An experimental investigation of the scope of object comparative quantifier phrases

Kristen Syrett, Adrian Brasoveanu, Atsushi Oho
Abstract

Recent investigations of the constraints on the scope of Comparative Quantifier Phrases (CQPs) (Fleisher 2015; Mayr & Spector 2012; Takahashi 2006) have revealed a puzzle: while CQPs give the appearance of behaving like generalized quantifier phrases in some environments, their apparent limited scopal range in other environments seems to indicate that treating CQPs as generalized quantifiers (Mayr & Spector 2012) cannot capture the full range of facts, even with a revision of Fox (2000)’s Scope Economy. At the same time, decompositional accounts (Fleisher 2015; Takahashi 2006) that can account for this apparently restricted scopal range via movement constraints cannot handle supposedly ‘exceptional’ cases in which object CQPs can take scope over an indefinite subject, or explain why inverse scope readings appears to be acceptable even in non-exceptional cases.

In this paper, we present a set of four experiments probing the scope of object CQPs relative to a singular indefinite in subject position – a key linguistic environment at the heart of this debate. Our results make two major contributions. First, they demonstrate that CQPs have a wider scopal range than has typically been assumed based on a small dataset, and than what is allowed by current decompositional accounts: object CQPs can uncontroversially take wide scope over an indefinite subject. Second, they shed light on the processing factors and felicity conditions contributing to the perceived relatively limited scope of object CQPs. The results are therefore informative about the optimal contexts for examining the full scopal range of quantificational phrases. The evidence calls upon us to reconsider fundamental assumptions underlying the core theoretical approaches to the scope of CQPs, tipping the scales in favor of the generalized quantifier approach, but not without caveats.
1 Introduction and Background

In many instances, two quantificational elements appearing in the same sentence (in particular, as subject and object) are able to scopally interact with each other freely, as shown in (1). Here, the indefinite (some student) in subject position interacts with either the universal (every book) or the indefinite (two (of the) books) in object position, giving rise to two distinct interpretations.

(1) Some student read [every/two(of the)] book(s).

\[
some > every/two (of the), every/(two of the) > some
\]

In contrast, the Comparative Quantificational Phrases (CQPs) in (2) and (3) appear not to behave in the same way.

(2) Some student read more than five books.

\[
some > \text{CQP}, \#\text{CQP} > some
\]


(3) One student read more than three books.

\[
one > \text{CQP}, \#\text{CQP} > one
\]

Takahashi (2006: 64 (16a))

A common assumption based on examples such as these is that a CQP in object position cannot take wide scope over an indefinite in subject position (cf. Beghelli & Stowell 1997; Fleisher 2015; Takahashi 2006).²

Takahashi (2006) observed that this restriction on the scope of object CQPs is in fact

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¹ In Beghelli & Stowell (1996), a CQP is a Counting Quantifier Phrase.
² We use ‘#’ throughout to indicate questionable or difficult to access, without commitment to whether or not the reading is actually barred by the grammar or not. Previous authors have marked such sentences as *, #, or %.
broader, applying not only to interaction with existentials in subject position but also to other upward monotone quantifiers such as *every*, downward monotone quantifiers such as *no*, and non-monotone quantifiers such as *exactly two*, leading Takahashi to offer the descriptive generalization in (4).³

(4) **The Comparative QP Scope Generalization**

Comparative QPs in object position must take narrow scope relative to QPs in subject position.

Takahashi (2006: 61 (9))

This restriction is surprising if one assumes that CQPs are generalized quantifiers, which are generally not barred from taking scope over a subject when they are in object position.⁴

It is not that object CQPs are obligatorily interpreted *in situ*. In fact, they are able to host Antecedent-Contained Deletion (ACD), as shown in (5). ACD is a construction that relies on the ability of the object QP to scope out of the VP (often formalized as Quantifier Raising, QR) so that the subsequent VP ellipsis can be properly licensed / resolved (Fox 2002; Jacobson 1992; Kennedy 1997; Larson & May 1990; May 1985; Sag 1976). In addition, CQPs in an indirect object position are able to take wide scope over a direct object in a dative construction, as in (6).

(5) John speaks **more than three of the languages** that Mary does *speak*.

Takahashi (2006: 61 (10))

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³ In the experiments reported in this paper, we concentrate on the interaction of CQPs with indefinites, though future research should probe a wider range of cases to see how general the pattern is.

⁴ For Beghelli & Stowell (1996), the restriction is a matter of the relative landing sites that are targeted in the Case-driven movement of the object CQP and reconstruction of the indefinite subject.
John submitted some paper to more than five journals this month.

John submitted some paper to more than five journals this month.

Takahashi (2006: 73 (42))

These patterns make the one observed in (2) and (3) rather surprising: why should extra-wide scope of an object CQP over an indefinite subject be barred, if a CQP can interact scopally with other elements in other environments?

Takahashi (2006) has argued that this restricted scopal range of object CQPs is derived from movement constraints tied to the decomposition of the CQP. Following Hackl (2000) and Heim (2001a, b), Takahashi assumes that CQPs such as more than N are decomposed into two constituent subparts: many N and the comparative operator –er than n, as illustrated in (7).

more than three books = [DP [DegP er than three] many books]

Takahashi (2006) further assumes that covert Scope Shifting Operations (SSOs) such as QR and QL are constrained by Shortest Move and that they cannot be semantically vacuous: that is, they must have a semantic effect. (See Fox (1995, 2000).)

Both the comparative operator –er than n, which heads a Degree Phrase, and the DP many N are scope-bearing elements, and take scope separately—a fact that is crucial in the decompositional approach barring the inverse scope reading (see Wold (1995) and Ferreira (2007)). In a sentence such as (2) or (3), the subject raises from a VP-internal position to TP. The object undergoes obligatory QR for interpretation, then decomposes into the two

Fleisher (2015) also adopts a decompositional approach, with a modification to Scope Economy to cover cases where a CQP interacts with negation.

The situation is slightly different for downward monotone CQPs such as fewer than N, which are not the subject of our investigation, although they do appear as filler items in Experiment 4.
subparts. The comparative operator raises for reasons of type mismatch, and binds its trace in
the DP, as shown in (8).

(8) \[ \text{TP one student}_1 [\text{VP er than three}_2 [\text{VP many books}_3 [\text{VP t}_1 \text{ read } t_3]]]] \]

A problem thus arises for the inverse scope reading, because in order for the CQP to scope
over the indefinite, both subparts of the CQP must take wide scope, and the interaction of the
indefinite subject with –er than \( n \) is semantically vacuous, and therefore barred.\(^7\)

However, there are examples in which a CQP in object position can take wide scope
over an indefinite in subject position: examples such as (9) or (10), where the surface scope is
not just false, but implausible given real world knowledge.

(9) A soldier is standing on more than ten government buildings.


(10) A body guard has been assigned to more than fifteen officials.

\[ a > \text{CQP}, \text{CQP} > a \]

Farkas (1997: 210 (8))

While advocates of approaches designed to account for the restricted CQP range (e.g.,
Fleisher 2015) do concede the possibility of such inverse scope readings, their approaches do

\(^7\) Takahashi notes (cf. footnote 23, pg. 89) that this approach cannot account for cases in
which an object CQP can take scope over negation (e.g., (i) John doesn’t speak more than
three (of the) languages.), and suggests that cases where a CQP interacts with a non-DP
quantificational element may be similar to instances in which a QDP can cross a tensed
clause boundary in ACD constructions, in that it eludes some constraints. However,
Cecchetto (2004) and Syrett (2015a, b) present compelling evidence with embedded ACD
constructions that QR is not subject to an arbitrary clause-boundedness constraint, so the
connection between the two unexpected scopal behaviors does not hold under closer scrutiny.
not incorporate a way to generate the inverse scope reading of such sentences, even in exceptional circumstances. Thus, what appears to license the inverse scope of CQPs in these circumstances but bar it in all others remains a puzzle for such approaches.

Other approaches, notably Mayr & Spector (2012), keep the CQP in tact as a generalized quantifier, and allow an object CQP to take inverse scope not only in surface scope implausible cases, but in cases such as (2) and (3) as well.\(^8,9\) Their account relies on the representation of CQP as pluralities with a part-whole structure à la Link (1983) and the presence of a distributivity operator DIST in the structure, as illustrated in (11) (Mayr & Spector (2012)’s (27) and (26) respectively).

(11) a. surface scope

\[^8\] Szabolcsi (1997) also makes a case for the object CQP being able to take wide scope over the subject CQP in (i), indicating that although this inverse scope reading is “very difficult,” it can be forced by the context. The accounts we discuss here do not actually mention such CQP-CQP sentences and their possible interpretations.

(i) **More than three** men read **more than six** books.

\[
\text{CQP}(3) > \text{CQP}(6), \text{CQP}(6) > \text{CQP}(3) \quad \text{Szabolcsi (1997: 115 (17))}
\]

While sentences such as this are featured in Experiment 1, we focus on those cases in which an object CQP interacts with a singular indefinite in subject position, because this linguistic environment stands at the center of the ongoing debate. Certainly, if these sentences are judged to be acceptable as well, then the theoretical accounts should be extended to sentences such as these.

\[^9\] Mayr and Spector (2012) also assume restrictions on movement of the CQP, modifying Fox (2000)’s Scope Economy Condition slightly to propose their *Generalized Scope Economy Condition*, which bars not only semantically vacuous SSOs, but also only licenses those in which the output is semantically weaker than the input.
b. inverse scope

\[ \text{[More than ten govt. buildings]} \ [DIST \ [\lambda X. \ (\text{a soldier stands on } X)]] \]

In the surface scope reading in (a), there is one single soldier who is standing on each of the atomic individuals comprising the plurality of more than ten government buildings. This, of course, is implausible given our real world knowledge, and so it is not the reading we readily retrieve. In contrast, in the inverse scope reading in (b), there is a plurality comprised of more than ten government buildings, and each has the property of having a soldier stand on it. While Mayr and Spector use this example to illustrate the possibility of inverse scope and the role of DIST, the same logic should license it in (2) and (3). However, Mayr and Spector do not mention the possibility of generating the inverse scope reading with examples where the surface scope is plausible, and extending their distributivity approach to those cases should predict that the inverse scope reading would be easily accessible. So while they can account for the inverse scope reading of (9) and (10), there remains a puzzle concerning the general availability (or lack thereof) of the inverse scope reading of sentences with object CQPs. Fleisher (2015)’s attempt to meld together characteristics of these two approaches to account for the scopal interaction between CQPs and negation does not address this problem.

To help settle the debate and identify the proper treatment of CQPs, the first order of business is to obtain evidence in support of the judgments about the acceptability of the inverse scope readings for sentences such as (9) and (10), and further, to determine whether the inverse scope reading is, in fact, available for sentences such as (2) and (3). If indeed the inverse scope reading is available in both surface-scope-implausible and surface-scope-plausible cases, then the evidence will tip the scales in favor of a non-decompositional,
generalized quantifier account of CQPs.\(^{10}\)

Before we present our experiments, however, we must consider why the surface scope reading would appear to be the only one available for (2) and (3). Let us grant for a moment that the inverse scope reading is not grammatically barred. If syntax/semantics proper is not preventing speakers from accessing it, then what is? We would like to consider a set of processing factors and felicity conditions tied to the use of CQPs that could play a role.

First, there is an assumption that speakers will be charitable and access a ‘true’ reading whenever they are able to do so. This Principle of Charity (Quine 1960) underlies the design of a number of experimental tasks. It is claimed to be operative in general, but Meyer & Sauerland (2009) claim that in (potentially) ambiguous sentences, it interacts with another principle, that of Truth Dominance, which predicts that if the more accessible reading makes the sentence true in a given situation, then speakers will judge the sentence to be true. Mayr & Spector (2012) predict that an uncontroversially true reading is made available by the surface scope, and this reading entails the inverse scope reading, then speakers are predicted to judge the sentence true, based on the surface-scope reading.

Second, it has been argued that a less presuppositionally complex analysis will be favored over others (Crain & Steedman 1985). This observation applies to the target sentences under consideration in the following way. Kurtzman & MacDonald (1993), following a proposal by Fodor (1982), demonstrated that a determiner phrase with an existential \(a\) in subject position is immediately interpreted as having a single referent and

\(^{10}\) With this issue settled, the next order of business would then be to tackle the behavior of object CQPs interacting with \(\text{every}\) in downward-entailing (DE) environments, and the interaction between CQPs and negation.
only later is this interpretation revised, if necessary.\footnote{A reviewer asks what exactly this means—whether the indefinite is semantically treated as ‘exactly one NP’ (perhaps because of a quantity implicature), or if there is a covert singleton restrictor in the parse. We are agnostic about the precise implications of this claim, and simply follow Kurtzman & MacDonald in assuming that the parser’s preference is to interpret the singular indefinite as referring to a single entity. One possibility is to interpret Kurtzman & MacDonald as describing a DRS (Discourse Representation Structure) construction principle along the lines of the ones proposed in Kamp & Reyle (1993).} Since the surface scope interpretation of the sentences in question here is interpreted as introducing one individual denoted by the subject, in lieu of multiple individuals (as the inverse scope reading might have it), then it would trigger a less complex representation relative to the inverse scope interpretation (that does not entail it), because it would (potentially) involve the accommodation of fewer individuals and events into the discourse context. Thus, we would predict that the surface scope would be preferred by default. As support, we note that research on the processing of quantificational sentences has shown that an inverse scope reading incurs a greater processing load (i.e., increased time to render a judgment) relative to the surface scope reading (Tunstall 1998, Anderson 2004). (See Reinhart (2006) and Brasoveanu and Dotlačil (2015).)

Third, we might consider the form of the indefinite in subject position. Certain indefinites are more likely than others to be interpreted specifically, and – as a result – to take wide scope. Intuitively, the judgment that a CQP in object position is unable to take scope over an indefinite in subject position arises from those sentences in which the subject is a one indefinite. Fleisher (2015) also shares this intuition, and notes that even for surface-scope-implausible sentences, where an object CQP can take scope over an ‘a’ indefinite in subject position, substitution of some or one for a renders the inverse scope unavailable. In fact,
examples cited in the literature on the constrained scope of object CQPs have typically included those with *one* and *some* in subject position. This same observation about the influence of the type of indefinite phrase should (and does) generalize beyond CQPs. Indeed, Tsai *et al.* (2014) have demonstrated that participants are significantly less likely to access an inverse scope reading of a sentence with a singular indefinite in subject position and a universal QP in object position if the indefinite is headed by *one* than if it is headed by *a*, leading them to conclude that *one* encodes an inference about specificity.\(^\text{12}\) If this is the case, then any probability that participants could ever accept a reading whereby an object CQP takes wide scope over a subject indefinite is diminished significantly if the indefinite is headed by *one* (cf. example (16) and (24) in Takahashi).

Fourth, just as the form of the subject indefinite may influence the extent to which it is interpreted specifically, the form of the object CQP may have an influence. That is, putting the CQP in a partitive form (e.g., *three of the books*) might increase the extent to which it is interpreted specifically (i.e., as having determined reference), and therefore its chances of taking widest scope. In fact, in discussing sentences where an object CQP is able to take wide scope over sentential negation – sentences that his framework cannot handle – Takahashi (2006: 89, ftnt. 23) notes that putting the CQP in partitive form seems to facilitate the availability of the ‘CQP > negation’ reading. Why should this be?

Geurts (2002) has argued that the “main duty” of \(\beta\) in a partitive ‘\(\alpha\) of \(\beta\)’ is to help identify the relevant \(\alpha\). While \(\beta\) is not obligatorily interpreted as definite or specific, according to Geurts, it is obligatorily backgrounded (and one might say presupposed, given the presence of the definite determiner heading the phrase in \(\beta\)), and is therefore likely to be interpreted specifically. Enç (1991) has argued that partitives (either overt or covert) are necessarily specific, since they refer to a group that is a subgroup of the referent of the DP \(\beta\)

\(^\text{12}\) We report the findings from their Experiment 2, on English.
contained in the partitive, and consequently, should be able to take wide scope. In a related vein, Farkas (2002) has observed that partitivity is a typical strategy to achieve determined reference, which in turn tends to yield wide-scope readings. Psycholinguistic evidence supports the role of overt or covert partitivity in facilitating inverse scope readings of scopally ambiguous sentences (Miller and Schmitt 2004; Musolino & Gualmini 2004).

Fifth and finally, there is the question of the felicity conditions and/or implicatures associated with the use of a CQP. One might ask why a speaker would violate conversational maxims and say *more than three* when s/he could have been more specific and brief and used a bare numeral (e.g., *four or five*). Why mention *three* as a lower bound? And why mention the numeral at all, in lieu of a plural indefinite? Given the speaker’s evasiveness or vagueness about reference and quantity, it seems that much harder to access a specific interpretation of the CQP (especially relative to a singular indefinite in subject position). If indeed the CQP requires certain felicity conditions for its usage, then presenting speakers with sentences in isolation devoid of a context that licenses the use of the CQP renders the processing of these sentences more difficult, making it that much more challenging to interpret the object CQP as taking wide scope over a singular indefinite. (See Cummins, Sauerland, & Solt (2012), Geurts & Nouwen (2007), Büring (2008), Nouwen (2010), Coppock & Brochhagen (2013), a.o., for related observations with modified numerals such as *at least n*.) Fleisher (2015) notes that the intermediate scope reading of sentences with *fewer* and *every* becomes more salient in scenarios that involve a threshold for completion, as in the following example.

(12)  

*Context: An airport security screening room. Each bag must be checked by at least three inspectors before the plane can be loaded.*

**Fewer than three inspectors** have checked **every bag**, so the plane can’t be loaded yet.

(Fleisher 2015: 162 (33a))
Here, we are easily able to access an inverse scope reading, where *each/every bag* is the ‘distributor’, and the *inspectors* are distributed over. Thus, aspects of the context satisfy the felicity conditions on the use of a CQP, facilitating the availability of inverse scope.

To summarize, then, the puzzle is this. CQPs in object position appear to be constrained by default, unable to take wide scope over a subject indefinite, and thus unable to generate an inverse scope reading. However, this reading appears to be available in certain circumstances (e.g., when the surface scope reading is ruled out by world knowledge).

Current decompositional approaches (Fleisher, 2015; Takahashi, 2006), even while acknowledging in passing instances of exceptional scope, can only account for the apparently limited scopal range of CQPs. At the same time, while approaches treating CQPs as generalized quantifiers (Mayr & Spector, 2012) are able to account for the availability of the inverse scope readings, they cannot account for why the scopal range of CQPs in these sentences seems constrained by default. We have suggested that there may be an explanation for the limited availability of the inverse scope reading of the target sentences tied to processing and pragmatics factors. Our goal in this paper is to harness these factors to our advantage to probe the ability of an object CQP to take wide scope over an indefinite subject, and thus to provide experimental evidence bearing on this debate.

Across four experiments, we show that participants not only judge the inverse scope reading to be acceptable for the surface-scope-implausible cases (as previously observed), but they also judge the inverse scope to be available – and quite robustly so – when the surface scope is false, but *not* implausible. Moreover, the processing factors and felicity conditions we outlined above appear to play a key role in facilitating the inverse scope reading, depending on the experimental context. These results thus bear directly on the theoretical approaches to the scope-taking ability of CQPs, since any theory of CQPs should be able to account for this pattern of results. Insofar as the generalized quantifier account is the only
account currently able to generate the inverse scope reading of sentences in which an object CQP scopally interacts with a subject indefinite, the experimental evidence favors such an account. Otherwise, a decompositional account will have to be revised in order to license the inverse scope reading, perhaps by weakening the role of economy constraints on movement.

2 Experiment 1

The purpose of Experiment 1 was threefold:

(a) to establish an initial baseline of acceptability of the inverse scope reading of sentences with a singular indefinite in subject position and a CQP in object position where the surface scope is implausible (sentences such as (9) and (10))

(b) to probe the effect of the type of indefinite in subject position

(c) to examine the role of partitivity in facilitating the inverse scope reading in sentences with and without CQPs

2.1 Participants

68 undergraduates participated. Data from four of these participants were excluded due to the participants’ non-native speaker status. The remaining participants were randomly and evenly assigned to four experimental conditions. Participants in all experiments were undergraduate students in introductory-level Linguistics and/or Cognitive Science and received extra credit in their course in return for their participation.13

13 All participants were undergraduate students, and only data from native speakers of English (as determined through collected demographic information) were used. Experiments 1-3 were conducted in a lab setting, with participants tested individually at computer stations in the lab. Visual stimuli in Experiment 1 were presented via Powerpoint, accompanied by slide-by-slide delivery of linguistic stimuli by an experimenter. Stimuli in Experiments 2 and 3 were presented via Superlab experimental software. Experiment 4 was administered online
2.2 Design

2.2.1 Procedure

The experimental design was modeled after a Truth Value Judgment Task (TVJT, Crain & Thornton, 1998). An experimenter narrated a series of stories, each of which was accompanied by a series of slides presented via PowerPoint. Each slide has a selection of images representing the entities involved in the story. The story was intended to favor one possible reading of a potentially ambiguous sentence, but to make an alternative reading accessible up until a certain point in the story, in order to satisfy the condition of Plausible Dissent (i.e., to satisfy a pragmatic felicity condition for rejecting or accepting a target sentence).

At the end of each story, the experimenter verbally delivered the target sentence, which was also printed on the screen. Participants were asked to judge the acceptability of the sentence, given the preceding context, on a five-point scale, using paper and pen(cil). They were provided with the labeled points in Table 1. Participants were instructed to rate the target sentence immediately, and not to change their responses later in the session.

<table>
<thead>
<tr>
<th>totally unacceptable</th>
<th>unacceptable</th>
<th>reasonably acceptable</th>
<th>acceptable</th>
<th>completely acceptable</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 1: 5-point rating scale used in Experiment 1

The entire experimental session took approximately 25 minutes, including a brief training session to acclimate participants to the procedure with non-target sentences. This amount was within the 30 minutes allotted for an in-lab experiment. Thus, although the total number of items is relatively small, given the factors tested and in comparison to the other experiments that follow, this number is comparable to the number of items typically featured on a [institution to be inserted after the review process] installation using Alex Drummond’s Ibex platform ([https://github.com/addrummond/ibex](https://github.com/addrummond/ibex)).
in TVJTs, and allowed for the length of the experimental session to be manageable for the 
experimenters and participants.

2.2.2 Stimuli

There were seven test sentences, five control sentences, and two filler sentences. (See 
Appendix A for all scenarios and target sentences.) All test sentences featured a numerical 
quantifier phrase in the object position. Participants were randomly assigned to one of four 
between-subject conditions, based on whether the test sentence featured a CQP or a bare 
umeral phrase in object position (±CQP), and whether or not this phrase was a partitive 
phrase (±partitive). In the two +CQP conditions, the object was a CQP; in the two –CQP 
conditions, it was a bare numeral phrase. The expression was always more than two (+CQP) 
or three (–CQP), so that the truth conditions and visual stimuli remained consistent across 
conditions.

There were two further conditions, based on whether the phrase was ±partitive (e.g., 
more than two (of the) Ns (+CQP) vs. three (of the) Ns (–CQP)). Thus, with the two between-
subject conditions, the quantificational phrase in object position was as indicated in (13).

(13) a. more than two books CQP, no partitive (+CQP –PART) 
b. more than two of the books CQP, with partitive (+CQP +PART) 
c. three books bare numeral phrase, no partitive (–CQP –PART) 
d. three of the books bare numeral phrase, with partitive (–CQP +PART) 

In all test sentences, the context presented in the story favored the inverse scope reading, and 
made the surface scope reading false. The stories were designed to satisfy the felicity 
conditions of the CQP and the partitive form, as discussed earlier.

There were three basic types of test sentences, based on the element interacting with 
the phrase in object position: an indefinite subject, a subject CQP, and sentential negation. 
The first sentence type (with the subject indefinite) is our key sentence type. We return to
these in a moment. The other two represent those in which the object CQP is claimed to be able to outscope the other indicated element, although acceptability of the inverse scope reading is predicted to not be robust, based on discussions in the literature about such cases. We included these sentences as a point of comparison, and to include variety within the experimental session and mask the identity of the target items.

Within the key subject indefinite cases, there were three types of sentences. The first featured an ‘a’ indefinite in subject position. In these sentences, the surface scope reading was implausible, given real world information, while the inverse scope reading was associated with a scenario that was not only consistent with possibilities in the world but also supported by the accompanying context. There were two such sentences in the set of test sentences, allowing us to demonstrate replicability of previous judgments for these sentence types. An example scenario and accompanying target sentence are presented in (14).

(14) ‘a’ Indefinite in Subject: Surface Scope Implausible and False

A convention for NY Times Bestsellers was being held. Many VIPs were expected to come and stay in the city during the convention, so Officer Hendricks, Officer Wilson, and Officer Murray were assigned as guards to two hotels where the VIPs were staying. Initially, all of the VIPs were expected to stay at only two hotels, since the city didn’t want to pay the fees for more locations. Officer Hendricks and Officer Wilson were assigned to the Marriott, and Office Murray was assigned to the Hyatt Regency. However, at the last minute, more VIPs decided to come, so a hasty arrangement was made to have some guests stay at the Embassy Suites hotel. The city officials knew that using more than two hotels would mean more fees, but they didn’t care; this convention was going to bring in a lot of much-needed revenue for the city. Officer Wilson was instructed to proceed to the Embassy Suites. At 9 am, each guard was standing at his post.
A guard was posted in front of [more than two (of the) / three (of the)] hotels.

The second two key sentence types featured a ‘one’ indefinite and an ‘a’ indefinite, respectively (one sentence each). In each, both the surface and inverse scope readings were plausible, but only the inverse scope reading was true, given the preceding scenario. This contrast allowed us to probe whether a ‘one’ indefinite more strongly resists an object CQP taking scope over it. An example scenario and target sentence for a ‘one’ indefinite subject are presented in (15).

(15) ‘one’ Indefinite in Subject: Surface Scope Plausible but False

Last week, the local bike shop had two red tricycles, and both of them sold immediately – each one to a woman. This was a little surprising to the owner, because usually it’s the dads who buy the tricycles in his shop. This week, the shop received a new shipment of five red tricycles. Based on last week’s sales, the owner of the bike shop predicted that at least two red tricycles would be sold today, and that each one would be purchased by a woman, not a man. At 10 am this morning, a woman came to the shop, looked around, and bought a red tricycle for her son. At 11 am, another woman bought a red tricycle for her son, too. The owner of the bike shop began to wonder if his prediction was on target. At 2 pm, a man came in looking for a tricycle, but wanted a blue one, so he walked out without purchasing anything. At 4 pm, however, a woman came in by herself looking for a birthday present for her nephew. She tried to decide between a red tricycle and an orange scooter, and eventually bought a red tricycle. The owner was happy, because his predictions were right on.

One woman bought [more than two (of the) / three (of the)] tricycles.

The number of test sentences in Experiment 1 is thus admittedly small, but the experiment serves as a first pass to highlight the relevant factors, allowing us to then move on to more expanded data sets in Experiments 2-4.
Control and filler sentences allowed us to control for response biases, to test for participants’ ability to access surface- and inverse-scope readings, and to mask any commonalities among test sentences. Because we predicted that a ‘false’ reading would most likely be favored in the test contexts, we designed the control and filler sentences to elicit more ‘true’ readings’ overall in order to vary participant responses and target the full range of the rating scale during the experiment session. The control sentences involved a scopal interaction between some combination of an indefinite, negation, a numeral phrase, a universal quantifier, and a CQP, but the context in which they were presented did not favor readings in which a CQP was intended to take wide scope. The filler sentences involved antecedent-contained deletion, and therefore quantification, but no scopal interaction between two operators.

2.3 Results

We begin with the filler and control items. Participants patterned as anticipated: the average rating for sentences that we expected to be judged false was 1.8, while the average for sentences we expected to be judged true ranged from 3.8 to 4.7. There was no difference among the four main test conditions for responses to these items within those conditions. These ratings serve as a baseline against which we can evaluate the ratings for the test items.

Since the response variable is ordinal, we used mixed-effects ordinal probit regression models to analyze the data. All models reported in this paper include the full fixed-effect structure (main effects and interactions) unless otherwise specified, and random intercepts for subjects. The experimental manipulations for the two fixed effects, namely CQP status (CQP vs. bare numeral; we will henceforth take ‘bare numeral’ to be the reference level) and partitivity status (-partitive vs. +partitive; we will take -partitive to be the reference level), were between subjects, so we will not include subject random slopes for any of the fixed effects. Furthermore, we do not include item random effects for this experiment, because
there was a small number of items per subject and condition (as described in the design section). When we estimate the models for 'a'-indefinite subjects with both scopes plausible, 'one'-indefinite subjects, and CQP subjects, we even the subject random intercepts given that in those cases, there would be as many subject random effects as there are observations. For these three cases, we simply estimate ordinal probit models with fixed effects only. Most of the figures and all the statistical models in this paper have been obtained / estimated with R (R Core Team 2015), the ggplot2 package (Wickham 2009), the ordinal package (Christensen 2012), the lme4 package (Bates et al 2013) and the lmerTest package (Kuznetsova et al 2016).

The ratings for the test sentences (the target indefinite cases and the two other types for comparison) are presented in Figure 1 and Figure 2. Recall that the five-point scale presented to participants had "1" as completely unacceptable, "5" as completely acceptable, with three intermediate, ordered readings from "2" to "4". The plots in Figure 1 provide a summary of the acceptability ratings for the bare numeral vs. CQP manipulation, while the plots in Figure 2 summarize the acceptability ratings for the –partitive vs. +partitive manipulation. In each case, we are interested in the relative distribution of the ratings, and how they compare with each other within and across the target conditions. This distribution can be seen easily at a relatively superficial level by observing the difference in shading in the columns.
Figure 1: Acceptability ratings for the inverse scope of bare numerals vs. CQPs (noted at the bottom of each column) with respect to: (A)-(B) "a"-indefinite subjects – with an implausible surface scope (A) and with surface scope plausible but false (B); (C) "one"-indefinite subjects with surface scope plausible but false, (D) CQP subjects, and (E) sentential negation.

Figure 2: Acceptability ratings for the inverse scope of non-partitive vs. partitive CQPs with
In line with previous judgments, sentences in which the surface scope reading was implausible and the inverse scope reading was plausible and supported by the context
(Column A) received an unquestionably acceptable rating across the board, regardless of the form of the object (bare numeral or CQP, + or - partitive). In fact, the highest mean ratings for these target sentences arose from those sentences where a singular ‘a’ indefinite interacted with a CQP object (4.2 in partitive form, 3.9 in non-partitive form).

Second, the tall column of gray for ‘1’ ratings for sentences with ‘one’ in subject position (Column C), indicates that these sentences received a consistently low, unacceptable rating, regardless of whether or not there was a CQP or a bare numeral phrase in object position, and irrespective of the partitive status of the direct object. These ‘1’ ratings vastly out-span those for the ‘a’ sentences (Column B). This pattern is the first piece of evidence that a ‘one’ indefinite in subject position favors a specific reading of the subject indefinite and prevents the direct object from taking inverse scope.14 While inverse scope reading is available in principle for bare numeral direct objects (there are some ratings of 3 and 4, as shown in the relevant plots), it is strongly dispreferred, as might be predicted. This preference for the surface scope reading is also reflected in the ratings for the sentences in which negation interacted with a quantificational object (Column E).

The sentences in which a CQP in subject position interacted with a quantificational object (here, a CQP) (Column D) have only been discussed by Szabolcsi (1997), and are only of interest insofar as they gave us a glimpse of the full range of scopal possibilities for CQPs in both subject and object position, we simply point out that an inverse scope reading of such sentences is possible in cases beyond those in which the surface scope is implausible.

Interestingly, even sentences with an ‘a’ indefinite in subject position and a non-comparative bare numeral phrase in object position did not elicit high acceptability ratings for the inverse scope reading (left side of Column B). Although nothing grammatically prohibits a non-comparative bare numeral phrase from taking wide scope over an indefinite

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14 This does not mean that a ‘one’ indefinite will always take wide scope, but rather that it more strongly resists an inverse scope reading than an ‘a’ indefinite.
in subject position, the ratings appear to reflect the processing preferences favoring surface scope, as discussed earlier. This pattern thus serves as a reminder that the kind of indefinite chosen to investigate scopal interaction matters, and that if participants have the opportunity to judge the truth value or acceptability of a sentence based on the availability of the most acceptable reading (i.e., the surface scope reading), they will most likely do so. When the object was an overt partitive, regardless of whether it was a bare numeral phrase or a CQP, the ratings were more likely to increase. In Figure 2, this difference is observed in the shift to more ratings at the higher end of the scale, resulting in the blocks for ratings of ‘4’ and ‘5’ spanning more surface area.

The influence of partitivity can begin to be seen with sentences where an object CQP interacted with negation, as illustrated in Figure 3, where the results of the ordinal probit regression models with at least one significant or close to significant fixed effect are plotted. This plot indicates the kind of models we estimated: our ordinal probit regression models estimate 4 thresholds that partition the area under a standard normal density curve in 5 distinct sub-areas, corresponding – from left to right – to the probabilities of getting a rating of 1 through 5. The thresholds are fixed for all the 4 fixed-effect conditions. What changes from condition to condition is the center (mean) of the normal density curve: the more acceptable a condition is, the more it will be displaced to the right relative to the reference condition, which is bare numeral & -partitive.
**Figure 3**: Plot of the ordinal probit regression model for the sentential negation test sentences in Experiment 1, as a way of illustrating the role of partitivity and bare numeral/CQP status.

As can be seen in the top right image, +partitive bare numerals shift the mean to the right by 0.2. Thus, the presence of partitivity makes inverse scope in uncontroversial cases more acceptable. However, -partitive CQPs (bottom left) shift the mean to the left relative to bare numerals by about 1.2. Thus, the absence of partitivity combined with a quantificational object makes inverse scope much less likely, but a CQP object in partitive form only shifts the mean to the left by .5.

In the model estimated for Experiment 1 data, the acceptability of inverse scope decreased significantly when switching from bare numerals to CQPs ($\beta=-1.19$, SE=0.32, $p<0.001$). There was no significant interaction of partitivity and CQP status. The main effect of partitivity became marginally significant when we estimate a model with main effects only (i.e., when we drop the non-significant interaction effect): $\beta=-0.4$, SE=0.21, $p=0.06$. Thus, as we anticipated, the presence of partitivity makes the inverse scope more acceptable. There was a close to significant effect of partitivity in the main-effects-only model for the CQP.
subject data: $\beta=0.49$, SE=0.27, $p=0.07$. Thus, partitivity increases the acceptability of inverse scope. We strongly suspect that with a larger data set and an increased sample size of participants, these effects would have reached significance. But recall that this experiment represents a first pass to replicate previous judgments and test for possible effects.

Interestingly, the model estimated for the 'a'-indefinite subject data with an implausible surface scope, the CQP main effect was close to significant ($\beta=0.49$, SE=0.29, $p=0.09$), and was positive: the presence of a CQP made the inverse scope reading more acceptable. This main effect was clearly significant when we estimated a mixed-effects model with main effects only (i.e., without the non-significant interaction effect): $\beta=0.56$, SE=0.21, $p<0.01$.

3.4 Discussion
Recall that we presented Experiment 1 as a first pass, aimed at replicating and extending previous judgments before moving on. There are three main takeaway points from this experiment. First, as shown by the data summaries in Figures 1 and 2, the form of the indefinite subject matters: a ‘one’ indefinite is more likely to elicit lower acceptability ratings than ‘a’, even in seemingly uncontroversial cases. Thus, testing for the availability of an inverse scope reading with a ‘one’ indefinite in subject position is stacking the deck against such a reading. Second, an object CQP can take scope over a subject and generate an inverse scope reading. Furthermore, the inverse scope reading is not only available in the surface-scope-implausible cases, but also when a CQP occupies the subject position, as shown in Figure 1. Finally, as illustrated in Figure 3, presenting the quantificational object in the form of a partitive has the effect of the availability of an inverse scope reading.

A key question we intended to address in Experiment 1 was whether acceptability of the inverse scope reading for sentences in which an object CQP interacts with an indefinite subject depends upon the surface scope being implausible with respect to real world
knowledge. Recall that there was one sentence in Experiment 1 in which an object CQP interacted with a CQP in subject position, and another in which the object CQP interacted with an ‘a’ indefinite in subject position. In each case, the surface scope was false, but not implausible. For each of these sentences, nine of the 16 participants rated the sentence with a 3 or above when the object CQP was in partitive form, 13 gave one or both of these sentences a 3 or above, and five judged both to be acceptable. Without the object CQP in partitive form, 10 of the 16 participants judged at least one of these two sentences to be acceptable, and three judged both to be acceptable. Thus, the findings indicate that the CQP is able to take wide scope over a quantificational subject for a small but solid contingent of participants in this experiment.

There is currently no account of the scope of CQPs that can neatly capture the pattern of CQPs seemingly not being able to take scope over an indefinite subject by default, but being able to do so without question when the surface scope is ruled out as implausible or deviant by world knowledge. Takahashi (2006) would predict that an object CQP could never take scope over an indefinite subject. Fleisher (2015) granted the possibility of the inverse scope for the scope-implausible cases without being able to account for them. He also observed that even with these sentences, replacing a with one or some appears to rule out the inverse scope reading, but offered no further explanation. Mayr & Spector (2012)’s approach licenses the inverse scope reading of indefinite-object CQP, but cannot account for the variability in judgments across different instances of these sentence types. Thus, even this initially small data set illustrates the value of systematic experimental investigation in resolving theoretical debates, and demonstrates that the current approaches to the representation of CQPs are insufficient, as they cannot account for the full range of data.

While a generalized quantifier account along the lines of Mayr & Spector (2012) goes

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15 We leave aside the ‘one’ indefinite cases here, for reasons outlined in section 1.
the farthest in accounting for the acceptability patterns witnessed here, in order for it to hold water, we must demonstrate that the inverse scope reading is not only available, but also robustly so under the right circumstances, and well beyond those cases in which the surface scope is implausible. To accomplish this goal, we conducted the next series of experiments, each of which manipulates the key factors highlighted in Experiment 1 (type of indefinite subject, ±partitivity of the object CQP), while also manipulating the context and presentation of the stimuli to facilitate the availability and processing of the CQP. Combined, they demonstrate without question that CQPs can take inverse scope over an indefinite subject.

Experiment 2 was designed specifically to target an expanded set of sentences with object CQPs in which the surface scope is false, but crucially not implausible, and the inverse scope is true. Within this sentence type, we targeted the best and worst cases from Experiment 1 (‘a’ indefinite subject + a partitive CQP object v. ‘one’ indefinite subject + a non-partitive CQP object). We predicted that if indeed an object CQP is able to take wide scope over a subject indefinite, acceptance rates will not only reflect this ability, but a difference in acceptance rates will also emerge between the best and worst case scenarios.

3 Experiment 2

3.1 Participants

63 undergraduates participated. Data from three of these participants were excluded due to the participants’ non-native speaker status. The remaining participants were randomly and evenly assigned to two experimental conditions.

3.2 Design

3.2.1 Procedure

The experiment was administered in a quiet laboratory setting. Stimuli were presented on an iMac using SuperLab stimulus presentation software and a response pad. Participants were run at separate, individual response stations. The experiment began with a brief training
session to acclimate participants to the procedure.

The experimental session proper consisted of 21 trials, presented in fully randomized order. Each trial proceeded in the same way: participants first read a short passage on one screen. They then proceeded to the next screen, where they were presented with the question

*Given what you just read, can the following statement be said?* This screen was then followed by another screen on which the passage appeared once more, this time accompanied by the target sentence directly below it. Participants entered a ‘yes’ or ‘no’ response by pressing a button on the response pad as indicated. Each experiment lasted approximately 20-30 minutes.

3.2.2 Stimuli

The stimuli included 12 test items and nine control items. Each of the nine control items featured scopal interaction between two elements. There were two between-subject conditions, based on the structure of the test sentences. In one condition (‘A’ … [CQP+PRT]), the test sentences all contained an ‘a’ indefinite in subject position and a CQP in partitive form in the object position. In the second condition (‘One’ … CQP[−PRT]), the sentences all contained a ‘one’ indefinite in subject position and a CQP that was not in partitive form in the object position. Given the results of Experiment 1, the predictions should be clear: the (‘A’ … [CQP+PRT]) combination should increase – while the ‘One’ … [CQP−PRT] combination should decrease – the probability of accessing the inverse scope reading.

Of the 12 test sentences, six contained a non-modified subject (e.g., *a woman*), while six contained a modified subject (e.g., *a woman wearing a turquoise dress*). Within these six, two of the CQPs contained the numeral *two*, two contained the numeral *three*, and two contained the numeral *five*. These manipulations were not necessarily predicted to result in any response pattern in particular, but were included to vary the form of the test sentences during the experiment session. An example scenario and target sentence are presented in (16).
The complete set of sentences for the test and control items appear in Appendix B.

(16) Sonia is an art lover who enjoys traveling around the world to see various art exhibits. She was reading about all of the exhibits taking place over the course of the next year, and remarked upon the following. French painters seemed to be very popular among exhibits. Four museums were hosting exhibits featuring the French painter Monet, three featured the French painter Renoir, two featured the French painter Matisse, three featured the American painter Mark Rothko, and three featured the Dutch painter Vincent Van Gogh.

Given what you just read, can this statement be said?

[A/One] French painter was featured in more than five (of the) exhibits.

Notice that in this example, it is clear from the description that each French painter (Monet, Renoir, Matisse) is featured in at most four exhibits, but that the total number exhibits featuring French painters is more than five (in fact, it is nine). Thus, the surface scope reading is false (although not implausible), while the inverse scope reading is true. In addition, in this example, the relatively large quantity of exhibits featuring a French painter – but not necessarily the precise quantity – is a salient feature, making the use of a CQP felicitous.¹⁶

3.3 Results

The percentage of ‘yes’ answers in response to the question served as the baseline. Results for the control items for both experimental conditions are presented in Figure 4.

Figure 4: Average acceptance rate for control sentences in the two experimental conditions

¹⁶ This particular stimulus involves a passive, which might favor the inverse scope of the direct object over the subject. However, many of the items in Experiments 2-4 did not involve passives. Furthermore, the item random effects in our mixed-effect models controlled for / factored out such differences between items.
of Experiment 2.

As Figure 5 shows, participants in both conditions patterned in a highly similar fashion for all control items. For sentences that were ambiguous, but for which the surface scope reading was true and the inverse scope reading false (T, F), participants unsurprisingly strongly preferred responding affirmatively to the target sentence, ostensibly favoring the surface scope reading (as shown in the bars to the far right) (as would have been predicted, based on our earlier discussion. Participants performed at or near ceiling with the controls (the F, F and T, T control bars in the graph). Finally, for controls in which the surface scope was false and the inverse scope was true (F, T), participants rejected the sentence if the subject was a CQP or a numeral phrase interacting with negation, but accepted it if the subject was a singular indefinite interacting with a universal quantifier in object position. These results provide a baseline showing that participants were willing to allow an object to take scope over a singular indefinite subject, and consequently accept an inverse scope reading, when it is licensed.

We now turn to the test items – the only items for which there was a difference between the two between-subject conditions. Since the response variable (inverse-scope
availability: yes vs. no; we designate 'yes' as the success level) is binary categorical, we use mixed-effects logistic regression models to analyze the data. There is only one (binary) fixed effect, namely type of quantificational structure: ‘A ... [CQP prt]’ vs. ‘One’... [CQP prt]’. We designated ‘One’... [CQP prt] as the reference level. Since the experimental manipulation encoded by the fixed effect was between subjects, we only include random intercepts for subjects; but we include both random intercepts and random slopes for items.

One of the items seems to have somehow allowed for the surface scope reading at a much higher rate than the other test sentences, so we drop all the observations for this item from the final data set.\textsuperscript{17} Doing so, we see that the rate of acceptance for the inverse scope of our reference level ‘One’... [CQP prt] was significantly below chance (0.5 probability; i.e., 0 on the logit scale): $\beta=-2.28$, SE=0.40, $p<.00001$, and there was also a highly significant difference in acceptance of inverse scope between the ‘A’... [CQP prt] and ‘One’... [CQP prt] conditions ($\beta=3.16$, SE=0.39, $p=8.6 \cdot 10^{-16}$), due to the inverse scope reading being much more acceptable for the ‘A’... [CQP prt] structure. The results of the mixed-effects logistic regression model (converted from the logit scale to the more easily understandable probability scale) are plotted in Figure 5.

\footnotesize
\textsuperscript{17} Compared to the averages presented in Figure 6, the respective averages for this item were 96.7\% and 86.7\%, an egregious deviation from the other averages, none of which went above 85\% in the ‘a’ condition or 37\% in the ‘one’ condition, the latter condition being the clearest indicator that it was an exception.) This item involved a scenario depicting movies in which ‘a boy with a bear’ always made an appearance. After reviewing this item post-hoc, we realized that, given the timeframe we included in the scenario, there could be a way to interpret the same boy as having been featured across different movies, in which case the surface scope would be true, instead of false, as intended.
4.4 Discussion

In Experiment 2, we presented participants with sentences with an indefinite in subject position and a CQP in object position in scenarios that rendered the surface scope false, but not conceptually implausible. We further manipulated the form of the indefinite in subject position (‘a’ v. ‘one’) and the form of the CQP in object position (±partitive). As expected based on Experiment 1, participants not only demonstrated a willingness to accept the inverse scope reading of sentences in which a CQP in object position took scope over a singular indefinite in subject position, but also the form of the subject and object mattered for the availability of the inverse scope reading. Those sentences in which the indefinite subject was ‘a’ and the object CQP was in partitive form were significantly more likely to result in an inverse scope reading than a ‘one’ non-partitive combination.

Combined, the first two experiments indicate that the type of indefinite and the partitive form of the CQP in object position have an ameliorating effect on the presence of an inverse scope reading. However, three questions arise from this combined data set. First, how generalizable are the results beyond the stimuli in these experiments? We have crafted contexts in which certain readings are (dis)favored, or made salient. Could similar results
regarding the scope of an object CQP hold in a very different sort of design? Second, although these tasks worked to facilitate the availability of the inverse scope reading, could the fact that they required the participants to hold crucial information about the context in their working memory and perceive the target sentences as fitting in to a coherent discourse have placed such a demand on their processing load that their ability to access the inverse scope reading was negatively affected? If so, we would predict that a less taxing task that nevertheless still highlighted particular scopal readings would result in even higher acceptance rates. Finally, while Experiment 1 offered suggestive evidence that partitivity plays a role in the accessibility of the inverse scope reading, Experiment 2 conflated indefinite form of the subject and partitive form of the object in the target items. Experiments 3 and 4 teased apart these factors to probe their individual roles.

4 Experiment 3

4.1 Participants

32 undergraduates participated. Data from 3 of these participants were excluded due to the participants’ non-native speaker status (n=1) or participants pressing numerous invalid keys when entering responses on the response pad (n=2).

4.2 Design

4.2.1 Procedure

The setting and administration of the experiment paralleled that of Experiment 2, with the exception of participants judging a sentence in a visual context in lieu of reading a passage and judging a sentence in the context of the written passage.

4.2.2 Stimuli

The experimental session proper consisted of 59 trials, presented in fully randomized order in SuperLab. In each trial, the participants saw a screen presenting some configuration of shapes, accompanied by a sentence below the shapes. The participants were asked to judge
whether the sentence was true or false, given the visual scene. Participants entered a ‘yes’ or ‘no’ response by pressing a button on the response pad as indicated. Errant button presses were discarded; there were eight of these overall, or .5% of the total number of responses. Each experiment lasted approximately 20 minutes. Similar approaches to eliciting truth values of sentences in a context of visual stimuli (i.e., shapes or dots in lieu of linguistic contexts) has been used effectively by a number of recent researchers (e.g., Chemla & Spector 2011, Geurts & Pouscoulous 2009, Geurts & van Tiel 2013). We thus had good reason to predict that such an approach might also prove fruitful with our target sentences.

Among the trials were 24 test trials: 6 each of sentences fully crossing type of subject (a v. one) and partitivity of CQP in object position (±partitive). The CQP was always more than three (of the) $N$. The rest of the items involved either scopal interaction between the subject and object (e.g., a/one…every, numeral phrase…every), or assessments of quantities or relations between objects in contexts in which the sentence would either be true or false (e.g., between $n$ and $n+2$ circles are green, more than half or the circles are green, four circles are connected to four squares, respectively). Examples of control/filler and test displays are presented in Figures 6 and 7, respectively. The full set of test and control/filler sentences is presented in Appendix C.

**Figure 6:** Examples of control/filler item displays, and the corresponding truth value of the target sentence, appearing in Experiment 3.

<table>
<thead>
<tr>
<th>Two triangles are connected to every circle.</th>
<th>Four circles are connected to four squares, respectively.</th>
</tr>
</thead>
<tbody>
<tr>
<td>True</td>
<td>True</td>
</tr>
</tbody>
</table>
Between 4 and 6 circles are green. Less than half of the circles are grey. 

<table>
<thead>
<tr>
<th>False</th>
<th>False</th>
</tr>
</thead>
<tbody>
<tr>
<td>(7 green, 7 red circles)</td>
<td>(12 grey, 4 red circles)</td>
</tr>
</tbody>
</table>

Figure 7: Examples of test item displays appearing in Experiment 3. All test sentences had the same truth values: SS: False, IS: True.

4.3 Results

Participants responded as anticipated to the control and filler items. Percentages of acceptance for these sentences are indicated with each item type in Appendix C. With the test items, quite remarkably – but perhaps much as predicted based on the two previous experiments – participants accepted the CQP test items with a in subject position an average of over 75% of the time, while they accepted those with one in subject position approximately 40% of the time, as shown in Figure 8.
As with the previous experiment, because of the binary categorical nature of responses, we used a mixed-effects logistic regression model to analyze the data. There were no interaction effects (a Likelihood Ratio Test comparing the model with and the model without interactions yields $\chi^2(1)=.01$, $p=.91$), so we report here the main-effects only model. There was a highly significant main effect of indefinite type: $\beta=-2.89$, SE=0.48, $p<.00001$. However, there was no main effect partitivity: $\beta=.35$, SE=0.33, $p=.28$. We attribute the lack of effect of partitivity in this task to the fact that the existence of all of the objects and their set membership were easily extractable from the visual display, and no information about set membership had to be held in working memory while considering the interpretation(s) and corresponding truth value of the target sentence.

### 4.4 Discussion

The results of Experiment 3 demonstrate without a doubt that experimental participants are able to access the inverse scope reading of sentences in which a CQP in object position scopally interacts with an indefinite in subject position. Furthermore, these results – in conjunction with those from Experiment 2 – firmly establish that the type of indefinite subject matters: sentences with *one* in the subject position resisted the inverse scope reading...
relative to those with a in the subject.

We note, however, that an acceptance rate greater than 30% (and in some cases approximately 60%) with one and between 70 and 80% with a more than suggests that the grammar does not bar this reading because of the decomposition and movement restrictions of the object CQP. If that were the case, then participants would consistently judge as false those sentences that were paired with a context in which the surface scope was false and the inverse scope true. (And even an ungrammatical sentence that was deemed passable in a particular context or experimental environment would not generate such consistently high acceptance rates.) Indeed, for the three other scopally ambiguous control sentences with an indefinite subject in which this same scopal relation held in their respective contexts (SS: F, IS: T), acceptance rates ranged between 57 and 75% (most likely for reasons we discussed earlier related to Truth Dominance and the processing of sentences with a singular indefinite in subject position). Thus, the acceptance patterns observed Experiment 3 are comparable to those for uncontroversially ambiguous cases. The lack of a partitivity effect in this experiment may also be attributed to the fact that participants did not have to store information about set membership in their working memory and retrieve it to render a judgment about the sentential interpretation and its corresponding truth value: the visual stimuli could be viewed en masse, facilitating parsing of the scene. To further solidify the acceptability of the inverse scope reading of the target sentences, and probe the role of partitivity in a text-based task that placed demands on participants’ working memory, we conducted Experiment 4.

5 Experiment 4

5.1 Participants

133 undergraduates participated. Data from 7 of these participants was excluded due to the participants’ non-native speaker status. Data from a further 7 participants was excluded
because of their low (<80%) accuracy of responses to control fillers. This left us with a final sample size of 119 participants.

5.2 Design

5.2.1 Procedure

The experiment was administered online using an installation of the Ibex platform locally hosted by a server at the home institution of one of the co-authors. Participants read a background scenario displayed on a first screen, which was then followed by a target sentence, displayed by itself on a new screen. The target sentence was presented for self-paced, non-cumulative, moving-window reading (Just et al. 1982): at the outset, all words are masked by dashes; participants press the space bar to reveal one word at a time; as a new word is revealed, the previous one is hidden again (the letters are replaced with dashes again). After the sentence, participants then moved to a third and final screen where they were required to answer the yes/no question Is that right?, which asked them to evaluate the target sentence against its background scenario. The experimental session proper was preceded by a brief training session to acclimate participants to this format.

5.2.2 Stimuli

The stimuli were designed to be text versions of the stimuli included in Experiment 3: that is, instead of shapes bearing some relation to each other (as in Experiment 3), the stimuli in Experiment 4 were short passages that made reference to individuals, the same sort of relation between them, and to object and events connecting them. An example of a target item follows.

(17) **Scenario:** Four local pastry chefs were competing in a contest for the best wedding cake last night. The winner would have their cake featured in a big wedding, and pictured on the cover of Weddings Today. In the first stage of the contest, five tiered cakes were set out, and some of the chefs were invited to decorate them. The cake
flavors were raspberry cream, strawberry cheesecake, lemon chiffon, French vanilla, and dark chocolate. Chef Nathan decorated the raspberry cream cake, Chef Olivier decorated the strawberry cheesecake, Chef Pierre decorated the lemon chiffon, while Chef Quincy had quit the contest because of a family emergency.

Sentence: I think that [a/one] cake was decorated by more than two (of the) chefs at the local pastry contest last night.

It should be apparent that this kind of item places more of a cognitive load on the participant by requiring the participant to hold more information in their memory leading up to the target sentence. Moreover, since the target sentence itself was not displayed all at once, the presentation of this sentence placed a slight burden on the working memory. We therefore predicted that we might see a difference in acceptability scores between Experiments 3 and 4, with more depressed rates in this experiment.

Target sentences all began with the lead-in *I think that*, as above, to provide a lead-in before participants read the subject indefinite. There were 16 such test items, randomized with 11 unambiguously true and 22 unambiguously false fillers. The stimuli also included two additional filler items involving scopal interaction between *every* in subject position and a CQP headed by *fewer* in object position (SS: False, IS: True), to probe whether the processing and pragmatic factors we have identified as playing a role in facilitating the inverse scope reading with our target indefinite subject-object CQP sentences with *more* could also facilitate the availability of the inverse scope reading of sentences with a universal subject and an object CQP with *fewer* (a sentence type that has similarities with the current one in being claimed to bar the inverse scope reading). See Appendix D for complete stimuli.

5.3 Results

Before analyzing the reading-time data, we dropped the data from 6 outlier participants whose mean reading times were more than two standard deviations away from the grand
mean reading time for all subjects. We report here the results based on the data collected from the remaining 113 participants.

Figure 9 displays the raw reading times (RTs) and their associated standard errors (SEs) for the 6 regions of interest (ROIs) following our two experimental manipulations (sentence-initial indefinite subject and CQP object in partitive or non-partitive form). The first ROI is the common noun inside the CQP, e.g., *chefs* in example (17) above, which immediately follows the +/-partitivity manipulation towards the end of the target sentence. 

**Figure 9:** Mean readings times (RTs) in ms and standard errors (SEs) for the 6 regions of interest (ROIs) in Experiment 4.

These data indicate that there is a significant effect of partitivity: in the first 3 ROIs, non-partitive stimuli took more time than their partitive counterparts. In comparison, the indefinite manipulation *a* vs. *one* seems to have had little if any effect. These impressionistic generalizations are supported by statistical data analysis. Since the response variable is continuous (reading time), we use linear mixed-effects regressions to model the data. However, we do not analyze the raw RTs directly. First, we log-transform them to mitigate the right skewness characteristic of response time data; the empirical distribution of the log-transformed data is much closer to a normal (Gaussian) distribution, which is assumed by
linear (mixed-effects) models. Second, following Trueswell et al (1994), we residualize the log RTs by factoring out word length (in characters). The linear model used to obtain the residualized log RTs also includes word position as a predictor (in addition to word length) intercept random effects for subjects. We use the residualized log RTs as the response variable in all linear mixed effect models (hence the small magnitude of the effects we will report). A series of Likelihood Ratio Tests we ran for each of the 6 ROIs determined that random effect structures richer than crossed random intercepts for subjects and items did not significantly improve data fit. Similarly, a comparison of models with interactions and main-effects-only models indicates that interactions are not significant in any of the ROIs. We will therefore report here the results of linear mixed-effects models with fixed-effect structures that include only main effects for +/-partitivity and a vs. one indefiniteness, and random-effect structures that include only (crossed) random intercepts for subjects and items.

In ROI 1 (the common noun inside the CQP), there was a highly significant effect of partitivity ($\beta=-0.16$, SE=0.02, $p=3 \cdot 10^{-13}$): there was a speed-up (indicating less processing difficulty) for +partitive CQPs relative to –partitive CQPs. There was also a significant effect of indefinite in the expected direction ($\beta=0.04$, SE=0.02, $p=0.04$): there was a slow-down (indicating higher processing load) when the indefinite in subject position was headed by ‘one’. In ROIs 2-4, there was only a significant main effect of partitivity ($\beta=-0.1$, SE=0.02, $p=1 \cdot 10^{-7}$, $\beta=-0.07$, SE=0.02, $p=9 \cdot 10^{-5}$, and $\beta=-0.05$, SE=0.02, $p=0.008$, respectively). There were no significant effects in ROIs 5 and 6.\footnote{There is a nearly significant effect of ‘one’ in ROI 5 in the unexpected direction ($\beta=-0.03$, SE=0.02, $p=0.08$). Given the relatively fleeting nature of this effect (it occurs in only one region) and its near significance, we will not discuss it further.} Thus, the self-paced reading time results of Experiment 4 complement the acceptability results of Experiment 3, in which the partitivity effects were neutralized as a result of the visual contexts, while the indefiniteness contrast...
between *a* and *one* surfaced robustly.

We now turn to an analysis of responses and times to render responses. The pattern for answers is qualitatively the same as for Experiment 3, as shown in Figure 10 below. Once again, we see a clear effect of indefiniteness, with an ‘*a*’ indefinite more easily allowing the CQP in object position to take inverse scope than ‘*one*’. We suspect that the depressed acceptability rate for the inverse scope reading observed in Experiment 4 relative to that of Experiment 3 is a reflection of the increase in cognitive load and the extent to which participants’ working memories were taxed in the more demanding self-paced reading task of Experiment 4. We also see no effect of partitivity in acceptability responses, just as in Experiment 3. These generalizations are confirmed by the data analysis.

**Figure 10:** Empirical probabilities of inverse scope as confirmed by a ‘yes’ answer to the comprehension questions in Experiment 4.

The best model (as determined by a series of Likelihood Ratio Tests) is a mixed-effects logistic regression model with main effects only (no interactions) and crossed random intercepts and indefiniteness random slopes for subjects and items. The only significant effect is the indefiniteness main effect (β=−1.01, SE=0.22, p=6·10⁻⁶), with acceptance less likely with ‘*one*’. The analysis of response times (once again we used linear mixed-effects models)
yielded no significant effects, so we will not discuss them any further.

Recall from the Stimuli section that we included two filler items in which *every* in subject position interacted with a *fewer* CQP in object position. The purpose of these two items was to probe whether the processing and pragmatic factors we harnessed to our advantage in our target sentence types also had an effect with this type of sentence structure, which has played a role in discussions of restricted scope-taking ability. The *fewer* object CQP is also claimed to not be able to take wide scope over a universal quantifier in subject position. In the scenarios we presented to participants (as shown in example (18) below), we made the surface scope False and the inverse scope True, as with our target cases. We also satisfied the felicity conditions in the discourse context for the use of a *fewer* CQP, and placed the CQP in partitive form.

(18) Dr. X came up with a fun game for his math students. He placed 100 red tokens in a large bowl. He then asked each of the students in his class to come up to the bowl, randomly select 15 of the tokens, initial each of them, and place them back in the bowl. After each student did this, he shuffled the tokens around in the bowl before the next student's turn. After every student had a turn and had initialed 15 tokens each, Dr. X asked his class to think about how many tokens had each student's initials. He guessed himself that there might be 10 tokens that had every student's initials. One of the students then inspected all the tokens to see if he was right. When done inspecting, the student announced that 8 tokens had each set of student initials.

I think that every student initialed fewer than 10 of the tokens.

The manipulation of these factors appears to have facilitated the inverse scope reading, since participants accessed this reading between 48.7% and 65.5% of the time for the two items (58/119 and 78/119, respectively). This pattern of responses thus serves as a call to future researchers to probe the scope-taking ability of *fewer* with the goal of determining to what
extent its scope-taking ability is indeed limited, what this says about the viability of a decompositional analysis for comparative quantifiers in general, and whether negative quantifiers such as fewer – even if still assumed to decompose – are subject to softer constraints on movement than has been previously thought. If indeed the scopal possibilities of such quantificational expressions is greater than was previously thought, and there are strong independent reasons to maintain a decompositional approach, then it is possible that the locus of the further revisions lies in Scope Economy, as Fleisher (2015) and Mayr & Spector (2012) have argued thus far.

6 General Discussion and Conclusions

We began this paper with the observation from previous literature that Comparative Quantifier Phrases (CQPs) appear to have a limited scopal range and appear to not be able to take inverse scope an indefinite in subject position. This restriction on their scope-taking ability seems surprising if they are treated as generalized quantifiers. This restricted scopal range seemed so robust that it led Takahashi to propose that Comparative QPs in object position obligatorily take narrow scope relative to QPs in subject position (not just indefinites). The set of experiments reported here, however, make it patently clear that we must abandon this generalization. Not only can object CQPs take wide scope relative to an indefinite in subject position when the surface scope reading is conceptually implausible, but CQPs are also consistently judged to take wide scope and generate an inverse scope reading in other circumstances, once the processing factors and felicity conditions we identified earlier have been controlled for. Given the acceptability of the inverse scope reading of sentences in which an indefinite subject interacts scopally with an object CQP demonstrated across four independent experiments using different methodologies, we are led to conclude that the lack of wide-scope readings for direct object CQP is not a hard constraint that should be captured in the grammar (syntax, semantics and/or their interface).
Instead, we argue that it is the outcome of processing preferences and should be accounted for within a more general theory of performance, very much along the lines of similar soft constraints on quantifier scope exhibited by other quantifiers. (See AnderBois et al (2012), Srinivasan & Yates (2009), Higgins & Sadock (2003), Saba & Corriveau (2001), Kurtzman & MacDonald, (1993), Gillen (1991), Micham et al (1980), Van Lehn (1978), Ioup (1975), among many others). The evidence thus seems to favor a non-decompositional, generalized quantifier account of CQPs along the lines of Mayr & Spector (2012), unless a decompositional account such as Fleisher (2015)’s can be modified to license the inverse scope reading of such sentences (e.g., by revisiting constraints on movement and Scope Economy that would otherwise bar the inverse scope reading).¹⁹

However, the leading contender for a GQ analysis (Mayr & Spector, 2012 (M&S)) still cannot account for the range of judgments linked to sentences with CQPs, even after taking into account the role of the factors that we manipulated in our experiments. In order to account for the apparent inability of subject CQPs taking scope below negation, M&S have to make extra assumptions about their version of scope economy, the homogeneity of pluralities, and the requisite existence of the entities in question. We suggest that future research should experimentally probe sentences such as these. If it turns out that that taking into account variables such as we did in the current experiments reveals that CQPs may be able to take scope below negation, then certain aspects of Mayr & Spector’s approach may be abandoned, and their Generalized Scope Economy Condition need not bar that inverse scope

¹⁹ As a reviewer points out, the lingering issue of scope-splitting readings, which motivated a decompositional account, would remain. As these were not a focus on the experimental research reported in this paper, we do not address them here.
reading.\textsuperscript{20} We take a first step towards probing such sentences here, using the following example, discussed by M&S.

Let us consider four different contexts in which a professor is teaching a graduate seminar, and delivers the utterance in (19). And let us further consider the truth values associated with the two candidate readings, and their implications.

(19) More than three students didn’t show up on time.

In context A, there are six students in the seminar, two of whom show up on time and four of whom do not show up on time. In this context, both the surface scope (CQP $>$ neg) and the inverse scope (neg $>$ CQP) readings are true. However, given that the inverse scope reading is competing against a true surface scope reading, its unavailability may be due to the processing reasons we reviewed earlier (and of which M&S are aware), and a mere judgment of ‘true’ does not help to disambiguate the readings.

In context B, the seminar is small, and there are only four students enrolled. Two students show up on time, and two do not. In this case, the surface scope reading is false, and the inverse scope reading is true. However, given M&S’s homogeneity assumption (that there must be a plurality where the predicate must be true of every individual member), they argue that this sentence has no truth value, because of a presupposition failure. It would, then, be worthwhile to evaluate whether participants also share this intuition, and whether they allow the sentence to be true, as inverse scope would have it.

In context C, there are eight students enrolled in the seminar, four of whom show up on time, and four of whom do not. In this case, the surface scope reading is true, since more than three students did not show up on time, and the inverse scope reading is false, since it is

\textsuperscript{20} Of course, as a reviewer notes, we have not addressed the ameliorating effect of a non-upward entailing embedded environment, which is a crucial observation for M&S, and one which we cannot address in the space of this paper.
the case that more than three students showed up on time. Here, the pluralities satisfy the homogeneity assumption, and the inverse scope reading does not entail the surface scope reading, so the inverse scope reading – while false and competing with a true surface scope – should in principle still be available (i.e., generated by the grammar). An open question, then, is whether there are circumstances under which participants might reject these sentences, or allow a false judgment to be acceptable.

Finally, in context D, consider a seminar of eight. Before the class starts, the professor makes a prediction that because the campus bus is running behind schedule today, she does not think that three or more students will show up on time. In actuality, five students show up on time, and three do not. In this case, both the surface scope reading and the inverse scope reading are false. At the start of class, the professor very quickly glances around the room and remarks, “I knew it! More than three students didn’t show up on time!” It seems possible that two of the five punctual students who were quietly sitting in the corner and were overlooked could politely correct the professor’s false statement (by accessing the inverse scope reading) to point out that in actuality, more than three students did show up on time. In fact, five did. This passing intuition, we think, merits more systematic follow-up, as we thought sentences with indefinites and CQPs did.

We highlight the case of interaction between a subject CQP with negation to illustrate that – as with our cases with object CQPs and subject indefinites – there has been an assumption about the limited scopal ability of CQPs, which, we argue, deserves to be revisited. The experimental manipulations that we incorporated into our designs could easily be extended to other instances such as this one in which CQPs have been claimed to have restricted scope. However, the much-needed extension to these other sentence types does not detract in any way from the current results, which demonstrate the scopal interaction between a subject indefinite and an object CQP, and show that the corresponding inverse scope
reading is in fact available – and robustly so across different discourse and linguistic contexts.

Thus, our experimental results call for a reevaluation of the syntactic-semantic treatment of CQPs and their scope-taking ability. To the extent that a decompositional treatment of CQPs inherently bars CQPs from taking scope over an indefinite in subject position under any circumstances, then a generalized quantifier account along the lines of Mayr & Spector (2012) gains ground. However, this statement comes with a caveat, since there are a number of linguistic environments that we did not test in the space of this targeted investigation on subject indefinites, which would need to be probed in order to shore up conclusions about the syntax/semantics of CQPs. We see this as an exciting line of future experimental research.
Appendix A: Scenarios and sentences appearing in Experiment 1

1.1 Test Sentences

Object: [Comparative Quantifier (±partitive) / Numeral (±partitive)]

(1) ‘One’ in subject position

Last week, the local bike shop had two red tricycles, and both of them sold immediately – each one to a woman. This was a little surprising to the owner, because usually it’s the dads who buy the tricycles in his shop. This week, the shop received a new shipment of five red tricycles. Based on last week’s sales, the owner of the bike shop predicted that at least two red tricycles would be sold today, and that each one would be purchased by a woman, not a man. At 10 am this morning, a woman came to the shop, looked around, and bought a red tricycle for her son. At 11 am, another woman bought a red tricycle for her son, too. The owner of the bike shop began to wonder if his prediction was on target. At 2 pm, a man came in looking for a tricycle, but wanted a blue one, so he walked out without purchasing anything. At 4 pm, however, a woman came in by herself looking for a birthday present for her nephew. She tried to decide between a red tricycle and an orange scooter, and eventually bought a red tricycle. The owner was happy, because his predictions were right on.

One woman bought [more than two (of the) / three (of the)] tricycles.

(2) Indefinite in subject position

A popular talk show host wanted to do a segment on physical fitness. She had an NBA basketball player appear on the show, and invited five audience members up on the stage to shoot hoops with him. The talk show host said that the audience members had to compete with the NBA player. The only catch was that he was going to be blindfolded! Once blindfolded, the basketball player took his first shot, but wasn’t even close to making it! The second try was better, but the ball bounced off the
backboard. The ball hit the rim on the third try. The player took a deep breath, set himself up, and made his last two shots—this time making them both. What a relief! Everyone assumed that the audience members might also have a difficult time, and would only be able to make two baskets total. However, the first and second audience members made their shots. Amazing! The third and fourth people didn’t, though. Everyone held their breath for the fifth person—would she make it? She did! The NBA player was shocked the audience members did as well as they had, and gracefully admitted defeat. All of the participants got tickets to the next game as a prize.

An audience member made [more than two (of the) / three (of the)] baskets.

(3) Indefinite in subject position, Surface scope implausible

A convention for NY Times Bestsellers was being held in Gary, Indiana. Many VIPs were expected to come and stay in the city during the convention, so Officer Hendricks, Officer Wilson, and Officer Murray were assigned as guards to two hotels where the VIPs were staying. They were told to be at their posts in front of their assigned hotels at 9 am sharp. Initially, all of the VIPs were expected to stay at only two hotels, since the city didn’t want to pay the fees for more locations. So Officer Hendricks and Officer Wilson were assigned to the Marriott, and Office Murray was assigned to the Hyatt Regency. However, at the last minute, more VIPs decided to come, so a hasty arrangement was made to have some guests stay at the Embassy Suites hotel. The city officials knew that using more than two hotels would mean more fees, but they didn’t care; this convention was going to bring in a lot of much-needed revenue for the city. Officer Wilson was instructed to proceed to the Embassy Suites. At 9 am, each guard was standing at his post.

A guard was posted in front of [more than two (of the) / three (of the)] hotels.
Indefinite in subject position, Surface scope implausible

Emily was planning a dinner for her parents’ 50th anniversary at a nearby restaurant. The staff set aside the back dining room for the event. She had asked them to place a centerpiece on each of the five tables in the room. The day of the event, Emily went to see how things were coming along. She was hoping that she could see at least a couple of the centerpieces in place. She was pleasantly surprised with what she saw. The staff was busy at work, and had already put a beautiful vase of roses on not one, not two, but three tables! And it looked like they were planning on setting out more shortly. This was going to be a wonderful anniversary dinner.

A vase of roses graced [more than two (of the) / three (of the)] tables.

Negation

In art class, the students were assigned to do projects for the school fundraiser. Each student was assigned six items to complete. Mary was assigned little wooden birdhouses, which she had to paint. John had to paint six toy boats. John was a diligent worker. He painted two boats before lunch, and two after lunch, leaving only two to paint the next day. He knew Mary was a slow painter and wondered how many she would leave for tomorrow. He suspected it would be more than he had. In the morning, Mary painted two birdhouses. But after lunch, she was tired and sluggish, and only got around to painting one more by the end of the day. She had to leave the rest for the next day.

Mary didn’t paint [more than two (of the) / three (of the)] birdhouses.

Negation

Sarah’s and Margaret’s daughters were on the same dance team. The dance team was going to travel to a competition in California, so the moms decided to hold a bake sale to raise money for the trip. They each choose six different cake recipes to bake, and
thought it was best to try them out first and make sure they were ready to sell. Each mom went to work baking and tasting her six cakes. Sarah was a pro. She baked four cakes in one day, tasted them, and thought they were very good. She baked her last two, tasted them, and congratulated herself with her success. Meanwhile, Margaret was working in her kitchen. She had to admit that it had been a long time since she had baked cakes, so she proceeded more cautiously. She chose the first cake recipe, baked the cake, tasted it, and thought it was all right. She continued to the second cake. She baked it, tasted it, and decided that it was okay, too, but not great. Worried about the time this was taking, she decided to work more quickly, hoping she could do more. She chose a third recipe. But this time she forgot the eggs. When she tasted the cake, she was discovered it was terrible. Margaret was really disappointed with herself and gave up baking for the day, leaving the rest of the cakes for tomorrow. 

Margaret didn’t taste [more than two (of the) / three (of the)] cakes.

(7) CQP in subject position

A middle school teacher wanted to pick a book for summer reading, but he couldn’t decide which one he should choose. So he picked five books and asked ten of his current students to choose a book among these. They could only select one book. Based on their selections, he would choose the book for summer reading for the incoming class. The five book choices were *Holes*, *Fantastic Mr. Fox*, *The Golden Compass*, *A Wrinkle in Time*, and *Little Women*. The teacher worried that the selections would be evenly distributed among the books. But that’s not what happened. After the students made their selections, he found out that four chose *Fantastic Mr. Fox*, three chose *Holes*, and three chose *Little Women*. Surprisingly, no one chose *The Golden Compass* or *A Wrinkle in Time*.

More than two students selected [more than two (of the) / three (of the)] books.
1.2 Control Sentences (Scopal Interaction) Truth value with scope

(8)  \( a > \pm \text{CQP} \) True, \( \pm \text{CQP} > a \) True

The children in Mr. Wilson’s class were going to decorate some boxes to deliver their valentines. There were five boxes to decorate. Mr. Wilson didn’t anticipate that any boys would be eager to decorate the boxes. He thought a boy would decorate one or two at most—and do it reluctantly. Little did he know that Michael had been looking forward to this all month, and had come to school equipped with stickers, ribbons, and bows! When it was time to decorate, Michael eagerly volunteered to decorate. He set to work on one box, and covered it with bows and stickers. He then turned to a second box and did the same. Just when Mr. Wilson thought he was done, Michael volunteered to do one more box, and went all out, covering it with bows, stickers, glitter, and sequins. Michael was very pleased with his work, and challenged a girl to do just as well with the remaining two boxes. This was going to be a great Valentine’s Day!

A boy decorated [more than two (of the) / three (of the)] boxes.

(9)  every > a True, a > every False

The students in a film class were compiling information about previous winners at the Oscars, and were specifically interested in how successful African Americans had been in acting roles. They started naming the major categories of Oscar awards for acting and the African Americans they knew had won the awards. One student remembered that Denzel Washington had been nominated for five or six awards, but knew he had only won two (Best Actor and Best Supporting Actor). Another student mentioned that Jamie Foxx and Forest Whitaker had also won Best Actor. As for the women, a third student remembered that Halle Berry had won Best Actress, and that Jennifer Hudson had won Best Supporting Actress for her work in *Dreamgirls*. 
An African American won every major Oscar for acting.

(10) every > a True, a > every True

A group of teenage girls wanted to start their own band. They’d never been in a band before, but they had some musical expertise. Each of them needed to pick their instrument. They thought they’d start with a guitar, a bass, and drums. Annie had the most experience with these instruments. She played the drums for a little, then switched over to the guitar. She was tempted to stick with the guitar, but when she tried out the bass, she thought she’d stick with that instrument. Jessica went next. She knew she loved the drums, so she sat right down and started playing them. Hillary was last, but that was okay with her, since she loved the guitar. She picked it up and started playing it right away. They had a band! Now all they had to do was pick a name.

A girl played every instrument.

(11) every > a False, a > every False

The Middle School teachers are hosting a big Career Day for their students. Each of the three teachers has to invite a guest to speak about his or her career. Ms. Granger thought about her choice, and decided to invite Dr. Greg Hammond, who is a pediatrician. Ms. Bailey had also wanted to invite him, but when she heard that Ms. Granger had invited him already, she didn’t invite anyone. Ms. Allen had also considered Dr. Hammond, and then thought about Bob Montgomery, who owns his own organic café and has a farmer’s market stand in the summer. She ended up inviting him. The middle school students were going to have an excellent group of Career Day speakers.

Every teacher invited a guest.

(12) neg > three True, three > neg False
The local petting zoo has three new animals and they’re allowing the public to visit and feed them. There is a goat, and two sheep. This morning, a kindergarten class is visiting the zoo. Little Timmy is happy to see the animals, but he is also very shy. He approaches the goat with an apple. The goat gobbles it right up, startling Timmy. He is uncertain about whether or not he wants to feed any more animals. But the zookeeper hands Timmy a handful of feed and encourages him to approach one of the sheep. Timmy holds out his hand to the sheep, and the sheep gobbles up the feed, licking Timmy’s hand. Timmy decides he has had enough, and it is time to go wash his hands! He doesn’t feed the second sheep.

Timmy didn’t feed three animals.

1.3 Filler Sentences (Antecedent-Contained Deletion) Truth value with indexation

(13)  True w/ either coindexing

The school choir is getting ready to perform their songs at the annual Winter Wonderland Holiday concert. Julie is very picky about Christmas songs and only likes to sing “Joy to the World,” “Silver Bells,” and “Carol of the Bells.” But she knows that she will have to sing whatever song the choirmaster selects. When Julie finally sees the list of songs the choirmaster has selected, she is thrilled that her three favorite songs are among those selected. At the concert, she sings her heart out to each and every song. Happy holidays!

Julie sang every song she wanted to.

(14)  False under either reading

Katy and her friend Faith were out shopping, and discovered a sale on dresses. They were so excited! They both picked out three dresses that they each wanted to try on, and handed these to the clerk to set up dressing rooms for them. Each girl had a very
different style, and it was clear from the dresses they chose: Faith’s choices were subtle and demure, while Katy’s were vibrant and bold. Faith went into her dressing room and tried on the three dresses she picked out. After much consideration, she decided on one she really liked. In another dressing room, Katy tried out the three dresses she had selected, and found one that fit perfectly. Faith walked away with a great little beige dress, and Katy got a stunning red dress. Now all they needed was a place to wear them!

She tried on every dress that Katy wanted to.
Appendix B: Scenarios and sentences appearing in Experiment 2

2.1 Test Sentences

Non-modified subject

(15) An advertising company recently had their annual retreat in Asheville, NC. The sales division had a series of competitions for the purpose of team building. Before the competitions started, the leader of the sales division started to worry that he had chosen activities that would favor the males, and thought that the women might only win two of the prizes, at most. At the end of the day, Larry (a man) and Ted (a man) each received a prize, but the sales leader was also very relieved to see that Edna (a woman) won two prizes, Diane (a woman) won a prize, and Joanne (a woman) won a prize.

[A/One] woman received more than two (of the) prizes.

(16) Metropolitan, a local salon, was offering a special called the “Metropolitan Metrosexual” last Saturday, which was intended to boost their male clientele. It featured a facial and haircut and $10 off high-quality shaving products. The owner advertised in area gyms and sports stores, and waited to see whether any men would be book an appointment. That Saturday, out of all of the appointments that were booked, Bob (a man) booked appointments for himself and for his partner Gary (also a man); John (a man) booked an appointment for himself; Glen (a man) booked an appointment for himself; Mary (a woman) booked appointments for herself and her two sisters, Janice and Elise; and Celeste (a woman) booked an appointment for herself.

[A/One] man booked more than two (of the) appointments.

(17) The school district held math and science competition for the middle school students at the end of the year. The superintendent wanted to increase student interest in these
areas, but she especially wanted to showcase the talents of the female students. She really hoped that the girls performed just as well as the boys, if not better. There were eight event categories, and the winner of each got a medal. The girls did really well! When the competition was over, four boys (Albert, Raymond, Gus, and Philip) each won a medal, and four girls (Gwendolyn, Hillary, Anastasia, and Raven) each won a medal.

[A/One] girl won more than three (of the) medals.

(18) Each day, the elementary school randomly selected a student to read the morning announcements. The principal realized that they should probably do things a little less randomly when a few students got upset that their classmates got more than one turn, when they hadn’t even had a turn yet. Here’s a good example. Last week, Jeremy (a third grader in Miss Ragazzo’s class) read the morning announcements on Monday and Wednesday, Harris (a third grader in Miss Hamilton’s class) read them on Tuesday and Thursday, and Thomas (a first grader in Miss Zambini’s class) read them on Friday.

[A/One] third grader read more than three (of the) morning announcements.

(19) Sonia is an art lover who enjoys traveling around the world to see various art exhibits. She was reading about all of the exhibits taking place over the course of the next year, and remarked upon the following. French painters seemed to be very popular among exhibits. Four museums were hosting exhibits featuring the French painter Monet, three featured the French painter Renoir, two featured the French painter Matisse, three featured the American painter Mark Rothko, and three featured the Dutch painter Vincent Van Gogh.

[A/One] French painter was featured in more than five (of the) exhibits.

(20) It is no secret that the photographer Jan van Jacobs had a preference for capturing
certain subject matter and certain kinds of people. For example, at a recent retrospective of his work, we walked around the gallery noticing just how many of the photographs featured the same old couple with grey hair sitting on a park bench together. The same blonde woman at a beach appeared in three photographs. And at least six or seven of the photographs featured a different redhead woman holding an umbrella.

[A/One] redhead appeared in more than five (of the) photographs.

Modified subject

(21) Food Network has come up with a new show, where contestants from each of the fifty states will compete to see whose state has the best new up and coming chef. In the first stage of the competition, there were five events. California, Massachusetts, and Michigan were each represented by three contestants. Contestants had to make a soup, a healthy seafood dish, a main entrée with mushrooms, a vegetarian appetizer, a dessert with fresh fruit. The contestants from Michigan didn’t win any of the events and didn’t advance. One contestant from California won the soup and vegetarian appetizer events, but the other two from this state didn’t advance. Surprisingly, each of the contestants from Massachusetts won an event: the seafood dish, the entrée with mushrooms, and the dessert. The judges were very impressed!

[A/One] contestant from Massachusetts won more than two (of the) events.

(22) National Geographic Magazine has a new app that presents stunning photographs on a range of carefully selected topics each week. Last week, they had photographs of textiles in the Middle East, and the week before that, they had photographs of mosaics in Barcelona. This week, they have photographs of bridges across the United States. When you see these pictures, you will want to visit all of these places, and in particular, New Hampshire. I say that, because among the photographs, there is a
bridge from Boston, MA, one from Charleston, SC, two from San Francisco, CA, and at least three or four different covered bridges from New Hampshire! What’s nice, too, is that each bridge has a photograph from two different times of the day: sunrise and sunset.

[A/One] covered bridge from New Hampshire was featured in more than two (of the) photographs.

(23) In an attempt to educate its customers about all of the countries in the world where coffee comes from, Starbucks is running a special promotion for the next seven days. Each day, they will offer a coffee special and select a country whose coffee roast they will feature. Even though they tried to make it somewhat balanced among the continents, they ended up favoring Africa, because those coffees are just so good! For example, Kenya, Ethiopia, Tanzania and Rwanda each had a day for a coffee special, while Colombia and Brazil from South America each had a day, and Guatemala from Central America only had one day.

[A/One] coffee from Africa was selected for more than three (of the) coffee specials.

(24) Bernard Adieu was a director whose short films bring you back to your childhood, but you might not realize all of the clever ways that he accomplished this in his movies. I recently read that he did little things like make sure that one of the actors sang a nursery rhyme in each movie, or in one movie, he placed well-known children’s picture books in the background when two characters were talking in a bookstore. A trick of his that I found particularly clever is that in at least four movies made within the space of six years, and filmed all over the world, Bernard Adieu had a prominent scene that featured a charming little boy who was smiling and holding a teddy bear. You must see his movies!

[A/One] boy holding a teddy bear appeared in more than three (of the) movies.
(25) It’s funny how certain colors are chosen by fashion magazines to express the feel of the season and the fresh look for women each year. This spring, turquoise appears to be the “it” color. Go to any newstand or book store, and you’ll see what I’m talking about. Last week, for example, Drew Barrymore, Kerry Washington, Kristen Bell, Anna Kendrick, Jennifer Lawrence, and Kate Winslet were all on magazine covers wearing a turquoise dress – and Kristen Bell was even wearing turquoise dress on three different magazine covers. It’s really something else!

[A/One] woman wearing a turquoise dress was featured on more than five (of the) magazine covers.

(26) New Jersey magazine holds a contest every year in which it asks its readers to vote on their favorite places all over the state. This includes a number of different categories: restaurants, parks, dance studios, gyms, and so forth. In the restaurants categories alone, there are also categories: best pizzeria, best diner, most kid friendly, and so on. Central New Jersey restaurants usually don’t do nearly as well as North Jersey restaurants, and some North Jersey restaurants even win multiple awards. For example, Johnnie Pepperoni’s awards won three last year. But this year, Central New Jersey restaurants faired really well, and at least six of the ten awards went to different Central New Jersey restaurants. I can’t wait to go out to eat!

[A/One] restaurant from Central New Jersey won more than five (of the) awards.

2.2 Control Sentences (Scopal Interaction)

Surface scope (SS) False, Inverse scope (IS) False

(27) Last night at Maxine’s Bistro, they ran a special. All of the vegetarian entrées included a free appetizer, but the meat entrées didn’t. My girlfriend almost considered ordering the butternut squash ravioli, so she could get the goat cheese and beet salad free with it, but when she saw that they had duck on the menu, she ordered that
instead, and therefore didn’t get a free appetizer. Of course, she was jealous when my eggplant parmesan dish arrived with a free arugula salad appetizer! It was delicious, so I let her have a bite.

Every entrée on the menu included a free appetizer.

SS True, IS True

(28) Trends in baby names come and go. My friend is a pediatrician, and she says she notices this all of the time. Lately the trend seems to be to name children after famous people in our country’s history. 10 moms brought their baby girls into her office yesterday. Of these babies, four baby girls were named after Eleanor Roosevelt (wife of President Franklin Delano Roosevelt), one girl was named after Amelia Earhart (the famous aviator), two girls were named after Jacqueline Kennedy (wife of President Kennedy), one girl was named after Rosa Parks (the Civil Rights activist), and two were named after Abigail Adams (wife of President Adams).

More than three of the moms named her child after a former First Lady.

SS False, IS True

(29) In one of the TV shows I watch on a regular basis, the writers made sure that in every single episode, no matter where they film, they are sure to incorporate certain things. One of these things is a merry-go-round. It doesn’t matter if they’re filming on a playground in Georgia, a park in Seattle, or a beach boardwalk in New Jersey: each episode will have some sort of merry-go-round in the background. They must do a lot of research to find these all over the place!

A merry-go-round appeared in every episode.

(30) When it’s that time of year to sell Girl Scout cookies, all of the Girl Scouts that I know are super excited to get out there and sell those boxes of cookies. This year in my neighborhood, every single house was visited, and every single little Girl Scout
was out there, eagerly knocking on doors to get people to purchase cookies to benefit their troop. It seems like they did a good job of dividing up the houses in the neighborhood, so that each of them had their assigned doors to knock on, and they ended up getting to every single one of the houses with a little teamwork.

A Girl Scout knocked on every door.

(31) We are getting ready to adopt a puppy, so I went to the dog park for the first time yesterday to see what it is like, before we got our dog. I was surprised, because I thought that that owners would be more responsible. For example, I thought that all of the dogs would be wearing a collar, but that was not the case. Of the four dogs there, two had a collar on, and two did not. I’m going to be sure my puppy wears his!

Three dogs were not wearing a collar.

(32) Prof. Yamaguchi is teaching a small honors class this semester, with only seven students enrolled: Ash, Bonnie, Christopher, Damon, Edgar, Francesca, and Gregory. She was hoping that because this was an honors seminar, the students would go above and beyond what was asked of them. After all, honors students are supposed to be highly motivated, right? She hoped the vast majority of the students would do extra credit. But when she gave them a chance to do an extra credit assignment, she did not get the enthusiastic response she had expected. Only Ash, Damon, Edgar, and Francesca did the extra credit. Bonnie, Christopher, and Gregory did not.

More than five students didn’t do the extra credit.

(33) Last week, there was a stomach bug going around, and the tap dancers in Miss Carla’s tap class were affected. Miss Carla had nine little tap dancers in her “mini tappers” class. She really hoped that most of them would be able to perform, since there was no way to cancel the performance, and the parents were really looking forward to it. So she told her dancers to get plenty of rest and take vitamin C, and she crossed her
fingers that more than five dancers would be able to perform in the recital. In the end, she was disappointed. What happened in the end was that four dancers did not perform in the recital, and five dancers did.

More than five dancers did not perform in the recital.

**SS True, IS False**

(34) Professor Tilborg was teaching a seminar on climate change last fall semester in which 13 students were enrolled. He assigned his students a final paper, and gave them a deadline in early December for turning it in. However, the students had consistently been lax about handing in their assignments on time during the semester, and the Professor had been bad about enforcing deadlines. So he did not think that all 13 students would turn their assignment in on time. When the deadline rolled around, there were three students who were late in turning it in, and 10 students who were diligent about adhering to the deadline.

Three students did not turn in the assignment on time.

(35) Chez Maurice was offering a lovely selection of after-dinner options two nights ago. They included four different desserts (crème brulée, tiramisu, chocolate cake, and lemon sorbet), and a cheese plate. There were four waitresses working last night: Emily, Tara, Suzanne, and Josie. As each of these ladies was waiting on their customers, they were constantly asked what they recommended for after dinner. Emily recommended the crème brulée and the cheese plate to her customers. Tara recommended the chocolate cake. Suzanne recommended the lemon sorbet and the cheese plate. Josie recommended the tiramisu. All in all, the customers ate very well that night!

Every waitress recommended a dessert.
Appendix C: Templates of sentences appearing in Experiment 3

3.1 Template of Test Sentences

(36) [A/One] (adjective) [shape$_1$] [is surrounding/is connected to] more than three (of the) [shapes$_2$].

3.2 Examples of images accompanying test sentences

a. A circle is connected to more than three squares.

b. A blue circle is surrounding more than three triangles.

c. A circle is connected to more than three of the triangles.
3.3 Templates of Control Sentences and range of acceptance rates

At least (SS: T, IS: F)

(n=2, acceptance rates 93.3% each)

(37) At least [two/three] [shapes₁] are connected to a [shape₂].

Between n and n+2

(n=15, acceptance rates 0.0-6.9% for n below range, 73.3% each for n at lower end of range, 93.1-96.7% for n within range, 73.3-80.0% for n at upper end of range, 6.9-20.0% for n above range)\(^{21}\)

(38) Between [n and n+2] circles are [color].

\(^{21}\) Numbers included 2 and 4, 3 and 5, and 4 and 6; the number of target dots was less than, within, or greater than the target range.
CQP partitive in subject

(n=5, acceptance rate 83.3-96.7% when T (n=4), 10.0% when F (n=1))

(39)  [More/Fewer] than [five/half] of the circles are [color].

Numerals and respectively

(n=2, acceptance rate 93.3% when T, 6.7% when F)

(40)  Four [shapes_1] are connected to four [shapes_2], respectively.

Scopal ambiguity

(n=8, acceptance rates provided in footnote with distribution of items)

(41)  [A/One] [shape_1] is connected to every (color) [shape_2].

(42)  [Two/three] [triangles/squares] are connected to every circle.

(43)  More than three (color) [shapes_1] are [surrounding/connected to] a (color) [shape_2].

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22 One a, every SS: F, IS: T (acceptance rate 56.7%), one a, every SS: T, IS: T (83.3%), two one, every SS: F, IS: T (66.7-72.4%), two one, every SS: T, IS: T (90.0-96.7%), two numeral, every SS: F, IS: T (96.7-100.0%), three CQP, a SS: T, IS: F (60.0-86.7%)
Appendix D: Scenarios and sentences appearing in Experiment 4

4.1 Test Sentences

(44) Jackie has five nieces, Ann, Beatrice, Clarissa, Deborah, and Eleanor. While she was traveling in Japan, she stopped in Wakkanai, a fairly large northern city, and mailed Beatrice and Deborah a wooden doll each, and Ann, Clarissa, and Eleanor a kimono each.

I think that [a/one] kimono was mailed to more than two (of the) girls from one of Japan's northern cities.

(45) Four fathers (Bernard, Charlie, David, and Edmund) took their children (Amelia, Betsy, Cindy, and Evan) to the park for a playdate yesterday. Charlie let his daughter Betsy play in the sandbox with the shovel and toy trucks. But Amelia, Cindy, and Evan saw three open swings, and begged their dads to push them in the swings, so Bernard, David, and Edmund pushed their children in the swings, and tried to see how high they could go.

I think that [a/one] parent let more than two (of the) children play in a swing yesterday at the park.

(46) Four local pastry chefs were competing in a contest for the best wedding cake last night. The winner would have their cake featured in a big wedding, and pictured on the cover of Weddings Today. In the first stage of the contest, five tiered cakes were set out, and some of the chefs were invited to decorate them. The cake flavors were raspberry cream, strawberry cheesecake, lemon chiffon, French vanilla, and dark chocolate. Chef Nathan decorated the raspberry cream cake, Chef Olivier decorated the strawberry cheesecake, Chef Pierre decorated the lemon chiffon, while Chef Quincy had quit the contest because of a family emergency.

I think that [a/one] cake was decorated by more than two (of the) chefs at the local
pastry contest last night.

(47) Every year, the linguistics seniors and the philosophy seniors who are doing an honors thesis at the local university have to decide who is going to supervise their thesis, and there is a group of faculty members they usually choose for this purpose. But this year, it's tricky, because some of those faculty members are away visiting other places for their research. That leaves five possible thesis advisors. Three philosophy seniors (Lily, Alex, and Simone) independently chose Prof. Austen, Prof. Barclay, and Prof. Caldecott, all of whom are semanticists. The four linguistics seniors then made their choice. Jessica also chose Prof. Austen. Marlene chose Prof. Barclay, Olivia chose Prof. Caldecott, and Benjamin chose Prof. Cornwall, a syntactician whom no philosophy student had chosen.

I think that [a/one] semanticist advises more than three (of the) seniors this year at the local university.

(48) Four copy editors, Gillian, David, Geoffrey, and Chris, were asked to practice their copy editing skills and locate ten mistakes in a book that was about to be published. They each read and made corrections independently of each other. Gillian caught four mistakes: one on page 20, another on page 63, a third on page 102, and a fourth on page 178. David and Geoffrey were only able to locate three mistakes: the one on page 20, the one on page 63 and a new one on page 200. Chris only found two mistakes: the one on page 200 and a new one on page 230.

I think that [a/one] copy editor located more than five (of the) mistakes in the book that was about to be published.

(49) Three millionaires, Andrew, Lisa and William, and two billionaires, Butch and Candace, decided that they each wanted to vacation in a European city over the holidays this year. Andrew chose to vacation in Paris, France, Lisa chose to vacation
in Nice, France, William chose to vacation in Toulouse, France, Butch decided to vacation in Florence, Italy and Candace decided to vacation in Barcelona, Spain. I think that [a/one] French city was favored by more than two (of the) millionaires for the holiday vacation this year.

(50) Two twin brothers Bob and Don have three girls each. Abby, Angela and Andrea are Bob's daughters, and Cassie, Charlotte and Clarissa are Don's daughters. For their family get-together last Saturday, they both bought popsicles for their daughters: Bob gave Abby a chocolate popsicle, Angela a vanilla popsicle and Andrea another chocolate popsicle. Don gave Cassie a fruit popsicle, Charlotte a chocolate popsicle and Clarissa a chocolate popsicle too. I think that [a/one] girl got more than three (of the) chocolate popsicles at the family get-together last Saturday.

(51) Two fashion models, Violetta and Natalie, had to present five luxury dresses each, for a total of ten dresses, at the fashion show last Sunday. Violetta presented two gold-laced dresses, a silver-laced dress and two diamond-laced dresses. Natalie presented two gold-laced dresses, two silver-laced dresses and one diamond-laced dress. I think that [a/one] model presented more than three (of the) gold-laced dresses at the fashion show last Sunday.

(52) Six young boys were playing a game at the county fair where they tried to toss rings on bowling pins to win a prize. They split up into two teams, and tossed red and green hoops onto the bowling pins. Adrian tossed a green hoop onto the third pin, and Brian tossed a green hoop onto the fifth bowling pin. Christopher tossed a red pin onto the first pin, Damian tossed a red hoop onto the second pin, Ernie tossed a red hoop onto the fourth pin. The green team thought they could even the score with the sixth pin when it was Frank's turn, but Frank accidentally chose a red hoop, and tossed it on the
sixth pin, so the red team won.

I think that [a/one] red hoop was tossed on more than three (of the) bowling pins at
the county fair game.

(53) Some of the university's researchers – a mix of linguists and anthropologists – were
given the opportunity to apply for a small grant to learn a new language over the
summer, if that would benefit their fieldwork. One of the linguists learned Mohawk,
and another one learned American Sign Language. Four of the anthropologists were
planning on working in Africa, so one learned Swahili, another learned Afrikaans,
another learned Wolof, and the fourth one learned Yoruba—all well-known languages
spoken in Africa.

I think that [an/one] anthropologist learned more than three (of the) African languages
as a consequence of the university's grant program.

(54) A small village was encouraging people to 'shop local' over the Thanksgiving
holidays. Six shops remained open over the weekend: a shoe store, a candle store, a
kids toy store, a women's clothing store, a sporting goods store, and a pet supplies
store. Each of the stores except for the pet supplies store offered customers a 50%
coupon if they shopped there on Black Friday.

I think that [a/one] 50% discount was offered at more than three (of the) local stores
during the Thanksgiving holidays.

(55) Six customers were in a hardware store last Saturday afternoon. They were all looking
for supplies that would help them get ready for the winter season. Jeff and Tim were
the two employees out on the floor that afternoon. Jeff helped Mrs. Peterson find
snow shovels, showed Mr. Roper where the windshield de-icing fluid was, and helped
Mrs. MacIntosh purchase snow salt for her driveway. Tim helped Mr. Lucas locate
replacement flood lights, and Mrs. Carloff find the right kind of outdoor lights for her
Christmas decorations.

I think that [a/one] hardware store employee helped more than three (of the) customers last Saturday afternoon at the hardware store.

(56) The fourth graders were doing their projects for the fall Annual Science Fair. The teachers suspected that at least three children would choose to do a botany project, and run an experiment with plants, looking at their growth in different conditions. Indeed, two girls in Mrs. Johnson's class and three girls in Mrs. Taylor's class chose to present a botany project. In contrast, they predicted the boys might like to look at the spread of germs and work with petri dishes. Sure enough, one boy in Mrs. Johnson's class looked at germs in the public restroom, another in Mrs. Taylor's class looked at germs on doorknobs, and a third in Mr. Bellfry's class chose to present on germ growth on the kitchen surface of the teacher's lounge.

I think that [a/one] project about botany was presented by more than three (of the) fourth-grade girls at the fall Annual Science Fair.

(57) For the Mostly Mozart Festival, the National Symphony Orchestra in Washington and the Chicago Symphony Orchestra asked the members of their respective string sections to vote for their favorite piece by Bach, so the orchestras could put together a special podcast to celebrate his birthday. The violinists and cellists debated fiercely about their choices. One violinist chose the second Brandenburg Concerto, another violinist chose the Concerto for Oboe and Violins, a third violinist chose the fourth Brandenburg Concerto, and a fourth violinist chose the Concerto for two violins. The cellists, however, were of course drawn to the cello suites: one picked the first cello suite, another cellist picked the third, and another cellist picked the sixth cello suite.

I think that [a/one] violinist selected more than three (of the) concertos for the podcast celebrating Bach's birthday.
In the weekly afternoon tutoring session offered by the public library, there is a responsible group of teenagers in the honors program who come in every Thursday to help younger children with their homework. Jonathan, Kristen, Lucy, and Mabel are really good in math, so they divided up and helped Amber, Julie, Jared, and Hope with their algebra. On the other hand, Vick, Wanda, Xavier, and Yaron are really good in language areas, so they divided up and helped Mitchell, Susie, Carlita, and Francis with their book reports. The younger students really benefitted from this assistance.

I think that [a/one] tutor assisted more than three (of the) students with their algebra at the weekly tutoring session.

There are a number of dogs that need to be walked each week in the Meandering Meadows neighborhood. Patty's Pet Companion covers that neighborhood, and Patty has a team of dog walkers who help her out. For example, on Tuesdays, there are five different dogs that need to be walked, and all at lunch time. Patty has four experienced dog walkers, and each of them walks a dog (a Bichon Frisse, a Jack Russell, a yellow Labrador, and a Beagle). But Patty has to rely upon a fifth dog walker, who is new and much less experienced, to walk the German short-haired pointer at the end of the road.

I think that [an/one] experienced dog walker walks more than three (of the) dogs every Tuesday in the Meandering Meadows neighborhood.

4.2 ‘Every – Fewer than’ Filler Sentences (SS: False, IS: True)

Dr. X came up with a fun game for his math students. He placed 100 red tokens in a large bowl. He then asked each of the students in his class to come up to the bowl, randomly select 15 of the tokens, initial each of them, and place them back in the bowl. After each student did this, he shuffled the tokens around in the bowl before the
next student's turn. After every student had a turn and had initialed 15 tokens each, Dr. X asked his class to think about how many tokens had each student's initials. He guessed himself that there might be 10 tokens that had every student's initials. One of the students then inspected all the tokens to see if he was right. When done inspecting, the student announced that 8 tokens had each set of student initials.

I think that every student initialed fewer than 10 of the tokens.

10 TSA agents at one particular airport are required to undergo training every six months. The purpose of the training is to make sure the TSA agents can inspect IDs accurately and efficiently. As part of this process, their supervisor compiles a stack of 500 IDs, and asks each of the agents to randomly inspect 50 of those IDs and to do it carefully, but as quickly as possible. The supervisor gives them all 1 hour, and will check their progress at the end of this time. She hopes that at the end of the hour, at least 75 IDs will have been inspected by every single one of the 10 TSA agents. After one hour, the supervisor checks the IDs, and realizes her 'random inspection' method might not have been the best strategy. She sees that the TSA agents had each completed inspecting between 80 and 90 IDs, but only 63 IDs had been inspected in total. This was less than the 75 she had hoped for.

I think that every TSA agent inspected fewer than 75 of the IDs.

4.3 False Filler Sentences

Three art critics – Ryan, Don and Elizabeth – work for Oklahoma Weekly. Last week, there were two new exhibitions available for review, one in the art gallery of Oklahoma City and one in the Tulsa city museum. Ryan reviewed the exhibition in the art gallery while Don and Elizabeth reviewed the exhibition in the Tulsa city museum.

I think that three art critics at Oklahoma Weekly reviewed two exhibitions last week.
(63) Last year, three students preparing for fieldwork had to learn one of two languages – Spanish or Portuguese. The first student learned Spanish, the second student learned Spanish and the third student learned Spanish too.

I think that three students preparing for fieldwork learned Spanish last year.

(64) Leo and Harry went to a store outside of town to buy groceries. They bought two bottles of wine, three bottles of beer and one bag of chips.

I think that Leo and Harry bought alcohol at the store.

(65) Liz and Helen are two young women who decided to vacation on an island with only three shops, a video store, a furniture shop and a grocery store. After checking in, Liz went to the video store, then she bought groceries and finally she went to the furniture store, while Helen stayed in her room.

I think that Helen stayed in her room and Liz went shopping.

(66) Tom and Keith are two musicians who love jazz. They have a band in which they use bass, trumpet and xylophone. Tom can play bass and Keith can play all three instruments.

I think that someone in the band can play any of the three instruments.

(67) Matt and Grant are two students studying at UC Irvine. Recently, they went to a store that had two discounted guitars, a Gibson and a Fender. Grant bought the Gibson and Matt bought the Fender.

I think that the shop sold the discounted guitars to Matt and Grant recently.

(68) Alex went on a business trip last week and brought home three gifts, a coloring book, a musical table and a doll. He has three children, Bill, Theo and Jane. He brought the coloring book for Bill, the musical table for Theo and the doll for Jane.

I think that Alex bought a doll for one of his children while on his trip.

(69) Last week at a dealership near a university campus, there were three used cars on the
lot, a Honda, a Mazda and a Toyota. Three students – Tim, Olga and Natalie – needed to buy a car. The dealership sold the Honda to Tim, the Mazda to Olga and the Toyota to Natalie.

I think that the dealership sold used cars to three students last week.

(70) Last week, three calculators were available at an electronics store, a Casio, an HP and a TI. Two accountants – Juliet and Jane – needed to buy a calculator and the store sold the Casio to Juliet, while Jane bought nothing.

I think that an accountant looking for a calculator bought one last week.

(71) The commander of a small recon unit selected three handguns for the training session last week, a Smith 'n Wesson, a Colt and a Browning. There are three soldiers in the unit – Juan, Ron and Betty – and the commander assigned the Smith 'n Wesson to Juan, the Colt to Ron and the Browning to Betty.

I think that all the soldiers in the unit got a handgun from the commander.

(72) A magazine had to review two books last week, a detective novel, and a historical novel. The magazine has three retirees as book reviewers, Benny, Theresa and Paul. The editor assigned the detective novel and the historical novel to Benny, and he did not assign anything to the other two reviewers.

I think that the editor assigned one or more novels to a retiree for review.

(73) The kindergarten class was being visited by a man who works with wild animals.

After he gave the children a demonstration about the animals, he let the children touch the animals very gently. Annie was very scared, but she mustered up enough courage to touch the hissing cockroach from Madagascar. Mathias was so happy that he got to touch a tarantula. Jeremy bragged about getting to touch the boa constrictor. Jason got a picture taken of him touching a snapping turtle. Gracie couldn't bring herself to touch any wild animals, so the animal man let her peek in the container where the
stick bug was.

I think that at least three kindergarteners touched a wild animal.

(74) Fourteen American tourists were traveling around southern Greece. Their tour guide took a quick poll to see how many of them had visited Greece before this trip.

Although they had all visited places like Italy and France, only one of them had ever visited Greece before.

I think that between two and four American tourists in the group had visited Greece before.

(75) Fourteen hotel workers have been given different responsibilities to get the hotel ready for the Pharmaceutical convention that was going to be hosted next weekend.

Because most of the activity was going to be done in the ballroom, the manager asked ten of them to assemble the podium, check the sound systems, set up tables and chairs, and so forth in the ballroom. Only four hotel workers were asked to work in the front lobby, polishing tables, setting out floral arrangements, and so forth.

I think that between two and four hotel workers were asked to work in the front lobby.

(76) Fourteen librarians were each asked to nominate one of their favorite children's book authors/illustrators. As it turns out, there was a lot of agreement among some of them, but the group was divided in their choices. Five of them chose Patricia Polacco, while nine of them chose Mo Willems.

I think that between three and six librarians selected Mo Willems as their favorite author/illustrator.

(77) Three hunters, David, Ron and Mitt, went hunting in the tiny forest by the local lake. Three bears lived there: two brown bears and a grizzly bear. David and Ron saw the same brown bear. Mitt only saw the grizzly bear. The other brown bear was not visible that day.
I think that a hunter saw every bear living in the tiny forest by the lake.

A journal was tasked with reviewing four linguistics books that appeared last month: a book about language change, another about child language, a third about Algonquian languages, and a fourth on morphological case assignment. The journal editor in chief asked four experts in the field to serve as book reviewers: Tony, Helen, Marcus, and Charles. Tony reviewed the book on language change, Helen reviewed the one on child language, Marcus reviewed the one about Algonquian languages, and Charles reviewed the one on morphological case. I think that one expert reviewed every linguistics book.

Recently it was Teacher Appreciation Day at the Sunny Day Preschool. The classroom moms for the four preschool classrooms decided they wanted to do something nice to recognize their children's teachers. Stephanie's mom collected money for a spa treatment gift card for Mrs. Anderson. Sterling's mom collected money for a Kohl's gift card for Ms. Baker. Jeanine's mom collected money to give Mrs. Whitacker a gift card to Applebee's. And Marcie's mom collected money to give a gift card to Ms. Riesbord for Michael's Arts & Crafts store. I think that one classroom mom gave a gift card to every preschool teacher.

Hugh was having a hard time deciding whom to vote for in the upcoming election. Voting for the school board was particularly hard. He didn't usually vote along party lines, because he wanted to select the best person for the job. But after reviewing the background and records of the five candidates, three of whom were Democrat and two of whom were Republican, Hugh made his choice. When he went into the voting booth that day, he cast his ballot for Donna Richards, Pranav Desai, and Angelica Huddlestone – all Democrats. I think that one man voted for every Democrat on the school board ticket.
Four young children (James, Carol, Lauren, and Molly) decided to decorate their bikes for the Fourth of July, so they could show their patriotic spirit as they rode around the neighborhood. Each of them hung two small American flags from the back of the bike, behind the seat. Then James and Lauren had an idea to hang a red, white and blue bow from their handle bars. Carol and Molly decided not to do this, because the bow would block their bell.

I think that two American flags were posted on every bike.

The local firefighters had to re-take an exam each year to demonstrate that they were keeping up with all of the necessary skills and knowledge. In previous years, they had been told in advance which day the exam would be administered, but this year, the date was not announced in advance, and it caught everyone off guard. Of the 19 firefighters, only three of them passed the exam. The rest had to take it again the following month.

I think that fewer than five of the firefighters passed the exam.

The city was hosting a summer music festival, and tried to invite some of the most popular rock groups to be a part of it in order to bring a younger crowd out to city-sponsored events. However, it seems that the right people were not put in charge of planning the event. They ended up selecting groups that are more popular with a much older crowd rather than people in their early twenties, so the event did not go as planned. Scanning around the audience during the first act, about 65% of the people looked like they were over 50+ years of age.

I think that more than half of the audience members were older than 40.

4.4 True Filler Sentences

Yesterday, a car salesman had just received two new cars, a Renault and a Volvo. He had two customers, Matilda and Juanita. He showed the Renault and the Volvo to
Juanita and he showed nothing to Matilda.

I think that no customer saw any car yesterday.

(85) For their final paper in a literature class, three students – Louise, Mark and Martin – had to review one of three plays. Louise reviewed 'Tamerlane' – a puppet drama, Mark reviewed 'Gladiator' – a comedy, and Martin reviewed 'Slap!' – another comedy.
I think that no student in the class reviewed a comedy for their final paper.

(86) Megan has three children, Sue, Anna and Jim. Yesterday she bought three popsicles for them, a chocolate popsicle, a vanilla popsicle and a fruit popsicle. She gave the chocolate popsicle to Sue, the vanilla popsicle to Anna and the fruit popsicle to Jim.
I think that only Sue and Jim got a popsicle from Megan yesterday.

(87) Last Wednesday, a daycare provider prepared three cupcakes for dessert, a chocolate cupcake, a banana cupcake and a blueberry cupcake. There are two toddlers at the daycare, Carmen and Danny. The daycare provider gave the chocolate cupcake, the banana cupcake and the blueberry to Carmen, while the other toddler got nothing.
I think that both toddlers got a chocolate cupcake last Wednesday.

(88) Meredith went to a pet store last week and bought a parrot, a cat and a dog. She has two children, Anna and Theo. She gave the parrot, the cat and the dog to Anna, while Theo got nothing.
I think that Meredith bought her children an elephant last week.

(89) Samantha has three boys, Tommy, Bobby and Timmy. Yesterday she bought two milkshakes for them, a chocolate milkshake and a mango milkshake. She gave the chocolate milkshake to Tommy, the mango milkshake to Bobby, and Timmy got nothing.
I think that no children got a milkshake yesterday.

(90) Phil bought three video games last week, an adventure video game, a basketball video
game and a first-person shooter. He has three friends – Sam, Jesse and Chris – who will have their birthday next month. He will give the adventure video game to Sam, the basketball video game to Jesse and the first-person shooter to Chris.

I think that Phil will give Jesse two games for his birthday.

(91) Four university professors were invited to a local magnet school as part of a special panel to present on important discoveries of the 20th century. The students were assigned to be their hosts for the day. Each invited professor was assigned a student to greet them in the morning and lead them to the auditorium, a second student to take them to lunch and tour the school, and a third student to escort them to the front office to handle paperwork, and then make sure they exited the building safely.

I think that fewer than three students were assigned to every invited professor.

(92) Six teenagers – four boys (Andy, Doug, Jim, and Clive) and two girls (Samantha and Jocelyn) – went to the local movie theater to see a movie. There were two movies they had to decide between – Jurassic Domination: Revenge of the Raptors, and Diary of a Lovestruck Vampire. Of course, the four boys chose to see Jurassic Domination, and the two girls opted for Diary of a Lovestruck Vampire. Regardless of their choice, they all enjoyed the movie.

I think that more than five of the teenagers saw a movie about dinosaurs.

(93) The local farmer's cooperative has nineteen members. This year, thirteen of the members chose to plant kale in their area. But six others chose to plant squash. In the end they shared what they grew, so that everyone could enjoy everything.

I think that at most five of the farmers grew kale in their area.

(94) During a recent weekday performance of 'A Christmas Carol' at the McCarter Theatre, the theater was packed. As I looked across the orchestra section, for example, I could only spot a few empty seats. The people who work at the theater must have done a
very good job of promoting the show. I'm sure they're pleased with the ticket sales.

I think that less than half of the seats in the orchestra section were filled.
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