentence: Some student wrote every video game paper that I read today.
Test Sentence: Some student wrote every video game paper that I read today.

(2) Surface scope context (Focal)
I am a professor of visual arts. In the past few years, I have read many papers about movies or video games, and none of them have ever been written by students. Today, however, while browsing online, I found a few new papers written by students. I was reading the three best papers on video games published in the Video Game journal. Each paper analyzed a game; Tetris, SimCity and Spacewar. I was impressed to learn that the author of the Tetris and SimCity papers was a female student majoring in Art. When I read the Spacewar paper, I thought it must have been written by a professor. But the author of the Spacewar paper was the same female art student.

Test Sentence: Some student wrote every video game paper that I read today.

Item 3: Some amateur won every award at the art competition this year.
(1) Inverse scope context (Focal)
Every year, an art competition awards three prizes in the areas of design, painting, and sculpture. At this prestigious competition, no amateur had ever won any of the prizes until this year. Last year, as usual, professional artists won all three prizes. This year, however, was a surprise to everyone. First, the design award was presented to an amateur. Still, people expected that the winners in the other two categories this year would be professionals. To everyone’s surprise, however, the winner of the painting award this year was another amateur. Then, winding up the awards, the audience was shocked to see a very young student amateur chosen as the winner for sculpture as well.

Test Sentence: Some student wrote every video game paper that I read today.

(2) Surface scope context (Focal)
Every year, an art competition awards three prizes in the areas of design, painting, and sculpture. At this prestigious competition, no amateur had ever won any of the prizes until this year. Last year, as usual, professional artists won all three prizes. This year, however, was a surprise to everyone. First, the design award was presented to a young female amateur. Still, people expected that the winners in the other two categories this year would be professionals. To everyone’s surprise, however, the same female amateur was the winner of the painting award this year, and of the sculpture award, too.

Test Sentence: Some student wrote every video game paper that I read today.

Item 4: Some company delivered every piano that Grandma bought for us this year.
(1) Inverse scope context (Focal)
My Grandma, a retired musician, always wanted her grandchildren to study the piano like she had. Two years ago, Grandma got the idea to buy grand pianos for us, but none of the three of us had space in our apartments. This year, however, she decided to buy pianos for us all and surprise us by having them delivered on our birthdays. She bought all three pianos and for my older cousin’s birthday, she called a moving company and had one delivered to him. Unfortunately, they weren’t very careful with it so for my younger cousin’s birthday, she called another company and had them deliver one to her. My birthday is last and since I live in a different state, Grandma had to hire yet another moving company to deliver my piano to me.

Test Sentence: Some company delivered every piano that Grandma bought for us this year.

(2) Surface scope context (Focal)
My Grandma, a retired musician, always wanted her grandchildren to study the piano like she had. Two years ago, Grandma got the idea to buy grand pianos for us, but none of the three of us had space in our apartments. This year, however, she decided to buy pianos for us all and surprise us by having them delivered on our birthdays. She bought all three pianos and for my older cousin’s birthday, she called a moving company and had one delivered to him. They were very careful with it, so for my younger cousin’s birthday, she called the same company and had them deliver one to her. My birthday is last and Grandma again hired the same moving company to deliver my piano to me.

Test Sentence: Some company delivered every piano that Grandma bought for us this year.

Item 5: Some scientist reviewed every sci-fi movie that I read about today.
(1) Inverse scope context (Focal)
I am a sci-fi movie critic so every day, I read various articles about sci-fi movies, so I can stay informed. Up to now, the articles that I have read have all been reviews by other movie critics. Today, though, I had a very different experience: I was reading three science articles and each of them discussed one of three sci-fi movies: Spiderman, Superman and X-men. When I read about Spiderman and Superman, I was surprised to see that the reviewers of the movies were real scientists, not movie critics – the Spiderman one was by an animal scientist, and the Superman one by a physicist. As for X-men, I expected at least its reviewer to be a movie critic. However, I was amazed that it was actually a third scientist who reviewed X-men, a physiologist this time.

Test Sentence: Some scientist reviewed every sci-fi movie that I read about today.
(2) Surface scope context (Focal)
I am a sci-fi movie critic so every day, I read various articles about sci-fi movies, so I can stay informed. Up to now, the articles that I have read have all been reviews by other movie critics. Today, though, I had a very different experience: I was reading three science articles and each of them discussed one of three sci-fi movies: Spiderman, Superman and X-men. When I read about Spiderman and Superman, I was surprised to see that the reviewer of the two movies was a real scientist, not a movie critic - a knowledgeable physicist. As for X-men, I expected at least its reviewer to be a movie critic. However, I was amazed that it was actually the same scientist who reviewed X-men.

Test Sentence: Some scientist reviewed every sci-fi movie that I read about today.

Item 6: Some participant took every poster that Jane brought today.

(1) Inverse scope context (Focal)
Jane was doing a survey and, as compensation, she gave each participant $5 in cash. She also brought three posters of celebrities each day, thinking that participants might want a gift instead of money. People didn’t always want the posters, though. Yesterday, for example, no one took any of the three posters that Jane had brought – apparently none of them were into celebrities. Today however, was unusual. Jane brought three new posters - Will Smith, George Clooney and Britney Spears. This morning, she had a female participant who wanted the poster of Will Smith. She continued her survey, but didn’t expect the remaining two posters would be very popular. This afternoon however, she had another woman participant who took the George Clooney poster, and at the end of the day, she had a third participant who wanted the last Britney Spears poster.

Test Sentence: Some participant took every poster that Jane brought today.

(2) Surface scope context (Focal)
Jane was doing a survey and, as compensation, she gave each participant $5 in cash. She also brought three posters of celebrities each day, thinking that participants might want a gift instead of money. People didn’t always want the posters, though. Yesterday, for example, no one took any of the three posters that Jane had brought – apparently none of them were into celebrities. Today however, was unusual. Jane brought three new posters - Will Smith, George Clooney and Britney Spears. This morning, she had two female participants and they wanted money. She continued her survey, but didn’t expect the three pictures would suddenly become popular. At the end of the day, however, she had a male participant who loved celebrity posters. So, all three posters went to the male participant.

Test Sentence: Some participant took every poster that Jane brought today.

236
Item 7: Some student criticized every professor at the café this morning.

(1) Inverse scope context (Focal)
I am a professor at this university. Early every morning, my colleagues and I meet at the campus café to chat. Until yesterday, we had had a great time at the campus café since there were never any students there that early in the morning. This morning, however, things weren’t so quiet. I was at the café with two of my colleagues, Dr. Johnson and Dr. Drew, and we were the only three faculty members at the café. Suddenly, we noticed some students nearby and heard them criticizing us. According to a psychology student, Dr. Johnson was never available to his students, and according to another philosophy student, Dr. Drew wasn’t either. I wasn’t really worried since I’m always very generous with my time. This made it all the worse when I heard one of my linguistics students criticizing me, too.

Test Sentence: Some student criticized every professor at the café this morning.

(2) Surface scope context (Focal)
I am a professor at this university. Early every morning, my colleagues and I meet at the campus café to chat. Until yesterday, we had had a great time at the campus café since there were never any students there that early in the morning. This morning, however, things weren’t so quiet. I was at the café with two of my colleagues, Dr. Johnson and Dr. Drew, and we were the only three faculty members at the café. Suddenly, we noticed some students nearby and heard them criticizing us. According to a psychology student, Dr. Johnson was never available to his students, and according to another philosophy student, Dr. Drew wasn’t either. I wasn’t really worried since I’m always very generous with my time. But then I felt terrible when I heard the same student criticizing me, too.

Test Sentence: Some student criticized every professor at the café this morning.

Item 8: Some student designed every logo that the newspaper featured today.

(1) Inverse scope context (Focal)
I’ve always been interested in advertising and tend to notice catchy logos. Recently, the design column of our local newspaper started featuring three unique logos each day. Until yesterday, none of the logos that I had seen were created by students: they were all done by design professionals. Today, however, the three great logos they featured were not done by professionals. To my surprise, the Art logo had been created by an undergraduate art student, and the Technoworks logo was another art student’s work. Still, I thought the last one, the Hilton logo, was really remarkable and must have been designed by a professional. I couldn’t believe it when I saw that the Hilton logo too was the work of a third student, this time a high school senior.

Test Sentence: Some student designed every logo that the newspaper featured today.
Test Sentence: Some student designed every logo that the newspaper featured today.

(2) **Surface scope context (Focal)**
I’ve always been interested in advertising and tend to notice catchy logos. Recently, the design column of our local newspaper started featuring three unique logos each day. Until yesterday, none of the logos that I had seen were created by students: they were all done by design professionals. Today, however, the three great logos they featured were not done by professionals. To my surprise, the Art logo and the Technoworks logo had been designed by a college art major student. Still, I thought the last one, the Hilton logo, was really remarkable and must have been designed by a professional. I couldn’t believe it when I saw that the Hilton logo too was designed by the same art student.

<Item 9: Some doctor hired every new lawyer in my legal firm this year.
(1) **Inverse scope context (Focal)**
I run a legal firm. Each year, I hire exactly three new lawyers to meet the needs of our client roster. For the past five years, unfortunately, not all the lawyers ended up staying with our firm. For instance, last year, only two lawyers out of three managed to keep enough clients and one ended up leaving our office. This year however, we were lucky. My legal firm hired three new lawyers specializing in medical cases, John, Bill, and Mary. Bill immediately got a client from the City Hospital and then Mary got a client from the Central Hospital. But, John was without any clients of his own for a while and he was worried about losing his job. Luckily, John was finally retained by a female surgeon from the Public Hospital.

(2) **Surface scope context (Focal)**
I run a legal firm. Each year, I hire exactly three new lawyers to meet the needs of our client roster. For the past five years, unfortunately, not all the lawyers ended up staying with our firm. For instance, last year, only two lawyers out of three managed to keep enough clients and one ended up leaving our office. This year however, we were lucky. My legal firm hired three new lawyers specializing in medical cases, John, Bill, and Mary. My office was going to handle a big medical issue that one female doctor had brought to us. Bill and Mary immediately were hired by that doctor and became involved in this big case. But, John was busy with something else and I was worried that he might not get any client. However, John finally got hired by the female doctor and joined the team.

Test Sentence: Some doctor hired every new lawyer in my legal firm this year.
**Item 10: Some boy painted every old bench that I recently brought.**

(1) **Inverse scope context (Focal)**
I love old wooden benches. For the past few years, I have been collecting many old benches for my garden that I always keep looking natural. My wife usually likes these natural-looking benches as well. Recently, though, I brought home three more old benches from a garage sale. This time, the benches were pretty weather-beaten and she didn’t like the way any of them looked. One day, she asked some boys in the neighborhood to come by and paint them for her. That morning, a boy came and painted the smallest bench. I was a little disappointed when I saw it and hoped that no more benches would be painted. To my surprise however, another boy came and painted one of the two bigger benches while I was out, and not long after, a third boy came and painted the last bench.

<picture 10>

Test Sentence: Some boy painted every old bench that I recently brought.

(2) **Surface scope context (Focal)**
I love old wooden benches. For the past few years, I have been collecting many old benches for my garden that I always keep looking natural. My wife usually likes these natural-looking benches as well. Recently, though, I brought home three more old benches from a garage sale. This time, the benches were pretty weather-beaten and she didn’t like the way any of them looked. One day, she asked some boys in the neighborhood to come by and paint them for her. That morning, a young boy came and painted one of those three benches. I was a little disappointed when I saw it and hoped that no more benches would be painted. To my surprise however, the young boy enjoyed doing that painting job, so he painted the remaining two benches.

<picture same picture>

Test Sentence: Some boy painted every old bench that I recently brought.

**Item 11: Some couple ordered every cake that the hotel prepared this Sunday.**

(1) **Inverse scope context (Focal)**
The hotel where I work prepares three special cakes each Sunday, and provides them free, upon request, to newlywed couples staying with us. Until last Sunday, we hadn’t had very many orders since the hotel only gets a few honeymooners. This Sunday, however, was an exceptional day. The hotel prepared three fresh cakes - a chocolate cake, a vanilla cake and a cheesecake. In the morning, the hotel got an order for the chocolate cake from one couple from Washington. They thought that would be the only one for the day. However, that afternoon, they got another order for the vanilla cake from a couple from California. Then, later in the day, the bakery was surprised to have a couple from Hawai‘i come and order the last remaining cake.

<picture 11>

Test Sentence: Some couple ordered every cake that the hotel prepared this Sunday.
(2) Surface scope context (Focal)
The hotel where I work prepares three special cakes each Sunday, and provides them free, upon request, to newlywed couples staying with us. Until last Sunday, we hadn’t had very many orders since the hotel only gets a few honeymooners. This Sunday, however, was an exceptional day. The hotel prepared three fresh cakes - a chocolate cake, a vanilla cake and a cheesecake. In the morning, the hotel happened to have a couple who really loves cakes. The hotel immediately got an order for the chocolate cake from the couple. Still, they didn’t expect the remaining two cakes to be gone. They were surprised to get another order for the two remaining cakes from the same couple.

Test Sentence: Some couple ordered every cake that the hotel prepared this Sunday.

Item 12: Some passenger found every bottle in the plane for New York this morning.

(1) Inverse scope context (Focal)
Not long ago, an international airplane company was alerted that there were several bottles with liquid explosives on one of their planes. That time, crew members managed to find all the bottles. Just this morning, an anonymous call again alerted the company that there were three small bottles with explosives hidden somewhere in the cabin of a plane leaving for New York. Luckily, things worked out okay again this time. Surprisingly, a woman passenger found one suspicious bottle under her seat. Everyone was worried that the other two bottles wouldn’t be found by passengers. Soon, however, a male passenger found the second bottle in the seat pocket in front of him, and the last bottle was found by a third passenger in the business-class section.

Test Sentence: Some passenger found every bottle in the plane for New York this morning.

(2) Surface scope context (Focal)
Not long ago, an international airplane company was alerted that there were several bottles with liquid explosives on one of their planes. That time, crew members managed to find all the bottles. Just this morning, an anonymous call again alerted the company that there were three small bottles with explosives hidden somewhere in the cabin of a plane leaving for New York. Luckily, things worked out okay again this time. Surprisingly, a brave woman passenger found a suspicious blue bottle in her seat pocket. Everyone was worried that the other two bottles wouldn’t be found by passengers. To everyone’s surprise, however, this brave female passenger found the other two bottles, too.

Test Sentence: Some passenger found every bottle in the plane for New York this morning.
APPENDIX G.
12 PRIME ITEMS

Item 1:
(1) Inverse scope prime (Expectation)
Residents shared three washers in my dormitory. Last week, I was told that two washers were broken, and that a sophomore and another careless senior student broke the two washers. I have been procrastinating about doing my laundry for a while. Yesterday, I finally got there to do laundry, hoping the last machine would be working. However, I found out that the 3rd machine had been broken, this time by a resident new to the building.

Prime Sentence: Some resident or other broke every washer in the dormitory.

(2) Surface scope prime (Expectation)
Residents shared three washers in my dormitory. Last week, I was told that two washers were broken, and it was because one careless resident kept leaving coins in his pockets, causing problems with the machines. I have been procrastinating about doing my laundry for a while. Yesterday, I finally got there to do laundry, hoping the last machine would be working. However, I saw that the 3rd machine got broken because of this careless resident, too.

Prime Sentence: The same resident broke every washer in the dormitory.

Item 2:
(1) Inverse scope prime (Expectation)
Thomson, an IBM manager, got a thank you card from an unusual sender. It was from a student who had attended an IBM conference. Back then, the conference was only for
professional consultants, but Thomson had let in several uninvited students. Later, he got another such thank you card from a different student. Then he got a third letter, and it was from another student who he had let in.

Prime Sentence: Some student or other wrote every thank you card that Thomson got.

(2) **Surface scope prime (Expectation)**
Thomson, an IBM manager, got a thank you card from an unusual sender. It was from a student who had attended an IBM conference. Back then, the conference was only for professional consultants, but Thomson had let in several uninvited students. Later, he got two more such thank you cards and these were also from that student who wrote the first letter.

Prime Sentence: The same student wrote every thank you card that Thomson got.

**Item 3:**
(1) **Inverse scope prime (Expectation)**
There were three coffee shops on campus, Coffee Brothers, Friday Café, and Coffee House, and they were about to close due to financial difficulties. Last week, the campus coffee club volunteered to help Coffee Brothers, and it stayed open. The other two coffee shops didn’t get help in time and closed. Meanwhile, this volunteering movement spread, and soon Friday Café reopened with the help of the international student association. Not long after, the Coffee House also began to serve coffee again thanks to the help of another association.
Prime Sentence: Some volunteer group or other helped every coffeehouse on campus.

(2) Surface scope prime (Expectation)
There were three coffee shops on campus, Coffee Brothers, Friday Café, and Coffee House, and they were about to close due to financial difficulties. Last week, a coffee-loving association volunteered to help Coffee Brothers. The other two coffee shops thought they wouldn’t receive help. However, this association began to flourish and soon they had enough volunteers to help reopen Friday Café and the CoffeeHouse as well.

Prime Sentence: The same volunteer group helped every coffeehouse on campus.

Item 4:
(1) Inverse scope prime (Expectation)
Walmart sells Needle Beetle, Crayon Holder, and Aim Fish in their toy section, and these products were the winners of the Invention Competition. Needle Beetle, the 2005 winner, is a device invented by a 5th-grade boy to reduce anxiety when receiving injections, and Crayon Holder, the 2006 winner, is a device invented by a 7th-grade girl for grabbing small pieces of crayon. The 2007 winner, Aim Fish, is an easy-to-use fishing rod, and I thought this product might have been the invention of an adult. However, its inventor was a child, too, this time a 7th-grade boy.

Prime Sentence: Some child or other invented every product that was mentioned.
Winners of invention competitions

Needle Beetle  Aim Fish  Crayon Holder

(2) Surface scope prime (Expectation)
Walmart sells Needle Beetle, Crayon Holder, and Aim Fish in their toys section. These products were the best works in the Kids Invention Exhibition. According to the 7th-grade girl inventor, Needle Beetle was designed to reduce anxiety when receiving injections, and Crayon Holder was designed to grab small pieces of crayon. The Aim Fish was designed to be an easy-to-use fishing rod, and I thought this product might have been the invention of a different child. However, its inventor was that 7-th-grade girl.

Prime Sentence: The same child invented every product that was mentioned.

Item 5:
(1) Inverse scope prime (Expectation)
The city had three female soccer teams. Women are bringing their leadership to these female soccer teams. The Mission team was the first to have a female coach, followed by the Yale team who had another female coach. Both teams have performed well in the city championship. But the Francisco team had persisted in having a male coach. Last year however, the Francisco team was reported to have hired a different young female coach as well.
Prime Sentence: Some woman or other coached every female soccer team in the city.

(2) Surface scope prime (Expectation)
The city had three female soccer teams. A woman is bringing her leadership to these female soccer teams. The Mission team was the first to have one talented woman coach, and that year they won the championship. Yale hired this female coach the following season, and won the championship that year. Next the Francisco team who had persisted in having a male coach hired this woman coach, and finally won the championship this year.

Prime Sentence: The same woman coached every female soccer team in the city.

Item 6:
(1) Inverse scope prime (Expectation)
I run a travel agency. One day, I had a group of young girls in my office. I heard them chatting about cities worth visiting. They selected three cities as the most popular travel destinations – Beijing, Paris and New York. They were so young, so I thought that none of them actually had visited any of the three cities. Surprisingly however, one girl among them said that she actually visited Beijing. The other girl said that she had visited Paris, and a third girl said that she visited New York.
Prime Sentence: Some girl or other visited every city mentioned.

(2) Surface scope prime (Expectation)
I run a travel agency. One day, I had a group of young girls in my office. I heard them chatting about cities worth visiting. They selected three cities as the most popular travel destinations – Beijing, Paris and New York. They were so young, so I thought that none of them actually had visited any of the three cities. Surprisingly however, one girl among them said that she actually visited Beijing. She said that she had visited Paris, and even New York.

Prime Sentence: The same girl visited every city mentioned.

Item 7:
(1) Inverse scope prime (Expectation)
I got three CDs as gifts when I was in the hospital, Britney, Gloria and Alanis. When I was in the City hospital, I got the CD of Britney as a get-well gift from a male nurse there. I knew that nurses are often nice to patients, but I wasn’t sure whether this was true in every hospital. After that, I was moved to the Central hospital, and I had similar experiences there. Another male nurse there brought the Gloria CD, and the Alanis CD was from a female nurse there.
Prime Sentence: Some nurse or other bought every CD gift that I got.

(2) Surface scope prime (Expectation)
I got three CDs as gifts when I was in the hospital, Britney, Gloria and Alanis. When I was in the City hospital, I got the CD of Britney as a get-well gift from a male nurse there. I knew that nurses are often nice to patients, but wasn’t sure whether this could happen more than once. After that, I got the Gloria and Alanis CDs as gifts in the same hospital. At first, I thought these two gifts might be from other nurses, but it was from that male nurse. I think he had a crush on me!

Prime Sentence: The same nurse bought every CD gift that I got.

Item 8:
(1) Inverse scope prime (Expectation)
Climbing events were held across three mountains on the Hawaiian islands over three days. The mountains were all very steep and dangerous and no one was likely to climb any of them. The first day however, a man from Australia climbed the Maui mountain. At the Big Island mountain, a man from New Zealand reached the top. The third day, a sudden rainstorm seriously attacked the Oahu event, and people thought no one would be able to climb the Oahu mountain in such a storm. Surprisingly, one experienced man from Hawaii reached the top of the Oahu mountain.
Prime Sentence: Some man or other climbed every mountain across the three islands.

**Surface scope prime (Expectation)**

Climbing events were held across three mountains on the Hawaiian islands over three days. The mountains were all very steep and dangerous and no one was likely to climb any of them. The first day however, a man from Hawaii climbed the Maui mountain, and even the Big Island mountain the second day. The third day, a sudden rainstorm seriously attacked the Oahu event, and people thought no one would be able to climb the Oahu mountain in such a storm. Surprisingly, that man reached the top of the Oahu mountain.

Prime Sentence: The same man climbed every mountain across the three islands.

**Item 9:**

**Inverse scope prime (Expectation)**

Everyone, young and old, loves a teddy bear. One day, Rose, who makes patchwork toys, made a special bear. This handmade bear was immediately sold to a delighted teddy bear collector. Later, Rose made two more bears, but she didn’t expect these two bears would become so popular among teddy bear collectors, too. Soon however, one of them was sold to a grandmother collector, and the last bear was sold to a child collector.
Prime Sentence: Some collector or other bought every teddy bear that Rose made.

(2) **Surface scope prime (Expectation)**
Everyone, young and old, loves a teddy bear. One day, Rose, who makes patchwork toys, made a special bear. This handmade bear was immediately sold to a delighted teddy bear collector. This collector was anxious to see more bears and was all ready to buy them. Later, Rose made two more bears and the two bears were sold immediately to that teddy bear collector.

Prime Sentence: The same collector bought every teddy bear that Rose made.

**Item 10:**

(1) **Inverse scope prime (Expectation)**
The university planned three social events this year, but they were concerned that they might have low attendance. But the spring event was a great success, because it was organized by a sociology student, not by a professor. Knowing this, officials encouraged more students to be involved in organizing future events, but still they were not expecting much. However, the summer event also became a great success with a neuroscience student organizer, and so was the fall event with a philosophy student organizer.
Prime Sentence: Some student or other organized every Univ. social event this year.

(2) Surface scope prime (Expectation)
The university planned three social events this year, but they were concerned that they might have low attendance. But the spring event was a great success with a sociology student organizer with great coordinating skills. Knowing this, officials encouraged future events to be student-directed, as well, but in fact they were not expecting much. But the summer event also became a great success, and so was the fall event, both with the efforts of this sociology student.

Prime Sentence: The same student organized every Univ. social event this year.

Item 11:
(1) Inverse scope prime (Expectation)
In the Goodwill shop, I saw three cute Halloween costumes for kids. Those costumes were all donations. The Spiderman costume was the donation of a male college student. The Bean was the donation of a female student. The Ladybug, I thought, must be given by a mother. But no, it was a donation from another younger female college student.
Some student or other donated every kid costume that I saw in the shop.

(2) **Surface scope prime (Expectation)**
In the Goodwill shop, I saw three cute Halloween costumes for kids. Those costumes were all donations. The Spiderman costume was the donation of a male college student, and so was the Bean costume. The Ladybug, I thought, must have been given by a mother. But no, it was a donation from that male student, too.

<same picture>

Prime Sentence: The same student donated every kid costume that I saw in the shop.

**Item 12:**
(1) **Inverse scope prime (Expectation)**
Mary, Jane, and I went to the movie complex, where they were showing three old movies in various theaters the same time. We split up and went to watch our favorite films in different theaters. I was in Theater 1 and watched Hannah and Her Sisters. I couldn’t enjoy the movie, though, because there was a young man criticizing it behind me. Oddly enough, Jane was in Theater 2 watching Wall Street and she had a similar experience: an old man criticized the movie the whole time. The same thing had also happened to Mary who was in Theatre 3 watching Pulp Fiction.
Some man or other criticized every movie we watched.

(2) Surface scope prime (Expectation)
Mary, Jane, and I went to the movie theatre, where they were showing three old movies consecutively on the same screen. We decided to watch these three movies together. First we watched Hannah and Her Sisters. We couldn’t enjoy the movie though, since there was a man criticizing it behind us. Then they showed Wall Street, and lastly Pulp Fiction. We only hoped nothing would distract us during these. But luck was not on our side, because that man kept criticizing so we couldn’t concentrate on any movie that day.

Prime Sentence: The same man criticized every movie we watched.
APPENDIX H.
16 FROZEN SCOPE NORMING STIMULI (EXPERIMENT 5)

3 Categories
A. frozen scope with matrix subject some $N$ – embedded subject every $N$ (6 items)
B. frozen scope with matrix subject some $N$ – embedded object every $N$ (6 items)
C. frozen scope with Relative Clause (4 items)

An asterisk marked in front of items indicates that the item obtained low acceptance rates and was selected in the subsequent experiments.

A. matrix subject some $N$ – embedded subject every $N$ (6 items)

**Subject every $N$ Item 1.**
(1) **Inverse scope context**
Three famous invited speakers were coming to the conference over three days. They were *Dr. Drew, Dr. Johnson, and Dr. Peter*. All three were worried about finding a ride from the airport. Fortunately, the first day, a senior student made sure that Dr. Drew had a ride. Yesterday, another junior student made sure that Dr. Peter had a ride. Lastly, today, another graduate student made sure that Dr. Johnson had a ride. The three invited speakers were all happy.

Frozen Sentence: Some student made sure that every invited speaker had a ride.

**Subject every $N$ Item 2:**
(1) **Inverse scope context**
A group of people were watching monkeys at the zoo. There were three monkeys living together as a family: father, mother and son. As the people watched, a zookeeper gave the monkeys some bananas. As a joke, some of the bananas were made of plastic. Some of the onlookers got mad because the zookeeper was teasing the monkeys with fake bananas. A group of young boys, however, were sure that the monkeys were all smart enough to tell what’s real and what’s fake. One boy was sure that the father monkey at least would be able to pick out a real banana. The other boy was even more sure that
the mother monkey would do so, too. Another boy was even sure that the monkey son would do so, too.

Frozen Sentence: Some boy was sure that every monkey would pick a real banana.

*Subject every N_Item 3:
(1) Inverse scope context
I was reading about three of the world’s most famous bridges, located in Sydney, London, and San Francisco. I’ve been wondering whether all of these bridges were really as beautiful in person. According to one tourist, he wrote that the bridge in Sydney was truly beautiful. The other tourist also wrote that the bridge in London was really beautiful as well. Another tourist wrote that the bridge in San Francisco was genuinely beautiful. I wish I could visit each of these bridges someday.

Frozen Sentence: Some tourist wrote that every world famous bridge was beautiful.
Subject every N_Item 4:
(1) Inverse scope context
When I lived in France, I volunteered as a tour guide for a while. I took tourist groups to the Eiffel Tower three times. After the first tour, I had one American tourist who reported that the tour was enjoyable. During the second tour, I had a French tourist who reported the same. After the last tour, I had a Japanese tourist who made a similar report which delighted me.

Frozen Sentence: Some tourist reported that every tour to the Eiffel Tower was enjoyable.

Subject every N_Item 5:
(1) Inverse scope context
Mickey was looking for a delicious apple. There were three apples: one was red, one was green and one was yellow. He asked some boys to choose him the most delicious apple. One of the boys claimed, “The red apple is the most delicious.” Another boy claimed, “The green apple is the most delicious.” A third boy claimed, “The yellow apple is the most delicious.” Mickey could not decide which apple was the most delicious.
Frozen Sentence: Some boy claimed that every banana was most delicious.

*Subject every N_Item 6:
(1) Inverse scope context
Several parents volunteered as school book reviewers. One day, they were asked to review about whether three historically banned books would be acceptable as school books. The three books were *Adventures of Huckleberry Finn*, *Catcher in the Rye*, and *Fahrenheit 451*. Each book was assigned to a different parent reviewer. For *Adventures of Huckleberry Finn*, one reviewer thought that it was acceptable. For *Catcher in the Rye*, the other reviewer thought that it was acceptable, too. For the last, *Fahrenheit 451*, the third reviewer thought that it was also acceptable.

Three banned books
- Fahrenheit 451
- Catcher in the Rye
- Adventures of Huckleberry Finn

Frozen Sentence: Some reviewer thought that every book was readable.

B. matrix subject some N – embedded object every N (6 items)

*Object every N_Item 1.
(1) Inverse scope context
Several students were in a Literature class together. There were three books to read on the syllabus the first week of class. One by *Hemingway*, *Twain*, and *Fitzerald*. Someone in class doubted whether the teacher himself did read any of the books. Yet one student personally knew that the teacher read *Hemingway*. Also, there was another student who knew that the teacher read *Twain*. Moreover, another female student knew that the teacher read *Fitzerald*. 
Frozen Sentence: Some student knew that the teacher read every book on the syllabus.

*Object every N_Item 2
(1) Inverse scope context
Our town was small and there were only three banks – Central, Hawaii, and Pacific. One man was convicted of robbing all of the three banks. The court was looking for witnesses and soon, one witness appeared and testified that the man robbed Central Bank. Soon, another witness appeared who testified that the man robbed Hawaii Bank. Finally, there appeared yet another witness, and he testified that the man robbed Pacific Bank.

Frozen Sentence: Some witness testified that the man robbed every bank in town.

Object every N_Item 3
(1) Inverse scope context
I work in a hospital together with a small group of doctors. Last week, we hired three new nurses named Mary, Alley and Jane. Each of us had a crush on a different nurse. Unfortunately, rumor had it that another doctor named Paul was dating all of the newly
hired nurses. Paul thought he was a real ladies man and he wanted to get the attention of women all the time. One doctor in our group was jealous that Paul dated the nurse named Mary. Another doctor was jealous that Paul dated the nurse named Alley. The last doctor was jealous that Paul dated the nurse named Jane.

Frozen Sentence: Some doctor noticed that Paul kissed every new nurse.

*Object every N_Item 4
(1) Inverse scope context
I was training computer technicians, and John was my assistant. One day, I brought three broken computers: A, B, and C. I made sure that each of the computers was assigned to a different technician, since I wanted to see how good they were at fixing computers. Later, however, it turned out that it was John who fixed all of the three broken computers. One technician confessed that John fixed computer A that he got. The other technician confessed that John fixed computer B that he was assigned. The last technician also confessed that John fixed computer C that he got. I was very disappointed.
Frozen Sentence: Some technician confessed that John fixed every broken computer that I brought.

*Object every N_Item 5
(1) Inverse scope context

The theater was showing three movies: Catch me if you Can, The Terminal, and A.I. A group of women were talking about the three movies. I never realized that the three movies were directed by the same person. One woman first mentioned that Steven Spielberg directed Catch me if you Can. And another woman also mentioned that the same person directed The Terminal. Finally, according to a third woman, A. I. was directed by Steven Spielberg, too.

Frozen Sentence: Some woman said that Steven Spielberg directed every movie mentioned.

Object every N_Item 6
(1) Inverse scope context

My fellow friends and I worked as guides at the National Toy Train Museum. There used to be an old man who often visited the museum. Sadly, the man has since passed away. We guides remembered that there used to be three trains in particular that he was most fond of. According to one guide, the old man liked the replica of a modern Amtrack train. The other guide remembered that the old man loved the model of The Polar Express. I remembered that he loved the model of the Lionel.
Frozen Sentence: Some guide remembered that the old man loved every train mentioned.

**C. Frozen scope with Relative Clause (4 items)**

**RC_Item 1**
(1) Inverse scope context
It was a stormy and windy day. Three kids were walking with their own umbrellas. Their names were Jane, Mary and Susie. Jane was carrying a red-colored umbrella, but huge gust of wind blew by and it got broken. Mary was carrying a yellow-colored umbrella, and it got broken, too. Unfortunately, Susie was carrying a blue-colored umbrella, but it got broken, too.

Frozen Sentence: Some umbrella that every child was carrying was broken.

*RC_Item 2*
(1) Inverse scope context
Three children went to the farm. Their names were John, Paul, and Tom. They wanted to ride on a horse. There were several horses. John rode on a white horse, and Paul rode on a brown horse. Lastly, Tom rode on a black horse.

Three kids at the farm

Frozen Sentence: There was some horse that every child was on.

*RC_Item 3

(1) Inverse scope context

A dance competition took place on campus over three days. Many girls competed in three areas, including Hula, Tango and Salsa. John planned to interview a winner of each award. The first day, a freshman girl won the Hula award, and John interviewed her. The second day, a junior girl won the Tango award, and John interviewed her, too. The last day, a senior girl won the Salsa award, and John interviewed her, too.
Frozen Sentence: John interviewed some girl that won every award at the dance competition.

*RC_Item 4
(1) Inverse scope context
A teacher and some children were playing a game in the park. The game was to carry a big balloon to the finish line. There were three big balloons – red, yellow and blue. One child was carrying the red balloon, and he was happy. The other child was carrying the yellow balloon, and she was happy, too. Lastly, someone had to carry the blue balloon. There was one young brave child left. He was carrying the blue balloon, and he was happy.

Frozen Sentence: Some child who was carrying every big balloon was happy.
APPENDIX K.
12 BI-CLAUSAL FROZEN SCOPE ITEMS
(USED IN THE EXPERIMENTS 7, 8, AND 9 IN CHAPTER 4)

3 frozen types:
1. matrix subject some N – embedded complement with subject every N (Subject every)
2. matrix subject some N – embedded complement with object every N(Object every)
3. matrix object some N – embedded relative clause with every N (RC)

<table>
<thead>
<tr>
<th>Task</th>
<th>Frozen type</th>
<th>Sentence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline task</td>
<td>Frozen1_Subj</td>
<td>Some tourist reported that every tour to the Eiffel Tower was enjoyable.</td>
</tr>
<tr>
<td></td>
<td>Every</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Frozen2_Subj</td>
<td>Some boy claimed that every apple was most delicious.</td>
</tr>
<tr>
<td></td>
<td>Every</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Frozen3_Object</td>
<td>Some woman said that Steven Spielberg directed every movie mentioned.</td>
</tr>
<tr>
<td></td>
<td>Every</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Frozen4_Object</td>
<td>Some doctor noticed that Paul kissed every new nurse.</td>
</tr>
<tr>
<td></td>
<td>Every</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Frozen5_Object</td>
<td>Some witness testified that the man had robbed every bank in town.</td>
</tr>
<tr>
<td></td>
<td>Every</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Frozen6_RC</td>
<td>John interviewed some girl that won every award at the dance competition.</td>
</tr>
<tr>
<td>Experimental</td>
<td>Frozen1_Subj</td>
<td>Some tourist wrote that every bridge mentioned was beautiful.</td>
</tr>
<tr>
<td>task</td>
<td>Every</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Frozen2_Subj</td>
<td>Some reviewer claimed that every book was acceptable.</td>
</tr>
<tr>
<td></td>
<td>Every</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Frozen3_Object</td>
<td>Some student reported that Jackson read every book on the first week’s syllabus.</td>
</tr>
<tr>
<td></td>
<td>Every</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Frozen4_Object</td>
<td>Some technician confessed that John fixed every broken computer.</td>
</tr>
<tr>
<td></td>
<td>Every</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Frozen5_Object</td>
<td>The teacher cheered on some child who was carrying every big balloon.</td>
</tr>
<tr>
<td></td>
<td>Every</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Frozen6_RC</td>
<td>The father watched some horse that every child wanted to ride.</td>
</tr>
</tbody>
</table>

Table 1. Experiments 7-9: Bi-clausal frozen scope items

1. Baseline_Frozen1_SubjEve.
   (1) Inverse scope context
   When I lived in France, I volunteered as a tour guide to the Eiffel Tower three times. During the first tour, I had an American tourist who reported that the first tour was enjoyable. During the second tour, I had a French tourist who reported the same. During the last tour, I had a Japanese tourist who made a similar report, which delighted me.
Frozen Sentence: Some tourist reported that every tour to the Eiffel Tower was enjoyable.

**Baseline_Frozen2_SubjEve**

(1) **Inverse scope context**
Mickey was looking for a delicious apple. There were three apples: one was red, one was green and one was yellow. He asked a group of boys to choose him the most delicious apple for him. First, one of the boys claimed “The red apple is most delicious.” The other boy claimed, “The green apple is most delicious.” A third boy claimed, “The yellow apple is most delicious.” Mickey could not decide which apple was most delicious.

Frozen Sentence: Some boy claimed that every apple was most delicious.

**Baseline_Frozen3_ObjEve**

(1) **Inverse scope context**
The theater was showing three movies: Catch me if you Can, The Terminal, and A.I. I decided to watch all of them one after the other. First, I bought a ticket for Catch me if you Can. One woman at the ticket counter said that Steven Spielberg directed Catch me if you Can. Later, I bought a ticket for The Terminal at another window. Surprisingly, another
woman there said that Steven Spielberg directed The Terminal. Finally, I bought a ticket for A.I, when I heard that according to a third woman, A. I. was also directed by Steven Spielberg.

3 movies by Steven Spielberg

A.I.  The Terminal  Catch me if you can

Frozen Sentence: Some woman said that Steven Spielberg directed every movie mentioned.

Baseline_Frozen4_ObjEve

(1) Inverse scope context
I work in a hospital together with a small group of doctors. Last week, we hired three new nurses named Mary, Alli and Jane. Each of us had a crush on a different nurse. Unfortunately, rumor had it that another doctor named Paul was dating all of the newly hired nurses. Paul thought he was a real ladies’ man and he wanted to get the attention of women all the time. One doctor in our group noticed Paul kissing the nurse named Mary. Also, another doctor noticed Paul kissing the nurse named Alli. The last doctor noticed Paul kissing the nurse named Jane.

3 new nurses

Mary  Alli  Jane

Frozen Sentence: Some doctor noticed that Paul kissed every new nurse.
Baseline_Frozen5_ObjEve
(1) Inverse scope context
Our town was small and there were only three banks – Central, Hawaii, and Pacific. A man was arrested for robbing all three of the banks. The prosecutor was looking for witnesses and soon, one witness appeared and testified that the man had robbed Central Bank. After that, a different witness appeared to testify that the man had robbed Hawaii Bank. Finally, there appeared a third witness, and he testified that the man had robbed the Pacific Bank.

Frozen Sentence: Some witness testified that the man had robbed every bank in town.

Baseline_Frozen6_RC
(1) Inverse scope context
A dance competition took place on campus over three days. Many girls competed in three areas, including Hula, Tango and Salsa. John planned to interview the winner of each award. The first day, a freshman girl won the Hula award, and John interviewed her. The second day, a junior girl won the Tango award, and John interviewed her, too. The last day, a senior girl won the Salsa award, and John interviewed her, as well.
Frozen Sentence: John interviewed some girl that won every award at the dance competition.

Experimental_Frozen1_SubjEve
(1) Inverse scope context
I was reading about the world’s most beautiful bridges. Three of these bridges are located in Sydney, London, and San Francisco. I found some recent first-hand accounts posted on the web by tourists. One tourist wrote that the bridge in Sydney was truly beautiful. The other tourist wrote that the bridge in London was really beautiful as well. A third tourist wrote that the bridge in San Francisco was genuinely beautiful. I wish I could visit each of these bridges someday.

![The world famous bridges](images)

Frozen Sentence: Some tourist wrote that every bridge mentioned was beautiful.

Experimental_Frozen2_SubjEve
(1) Inverse scope context
Several parents volunteered as school book reviewers. One day, they were asked to review three historically banned books and decide if they would be acceptable as school books now. The three books were The Adventures of Huckleberry Finn, Catcher in the Rye, and Fahrenheit 451. For Adventures of Huckleberry Finn, one reviewer claimed that it was acceptable. For Catcher in the Rye, another reviewer claimed that it was acceptable. For the last, Fahrenheit 451, a third reviewer claimed that it was also acceptable.
Frozen Sentence: Some reviewer claimed that every book was acceptable.

Experimental_Frozen3_ObjEve
(1) Inverse scope context
I was teaching a Literature class, and Jackson was my teaching assistant. Jackson was a responsible TA. The first week of class, three book chapters had been on the syllabus to read. One by Hemingway, one by Twain, and one by Fitzgerald. A freshman student reported to me that Jackson had read the entire Hemingway novel. Also, there was a junior student who reported that Jackson had read the book by Twain. Moreover, a senior student reported that Jackson had read the book by Fitzgerald. I was proud of Jackson.

Frozen Sentence: Some student reported that Jackson read every book on the first week’s syllabus.

Experimental_Frozen4_ObjEve
(1) Inverse scope context
I was training computer technicians, and John was my assistant. One day, I brought in three broken computers: a Mac, a Dell, and a Sony. I wanted to see how good the technicians were at fixing broken computers. Later however, one technician confessed that
John fixed the Mac. Another technician confessed that John fixed the Dell. A third technician also confessed that it was John who fixed the Sony. I was very disappointed because John did all the work.

Frozen Sentence: Some technician confessed that John fixed every broken computer.

**Experimental_Frozen5_RC**

(1) **Inverse scope context**

A teacher and some children were playing a game in the park. The game was to carry a big balloon to the finish line. There were three big balloons – red, yellow, and blue. One girl was carrying the red balloon, and the teacher cheered her on. Another girl was carrying the yellow balloon, and the teacher cheered her on, too. Last, there was one blue balloon left. A third young boy was carrying the blue balloon, and the teacher cheered him on, too.

Frozen Sentence: The teacher cheered on some child who was carrying every big balloon.

**Experimental_Frozen6_RC**

(1) **Inverse scope context**
Three children and their father went to the farm. The children’s names were Mike, Tiffany, and Julie. They each wanted to ride on a horse, but their father was worried the horses were too wild. There were several horses to choose from. First, Mike picked a white horse to ride so his father watched the horse run to see if it was calm enough. Next, Tiffany picked a brown horse, so her father watched that horse, too. Last, Julie picked a black horse and her father watched the black horse, too. The three children got to ride them and had lots of fun.

Frozen Sentence: The father watched some horse that every child wanted to ride.
APPENDIX J.
12 TARGET SOME-EVERY SENTENCES: BASELINE CONTEXT
(ENUMERATION)

Item 1: Some man requested every pop artist that the DJ liked most.

(2) Inverse scope context (Baseline-enumeration)
A radio DJ had three favorite classic pop artists. They were Elvis Presley, Louis Armstrong, and B. B. King. One morning, he was taking song requests. One man requested a song by Elvis Presley and then another man requested a song by Louis Armstrong. Lastly, a third man called in and requested a song by B. B. King. The DJ was happy.

Test Sentence: Some man requested every pop artist that the DJ liked most.

(1) Surface scope context (Baseline-enumeration)
A radio DJ had three favorite classic pop artists. They were Elvis Presley, Louis Armstrong, and B. B. King. One morning, he was taking song requests. One man requested a song by Elvis Presley and then requested a song by Louis Armstrong. He further requested a song by B. B. King. The DJ was happy.

Test Sentence: Some man requested every pop artist that the DJ liked most.

Item 2: Some student interviewed every new assistant professor hired recently.

(2) Inverse scope context (Baseline-enumeration)
Our department recently hired three new assistant professors. Their names were Dr. James, Dr. Dean, and Dr. Anderson. Rumor had it that the chair didn’t like them, because they were so innovative. To see whether they were really innovative, the student council planned an interview with each of these new assistant professors. One student interviewed
Dr. James, and another student interviewed Dr. Dean. Finally, a third student interviewed Dr. Anderson. All of them really were innovative.

Test Sentence: Some student interviewed every new assistant professor hired recently.

(1) Surface scope context (Baseline-enumeration)
Our department recently hired three new assistant professors. Their names were Dr. James, Dr. Dean, and Dr. Anderson. Rumor had it that the chair didn’t like them, because they were so innovative. To see whether they were really innovative, the student council planned an interview with each of these new assistant professors. One student of the council interviewed Dr. James, and then interviewed Dr. Dean, and finally interviewed Dr. Anderson. All of them really were innovative.

Test Sentence: Some student interviewed every new assistant professor hired recently.

Item 3: Some girl admired every remaining member of Queen.

(2) Inverse scope context (Baseline-enumeration)
I like the rock band Queen. One day, I saw my daughter and her friends watching a video of a Queen concert in memory of the Queen lead singer Freddie who died from AIDS. Queen then had only three remaining members. I noticed that the three remaining members of Queen were still pretty popular among the younger generations. One girl admired John Deacon, the bass guitarist. Another girl admired Brian May, the Queen guitarist. A third girl admired Roger Taylor, the Queen drummer. I was so impressed by Queen.
Test Sentence: Some girl admired every remaining member of Queen.

(1) **Surface scope context (Baseline-enumeration)**
I like the rock band of Queen. One day, I saw my daughter and her friends watching a video of a Queen concert in memory of the Queen lead singer Freddie who died from AIDS. Queen then had only three remaining members. I noticed that the three remaining members of Queen were still pretty popular among the younger generations. One girl admired John Deacon, the bass guitarist. She also admired Brian May, the Queen guitarist, and Roger Taylor, the Queen drummer, too. I was so impressed by Queen.

Test Sentence: Some girl admired every remaining member of Queen.

Item 4: Some member watched every movie this week.

(2) **Inverse scope context (Baseline-enumeration)**
Movie club members, including John, Jane, and Jacob, decided to discuss three movies every week. The movies selected for this week were sci-fi films based on the works of Philip Dick, an American science fiction novelist. The titles were Blade Runner, Total Recall and Minority Report. The members wondered who would actually watch the movies this week. It turned out that John watched Blade Runner, Jane watched Total Recall, and Jacob, a new member, watched Minority Report.
3 sci-fi films based on the works of Philip Dick

Test Sentence: Some member watched every movie this week.

(1) Surface scope context (Baseline-enumeration)
Movie club members, including John, Jane, and Jacob, decided to discuss three movies every week. The movies selected for this week were sci-fi films based on the works of Philip Dick, an American science fiction novelist. The titles were Blade Runner, Total Recall and Minority Report. The members wondered who would actually watch the movies this week. It turned out that Jacob, a new member, watched Blade Runner, and then watched Total Recall, and also watched Minority Report.

Test Sentence: Some member watched every movie this week.

Item 5: Some member tested every gross recipe that was created.
(2) Inverse scope context (Baseline-enumeration)
For Halloween, members of the social club created three gross recipes. They named them Monster Toe, Apple eyeball, and Pumpkin brain. The social club wondered whether their recipes were all edible. The president of the club tested the Monster Toe. The vice president tested the Apple eyeball. Last, the secretary tested the Pumpkin brain. It turned out that all were edible.
Test Sentence: Some member tested every gross recipe that was created.

(1) Surface scope context (Baseline-enumeration)
For Halloween, members of the social club created three gross recipes. They named them Monster Toe, Apple eyeball, and Pumpkin brain. The social club wondered whether their recipes were all edible. The president of the club tested Monster Toe. He tested Apple eyeball, and Pumpkin brain, too. It turned out that all were edible.

Test Sentence: Some member tested every gross recipe that was created.

Item 6: Some girl had made every snowman near the pond.
(2) Inverse scope context (Baseline-enumeration)
As I was walking by the pond last winter, I saw a group of girls playing in the snow. On my way back, I found three cute snowmen standing near the pond – a small one, a medium one and a big one. I learned that one little girl named Susie had made the small snowman, and another girl named Judy had made the medium sized one. Last, the big snowman was made by a girl named Sandra.
Test Sentence: Some girl had made every snowman near the pond.

(1) **Surface scope context (Baseline-enumeration)**
As I was walking by the pond last winter, I saw a group of girls playing in the snow. On my way back, I found three cute snowmen standing near the pond – a small one, a medium one, and a big one. I learned that one little girl named Susie had made the small snowman. She also made the medium sized one, and the big one, too.

Test Sentence: Some girl had made every snowman near the pond.

Item 7: **Some student recognized every piece of art work that I love.**
(2) **Inverse scope context (Baseline-enumeration)**
There are three art works on the UH campus that I love. One is a bronze sculpture entitled Chance Meeting, and the second is a red-orange steel sculpture entitled Gate of Hope. The last one is the huge stained-glass windows at the Keller Hall main entrance. I wondered whether these three art works would also be recognized by other UH people. Indeed, I met a law student who recognized Chance Meeting. Also, I met an engineering student who recognized the Gate of Hope. Lastly, I met a mathematics student, and he recognized the stained-glass windows.
Test Sentence: Some student recognized every piece of art work that I love.

(1) Surface scope context (Baseline-enumeration)
There are three art works on the UH campus that I love. One is a bronze sculpture entitled Chance Meeting, and the second is a red-orange steel sculpture entitled Gate of Hope. The last one is the huge stained-glass windows at the Keller Hall main entrance. I wondered whether these three art works would also be recognized by other UH people. Indeed, I met an art student who recognized the Chance Meeting. She recognized the Gate of Hope and the stained-glass windows, too.

Test Sentence: Some student recognized every piece of art work that I love.

Item 8: Some visitor had touched every Lego sculpture in the lobby.

(2) Inverse scope context (Baseline-enumeration)
I am a Lego artist. I displayed three huge Lego works in the lobby of the Aloha tower to encourage creativity among viewers. My Lego sculptures were called Huge Pencil, Infinity, and Sing. The three works on display attracted many visitors. The next day however, I found the displays had been altered. According to somebody, one eager viewer had touched Huge Pencil and another viewer had touched Infinity. Yet another viewer had touched Sing.
Test Sentence: Some visitor had touched every Lego sculpture in the lobby.

(1) **Surface scope context (Baseline-enumeration)**
I am a Lego artist. I displayed three huge Lego works in the lobby of the Aloha tower to encourage creativity among viewers. My Lego sculptures were called Huge Pencil, Infinity, and Sing. The three works on display attracted many visitors. The next day however, I found the displays had been altered. According to somebody, one eager viewer had touched Huge Pencil and went on to touch Infinity and Sing.

Test Sentence: Some visitor had touched every Lego sculpture in the lobby.

**Item 9: Some scout put up every tent around the campsite.**

(2) **Inverse scope context (Baseline-enumeration)**
One summer, I took a group of boyscouts camping near the Great Lakes. We unpacked three camping tents – a large, a medium, and a small one. I left the group for a while to buy snacks. When I got back, I found the tents were nicely put up around the campsite. According to people, one scout put up the large tent first, and another scout put up the medium sized tent. Last, a third scout put up the small tent.
Test Sentence: Some scout put up every tent around the campsite.

(1) Surface scope context (Baseline-enumeration)
One summer, I took a group of boy scouts camping near the Great Lakes. We unpacked three camping tents – a large, a medium, and a small one. I left the group for a while to buy snacks. When I got back, I found the tents were nicely put up around the campsite. According to people, one experienced scout put up the large tent first, then the medium sized tent, and lastly the small tent.

Test Sentence: Some scout put up every tent around the campsite.

Item 10: Some girl wrote every winning story last year.
(2) Inverse scope context (Baseline-enumeration)
I used to teach science in elementary school. I encouraged students to write science fiction stories to learn more about science. The school selected and awarded prizes for the three best works of fiction. The stories awarded prizes last year were those entitled Dragon fire, Our future home, and Magic car. I later found that the author of Dragon fire was a 3rd-grade girl, and the author of Our future home was a 4th-grade girl. It was a 5th-grade girl who wrote Magic car.
Test Sentence: Some girl wrote every winning story last year.

(1) Surface scope context (Baseline-enumeration)
I used to teach science in elementary school. I encouraged students to write science fiction stories to learn more about science. The school selected and awarded prizes for the three best works of fiction. The stories awarded prizes last year were those entitled Dragon fire, Our future home, and Magic car. I later found that one 5th-grade girl wrote Dragon fire, and Our future home, too. She even also wrote Magic car.

Test Sentence: Some girl wrote every winning story last year.

Item 11: Some kid took every button that I glued.
(2) Inverse scope context (Baseline-enumeration)
I noticed that kids have a weird desire to press random buttons without any reason. So I decided to make three big fake buttons to entertain them, and glued each on a different machine - the dish-washer, the oven, and the refrigerator. My son brought his friends over to show them these amazing buttons. Later, I found that all the buttons had been stolen. According to my son, one kid named Jimmy took the button on the dish-washer, another kid named John took the button on the oven. It was yet another kid named Jane who took the button on the refrigerator.
Test Sentence: Some kid took every button that I glued.

(1) Surface scope context (Baseline-enumeration)
I noticed that kids have a weird desire to press buttons without any reason. So I decided to make three big fake buttons to entertain them, and glued each on a different machine - the dish-washer, the oven, and the refrigerator. My son brought his friends over to show them these amazing buttons. Later, I found that all the buttons had been stolen. According to my son, one kid named Jimmy took the button on the dish-washer, then took the button on the oven. He took the button on the refrigerator, too!

Test Sentence: Some kid took every button that I glued.

Item 12: Some tourist visited every sandwich place that I recommended.
(2) Inverse scope context (Baseline-enumeration)
I work as a tour guide in New York. Here are some nice places in New York where you can get a tasty sandwich. The first place is Cosi. The next is Max Brenner’s restaurant. The third nice place to go is Katz’s Deli. I had a group of European tourists, and recommended these three places. I later heard that one tourist from Spain actually visited Cosi, and another tourist from France visited Max Brenner’s. A third tourist from Germany visited Katz’s Deli.
Test Sentence: Some tourist visited every sandwich place that I recommended.

(1) Surface scope context (Baseline-enumeration)
I work as a tour guide in New York. Here are some nice places in New York where you can get a tasty sandwich. The first place is Cosi. The next is Max Brenner's restaurant. The third nice place to go is Katz’s Deli. I had a group of European tourists, and recommended these three places. I later heard that one tourist who was an Italian chef actually visited Cosi, and Max Brenner’s. He even visited Katz’s Deli, too!

Test Sentence: Some tourist visited every sandwich place that I recommended.
APPENDIX K.
EXPERIMENT 6B

1. Experiment 6B: Baseline Context - Paraphrase Version

1.1 Purpose
We changed the baseline context minimally from experiment 6A by removing the explicit enumeration, and adding a paraphrase at the end of the context. The purpose was to investigate the role of the enumeration and to help establish which version should be the baseline.

1.2 Materials
The design and material were the same as in experiment 6A, except that the discourse was the baseline “paraphrase” version. In this paraphrase version, surface or inverse scope reading was conveyed in one single sentence of a paraphrase, not enumerating a single or multiple events. The paraphrase summary sentence of either scope reading was presented at the end of a story. For instance, the surface scope paraphrase was like “there was one enthusiastic man who called. He requested songs by all of the DJ’s favorite pop artists.” The inverse scope paraphrase was like “a different man requested a song by each of his favorite pop artists.” See the same stories below.

Sample Target:
(1) Inverse scope context (baseline context, paraphrase)
A radio DJ has three favorite pop artists. They are Elvis Presley, Louis Armstrong, and B. B. King. One morning, he was taking song requests but really wanting to play his favorite artists. Many listeners called in. Luckily in the end, a different man requested a song by each of his favorite pop artists. The DJ was happy.

Test Sentence: Some man requested every pop artist that the DJ liked.
Surface scope context (baseline context, paraphrase)

A radio DJ has three favorite pop artists. They are Elvis Presley, Louis Armstrong, and B. B. King. One morning, he was taking song requests but really wanting to play his favorite artists. That morning, there was one enthusiastic man who called. He requested songs by all of the DJ’s favorite pop artists. The DJ was happy.

Test Sentence: Some man requested every pop artist that the DJ liked.

1.3 Procedure
The procedure and task instructions (yes, okay) were identical to experiment 5A.

1.4 Participants
Fifteen native speakers of English participated in experiment 6B, all undergraduate students at the University of Hawaii. 5 were excluded due to low accuracy (below 70%) on fillers. Data from ten participants were analyzed.

1.5 Results
Data analyses were conducted on the accuracy and proportions of Yes (okay) / No (not okay) judgment responses. The results of the test items from experiment 5B (baseline-paraphrase context) are presented in the table below (k = number of tokens; N = number of participants; M = Mean number of items (out of 6) rated as ‘Okay’ description of the story; SD = Standard Deviation; M % = Percent acceptance out of all items (total = 60)).

<table>
<thead>
<tr>
<th>Type</th>
<th>Sentence</th>
<th>Context (baseline-paraphrase)</th>
<th>N</th>
<th>M (SD, M %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target</td>
<td>Some-Every (k=6)</td>
<td>Surface</td>
<td>10</td>
<td>5.20 (1.03, 86.67)</td>
</tr>
<tr>
<td></td>
<td>Some-Every (k=6)</td>
<td>Inverse</td>
<td>10</td>
<td>2.20 (1.48, 36.67)</td>
</tr>
</tbody>
</table>

Table 1. Experiment 6B: Results: Target items

Participants accepted some-every sentences in the surface scope baseline (paraphrase) contexts 87% of the time. The acceptance rate of the test sentences in the inverse scope...
baseline (paraphrase) contexts was 37%. The accuracy rate with filler items (k=14) was 89%.
APPENDIX L.

REVISED 12 BI-CLAUSAL FROZEN SCOPE ITEMS
(USED IN THE EXPERIMENTS 10 THROUGH 13 IN CHAPTER 5)
(Pictures were the same as in the frozen scope items in Chapter 4)

3 frozen types:
1. matrix subject some N – embedded complement with subject every N (Subject every)
2. matrix subject some N – embedded complement with object every N (Object every)
3. matrix object some N – embedded relative clause with every N (RC)

<table>
<thead>
<tr>
<th>Task</th>
<th>Frozen type</th>
<th>Sentence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline task</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frozen1_Subj</td>
<td>Subject Every</td>
<td>Some tourist reported that every tour that I guided was enjoyable.</td>
</tr>
<tr>
<td>Frozen2_Object</td>
<td>Object Every</td>
<td>Some girl guessed that Spielberg directed every movie mentioned.</td>
</tr>
<tr>
<td>Frozen3_Object</td>
<td>Object Every</td>
<td>Some doctor noticed that Paul kissed every new nurse.</td>
</tr>
<tr>
<td>Frozen4_RC</td>
<td>RC</td>
<td>John interviewed some girl that won every award at the dance competition.</td>
</tr>
<tr>
<td>Frozen5_RC</td>
<td></td>
<td>The teacher cheered on some child who was carrying every big balloon.</td>
</tr>
<tr>
<td>Frozen6_RC</td>
<td></td>
<td>The father watched some horse that every child wanted to ride.</td>
</tr>
<tr>
<td>Experimental task</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frozen1_Subj</td>
<td>Subject Every</td>
<td>Some boy claimed that every apple was delicious.</td>
</tr>
<tr>
<td>Frozen2_Object</td>
<td>Object Every</td>
<td>Some witness testified that the man had robbed every bank in town.</td>
</tr>
<tr>
<td>Frozen3_Object</td>
<td>Object Every</td>
<td>Some student found that Jackson had read every book assigned.</td>
</tr>
<tr>
<td>Frozen4_RC</td>
<td>RC</td>
<td>The school had some reviewer that found every book acceptable.</td>
</tr>
<tr>
<td>Frozen5_RC</td>
<td></td>
<td>John rewarded some technician that had fixed every broken computer.</td>
</tr>
<tr>
<td>Frozen6_RC</td>
<td></td>
<td>The architect found some tourist that had visited every bridge mentioned.</td>
</tr>
</tbody>
</table>

Table 1. Experiments 10-13: Bi-clausal frozen scope items

The discourse was clarified in a crystal-clear inverse-scope manner, excluding the surface-scope reading circumstance by adding a sentence at the end.

Baseline_Frozen1_SubjEve_Clarified
(1) Inverse scope context
When I lived in France, I volunteered as a tour guide taking visitors to the Eiffel Tower three times. I had three tourists, who found the tours enjoyable. During the first tour, an
American tourist reported that the tour was enjoyable. During the second tour, a French tourist reported the same. During the last tour, I had a Japanese tourist who agreed as well that the tour was enjoyable. I didn’t have a tourist who attended all of the tours. Yet, everyone found the tour enjoyable, which delighted me.

Baseline_Frozen2_ObjEve_Clarified
(1) Inverse scope context
I brought my niece and her friends to the theatre. The theater was showing three movies: Catch Me If You Can, The Terminal, and A.I. While we waited, I quizzed them about which of these movies had been directed by Steven Spielberg. The girls chose different movies: One girl guessed that Spielberg directed Catch Me If You Can. Another girl then guessed that he directed The Terminal. Finally, a third girl guessed that A. I. was directed by Spielberg. In fact, Spielberg had directed all three movies, but none of the girls knew it.

Baseline_Frozen3_ObjEve_Clarified
(1) Inverse scope context
A small group of doctors work in a hospital together. Recently, the hospital hired three new nurses named Mary, Alli and Jane. Rumor had it that a doctor named Paul was dating all of the newly hired nurses. One week, three other doctors noticed Paul kissing the nurses: First, a surgeon noticed Paul kissing Mary. Next day, a pediatrician noticed Paul kissing Alli, and a third doctor noticed Paul kissing Jane. No single doctor saw Paul kissing all these new nurses.

Baseline_Frozen4_RC_Clarified
(1) Inverse scope context
A dance competition took place on campus. Many girls competed in three areas: Hula, Tango and Salsa. John planned to interview the winner of each award. A different girl won each award. A freshman girl won the Hula award, and John interviewed her. A junior girl won the Tango award. Last, a third senior girl won the Salsa award, and John interviewed her. John didn’t find a girl who had danced in all three competitions, so he was busy interviewing three different girls.
Frozen Sentence: John interviewed some girl that won every award at the dance competition.

Baseline_Frozen5_RC_Clarified
(1) Inverse scope context
A teacher and a group of children were playing a game in the park. The game was to carry a balloon from the starting line to the finish line. There were only three big balloons – a red one, a yellow one, and a blue one. One girl was carrying the red balloon, and the teacher cheered her on. Another girl was carrying the yellow balloon, and the teacher cheered her on. A third young boy was carrying the last blue balloon, and the teacher cheered him on. None of the children attempted to move all three balloons because they were too big.

Baseline_Frozen6_RC_Clarified
(1) Inverse scope context
Three children and their father went to a farm. The children’s names were Mike, Tiffany and Julie. They each wanted to ride on a horse, but their father was worried that the horses were too wild. There were several horses to choose from. First, Mike picked a white horse to ride so his father watched the horse run to see if it was tame enough. Next, Tiffany picked a brown horse, so her father watched that horse, too. Last, Julie picked a black horse and her father watched the black horse, as well. The three children picked different horses to ride, so the father was busy watching them all.

Experimental_Frozen1_SubjEve_Clarified
(1) Inverse scope context
Mickey was looking for a delicious apple. There were three apples to choose from: one was red, one was green, and one was yellow. Mickey asked a group of boys to choose a delicious apple for him. First, one of the boys claimed “Only the red apple is delicious and the others are not” The other boy claimed, “The green apple only is delicious.” A third boy claimed, “The only delicious is the yellow apple.” Three different boys chose three different apples, so Mickey could not decide which apple to choose.

Experimental_Frozen1_SubjEve_Clarified
(1) Inverse scope context
Mickey was looking for a delicious apple. There were three apples to choose from: one was red, one was green, and one was yellow. Mickey asked a group of boys to choose a delicious apple for him. First, one of the boys claimed “Only the red apple is delicious and the others are not” The other boy claimed, “The green apple only is delicious.” A third boy claimed, “The only delicious is the yellow apple.” Three different boys chose three different apples, so Mickey could not decide which apple to choose.

Experimental_Frozen1_SubjEve_Clarified
(1) Inverse scope context
Mickey was looking for a delicious apple. There were three apples to choose from: one was red, one was green, and one was yellow. Mickey asked a group of boys to choose a delicious apple for him. First, one of the boys claimed “Only the red apple is delicious and the others are not” The other boy claimed, “The green apple only is delicious.” A third boy claimed, “The only delicious is the yellow apple.” Three different boys chose three different apples, so Mickey could not decide which apple to choose.

Frozen Sentence: The father watched some horse that every child wanted to ride.

Frozen Sentence: The teacher cheered on some child who was carrying every big balloon.

Frozen Sentence: John interviewed some girl that won every award at the dance competition.
Experimental_Frozen2_ObjEve_Clarified
(1) Inverse scope context
Our town was small and there were only three banks – Central, Hawaii, and Pacific. A man was arrested for robbing all three banks. The prosecutor was looking for witnesses. One day, three witnesses came forward to testify: One witness testified that the man had robbed Central Bank. Another witness testified that the man had robbed the Hawaii Bank. A third witness testified that the man had robbed the Pacific Bank. Three different witnesses testified about different banks, and none of them saw the man robbing all the banks.

Frozen Sentence: Some witness testified that the man had robbed every bank in town.

Experimental_Frozen3_ObjEve_Clarified
(1) Inverse scope context
One day, I was giving a lecture on American literature. I had assigned three books to read that day. One by Hemingway, one by Twain, and one by Fitzgerald. There was one talented student named Jackson. Several students interviewed Jackson and were impressed that he actually had done all of the readings. A freshman student found that Jackson had read the Hemingway novel. A junior student found that Jackson had read the book by Twain. A senior student found that Jackson had read the book by Fitzgerald. None of the students asked Jackson if he had read all the books.

Frozen Sentence: Some student found that Jackson had read every book assigned.

Experimental_Frozen4_RC_Clarified
(1) Inverse scope context
The school wanted to decide if three historically banned books would be acceptable as school books today. The three books were *The Adventures of Huckleberry Finn*, *Catcher in the Rye*, and *Fahrenheit 451*. Several parents volunteered to review these banned books. One reviewer found that only *The Adventures of Huckleberry Finn* was acceptable. Another found that only *Catcher in the Rye* was acceptable. A third reviewer found that only *Fahrenheit 451* was acceptable. Three different reviewers found different books acceptable, and none of them had time to read all three banned books.

Frozen Sentence: The school had some reviewer that found every book acceptable.

Experimental_Frozen5_RC_Clarified
(1) Inverse scope context
John was training computer technicians. One day, he brought in three broken computers: a Mac, a Dell, and a Sony. He asked the technicians to fix all these broken computers. Several technicians volunteered: One technician fixed the Mac, and John rewarded him. Another technician fixed the Dell, and John rewarded him. A third technician fixed the
Sony, and John rewarded her. Three different technicians fixed different broken computers, and none of them had the skill required to fix all three.

Frozen Sentence: John rewarded some technician that had fixed every broken computer.

**Experimental_Frozen6_RC_Clarified**

(1) Inverse scope context

An architect was reading about the world’s most popular bridges. The website mentioned three bridges - one in Sydney, one in London, and one in San Francisco. The architect wondered whether these bridges were really popular. He found accounts posted about these bridges by tourists: He found a French tourist, who had visited the bridge in Sydney but not the other bridges. He then found an American tourist, who had visited the bridge in London only. Finally, the architect found a British tourist, who had visited the bridge in San Francisco only. None of the tourists had seen all three bridges.

Frozen Sentence: The architect found some tourist that had visited every bridge mentioned.
APPENDIX M.
SUMMARY OF RESULTS OF CONTROL 3
(OTHER QUANTIFIER PAIRS)

The same set of Control 3 items (k=2) was tested in the inverse scope contexts across 13 experiments. One was Some N – Each N type, and the other was Someone-Every N type, one item respectively. Results on the two items from the 13 experiments are summarized in table 1 and figure 1.

<table>
<thead>
<tr>
<th>Experiment</th>
<th>1. Some N-Each N</th>
<th>2. Someone-Every N</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inverse scope context</td>
<td>Inverse scope context</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Chapter 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (N=36)</td>
<td>0.36</td>
<td>0.49</td>
</tr>
<tr>
<td>2 (N=27)</td>
<td>0.59</td>
<td>0.50</td>
</tr>
<tr>
<td>3 (N=25)</td>
<td>0.60</td>
<td>0.50</td>
</tr>
<tr>
<td>4 (N=21)</td>
<td>0.81</td>
<td>0.40</td>
</tr>
<tr>
<td>Chapter 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 (N=31)</td>
<td>0.29</td>
<td>0.32</td>
</tr>
<tr>
<td>8 (N=29)</td>
<td>0.38</td>
<td>0.38</td>
</tr>
<tr>
<td>9 (N=31)</td>
<td>0.35</td>
<td>0.45</td>
</tr>
<tr>
<td>Chapter 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 (N=78)</td>
<td>0.29</td>
<td>0.41</td>
</tr>
<tr>
<td>11 (N=83)</td>
<td>0.34</td>
<td>0.45</td>
</tr>
<tr>
<td>12 (N=82)</td>
<td>0.41</td>
<td>0.33</td>
</tr>
<tr>
<td>13 (N=84)</td>
<td>0.25</td>
<td>0.39</td>
</tr>
</tbody>
</table>

Table 1. Results: Other Quantifier Pairs
1. Some student checked out each Davinci book in the library.
2. Someone played every musician that I wanted to hear this morning.

Figure 1. Results: Other Quantifier Pairs
The results found contrast between the two items. Across the 13 groups, the sentence of *someone-every N* consistently obtained numerically higher rates of acceptance than the sentence of *some N–each N*. This piece of finding seems to suggest these two – (i) the type of indefinites (*some N versus someone*) is more a critical factor for easing inverse scope difficulty than the type of universal quantifiers (*each versus every*); (ii) *some N* seems to be more demanding for readers in accessing inverse scope than *someone*, which is normally expected.

We conducted group analysis, as table 2 shows, to see how low, medium, high-inverse people in the Baseline task responded to these two items (0 means rejection of the item; 1 means acceptance of the item). Strikingly, more than half of the low-inverse people in the Baseline task (122/181, 67%) rejected inverse scope on both items of other quantifier pairs. Half of the low-inverse people in the Baseline target *some-every sentences* were not sensitive to differential quantifier types at all.

<table>
<thead>
<tr>
<th>Baseline Group</th>
<th>Someone-Every</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Inverse</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some-</td>
<td>0</td>
<td>122</td>
</tr>
<tr>
<td>Each</td>
<td>1</td>
<td>34</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>156</td>
</tr>
<tr>
<td>Medium Inverse</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some-</td>
<td>0</td>
<td>29</td>
</tr>
<tr>
<td>Each</td>
<td>1</td>
<td>18</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>47</td>
</tr>
<tr>
<td>High Inverse</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some-</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Each</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>18</td>
</tr>
</tbody>
</table>

Table 2. Results: Other Quantifier Pairs: Group Analysis
APPENDIX N.
POST-EXPERIMENT SURVEY
THE LOGICAL INTERPRETATION OF SOME

1 Purpose

In classical logic and semantics, some means at least one and possibly all. Some statements can be accepted in every context; if every boy swam, then, some boy swam (every boy swam entails some boy swam). In pragmatics, however, the use of indefinite NP some N is associated with not every implicature. If you know every boy swam, then use every instead of some. Experimental evidence indeed suggests that English-speaking adults typically prefer the pragmatic interpretation of some (implying not all) (Grodner et al., 2010; Huang and Snedeker, 2009, 2011).

Given that, it is expected that indefinite “some” leads to interpretive complexity in these three fashions. First, the indefinite some can be quantificational or referential. Second, the same form of indefinite article some can be used as singular or plural. Third, the use of some is associated with not every pragmatic implicature (some but not all).

We collected extra data in connection with participants’ lexical knowledge of a quantifier some N from the post-questionnaire survey, where we tested adults’ knowledge of some N as logical operators through two picture-selection items. This section reports the results on the items from the last set of experiments (327 participants). The crucial point to show here is that the lexical understanding of some N for our participants in the last set of experiments was more or less consistent with classical logic. The finding enables us to eliminate the concern that pragmatic or referential biases crucially affected our data (marginal rates of acceptance for the target inverse items).

2 Procedure and Materials:

As soon as participants completed the Experimental task, they were given a post-questionnaire survey. The first two items were questions that tested readers’ understanding of some N (Quiz A and B presented below). The test sentence was Some animal is standing. The sentence was followed by a set of four pictures. Each picture had the same three animals, a cat, a dog, and a cow. The four pictures varied in the number of animals standing.

In Quiz 1, the 1st picture had no animal standing; the 2nd picture had only one animal standing (a cat); the 3rd picture had exactly two animals standing (a cat and a dog); the last picture had all three animals standing (a cat, a dog, and a cow). Participants were instructed to choose ALL possible situations that make the test sentence true, and then briefly explain why each picture is true.
Quiz A: Test sentence: Some animal is standing.

![Quiz A](quiz_a.png)

Briefly explain your answer choices: _________

Quiz 2 was additionally tested to make sure that readers’ response is not random. In Quiz 2 (see below), the pictures were exactly the same as in Quiz 1, except the third one. In Quiz 1, the third picture had two animals standing. In the third picture of Quiz 2, only one animal was standing. For that reason, Quiz 2 came to have two pictures (2 and 3) with one single standing animal. But they were of a different kind – a cat and a dog.
Quiz B: Some animal is standing.

Briefly explain your answer choices: _________

3 Prediction

The key logic underlying this manipulation is as follows:

1. Participants are expected to select the picture situations where at least one animal is standing consistently in both Quizzes (i.e., pictures 2, 3, 4 twice), if they indeed read some singular N as a logical expression.
2. Participants are expected to select the situations where only one particular animal is standing (i.e., picture 1 in Quiz A, and pictures 2 and 3 in Quiz B), if they read some singular N as a referring expression (i.e., some similar to only one).
3. Participants are expected to select the situations where at least one but not all animals are standing (i.e., pictures 2 and 3, in both Quizzes), if they read some singular N pragmatically as some but not all.
4. Participants are expected to select the situations where more the one animal are standing (i.e., pictures 3 & 4 in Quiz 1; picture 4 in Quiz 2), if they read the indefinite article some as inherently plural.

4 Results

See table 1 for the results from a total of 327 participants in the last set of experiments. We found four patterns of response, as illustrated. These patterns are presented in the order of frequency.
Below are descriptions of the four patterns that emerged.

1. A majority of people (240/327, 73 %) corresponded to the logical interpreters of some animal as at least one and possibly all (called at least one responders). Their logical interpretation was clear in their justifications. The justifications took various forms of a paraphrase of some animal, all intending “at least one and all.” Half of the at least one responders (110/240) justified their choices by clearly paraphrasing some as at least one (e.g., As long as there is at least one animal standing this sentence is applicable – more examples of justifications are in footnote 1).³⁰

³⁰ Below are examples of “at least one paraphrase” justifications that “at least one responders” provided:

- As long as there is at least one animal standing this sentence is applicable.
- To me, some entails that at least 1 animal is standing as in 2, 3, and 4.
- Some means one, and at least one animal was standing in 2, 3, 4.
- When using the word “some”, you can automatically assume that at least one or more is being displayed. That is why I chose the above three.
- As noted, “some” can be a technical term. Therefore, when one uses the word “some,” one is usually referring to more than one or one but not none.
- The fact that at least one is standing in each could make the sentence true, though the sentence could be worded better.

About one third of the at least one responders (68/240) justified their choices by enumerating “some” as being one, or two, or all:

- No animal is standing in the first situation. One animal is standing in the 2nd, two in the 3rd, and all animal are standing in the fourth situation.
- Picture 2 is true because the cat is standing; picture 3 is true because the dog and cat are standing; picture 4 is true because all animals are standing.

The remaining few (26/240) repeated “some animal” or “a/one animal” in their justification, or pointing out picture 1 having no animal standing as a reason why it is not counted as an answer:

---

### Table 1. Results: Interpretation of some singular N

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Quiz 1 pictures</th>
<th>Quiz 2 pictures</th>
<th>some N</th>
<th>Interpretation pattern</th>
<th>frequency</th>
<th>percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>2, 3, 4</td>
<td>2, 3, 4</td>
<td>At least one, all</td>
<td>1. Logical</td>
<td>240</td>
<td>73.4</td>
</tr>
<tr>
<td>b</td>
<td>2</td>
<td>2, 3</td>
<td>Only one, not all</td>
<td>2. Referential</td>
<td>44</td>
<td>13.5</td>
</tr>
<tr>
<td>c</td>
<td>2, 3</td>
<td>2, 3</td>
<td>One or two, not all</td>
<td>3. Pragmatic</td>
<td>19</td>
<td>5.8</td>
</tr>
<tr>
<td>d</td>
<td>3, 4</td>
<td>4</td>
<td>plural, all</td>
<td>4. Plural</td>
<td>6</td>
<td>1.8</td>
</tr>
<tr>
<td>e</td>
<td>3</td>
<td>none</td>
<td>plural, not all</td>
<td></td>
<td>7</td>
<td>2.1</td>
</tr>
<tr>
<td>f</td>
<td>4</td>
<td>4</td>
<td>all</td>
<td></td>
<td>5</td>
<td>1.5</td>
</tr>
<tr>
<td>g</td>
<td></td>
<td></td>
<td>Not Mark</td>
<td></td>
<td>6</td>
<td>1.8</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>327</td>
<td>100</td>
</tr>
</tbody>
</table>
2. There were people (44/327, 14 %), but only a few, whose interpretation of some singular N corresponded to the referential meaning (only one and not all) (called only one responders). Their justifications explicitly mentioned that some animal refers to one animal, and that if there were more than one animal standing, it would say some animals are standing. See the type of justifications in footnote 2.

3. Very few people (19/327, 6 %) selected pictures with one or two animals, but not all, consistently in both Quizzes. They seem to interpret some animal in pragmatic manner. Their justifications were like only some 1 or 2 out of 3; because it says “some” not “all”; because 2 out of 3 animals are standing; not one or not all.

4. Lastly, for some few people, it appears that some is “intrinsically” (always) plural. These participants (18/327; 6 %) consistently rejected pictures with a single animal standing, claiming to take some singular N as if plural (always more than one). To those, some indeed means “more than one”, as their justifications clearly show: because some is more than one but not all; because some animals are standing, 2 out of 3, if it was 1 out of 3, then one will be standing not some, some is more than 1 and 3 out of 3, would be all.

5 Key findings are summarized as follows:

1. 73 % of the population (240/327) endorsed the logical (non-pragmatic) meaning of the indefinite some N as at least one N. The participants were able to cancel some-associated implicature, accepting some statement in every context. The data show that our participants’ knowledge of some is consistent with classical logic.

2. Only 13 % of the population (44/327) endorsed the conception of “some singular N” as “only one”.

3. Lesser than 4 % of the population (13/327) accessed “some singular N” as if plural.

31 See the justifications by the only one responders to some N:

- These pictures are true because there is an animal standing in each of the three that I selected.
- Because some animal(s) in each picture are standing.
- In 2, 3, and 4, “some” one or more animal is standing; some, referring to either 1 or more animals, is seen standing.
- No animal is standing in picture 1; all animals in picture 1 are lying down.
- These are true because there is an animal standing in each of the three that I selected.
- Because some animal(s) in each picture are standing.
- In 2, 3, and 4, “some” one or more animal is standing; some, referring to either 1 or more animals, is seen standing.
- No animal is standing in picture 1; all animals in picture 1 are lying down.

31 See the justifications by the only one responders to some N:

- Because the sentence states “some animal” not “some animals” and the word “is” refers to one.
- Some animal implies only one because “animal” is not plural; “is” means only one.
- Some animal means only one otherwise it would be “some of the animals” or “the animals are.”
- Some can refer to one or more but “animal” is singular.
- Only one animal is standing; the word “is” refers to one; “some animal” refers to one animal;
- The question was “some animal is standing”, which means “there is only one.”
4. Important for us, it turns out that lesser than 6% of the population (19/327) was biased to interpret some N pragmatically.

Therefore, we can conclude that, even if some adults’ semantics for existential quantification was not fully logical, their referential and pragmatic lexical bias was only marginally present in our data, and thus cannot explain the low inverse-scope rates that we observed.

6 Further Analysis: Single-reference bias affects inverse scope performance

This section reports analyses clearly showing that the single-reference bias affects inverse scope performance. Those speakers with the lexical constraint (strictly single referent bias), if they were given scope ambiguous doubly quantified sentences, are expected to be less proficient in accessing inverse scope. This was indeed the case. As table 2 and figure 1 shows, the “Only One” Group scored the lowest of the scores across the Inverse and Frozen scope conditions, in the Baseline and Experimental tasks.

<table>
<thead>
<tr>
<th>Experiments 10 through 13</th>
<th>Inverse</th>
<th>Frozen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline M (SD)</td>
<td>Experimental M (SD)</td>
<td>Baseline M (SD)</td>
</tr>
<tr>
<td>Responders to &quot;some N&quot; as &quot;at least one and all&quot; (N=240)</td>
<td>1.66 (0.11)</td>
<td>2.01 (0.14)</td>
</tr>
<tr>
<td>Responders to &quot;some N&quot; as &quot;only one&quot; (N=44)</td>
<td>1.32 (0.25)</td>
<td>1.27 (0.24)</td>
</tr>
</tbody>
</table>

Table 2. Results: Performance on Inverse and Frozen scope items across the two groups

Figure 1. Performance on Inverse and Frozen scope items across the two groups
For the “only one” group, the Baseline-Experimental scores almost did not change (Paired samples t-tests, for inverse, \( t(43) = -0.184, p = .855 \); for frozen, \( t(43) = -0.670, p = .506 \)). On the other hand, for the “at least one and all” group, for inverse scope items, the score in the Experimental task was higher than the score in the Baseline task \( (t(239) = 3.068, p = .002) \), although for frozen scope items, the two scores were not different \( (t(238) = -0.63, p = .529) \).

The same tendency is repeatedly observed in the following contingency table analysis.

<table>
<thead>
<tr>
<th>Inverse Group</th>
<th>Some Animal Category</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A. at least one and all</td>
</tr>
<tr>
<td>Baseline</td>
<td></td>
</tr>
<tr>
<td>low</td>
<td>131</td>
</tr>
<tr>
<td>medium</td>
<td>73</td>
</tr>
<tr>
<td>high</td>
<td>36</td>
</tr>
<tr>
<td>Experimental</td>
<td></td>
</tr>
<tr>
<td>low</td>
<td>125</td>
</tr>
<tr>
<td>medium</td>
<td>52</td>
</tr>
<tr>
<td>high</td>
<td>63</td>
</tr>
<tr>
<td>Total</td>
<td>240</td>
</tr>
</tbody>
</table>

Table 3. Results: Low, Medium, High inverse people across the two lexical groups

The table shows that for only one responders (referential reading), the ratio of low, medium and high hardly changed from the Baseline to the Experimental task, whereas for at least one responders (logical reading), one can see a change in the ratio; high inverse scope people increased from 36 to 63.

7 Conclusion to the Further Analysis above

The analysis above hints that logical responders to some N are more amenable to discourse influence, compared to referential responders to some N. It was very much expected that the non-logical understanding of some N could impede the influence of discourse in the accessibility of inverse scope. Nevertheless, a real puzzle for us is that the logical understanding of some singular N as at least one does not necessarily translate into the ability to access inverse scope.

Lastly, it should be noted that the “only one” people were not simply rejecting all (i.e., no-bias). The single-reference biased people did well with “some N or other” prime sentences: for the population from two experiments 11 and 13, the logical and non-logical responders scored similar inverse prime rates (3.69 (SD = 2.10) for those that took some N as at least one and all (N=128) and 3.50 (SD=1.69) for those that took some N as only one (N=24)). Additionally, the single-reference biased people were also perfect with the Control 1 items (k=3) (existential some N items). This suggests that the group of “some as only one” people, despite their lexical constraint, successfully accessed the multiple-denotation reading of “some singular N” in the other “easy-scope” environments.
APPENDIX O:
INFORMATION ON PERSONAL AND
MATHEMATICS BACKGROUND

(1) Personal background
We summarize information on the participants’ gender and age (in table 1), hometown and their class background at the time of their survey taking (in table 2), both across the 13 experiments.

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Gender</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Female</td>
</tr>
<tr>
<td>Chapter 3</td>
<td>Exp 1</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>Exp 2</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Exp 3</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Exp 4</td>
<td>21</td>
</tr>
<tr>
<td>Chapter 4</td>
<td>Exp 7</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>Exp 8</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>Exp 9</td>
<td>31</td>
</tr>
<tr>
<td>Chapter 5</td>
<td>Exp 10</td>
<td>78</td>
</tr>
<tr>
<td></td>
<td>Exp 11</td>
<td>83</td>
</tr>
<tr>
<td></td>
<td>Exp 12</td>
<td>82</td>
</tr>
<tr>
<td></td>
<td>Exp 13</td>
<td>84</td>
</tr>
</tbody>
</table>

Table 1. Results: Post-questionnaire survey: Personal Information (Gender, Age)

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Hometown</th>
<th>Class Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Hawaii</td>
</tr>
<tr>
<td>Chapter 3</td>
<td>Exp 1</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>Exp 2</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Exp 3</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Exp 4</td>
<td>21</td>
</tr>
<tr>
<td>Chapter 4</td>
<td>Exp 7</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>Exp 8</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>Exp 9</td>
<td>31</td>
</tr>
<tr>
<td>Chapter 5</td>
<td>Exp 10</td>
<td>78</td>
</tr>
<tr>
<td></td>
<td>Exp 11</td>
<td>83</td>
</tr>
<tr>
<td></td>
<td>Exp 12</td>
<td>82</td>
</tr>
<tr>
<td></td>
<td>Exp 13</td>
<td>84</td>
</tr>
</tbody>
</table>

Table 2. Results: Post-questionnaire survey: Personal Information (Hometown, Class)
(2) Math background information

The post-experiment survey included three or four items for surveying participants’ mathematical education background. Their results are presented in tables below: table 3 for results from the participants in the four experiments in chapter 3, table 4 for results from the participants in the three experiments in chapter 4, and table 5 for the results from the participants in the four experiments in chapter 4.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Is the following sentence true? Some real number is the additive inverse of every real number.</td>
<td>Yes</td>
<td>5</td>
<td>3</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>10</td>
<td>5</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Don’t understand</td>
<td>5</td>
<td>18</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Not mark</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>(2) For how many college-level courses have you been required to write proofs?</td>
<td>0</td>
<td>13</td>
<td>17</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>4</td>
<td>5</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Not mark</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>(3) How comfortable are you with the mathematical English that is used in mathematical proofs?</td>
<td>Neutral</td>
<td>12</td>
<td>13</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Uncomfortable</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Comfortable</td>
<td>1</td>
<td>5</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Not mark</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 3. Results: Post-questionnaire survey: Background information
(Experiments from Chapter 3)
<table>
<thead>
<tr>
<th>Question items</th>
<th>Answer</th>
<th>frequency of participants in each answer category</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Exp 7 (N=31)</td>
</tr>
<tr>
<td>(1) Is the following sentence true?</td>
<td>Yes</td>
<td>7</td>
</tr>
<tr>
<td>Some real number is the additive inverse of every real number.</td>
<td>No</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Don’t understand</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>Not mark</td>
<td>2</td>
</tr>
<tr>
<td>(2) For how many college-level courses have you been required to write proofs?</td>
<td>0</td>
<td>23</td>
</tr>
<tr>
<td>courses</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Not mark</td>
<td>2</td>
</tr>
<tr>
<td>(3) How comfortable are you with the mathematical English that is used in</td>
<td>Very uncomfortable</td>
<td>2</td>
</tr>
<tr>
<td>mathematical proofs?</td>
<td>Uncomfortable</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Neutral</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Comfortable</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Very comfortable</td>
<td>2</td>
</tr>
<tr>
<td>(4) How many college-level logic courses have you taken?</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 4. Results: Post-questionnaire survey: Background information (Experiments from Chapter 4)
The present study recruited many students in the mathematics department. It is agreed among mathematicians that quantified sentences in the mathematical formal language are read in their surface order. It means that *some-every* sentences in the formal ENGLISH are unambiguous, unlike the same string in natural language English. It can be conjectured that being more experienced with the mathematical language means being less willing to perceive ambiguity in *some-every* natural language English; it was often observed that some professors in the mathematics department declined to read *some-every* English sentences as inverse scope, although they were fully aware of the presence of ambiguity in the sentences in their natural language English.

Conversely, it could be the case that higher proficiency with the mathematical language could relate to higher probability of ambiguity perception in *some-every* natural languages. In one way or another, we were interested in finding out whether, for our participants (students from classes in the mathematics department), mathematical proficiency or background may play any role in the percentage of accessing inverse scope. By asking the first “additive inverse” question, we assumed that the knowledge of the additive inverse question itself and thus being able to give either kind of answer (yes or
no) would reflect a certain amount of math proficiency. The first measure, however, does not look informative for our purpose. The second question asked participants how many college-level courses they have been required to write proofs. A large portion of students in each group reported to have taken zero. The third question asked participants for their degree of comfortableness with the mathematical English. All groups indicated mostly “neutral”. The data overall indicate that participants in our experiments were close to general ordinary populations.

Future study may explore whether and to what extent proficiency with the mathematical language (i.e., the amount of experience with the mathematical language) would influence the perception of scope ambiguity in the natural language English.
REFERENCES


