UNIVERSITY OF CALIFORNIA
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EXTRACTION FROM RELATIVE CLAUSES:
AN EXPERIMENTAL INVESTIGATION INTO VARIABLE ISLAND EFFECTS IN ENGLISH

—OR—

THIS IS A DISSERTATION THAT WE REALLY NEEDED TO FIND SOMEONE WHO'D WRITE

A dissertation submitted in partial satisfaction of the requirements for the degree of

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by

Jake Wayne Vincent

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Abstract

Extraction from Relative Clauses:

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This dissertation centers around the islandhood of relative clauses in English and aims to determine whether relative clauses in English ever permit extraction of a relative clause argument to a relative clause-external position. It picks up a thread in English that started with studies on Mainland Scandinavian languages, which are well-known for permitting extraction from relative clauses under certain conditions. The main contributions of this work are empirical and methodological in nature, but it also makes minor but contentful theoretical contributions.

On the empirical side, the dissertation presents findings from eight acceptability judgment experiments, which together present a challenge to the idea that relative clauses in English are always strong islands. Experiment 1, which was run in the early stages of this work, shows that the definiteness of the nominal phrase that contains a relative clause has no independent impact on that relative clause's transparency to extraction (porosity, as it is

called in this work). Experiments 2 and 3 represent perhaps the strongest challenge to the traditional idea that relative clauses are always strong islands. Those experiments probe three environments in which a nominal phrase can reside—the pivot of an existential assertion, the predicate of a nonverbal clause or sentence, and the direct object of transitive verb—and using a factorial definition of island effects (Sprouse et al. 2012), shows that in the former two environments, island effects are reduced nearly completely. The two following experiments, Experiment 4 and Experiment 5, investigate the islandhood of infinitival relatives formed on the relative clause subject. These relative clauses are found to be porous in any environment, indicating a lack of selective islandhood and a lack of islandhood in general, a finding which I believe to be novel but which is compatible with Bhatt's (1999) analysis of subject infinitival relative clauses. Experiment 6 through Experiment 8 turn back to finite relative clauses, focusing specifically on relative clauses under two sets of transitive verbs. The first set is composed of eight "ordinary" transitive verbs and the second is composed of six transitive verbs which each have a felicitous use as an "evidential existential" verb—one that can be used to indirectly make an existential assertion (Rubovitz-Mann 2000). The predicted results fail to obtain in those experiments, from which it is tentatively concluded that there are no transitive environments which facilitate extraction from a relative clause within the direct object of one of these verbs.

On the methodological side, the dissertation serves as a sort of educational tool (Chapter 3) and case study (Chapters 4–6) for three different experiment designs and methodologies. The first is an experiment design, due to Sprouse et al. (2012), that is referred to in this work as the *length by structure* design. I present a thorough overview of the design and how it can be extended to compare relative clause island effects in different syntactic and semantic environments. The design faces some challenges for relative clauses specifically, and an alternative design is presented which permits measurement of relative, but not absolute, island effects. The alternative design is referred to as the *dependency by environment* design. Finally, a computational quantitative modeling method is presented, referred to here as *mixture modeling*, which can be used to gain insight into the nature of ratings distributions

in acceptability judgment experiments. The mixture modeling method is described in detail and is used to argue that the results of certain conditions in Experiment 3 are the result of a sizeable chunk of participants rating the condition as genuinely grammatical and another sizeable chunk rating the condition as genuinely ungrammatical, as opposed to all participants giving roughly similar ratings to each other.

On the theoretical side, the dissertation addresses several different families of hypotheses that aim to explain the extraction phenomena described in this work. The hypotheses are separated into two families: those which take acceptable extraction from relative clauses to be not a grammatical issue but an issue concerning the mapping between acceptability and grammaticality and those which take it to be a grammatical issue. The former family of hypotheses is rejected. Within the second family of hypotheses are two subfamilies of hypotheses: so-called "reductionist" hypotheses, which generally aim to explain away island effects as non-grammatical phenomena, and grammatical hypotheses, which take the stance that island effects are the result of grammatical constraints. The hypothesis advocated for in this work is the latter, and the experiment results presented here are argued to support that hypothesis.

All supplemental materials for this work (or links to them) can be found on my website: `https://jakewvincent.github.io/dissertation.html`.

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for cucumber beetles, picking strawberries, sampling any of the odd greens I could get my hands on—helped provide the space for my inner world to flourish. Dad, I know for a fact that helping you on your projects, and later working for you, helped me develop my patience and exercise the abstract thinking that I had no idea I would use in graduate school. You are both such wonderful people, and I will always admire and look up to you.

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Chapter 1

Introduction

1.1 Some background

Ross's (1967) discovery of syntactic islands is often regarded as one of the most important findings in generative linguistics.[1] His effort to detail the structural domains into which certain kinds of long-distance dependencies could not hold set off a flurry of research on the topic. Two important (and interconnected) lines of inquiry in this work aimed to understand how cross-linguistically stable the generalizations were and whether islandhood could be derived from general syntactic principles. From the beginning, it was observed that certain kinds of constructions that could readily be considered islands in some languages might not follow the same constraints in others, despite apparent structural analogy.[2] For instance, while *wh*-clauses are islands in English, they are reported to permit a movement dependency across the clause boundary in Italian (Rizzi 1982), Spanish (Pañeda and Kush 2021; Torrego 1984), Brazilian Portuguese (Almeida 2014), Hebrew (Keshev and Meltzer-Asscher 2018), French (Sportiche 1981), and others (Aldosari 2015).

The islandhood of the just-mentioned *wh*-clauses is perhaps the most cross-linguistically variable, which has resulted in proposals that effectively allow islandhood to be parameter-

1. See the comment and excerpts, respectively, in Boeckx (2012, pp. ix, 140).
2. Ross (1967, pp. 236–240) noted, for instance, that the Left Branch Condition appears to be in effect in English, German, French, Danish, Italian, and Finnish, but not in Russian or Latin; and that while prepositional phrases in English could be extracted from, other languages are not as tolerant.

ized by language. For instance, under Chomsky's (1977) formulation of subjacency (1), NP and S (TP) are cyclic nodes (for English); but Rizzi (1982) proposes that the appropriate formulation of subjacency for Italian analyzes NP and $\overline{\text{S}}$ (CP) as cyclic nodes.

(1) a. $\ldots X \ldots [_{\alpha} \ldots [_{\beta} \ldots Y \ldots] \ldots] \ldots X \ldots$

b. No cyclic rule can move a phrase from position Y to position X if α and β are cyclic nodes.

If handling cross-language variation is relatively straightforward, then a more challenging situation is *within*-language variation or within-construction variation, such as the variation in Danish relative clauses originally discussed by Erteschik-Shir (1973) and Erteschik-Shir and Lappin (1979). Put simply, some Danish relative clauses give rise to island effects (2a),[3] some do not (2b), and although the phenomenon is systematic, it troublingly[4] does not appear to be amenable to a structural analysis (note in particular that the bracketed relative clauses in (2) are string-identical). This stark difference in the island effects exhibited by relative clauses does not obtain in English (3),[5] and it is not a stretch to suppose that Chomsky's formulation of subjacency 1977 may have been different had Chomsky faced the kind of data for English that Erteschik-Shir described for Danish.

(2) a. *Det$_i$ har jeg peget paa mange [der har gjort ___$_i$].
that have I pointed at many who have done
('I have pointed at many who have done that.') (Erteschik-Shir 1973, p. 64)

b. Det$_i$ har jeg talt med mange [der har gjort ___$_i$].
that have I talked to many who have done
'I have talked to many who have done that.' (Erteschik-Shir 1973, p. 63)

(3) a. *That's something$_i$ that I have pointed at many [who have done ___$_i$].

b. *That's something$_i$ that I have talked to many [who have done ___$_i$].

3. The location of the gap is provided for the reader's convenience, and the element associated with the gap is coindexed with it. The indexing on the associated gap is intended to be theory-agnostic and should be taken as a guide, rather than a theoretical claim.

4. It is troubling under the assumption that island effects are best accounted for by syntactic constraints such as subjacency. This is not to say that a structural account is impossible or even non-ideal, but that the Danish facts complicate a structural account, especially in the era in which they were first brought to the generative linguistics community.

5. These examples were constructed to have a similar function as the Danish examples without using topicalization, which tends to be quite marked in English.

The variation in relative clause island effects found in Danish was not a singular exception, as it was soon shown to have parallels in the other North Germanic languages spoken in Mainland Scandinavia, Norwegian and Swedish (Allwood 1976, 1982; Maling and Zaenen 1982; Taraldsen 1981, 1982). More recently, Cinque (2010) has identified parallel facts for Italian, Spanish, and French; and Rubovitz (1999), Rubovitz-Mann (2000), and Sichel (2018) have identified parallel facts for Hebrew. Across these languages, the data have some remarkable commonalities: in order of generality, relative clauses fail to give rise to island effects under subextraction when they are

(4) a. within the DP pivot of a canonical existential,

b. within the object of a transitive verb that has a first person subject and serves an introductory ("evidential existential"[6]) function, or

c. within a predicate nominal (a DP complement of the copula).

The reader will find a more in-depth review of these conditions in Chapter 2.

These facts potentially have major implications for a theory of islands, which perhaps is highlighted by the diversity of analyses that have been proffered to account for them. Erteschik-Shir; Rubovitz-Mann give fundamentally pragmatic accounts; Cinque; Taraldsen give syntactic accounts; and Sichel gives a syntactic account with an explicit assumption about the way in which the information structural properties of existence presuppositions relate to syntactic movement. Related works by Deane (1991), Hofmeister and Sag (2010), Kluender (1992), and Kluender and Kutas (1993) seek to capture these and other facts with processing-based accounts of island effects, some of which tie into the aforementioned pragmatic accounts. Given the dominant view—that island effects have a structural source—and the role that islands have played in the development of syntactic theory, these facts deserve serious consideration.

6. This is the term Rubovitz-Mann (2012, p. 24) coins to refer to "constructions whose discourse function can be characterized as providing information that establishes the existence of an entity by providing evidence for its existence."

1.2 English

So there appears to be a relative abundance of exceptions to the relative clause subpart of Ross's Complex Noun Phrase Constraint (CNPC). But as long as it is still the cross-linguistic norm for a given language's relative clauses to more or less uniformly give rise to island effects under subextraction, relative clauses may yet hold on to their place in the inventory of classical strong islands (Szabolcsi 2006)—as long as there is a principled explanation for the effects noted above.

However, there is reason to believe that even English is subject to the generalizations in (4), at least to some extent. The selective tolerance of extraction described above appears to have echoes in English, which of course has been a major source of data undergirding accounts of island effects since their discovery. Kuno (1976), for instance, discusses the following contrast, noting that "[(5a)] is acceptable to some speakers, and for all speakers, it is considerably better than [(5b)]."

(5) a. This is the child who$_i$ there is nobody [who is willing to accept ___$_i$]. (Kuno (1976, p. 423))

b. * This is the child who$_i$ John married a girl [who dislikes ___$_i$]. (Kuno (1976, p. 423))

McCawley (1981) also highlights a mysterious class of CNPC-violating extractions from relative clauses that are "often somewhat awkward," but "never sound as bad as similar sentences in which matter is moved out of a restrictive relative" (6). The contrastive tone here is due to McCawley's argument that relative clauses like those bracketed in (6) are not bona fide relative clauses, but are what he calls *pseudo-relatives*.

(6) a. Then you look at what happens in languages that you know and languages$_i$ that you have a friend [who knows ___$_i$]. (McCawley 1981, p. 108)

b. This is the one$_i$ that Bob Wall was the only person [who hadn't read ___$_i$]. (McCawley 1981, p. 108)

c. Violence is something$_i$ that there are many Americans [who condone ___$_i$]. (McCawley 1981, p. 108)

These and several more examples are discussed in a squib by Chung and McCloskey (1983),

a selection of which are provided in (7).

(7) a. That's one trick$_i$ that I've known a lot of people [who've been taken in by ___$_i$].
(Chung and McCloskey 1983, p. 708)

b. Isn't that the song$_i$ that Paul and Stevie were the only ones [who wanted to record ___$_i$]? (Chung and McCloskey 1983, p. 708)

c. This is a paper$_i$ that we really need to find someone [who understands ___$_i$].
(Chung and McCloskey 1983, p. 708)

The parallelism between these acceptable cases of extraction and those described in (4) is notable. The existential condition (4a) is reflected in (5a) and (6c); the first-person introductory condition (4b) is reflected in (7a), (7c), and perhaps (6a); and the predicate nominal condition (4c) is reflected in (6b) and (7b).

Despite these relatively early discussions of examples like (5–7), there does not seem to be widespread awareness in the syntax community about such examples, nor of their comparability to the kinds of examples noted to be acceptable in the Mainland Scandinavian languages, Romance languages, and Hebrew. A hunch about why this might be the case is given some space in §2.5. For the reasons discussed at the end of §1.1, these patterns deserve a systematic investigation.

The goal of this work, perhaps at the risk of trying to be too much at once, is to address three questions about extraction from relative clauses in English:

(8) a. Under what conditions is it (more) acceptable to extract from a relative clause in English?

b. How can we reliably measure island effects when informally collected acceptability judgments are inconsistent or ambiguous?

c. Why should relative clauses be more porous[7] under these conditions, both in English and cross-linguistically?

The bulk of the dissertation will be in service of (8a), which is an empirical question about relative acceptability judgments. This question will be addressed with the support of data from eight different experiments run over the course of this project. In order to be confident

7. By which I mean "transparent to extraction", or resulting in substantially reduced island effects under subextraction.

about the acceptability judgments collected and how they are analyzed, the dissertation will also address (8b), a methodological question about how to isolate island effects using acceptability judgment experiments and how to compare island effects in different syntactic environments. (8c) is a theoretical question. Although the reader will find theoretical considerations at various points, the dissertation should be thought of mainly as an empirical and methodological guide that can serve as a foundation for future research on relative clauses and the nature and source of island effects.

1.3 Outline

The dissertation is structured as follows. Chapter 2 is a review of the cross-linguistic literature on extraction from relative clauses. The patterns described by the authors cited above are summarized and illustrated with selected examples, and the chapter ends with a discussion about English.

Chapter 3 details the methodologies used in the studies conducted for this work, which includes two kinds of acceptability judgment experiments and a kind of quantitative computational modeling. That chapter uses the first of eight experiments as a test case for the experiment design used in all but two of the eight experiments (the LENGTH × STRUCTURE design that gained traction in Sprouse et al. 2012).

Chapter 4 is devoted to two experiments which together are used to measure relative clause island effects in three different syntactic contexts: the pivot of a canonical existential (4a), the predicate nominal in a copular clause (4c), and the direct object of an ordinary transitive verb. A second part of the chapter uses the computational modeling techniques described in Chapter 2 to gain insight into the nature of the observed ratings. The chapter concludes that English relative clauses are significantly more porous in the former two environments as compared to the latter.

Chapter 5 presents two experiments designed to investigate the role that the finiteness of the relative clause plays in acceptable extraction. The results of these experiments sug-

gest that infinitival relatives formed on the subject of the relative clause (subject-gap relative clauses) are simply not islands, a finding which I believe to be novel but which validates Bhatt's 1999 analysis of subject-gap infinitival relatives.

Chapter 6 takes a foray into the role that context might play in acceptable extraction from relative clauses. In particular, the chapter focuses on relative clauses embedded within the direct object of transitive verbs with varying likelihoods of serving an introductory or presentational discourse function (as in (4b)), or what Rubovitz-Mann (2000) calls an "evidential existential" statement. The three experiments presented there find no evidence that relative clauses in these contexts are more porous than in the context of an ordinary transitive verb, even when the relevant verb has a clear evidential existential use, and even when context supports this use.

Chapter 7 concludes the dissertation with a birds-eye view of the work. There, I summarize the empirical findings of the experiments, consider how the methodologies used here can and should be combined in future work on islands, discuss the implications of this work for relative clause syntax and a theory of islands, and review open questions for future work.

Chapter 2

A cross-linguistic survey of extraction from relative clauses

Although relative clauses (RCs) are famous for their *opacity* to extraction, it is apparent that there are systematic exceptions to this opacity—at least in certain languages. The North Germanic languages of Mainland Scandinavia are perhaps the most noted for this feature, selectively permitting extraction from relative clauses in certain syntactic or semantic environments (Danish: Erteschik-Shir 1973; Erteschik-Shir and Lappin 1979; Swedish: Allwood 1982; Engdahl 1997; and Norwegian: Taraldsen 1982). Recent work on Hebrew shows that selective extraction from RCs isn't limited to the Mainland Scandinavian languages or the Indo-European language family (Rubovitz-Mann 2012; Sichel 2018), and Cinque (2010) highlights that selective extraction from RCs exists in several Romance languages, as well.

The cited works offer varying explanations for selective extraction from RCs, but the environments in which extraction is successful seem to have in common either an existential semantics (the existence of the referent of the head NP is asserted or denied canonically, or is at least not presupposed; see 9) or an existential pragmatics (the existence of the referent of the head NP is not canonically asserted but in context, the sentence has an existential-like function; see 10 and Rubovitz 1999). The latter sort will be referred to as *non-canonical existentials*. Representative examples (adapted from the cited source) from each language group

are given below.

(9) a. Det språket finns det många som talar.
that language exist it many that speak
'There are many who speak that language.' (Swedish: Engdahl 1997, p. 13)

b. Al lexem šaxor, yeš rak gvina axat še-keday limroax.
on bread black BE only cheese one that-worth to.spread
'On black bread, there is only one cheese that's worth spreading.'
(Hebrew: Sichel 2018, p. 357)

c. Ida, di cui non c'è nessuno che sia mai stato innamorato, …
'Ida, whom there is nobody that was ever in love with, …'
(Italian: Cinque 2010, p. 83)

(10) a. Det kender jeg mange der kan lide.
that know I many who like
'I know many who like *that*.' (Danish: Erteschik-Shir and Lappin 1979, p. 55)

b. Miškafayim yerukot ka-ele, ra'iti kan etmol mišehu še-moxer.
eyeglasses green like-that saw.I here yesterday someone that-sells
'That kind of green eyeglasses, I saw here yesterday someone who sells.'
(Hebrew: Sichel 2018, p. 358)

c. (?)Jean, à qui je ne connais personne qui soit prêt à confier ses secrets, …
'Jean, to whom I don't know anybody that would be ready to confide their secrets, …'
(French: Cinque 2010, p. 84)

Extraction from relative clauses in English has received relatively little attention. Indeed, English relative clauses are often considered textbook examples of islands. Although some of the writing on the aforementioned languages explicitly assumes that English bans any comparable cases of extraction from relative clauses, others point towards parallel judgment patterns in English and call for further research.[1] However, examples of notably acceptable cases of extraction from relative clauses in English have been discussed in the literature, primarily in Chung and McCloskey (1983), Kuno (1976), and McCawley (1981). Many of these

1. Engdahl (1997, p. 34), for instance, poses "the intriguing question how come extractions out of relative clauses are possible in the Scandinavian languages but not in related languages such as Dutch, German and English or in the Romance languages," and Allwood (1982, p. 29) similarly wonders "what distinguishes those languages in which the [Complex NP] constraint applies (e.g. English) from those in which it does not generally apply (e.g. Swedish)." But Erteschik-Shir and Lappin (1979, p. 58) notes that "the extraction facts for English are parallel to those in Danish."

examples bear resemblance to the acceptable examples above not only in their syntax, but also in the immediate environment of the relative clause: the examples in (11) involve a relative clause under an existential, and (12) involves a relative clause under a non-canonical existential.

(11) a. This is the child who there is nobody who is willing to accept.
(Kuno 1976, p. 423)

b. Violence is something that there are many Americans who condone.
(McCawley 1981, p. 108)

(12) That's one trick that I've known a lot of people who've been taken in by.
(Chung and McCloskey 1983, p. 708)

The main aim of this chapter is to review the facts on extraction from relative clauses in other languages. The Mainland Scandinavian data is surveyed in §2.1, the Hebrew data in §2.2, and the Romance data in §2.3. Although the focus will be empirical (focusing on the judgment patterns), the account each author gives is also summarized. After this, §2.5 summarizes what is known about extraction from RCs in English so far and in what way the English facts compare and contrast with the Mainland Scandinavian languages, Hebrew, and the subset of Romance languages described by Cinque (2010).

2.1 The Mainland Scandinavian languages

2.1.1 Danish

Erteschik-Shir and Lappin (1979, p. 55) write that in Danish, RC subextraction is impossible in most environments (much like English). Although they put the criteria for acceptable RC subextraction in terms of their pragmatic notion of dominance,[2] they note several lexical and structural factors that are typically compatible with their pragmatic criteria. First, RC subextraction is usually possible if the matrix clause is an existential clause (13).

2. They define dominance as a property belonging to a constituent whose intension the speaker intends to direct the hearer's attention to. This notion works together with their Dominance Hypothesis, which states that RC subextraction is possible iff the clause containing the NP that hosts the relative clause is dominant (or if the NP that hosts the relative clause is itself dominant).

(13) Det er der mange der kan lide.
That there are many who like.
(There are many who like *that*.) (Erteschik-Shir and Lappin 1979, p. 55)

Extraction is also possible, they write, when the matrix clause can be construed as serving to "[introduce] into the sentence the head of the relative clause," such as when the matrix predicate is 'know' (14a) or 'meet' (14b). A first person matrix subject is apparently critical for this function (1979, p. 57). It is implied here that these predicates have somewhat of an existential "flavor" (see §2.2 for some discussion of the role of so-called non-canonical existentials).

(14) a. Det kender jeg mange der kan lide.
That know I many who like.
(I know many who like *that*.) (1979, p. 55)

b. Det har jeg mødt mange der har gjort.
That have I met many who have done.
(I have met many who have done *that*.) (1979, p. 55)

The more complex the matrix clause is (mainly affected by the matrix predicate, but also the definiteness of the head NP of the RC), they write, "the more difficult it is to interpret this matrix in a manner analogous to the existential operator." Thus, examples like those in (15) have diminished acceptability. (15a-15b) have different, more "semantically complex" matrix predicates, and (15c)'s stressed matrix predicate (emphasis in example is mine) reportedly affects the acceptability of subextraction (Erteschik-Shir and Lappin 1979, p. 57).

(15) a. *Det$_i$ har jeg spurgt mange der har gjort ___$_i$.
that have I asked many who have done
('I have asked many who have done *that*.') (1979, p. 55)

b. *Det$_i$ har jeg drillet mange der har gjort ___$_i$.
that have I made.fun.of many that have done
('I have made fun of many that have done *that*.') (1979, p. 55)

c. *[Det hus]$_i$ *kender* jeg en mand som har købt ___$_i$.
that house know I a man who has bought
('I *know* a man who has bought that house.') (1979, p. 55)

In summary, RC subextraction in Danish is most acceptable in existential clauses and with

certain verbs like *know* or *meet*. More semantically complex predicates lower the possibility for RC subextraction.

2.1.2 Swedish

Another Scandinavian language, Swedish, has also been argued to allow extraction from RCs. Engdahl (1997) argues that typical RC subextractions in Swedish involve "presentational constructions," which introduce a new referent. This type of sentence is often formed as an existential sentence with the expletive nominal *det* 'it' (16), or *där*/*der* 'there' in certain dialects. There are also a number of cleft constructions that Engdahl assumes contain relative clauses, and these also often tolerate subextraction.

(16) Det språket$_i$ finns det många som talar ___$_i$.
that language exist it many that speak
'That language, there are many who speak (it).' (Engdahl 1997, p. 13)

While RC subextractions in Swedish often occur when the main predicate is the existential operator, Engdahl (1997) reports that RC subextractions also can occur when the relative clause is situated in an NP object of a verb like *känner* 'know' (17a), *behöva* 'need' (17b), *känna till* 'know of', *se* 'see' (17c), *hitta på* 'make up', and *beundra* 'admire', perhaps related to the predicates noted by Erteschik-Shir and Lappin (1979) and mentioned in §2.1.1. Engdahl suggests that what is important is that what follows the fronted constituent must be able to be construed as a relevant comment (or predicate) of that constituent.

(17) a. [Den teorin]$_i$ känner jag ingen$_j$ som tror på ___$_i$.
that theory know I nobody that believes in
'That theory, I know nobody that believes in (it).' (1997, p. 24)

b. Det$_i$ bohöver vi någon som tar hand om ___$_i$.
that need we someone who takes care of
'That, we need someone who takes care of (it).' (1997, p. 24)

c. [En sådan frisyr]$_i$ har jag aldrig sett någon som ser snygg ut i ___$_i$.
that such hairstyle have I never seen anyone who looks good in
'That kind of hairstyle, I have never seen anyone who looks good in (it).'
(1997, p. 24)

Engdahl notes that "one sometimes comes across the claim that extractions out of relative clauses are only possible if the head NP is indefinite," but argues that the correlation between RC subextraction and an indefinite RC head is a consequence of the types of sentences that allow RC subextraction, rather than a consequence of the definiteness of the head NP. For instance, existential sentences exhibit a definiteness effect (18), but cleft constructions allow RC subextractions whether the head NP is definite (19a) or indefinite (19b).

(18) EXISTENTIAL

a. [Det språket]$_i$ finns det många som talar ___$_i$.
that language exist it many that speak
'That language, there are many that speak (it).' (1997, p. 25)

b. *[Det språket]$_i$ finns det kvinnan som talar ___$_i$.
that language exist it the.woman that speaks
('That language, there is the woman that speaks (it).') (1997, p. 25)

(19) CLEFT

a. Detta$_i$ är det bara presidenten som kan avgöra ___$_i$.
this it only the.president who can decide
'This, it's only the president who can decide (it).' (1997, p. 26)

b. Lax$_i$ var det många som ville ha ___$_i$.
salmon was it many who wanted
'Salmon, it was many who wanted (it).' (1997, p. 27)

Engdahl observes that in some cases where the definiteness of the head NP appears to affect the acceptability of RC subextraction, the effect is really due to the compatibility of the head NP with the main predicate inside the RC—particularly, a property she refers to as its distributivity. For example, a definite head NP of a subject relative will be most compatible with a predicate that typically denotes a unique-individual-to-one relation, and an indefinite head NP will be most compatible with a predicate that typically denotes a many-to-one relation.

Believing, for example, is typically a many-to-one relation, and when this is the RC predicate, the most natural head NP is one that does not entail a unique believer (20). This effect holds even when RC subextraction does not occur (21), showing that the effect is independent of RC subextraction. On the other hand, inventing is typically a one-to-one relation, and when *invent* is the RC predicate, the most natural head NP entails uniqueness (22).

(20) a. [Den teorin]$_i$ känner jag ingen som tror på ___$_i$.
that theory know I nobody that believes in
'That theory, I know nobody that believes in (it).' (1997, p. 27)

b. ??[Den teorin]$_i$ känner jag mannen som tror på ___$_i$.
that theory know I the.man that believes in
('That theory, I know the man that believes in (it).') (1997, p. 27)

(21) ??Jag känner mannen som tror på den här teorin.
I know the.man that believes in this here theory
('I know the man who believes in this theory.') (1997, p. 27)

(22) a. [Den här teorin]$_i$ känner jag mannen som uppfann ___$_i$.
this here theory know I the.man that invented
'This theory, I know the man who invented (it).' (1997, p. 28)

b. ??[Den här teorin]$_i$ känner jag ingen som uppfann ___$_i$.
this here theory know I nobody that invented
('This theory, I know nobody who invented (it).') (1997, p. 28)

In summary, Swedish also appears to allow RC subextraction in existential clauses and clauses with predicates that serve to introduce or present a DP referent into the discourse. This latter type of predicate is presumably related to the predicates that Erteschik-Shir and Lappin (1979) observe to be compatible with RC subextraction (*know* and *meet*).

2.1.3 Norwegian

Norwegian is also claimed to allow RC subextraction (Taraldsen 1982). Like the previous authors, Taraldsen notes that there are only certain environments in which RC subextraction is possible in Norwegian, but focuses on the apparent need for an RC out of which subextrac-

tion has occurred to be extraposed, noting the contrast in (23–24).

(23) a. *Her er en bok$_i$ som ingen som har lest ___$_i$, kommer til himmelen.
here is a book that nobody that has read comes to heaven
('Here is a book that nobody that has read (it) comes to heaven.') (1982, p. 206)

b. Her er en bok$_i$ som ingen kommer til himmelen som har lest ___$_i$.
here is a book that nobody comes to heaven that has read
'Here is a book that nobody that has read (it) comes to heaven.' (1982, p. 206)

(24) a. *Rødsprit$_i$ slipper vi ingen som har drukket ___$_i$, inn.
red.spirit let we nobody that has drunk in
('Red Spirit, we let nobody in that has drunk (it).')

b. Rødsprit$_i$ slipper vi ingen inn som har drukket ___$_i$.
red.spirit let we nobody in that has drunk
'Red spirit, we let nobody in that has drunk (it).' (1982, p. 206)

Taraldsen argues that examples such as (23b) and (24b) are acceptable because of an ordering of operations. Once extraposition of the relative clause has taken place, constituents within the relative clause can be acceptably extracted because they no longer have to cross the NP bounding node within which the relative clause was generated.

The other pattern Taraldsen observes is that when RC subextraction takes place out of a relative clause base-generated in subject position, the result is unacceptable even when the relative clause is extraposed (25a). When there is no RC subextraction, the sentence is acceptable (25b).

(25) a. *[Hans kone]$_i$ besøker ingen Jens som kjenner ___$_i$.
his wife visits nobody Jens that knows
('His wife, nobody that knows (her) visits Jens.') (1982, p. 208)

b. Ingen besøker Jens som kjenner hans kone.
nobody visits Jens that knows his wife
'Nobody that knows his$_i$ wife visits Jens$_i$.' (1982, p. 208)

The apparent ban on subextractions from RCs generated in subjects may be related to so-called freezing effects, which occur when extraction takes place out of a constituent that has already moved as a whole.

Regarding Taraldsen's observations about relative clauses out of which something has been extracted needing to be extraposed, Engdahl (1997, p. 7) writes that his observations capture "what seems to be a characteristic property of relative clause extractions, namely the fact that the relative clause tends to be clause-final."

Although Taraldsen focuses on an apparent need for the RC out of which subextraction occurs to be clause-final, it is worth noting that many of his examples illustrating RC subextraction exhibit properties related to those discussed for Danish and Swedish. For instance, one example involves extraction from an RC in the object of the verb *møtt* 'meet', and the examples above involve RC subextraction out of a DP that is inherently non-presupposed, *ingen* 'nobody'.

2.2 Hebrew

Regarding RC subextraction in Hebrew, Sichel (2018) observes several factors that influence transparency to extraction, some of which have not been discussed for the Scandinavian languages. First, the relative clause must be situated in a non-presuppositional DP—i.e. a DP whose referent's existence is not presupposed, but is asserted. This condition is met in a number of different types of sentences, including canonical existentials (26) (as observed for Danish in Erteschik-Shir and Lappin (1979), Swedish in Engdahl (1997), and English in Kush et al. (2013)).

(26) EXISTENTIAL

a. Al lexem šaxor, yeš rak gvina axat še-keday limroax.
on bread black BE only cheese one that-worth to.spread
'On black bread, there is only one cheese that's worth spreading.
(Sichel 2018, p. 357)

b. Me-ha-sifria ha-zot$_j$, yeš ulay [xamiša sfarim$_i$ [še-keday PRO
from-the-library the-this BE maybe five books that-worth
lehaš'il ___$_i$ ___$_j$.
to.borrow
'From this library, there are hardly five books worth borrowing.'
(Sichel 2018, p. 357)

In addition to canonical existentials, sentences with nonverbal predicates in which the predicate is the DP containing the relative clause also tolerate RC subextraction (27).

(27) NON-VERBAL PREDICATE

a. Al ha-haxlata ha-zot$_i$, yair lapid haya [ha-axaron še-yada ___$_i$].
about the-decision the-this Yair Lapid was the-last that-knew
'About this decision, Yair Lapid was the last to know.' (Sichel 2018, p. 358)

b. Et ha-toxnit ha-zot$_i$, ata [ha-yaxid še-ro'e ___$_i$.
ACC the-program the-this you the-single that-watches
'This program, you're the only one who watches.' (Sichel 2018, p. 358)

Finally, non-canonical existential sentences in which the DP referent's existence is asserted or implied (28a-28b), or denied (28c) are compatible with RC subextraction. (28b) is repeated from (10b). Also important for the DP to be interpreted non-presuppositionally in non-canonical existentials is for the matrix subject to be first person, a factor that was also observed by Erteschik-Shir and Lappin (1979) and noted in §2.1.1.

(28) NON-CANONICAL EXISTENTIAL

a. Al lexem šaxor$_j$, ani makira rak [gvina levana axat]$_i$ še-efšar
on bread black I know only cheese white one that-possible
limroax ___$_i$ ___$_j$.
to.spread
'On black bread, I know only one white cheese that can be spread.'
(Sichel 2018, p. 358)

b. Miškafayim yerukot ka-ele, ra'iti kan etmol mišehu še-moxer.
eyeglasses green like-that saw.I here yesterday someone that-sells
'That kind of green eyeglasses, I saw here yesterday someone who sells.'
(Sichel 2018, p. 358)

c. Me-ha-sifria ha-zot$_j$, od lo macati [sefer exad$_i$ [še-keday PRO
from-the-library the-this yet not found.I book one that-worth
lehaš'il ___$_i$ ___$_j$]].
to.borrow
'From this library, I haven't yet found a single book that's worth borrowing.'
(Sichel 2018, p. 358)

Separate from the presuppositionality of the DP containing the relative clause, Sichel also argues extensively that any relative clause out of which a constituent is acceptably extracted must be a raising relative clause (in the sense of Kayne 1994; Vergnaud 1974, among others). When other factors force a matching relative clause analysis, such as when reconstruction of the relative clause head would give rise to a Principle C violation, (Bhatt 2002; Hulsey and Sauerland 2006) RC subextraction is not acceptable (29a). When the raising analysis would not give rise to a Principle C violation, RC subextraction is acceptable (29b).

(29) a. *Me-ha-doda ha-zot$_k$, yeš [kama tmunot bar micva šel dani$_i$]$_j$ še-hu$_i$
from-the-aunt the-this BE few photos bar mitzvah of Dani that-he
ša'al ___$_j$ ___$_k$.
borrowed
'From this aunt, there are a few bar mitzvah pictures of Dani that his mother borrowed.' (Sichel 2018, p. 343)

b. Me-ha-doda ha-zot$_k$, yeš [kama tmunot bar micva šel dani$_i$]$_j$
from-the-aunt the-this BE few photos bar mitzvah of Dani
še-ima šelo$_i$ ša'ala ___$_j$ ___$_k$.
that-mother his borrowed
'From this aunt, there are a few bar mitzvah pictures of Dani that his mother borrowed.' (Sichel 2018, p. 343)

Although Hebrew belongs to an entirely different language family than the Scandinavian languages, the factors affecting the acceptability of RC subextraction are remarkably similar. Much like Danish and Swedish, the language's canonical existential construction facilitates subextraction. Non-canonical existential clauses work just as well, and these involve predicates like *know*, *see*, and *find*, which are often used to implicitly assert or deny the existence of their complement. This class of predicates is likely the same class of predicates noted by

Erteschik-Shir and Lappin (1979) and Engdahl (1997) to improve RC subextraction.

2.3 Romance languages

Cinque (2010) presents the following examples of RC subextraction in Italian. (30a) is similar to the non-canonical existentials discussed in §2.2, having a first person matrix subject and a non-presuppositional DP which contains the relative clause. (30b-30c) have existential matrix clauses that deny the existence of the referent of the DP containing the relative clause.

(30) a. Giorgio, al quale non conosco nessune che sarebbe disposto ad affidare i propri risparmi, …
'Giorgio, whom I don't know anybody that would be ready to entrust with their savings, …' (Cinque 2010, p. 83)

b. Ida, di cui non c'è nessuno che sia mai stato innamorato, …
'Ida, whom there is nobody that was ever in love with, …' (Cinque 2010, p. 83)

c. Gianni, al quale non c'è nessuno che sia in grado di resistere, …
'Gianni, whom there is nobody that is able to resist, …' (Cinque 2010, p. 83)

Cinque also presents examples from French (31) and Spanish (32), both of which involve RC subextraction from DPs in existential clauses.

(31) French

a. Jean, à qui il n'y a personne qui puisse s'opposer, …
'Jean, whom there is nobody that could oppose, …' (Cinque 2010, p. 84)

b. (?) C'est un endroit où il n'y a personne qui voidrait vivre.
It's a place where there is no one that would like to live. (Cinque 2010, p. 84)

(32) Spanish

a. Ida, de quien no hay nadie que se haya enamorado alguna vez, …
'Ida, whom there is nobody that was ever in love with, …' (Cinque 2010, p. 84)

b. Ese es un sitio en el que no hay nadie que querría vivir.
'This is a place where there is no one that would like to live.' (Cinque 2010, p. 84)

2.4 Interim summary

The following table summarizes observations about the factors that affect the acceptability of RC subextraction, both those made by the authors cited in this subsection and those made by the current author about the examples given by those authors.

Table 2.1: Properties argued to affect RC transparency to extraction

Language	Syntactic-semantic property			
	Existential	Predicates like *know*	Extraposed RC req'd	Raising RC req'd
Danish	✓	✓	?	?
Swedish	✓	✓	?	?
Norwegian	✓	✓	✓	?
Hebrew	✓	✓	×	✓
Romance	✓	✓(?)	?	?

2.5 What we know about English

Research on extraction from relative clauses in English is somewhat limited, and much of the research on languages that selectively allow RC subextraction either implicitly or overtly assumes that English is fundamentally different, banning RC subextraction in all environments (although Erteschik-Shir and Lappin 1979, p. 58 notably observe that the English extraction patterns seem to be similar to Danish). There is some reason to treat the assumption that English is different with skepticism, though. First of all, there is some discussion in the published literature on cases of RC subextraction in English that seem unusually acceptable (33).

(33) a. This is the child who there is nobody who is willing to accept.
(Kuno 1976, (1–20a))

b. Then you look at what happens in languages that you know and languages that you have a friend who knows. (McCawley 1981, (15a))

c. This is the one that Bob Wall was the only person who hadn't read.
(McCawley 1981, (15b))

d. That's one trick that I've known a lot of people who've been taken in by.
(Chung and McCloskey 1983, (9a))

e. Isn't that the song that Paul and Stevie were the only ones who wanted to record?
(Chung and McCloskey 1983, (9b))

f. This is a paper that we really need to find someone who understands.
(Chung and McCloskey 1983, (9c))

Second, Kush et al. (2013) present experimental evidence which suggests that the environments in which RC subextraction is acceptable in Swedish also attenuate island effects in English. In particular, they show that when a relative clause appears in the pivot of an existential (34a), in the object position of a verb of perception (34b), or in the object position of the verb 'know' (34c), acceptability ratings significantly increase relative to sentences that are otherwise identical but have the predicate 'meet' (34d). Some of these environments are found in the examples cited in (33).

(34) a. ? That was the bill$_i$ that **there were** many senators who supported ___$_i$ in the congress.

b. ? That was the bill$_i$ that **he saw** many senators who supported ___$_i$ in the congress.

c. ? That was the bill$_i$ that **he knew** many senators who supported ___$_i$ in the congress.

d. * That was the bill$_i$ that **he met** many senators who supported ___$_i$ in the congress.
(adapted from Kush et al. 2013, pp. 260–264)

The first purpose of this work is to present experimental evidence that island effects are substantially reduced in English when the relative clause is within the pivot of an existential (35a) or a non-verbal predicate nominal (35b), relative to transitive object environments (35c). The research presented here thus extends the findings of Kush et al. (2013) and identifies another environment (predicate nominals) that increases relative clause transparency to extraction—one that is known to increase transparency to extraction at least in Hebrew (Sichel 2018, p. 357).

(35) a. ? [Which article]$_i$ did you say that there is only one journalist who read ___$_i$?

b. ? [Which article]$_i$ did you say that Michael thinks he's the only journalist who read ___$_i$?

c. *[Which article]$_i$ did you say that Michael remembered the only journalist who read ___$_i$?

Some of the research on both RC subextraction and extraction from DP generally suggests that the definiteness of the DP out of which extraction occurs is one of the main factors affecting the DP's transparency to extraction, such that indefinite DPs are more transparent, and definite DPs are not (for discussion, see Kush et al. 2013, pp. 245–246, as well as Sichel 2018, pp. 354–361; for an account of DP transparency based on definiteness, see Jiménez Fernández 2009). Based on experimental evidence, this dissertation argues against DP definiteness as one of the main factors affecting DP transparency. In line with Sichel (2018), it is argued that the apparent correlation between DP transparency and indefiniteness is due to the presuppositionality of the DP referent, which is determined largely by the syntactic-semantic environment of that DP. Whether or not a DP referent is presupposed is loosely related to the definiteness of the determiner used, but the notions are independent, such that an indefinite DP that is presupposed is not transparent to extraction, and a definite DP that is non-presupposed *is* transparent to extraction.

This work also aims to evaluate two experimental designs intended to measure island effects and discuss methodological challenges associated with them. Three of the five experiments discussed in the present paper employ a factorial design based on Sprouse et al. (2012)[3] that allows the impacts of island-violating extraction to be isolated from two other potentially confounding factors: the length of the extraction, and the complexity/structure of clauses typically considered to be islands (hence the "length by structure" name sometimes given to this design). Since the design allows the costs for each of these factors to be calculated, the strength of an island can be isolated, potentially allowing for comparison across syntactic environments, across different island types, and across languages.

An alternative design is deployed in the second and fifth experiments which compares long-distance extraction to a long-distance referential dependency. Since the design compares two sentences with equal-length dependencies, one of which is an island-sensitive de-

3.

pendency and one of which is island-insensitive, an estimate of the difference between at least two domains' transparency to extraction can be determined. The current paper argues that the length by structure design is more successful for estimating island effects precisely, but that care needs to be taken when attempting to compare island effects in different syntactic environments and when attempting to identify constructions to be used in the baseline conditions. When appropriate baseline conditions can't be found, the alternative design used here can provide an estimate of island strength where the length by structure design would have been unable to.

Chapter 3

Measuring the strength of an island and estimating the source(s) of ratings distributions

3.1 The factorial definition of islands

The length by structure design (Sprouse et al. 2012, and others) is a factorial experimental design intended to allow the researcher to isolate island violation effects from the potentially confounding factors of extraction distance and the additional complexity associated with typical island structures. Extraction distance is independently known to affect sentence processing, such that grammatical longer-distance extractions are more difficult to process than grammatical shorter-distance extractions. Typical islands such as relative clauses or embedded WH-questions are also more difficult to process (relative to embedded *that*-clause complements), and this is typically ascribed to the A-bar dependency involved in their formation. Both of these processing challenges have been shown to impact the ratings that experiment participants give to these sentences.

At its simplest, the length by structure design requires two factors with two levels each. The first factor is extraction length, comparing extraction of a matrix subject (a SHORT ex-

traction) to extraction of an argument in an embedded clause—here, an embedded object (a LONG extraction). The SHORT level is taken as the baseline, on the assumption that short extractions are easiest to process. The second factor is the structure of the embedded clause, in which embedded *that*-clauses (NON-ISLAND) are compared to an embedded clause considered to be an island (ISLAND). For Experiment 1, this is a Complex DP containing either a relative clause or a CP complement to N. The NON-ISLAND level is taken to be the baseline here, on the assumption that embedded *that*-clauses are easier to process than embedded clauses typically considered to be islands.

Crossing these two factors results in an experiment with four conditions, laid out in Table 3.1. An abstract template for each of these conditions is shown in (36).

Table 3.1: Conditions in a minimal length by structure experiment

STRUCTURE	LENGTH	
	SHORT	LONG
NON-ISLAND	NON-ISLAND | SHORT	NON-ISLAND | LONG
ISLAND	ISLAND | SHORT	ISLAND | LONG

(36) a. DP_i [$_{TP}$ ___$_i$ ..... [$_{CP}$ *that* .....]] NON-ISLAND | SHORT

b. DP_i [$_{TP}$ ..... [$_{CP}$ *that* ..... ___$_i$]] NON-ISLAND | LONG

c. DP_i [$_{TP}$ ___$_i$ ..... [$_{ISLAND}$ .....]] ISLAND | SHORT

d. *DP_i [$_{TP}$ ..... [$_{ISLAND}$ ..... ___$_i$]] ISLAND | LONG

Taking NON-ISLAND to be the baseline level in the STRUCTURE factor and SHORT to be the baseline level in the LENGTH factor, the condition combining these two levels will be the baseline condition against which all the others are measured. The baseline condition is assumed to involve some processing cost, β, that will be reflected in the acceptability ratings given to sentences in this condition. The remaining conditions are assumed to involve the same processing cost of the first condition plus some other cost. Imagine this cost as a penalty to the ratings given to that condition. The NON-ISLAND | LONG condition is assumed to have a penalty resulting from the length of extraction, and the ISLAND | SHORT condition is assumed to have a

penalty due to the added complexity of the island structure. Finally, the ISLAND | LONG condition is assumed to have both the length and structure penalties, as well as an island violation penalty. The penalties associated with each condition are summarized in (37).

(37) a. NON-ISLAND | SHORT = β

b. NON-ISLAND | LONG = β + LENGTH

c. ISLAND | SHORT = β + STRUCTURE

d. ISLAND | LONG = β + LENGTH + STRUCTURE + ISLAND VIOLATION

With these assumptions in place, isolating the island violation penalty can be achieved arithmetically, since in an acceptability judgment experiment, each condition receives a numerical rating. First, we can take the average rating for the ISLAND | LONG condition and remove the baseline penalty and the length penalty by subtracting that rating from the average rating for the NON-ISLAND | LONG condition, as illustrated in (38). Following previous work, this difference is called D1. Note that since all of these factors are penalties, their values will actually be negative. However, the difference scores are calculated in such a way that the penalty is represented by a positive number.

(38)

	β + LENGTH	(NON-ISLAND | LONG)
–	β + LENGTH + STRUCTURE + ISLAND VIOLATION	(ISLAND | LONG)
=	– (STRUCTURE + ISLAND VIOLATION)	(D1)

Next, the structure penalty needs to be isolated so that it can be removed from the difference in (38). This penalty can be calculated by finding the difference between the NON-ISLAND | SHORT condition and the ISLAND | SHORT condition, as illustrated in (39). This difference is called D2.

(39)

	β	(NON-ISLAND | SHORT)
–	β + STRUCTURE	(ISLAND | SHORT)
=	– STRUCTURE	(D2)

After calculating differences D1 and D2, a final subtraction yields a differences-in-differences (DD) score, which isolates the island violation penalty (40). In other work utilizing the length by structure design, a DD score greater than zero is known as a *super-additive* island effect,

since the ratings penalty caused by extracting from an island is not a simple sum of the length and structure penalties.

(40)

	– (STRUCTURE + ISLAND VIOLATION)	(D1)
–	– STRUCTURE	(D2)
=	– ISLAND VIOLATION	(DD)

With the logic of the length by structure design now in place, we will consider a mock experiment that compares embedded *that*-clauses to subject relative clauses with the relative pronoun *who* and compares a short matrix subject extraction to a long embedded object extraction. This mock experiment will have conditions with the structures in (41). Since (36d) involves movement out of a relative clause, which typically results in a severely degraded sentence, it is expected to be receive the lowest ratings.

(41)
a. DP_i [$_{TP}$ ___$_i$ ..... [$_{CP}$ *that* .....]] NON-ISLAND | SHORT
b. DP_i [$_{TP}$ ..... [$_{CP}$ *that* ..... ___$_i$]] NON-ISLAND | LONG
c. DP_i [$_{TP}$ ___$_i$ ..... [$_{RC}$ *who* .....]] ISLAND | SHORT
d. DP_i [$_{TP}$ ..... [$_{RC}$ *who* ..... ___$_i$]] ISLAND | LONG

To minimize confounding factors, the stimuli within each item should be made as similar as possible, including lexical material, number of words, etc. For an experiment comparing embedded *that*-clauses to relative clauses, one way to minimize differences across the NON-ISLAND and ISLAND conditions is to only use matrix verbs that can take either a *that*-clause complement or a DP complement, such as *understand*, *notice*, or *believe*. The following is a sample item that meets these criteria and uses WH-movement for extraction.

(42) SAMPLE ITEM FOR A MOCK LENGTH BY STRUCTURE EXPERIMENT

a. Who ___ understands that the teachers dislike unstapled papers? NON-ISLAND | SHORT
b. What does Lorena understand that the teachers dislike ___? NON-ISLAND | LONG
c. Who ___ understands the teachers who dislike unstapled papers? ISLAND | SHORT
d. What does Lorena understand the teachers who dislike ___? ISLAND | LONG

Let us assume that an acceptability judgment experiment is run with items modeled on (42), using a ratings scale of 1-6, 1 being "clearly bad" and 6 being "clearly good". Imagine that the

Table 3.2: Mock results for a simple length by structure experiment

Structure	Length	
	short	long
non-island	5.0	3.9
island	4.7	1.9

conditions received the average ratings presented in Table 3.2, which are also represented graphically in Figure 3.1. Note that the highest-rated condition is the non-island | short condition, and that the island | long condition is rated lowest. This is expected for a condition representing extraction from an island.

Using these average ratings, we can calculate an island score for English relative clauses as illustrated above. First, following (38), D1 is calculated as in (43), which gives us the combined cost of structure and island violation. Next, following (39), D2 is calculated as in (44), giving us the isolated structure cost. Finally, D2 is subtracted from D1, resulting in the DD score (45), which represents the island score—the strength of the island used in the experiment. Due to the direction in which the subtractions are done, the resulting island score is a positive number. The higher the island score is, the stronger the island is considered to be, and the more degraded subextraction is predicted to be. For the remainder of the paper, the DD score calculation will be represented in a DD table, as shown in Table 3.3.

(43) Structure + island violation penalty

	3.9	(non-island | long)
–	1.9	(island | long)
=	2.0	(D1)

(44) Structure penalty

	5.0	(non-island | short)
–	4.7	(island | short)
=	0.3	(D2)

(45) Island violation penalty

	2.0	(D1)
–	0.3	(D2)
=	1.7	(DD)

The island score for the relative clause island used in this experiment is 1.7. Since the

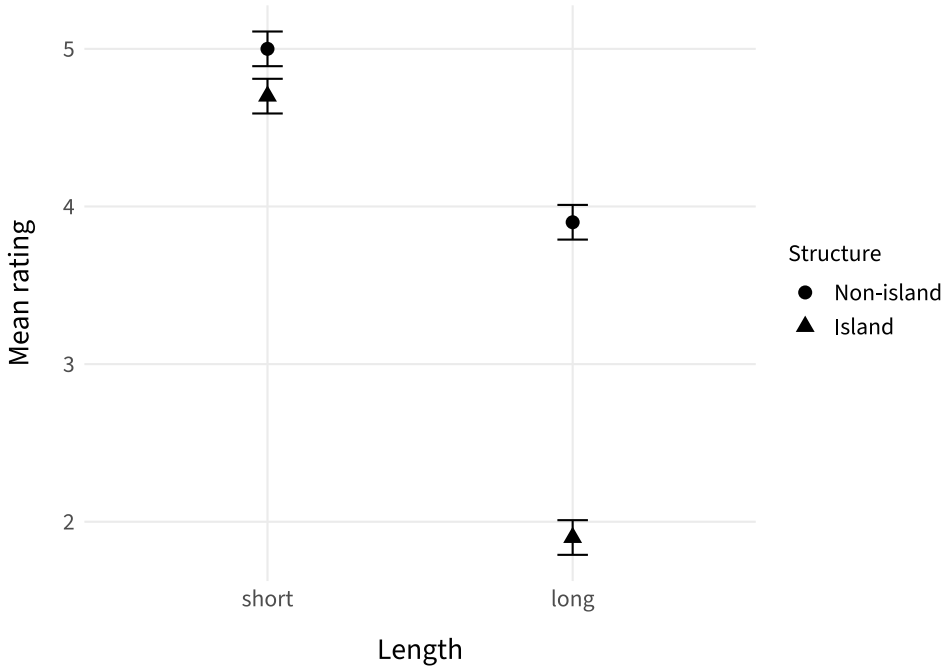


Figure 3.1: Mock results for a simple length by structure experiment, arranged by LENGTH

Table 3.3: Mock DD scores for a simple length by structure experiment

NON-ISLAND | SHORT	NON-ISLAND | LONG	ISLAND | SHORT	ISLAND | LONG	D1 (STRUCTURE + ISLAND VIOL.)	D2 (STRUCTURE)	DD (ISLAND VIOL.)
5.0	3.9	4.7	1.9	2.0	0.3	1.7

above calculation is done on the averages of the raw ratings given by the mock participants, the DD score represents the average ratings penalty caused by relative clause subextraction in this specific experiment (with this experiment's items). In papers based on actual length by structure experiments, the ratings are *z*-scored before these calculations are made, which allows for a more accurate comparison across participants, syntactic-semantic environments, and experiments. From here on, average ratings will be shown in plots like the one in Figure 3.1, but DD scores will be calculated using *z*-scored ratings.

Now that it is clear how a simple length by structure experiment can be used to gain insight into the strength of an island, Experiment 1 is presented, which extends the simple design by adding an additional factor relating to the definiteness of the DP containing the relative clause. It was mentioned in the introduction that some work has characterized the definiteness of the containing DP as being one of the factors affecting the acceptability of relative clause subextraction (and extraction from DPs generally), so it is worth testing the claim experimentally, both to gauge the validity of the claim for English and to show how the length by structure design can be used to compare island strength in different syntactic-semantic environments.[1]

3.2 Experiment 1: Definiteness

The goal of Experiment 1 is to investigate whether the definiteness of a DP containing either a relative clause or a CP complement to N has a detectable impact on the acceptability of subextraction. Experiment 1 builds on the design of the mock experiment discussed above.

3.2.1 Participants

32 individuals participated in Experiment 1, 14 of which were family members of the author and 18 of which were UC Santa Cruz undergraduates who received course credit for their

1. See, for instance, Erteschik-Shir and Lappin (1979, pp. 55–56) regarding extraction from complex DPs (containing clauses), and Diesing (1992, pp. 127–136) regarding extraction from simple DPs (containing PPs, for instance).

participation. One participant did not complete the experiment due to time constraints, but that participant's data is included in the analysis.

3.2.2 Materials & methods

Experiment 1 extends the length by structure design discussed above by adding an additional factor, resulting in a 2×2×2 factorial design. The third factor relates to the definiteness of the DP that hosts the relative clause or CP complement to N. This factor is named DEFINITENESS, and its levels are DEF(INITE) and IND(EFINITE). In the ISLAND conditions, this factor pertained to the DP that contains the relative clause/CP complement; however, since the NON-ISLAND conditions use an embedded *that*-clause complement of a verb, the embedded clause is not embedded inside a DP, and an analogous DP had to be chosen on which to reflect the DEFINITENESS factor. Since the DP hosting the relative clause in the ISLAND conditions contained a subject relative clause, in the NON-ISLAND conditions this DP's lexical material was recycled as the subject of the embedded clause. It was this DP whose definiteness was manipulated in the NON-ISLAND conditions. This difference across the ISLAND and NON-ISLAND conditions is best seen by studying the DP *the teachers* in (46a) and (46e)

This combination of factors gives a total of eight conditions per item. 32 items were created. Half of these items had a relative clause as the island, and the other half had a CP complement to N as the island. The DEFINITE conditions all used the article *the*. 24 of the items' INDEFINITE conditions used the indefinite article *a(n)*, and the remaining eight items used bare plurals. This was done selectively when using the indefinite article didn't sound natural, and it was assumed that this change would have no effect on processing. Henceforth, the items that used CP complements to N instead of relative clauses are ignored because the choice between these two clause types didn't have a significant impact on the acceptability of subextraction. The interested reader can find a description of the CP complement conditions in Appendix A.1.2.

A sample item is presented below, representing the items with relative clauses as the island (46). As in the mock experiment above, matrix verbs were chosen that are compatible

with either a CP or a DP complement. In the NON-ISLAND conditions, the verbs had a CP complement, and in the ISLAND conditions, the verbs had a DP complement.

(46) EXPERIMENT 1 SAMPLE ITEM

a. Who understands that the teachers dislike unstapled papers? NON-ISLAND | SHORT | DEF

b. Who understands that teachers dislike unstapled papers? NON-ISLAND | SHORT | IND

c. What does Lorena understand that the teachers dislike? NON-ISLAND | LONG | DEF

d. What does Lorena understand that teachers dislike? NON-ISLAND | LONG | IND

e. Who understands the teachers who dislike unstapled papers? ISLAND | SHORT | DEF

f. Who understands teachers who dislike unstapled papers? ISLAND | SHORT | IND

g. What does Lorena understand the teachers who dislike? ISLAND | LONG | DEF

h. What does Lorena understand teachers who dislike? ISLAND | LONG | IND

The experimental conditions were distributed among eight lists using a Latin Square so that four observations per condition were obtained per participant, and no more than one condition per item was seen by any participant. Each participant saw a total of 32 experimental sentences. These were randomly sorted with 64 filler sentences, for a total of 96 sentences. The filler sentences were adapted from Sprouse et al. (2013a), a study based on a random sample of example sentences from Linguistic Inquiry articles from 2001–2010. Modifications were made to 18 of these sentences so that the average length of the filler sentences (10.6 words) was not substantially greater than the average length of the experimental sentences (10.0 words). Fillers were selected so that each participant saw an equal number of declarative and interrogative sentences in the course of the experiment (48 of each), and a reasonable balance of expected grammatical and expected ungrammatical sentences (70% grammatical, 30% ungrammatical)

This experiment was deployed as a pen-and-paper survey. Participants were instructed to rate each sentence by circling a number on a 1 to 6 Likert scale, where 1 is described as "clearly bad", 2 is "pretty bad", 3 is "somewhat bad", 4 is "somewhat good", 5 is "pretty good", and 6 is "clearly good". The survey formed from List 1 is given in Appendix A.1.4. The 14 family member participants were instructed to complete the survey individually, but the environ-

ment was unable to be controlled for noise and background talking. The 18 undergraduate participants completed the survey in the psycholinguistics lab at UC Santa Cruz.

3.2.3 Analysis

A mixed effects ordinal regression model was fit to the data with a maximal random effects structure. The model coefficients for Experiment 1 are provided with commentary in Appendix A.1.1.

3.2.4 Predictions

We expect to see some degree of degradation for longer movement dependencies relative to shorter ones, which would show up as a main effect of LENGTH, as well as a general degradation for ISLAND conditions relative to NON-ISLAND conditions due to the complexity of a relative clause structure as compared to an embedded *that*-clause. Statistically, this would surface as a main effect of STRUCTURE.

We also predict there to be a significant degradation for ISLAND | LONG conditions, since these involve extraction out of an island. A general island effect would show up as an interaction between STRUCTURE and LENGTH.

Finally, on the hypothesis that relative clauses in INDEFINITE DPs are more porous than those in DEFINITE DPs, we would expect to see a three-way interaction between STRUCTURE, LENGTH, and DEFINITENESS.

3.2.5 Results

As predicted, general ratings decreases were found for conditions with long extractions, as well as for conditions with islands. The ISLAND | LONG conditions were rated lowest of all, which is unsurprising given that this condition involves extraction from an island. The INDEFINITE conditions as a whole were rated slightly lower than the DEFINITE conditions. This is visualized in Figure 3.2.5.

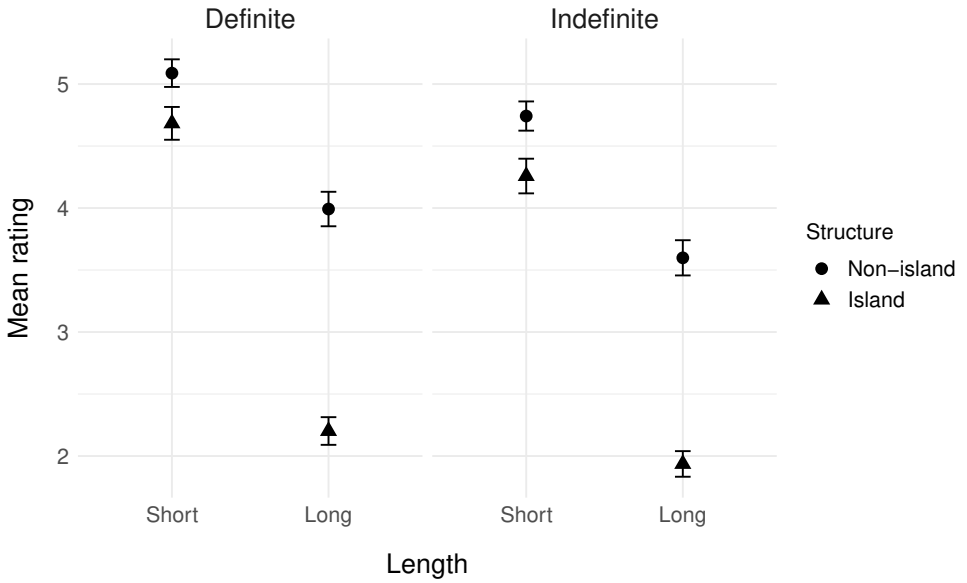


Figure 3.2: Experiment 1 results, faceted by DEFINITENESS and arranged by LENGTH. Error bars represent standard error.

In the statistical analysis, there were main effects of LENGTH ($p < 0.001$) and STRUCTURE ($p < 0.001$). The overall penalty of the INDEFINITE conditions also surfaced as a main effect of DEFINITENESS ($p < 0.001$). The interaction of STRUCTURE and LENGTH was significant ($p < 0.001$), which is the predicted island effect. The hypothesis that indefinite DPs will be more porous predicts a significant interaction between STRUCTURE, LENGTH, and DEFINITENESS, but this interaction was found not to be significant ($p = .866$).

The averaged z-scores for each condition are shown in Table 3.4. The DD scores are printed in that table for each level of DEFINITENESS. As shown in the last column, the island score (DD) is slightly higher for the DEFINITE condition (0.83) compared to the INDEFINITE condition (0.70), indicating a slightly higher penalty for island-violating extraction in the DEFINITE conditions. As noted above, though, this difference was not significant.

Table 3.4: Experiment 1 *z*-score ratings and DD scores

Definiteness	non-island | short	non-island | long	island | short	island | long	D1 (structure + island viol.)	D2 (structure)	DD (island viol.)
definite	0.75	0.09	0.53	−0.96	1.05	0.22	**0.83**
indefinite	0.58	−0.11	0.24	−1.14	1.03	0.34	**0.70**

3.2.6 Discussion

Since no significant interaction was found between Structure, Length, and Definiteness, we cannot conclude that the definiteness of the intervening DP has an effect on porosity. This is a surprising result on the simplistic view that definiteness is the only factor or is one of the main factors affecting porosity, as has sometimes been suggested (see fn. 1). However, on the view that the DP's presupposition status is one of the main factors affecting porosity (Sichel 2018), this result may be less surprising. DPs may only be non-presupposed in particular syntactic-semantic environments, such that even an indefinite DP might be presupposed in one environment, and a definite DP might be non-presupposed in another.

This experiment did not control for the effect that the environment of the DP containing the relative clause would have on the DP's presuppositionality. All DPs containing the relative clause were the object of one of the transitive verbs listed in (47). A small handful of these verbs might have presentational uses that allow them to be interpreted as asserting the existence of their object (possibly *notice*, *find*, *reveal*, and *know*), but most of them are unlikely to be used in a presentational context and are more likely to be used in a context in which the referent of the DP object is already assumed to exist.

(47) Experiment 1 verbs (conditions in which island = RC)
notice, *trust*, *respect*, *find*, *like*, *believe*, *know*, *predict*, *understand*, *report*, *remember*, *teach*, *write*, *appreciate*, *reveal*, *suggest*

3.2.7 Interim summary

The design described in this section is a powerful experimental design that permits measurement of absolute island effects. When the researcher obtains measurements of absolute island effects for multiple constructions or environments, the measurements for those constructions or environments can be compared to determine whether one construction or environment gives rise to a stronger island effect than the other. However, the success of the design in producing a trustworthy measurement of an island effect depends on the identification of a reasonable NON-ISLAND baseline. A reasonable baseline construction should enable close lexical matching to the ISLAND conditions and should result in all the same processing costs except for the cost associated with complex operator-variable constructions like a relative clause. Should a suitable baseline construction not be available, it may not be possible to derive a reliable measurement for an absolute island effect. In this case, if a measure of absolute island effects is not needed, the researcher can rely on an alternative design which permits measurement of relative island effects. One such design is presented in §3.3, below.

3.3 An alternative design: DEPENDENCY × ENVIRONMENT

This section presents the logic of an alternative design which will be called the "dependency by environment" design. This design can be used to measure relative island effects. It is useful when the length by structure design cannot be used for linguistic reasons, such as if no suitable NON-ISLAND baseline construction can be found. The length by structure design requires twice as many conditions as the dependency by environment design, so this design may be more practical when it is not necessary to measure absolute island effects. In the current work, the alternative design is used in Experiment 2 (Chapter 4) and Experiment 5 (Chapter 5).

The dependency by environment design relies on the differences between free pronominal dependencies and movement dependencies. Free pronominal dependencies are not only unbounded but are not subject to island constraints; the reference of a pronoun inside

of an island can freely gain reference from an R-expression outside of the island. Movement dependencies, of course, are subject to island constraints. The alternative design leverages this difference by permitting ratings penalties associated with movement dependencies into islands to be compared across different environments.

The factors are DEPENDENCY TYPE (PRONOMINAL, MOVEMENT) and ENVIRONMENT. Following the hypotheses tested with Experiment 1 (§3.2), one might wish to consider PRONOMINAL and MOVEMENT dependencies in DEFINITE and INDEFINITE environments. This results in a 2×2 factorial experiment with the four conditions laid out in Table 3.5 and illustrated by the item template in (48). A hypothetical sample item is provided in (49).

Table 3.5: Conditions in a minimal dependency by environment experiment

DEPENDENCY	ENVIRONMENT	
	DEFINITE	INDEFINITE
PRONOMINAL	PRONOMINAL | DEFINITE	PRONOMINAL | INDEFINITE
MOVEMENT	MOVEMENT | DEFINITE	MOVEMENT | INDEFINITE

(48) a. DP_i [$_{TP}$ ……. *the* … [$_{ISLAND}$ … x_i …]] PRONOMINAL | DEFINITE

b. DP_i [$_{TP}$ ……. *a* … [$_{ISLAND}$ … x_i …]] PRONOMINAL | INDEFINITE

c. * DP_i [$_{TP}$ ……. *the* … [$_{ISLAND}$ … ___ $_i$ …]] MOVEMENT | DEFINITE

d. * DP_i [$_{TP}$ ……. *a* … [$_{ISLAND}$ … ___ $_i$ …]] MOVEMENT | INDEFINITE

(49) a. My Spanish teacher$_i$ says that the student who gives her$_i$ unstapled papers will be kicked out. PRONOMINAL | DEFINITE

b. My Spanish teacher$_i$ says that a student who gives her$_i$ unstapled papers will be kicked out. PRONOMINAL | INDEFINITE

c. * My Spanish teacher is someone who$_i$ the student who gives ___ $_i$ unstapled papers will be kicked out. MOVEMENT | DEFINITE

d. * My Spanish teacher is someone who$_i$ a student who gives ___ $_i$ unstapled papers will be kicked out. MOVEMENT | INDEFINITE

Consideration of the sources likely to cause penalties to acceptability ratings will reveal why this design should only be used to measure relative island effects. First of all, each item

should have a relatively consistent penalty across conditions (β) that is the result of the particular lexical items chosen for that item and how they are combined with each other. In contrast to the length by structure design, all conditions in the alternative design share the complexity cost associated with the island structure (here, a relative clause), so this is part of β. In the MOVEMENT conditions, there are two additional costs: the cost of long-distance movement (or *length*, as it was called in §3.1), and there is a distinct cost associated with this long-distance movement occurring across the island boundary (island violation).

Although the pronominal dependency in the PRONOMINAL conditions is also long-distance, I assume that the cost associated with free pronominal dependencies is negligible compared to the cost associated with movement (filler-gap) dependencies. Unlike filler-gap dependencies, free pronominal dependencies are not mandatory, so a reader encountering an R-expression that may or may not be coextensive with a free pronoun later in the sentence does not initiate an active dependency formation process like encountering a filler-phrase does. The reference resolution of free pronouns is a separate pragmatic process that involves notions of salience ("Is there a salient referent in the discourse?") and feature-matching ("Is there a referent that matches the gender/number features of this pronoun?"), and in an experimental setting in which there is only one salient referent ("my Spanish teacher" in (49a–49b)), I assume that the reference resolution process has virtually no cost as compared to the resolution of a filler-gap dependency (Nicol and Swinney 1989). The penalties associated with the four conditions discussed above are summarized in (50).

(50) a. PRONOMINAL | DEFINITE = β

b. PRONOMINAL | INDEFINITE = β

c. MOVEMENT | DEFINITE = β + LENGTH + ISLAND VIOLATION A

d. MOVEMENT | INDEFINITE = β + LENGTH + ISLAND VIOLATION B

For each ENVIRONMENT level, the rating for the MOVEMENT condition is subtracted from the rating for the PRONOMINAL condition to derive a combined difference score, which I will call DA for the first ENVIRONMENT level and DB for the second, which represents the cost of long-distance movement that crosses an island boundary (51).

(51) a. β (PRONOMINAL | DEFINITE)
– β + LENGTH + ISLAND VIOLATION A (MOVEMENT | DEFINITE)
= – (LENGTH + ISLAND VIOLATION A) (DA)

b. β (PRONOMINAL | INDEFINITE)
– β + LENGTH + ISLAND VIOLATION B (MOVEMENT | INDEFINITE)
= – (LENGTH + ISLAND VIOLATION B) (DB)

Although the penalty associated with crossing an island boundary is not isolated in either of these scores, the length penalty is expected to be relatively stable within each item. I argue that this expectation is reasonable as long as care was taken in construction of the items to allow only the strictly necessary variations across ENVIRONMENT types, as was the case in the sample item (49), the relevant conditions of which are repeated as (52a–52b; emphasis added to highlight the ENVIRONMENT modulation).

(52) a. * My Spanish teacher is someone who$_i$ **the** student who gives ___$_i$ unstapled papers will be kicked out. MOVEMENT | DEFINITE

b. * My Spanish teacher is someone who$_i$ **a** student who gives ___$_i$ unstapled papers will be kicked out. MOVEMENT | INDEFINITE

As long as the length penalty is constant across DA and DB, any difference between DA and DB is predicted to be the result of a difference in the island violation penalty (53), granting us a semi-transparent window into how the tested environments affect island porosity.

(53) – (LENGTH + ISLAND VIOLATION A) (DA)
– – (LENGTH + ISLAND VIOLATION B) (DB)
= ISLAND VIOLATION B – ISLAND VIOLATION A (DC)

The outcome of this arithmetic represents the extent to which ISLAND VIOLATION A is greater than ISLAND VIOLATION B. If the outcome is positive, then ISLAND VIOLATION A is greater than ISLAND VIOLATION B. In other words, the effect of extracting from the island in the DEFINITE environment is greater than the effect of extracting from the island in the INDEFINITE environment. If the outcome is negative, then ISLAND VIOLATION A is lesser than ISLAND VIOLATION B, or in other words, the effect of extracting from the island in the INDEFINITE environment is greater than the effect of extracting from the island in the DEFINITE environment.

Because we can only deduce the difference in island violation penalties using this design—and not values for the length penalty or the individual island violation penalties—there is no way to estimate the change in the island effect in proportion to the other. We can only estimate the range of proportional change that is compatible with the observed difference score DC. For illustration purposes, let us imagine that we find a DA value of 4.5 and a DB value of 3. The DC value will then be 1.5, and the positive value indicates that ISLAND VIOLATION A is stronger than ISLAND VIOLATION B. What range of proportional changes is compatible with this score for DC?

On the low end of extremes, DA could be the result of a minimal length penalty (zero) and maximal island violation penalty of 4.5, in which case the proportional change in island violation penalty across the two environments is 1.5 ÷ 4.5 = 0.33, or a 33% reduction. On the other end, DA could be the result of a maximal length penalty and a minimal island violation penalty. The lowest possible value for ISLAND VIOLATION A is the difference between ISLAND VIOLATION A and ISLAND VIOLATION B (1.5), so on the high end of extremes, the proportional change in island violation penalty across the two environments is 1.5 ÷ 1.5 = 1, or a 100% reduction. In (54) are two formulas that summarize how this range is calculated.

(54) a. Minimum reduction = DC / DH
b. Maximum reduction = DC / (DH – DL)

(where *DH* is whichever of *DA* and *DB* is highest and *DL* is whichever of *DA* and *DB* is lowest)

The outcomes of (54a) and (54b) represent the range of possible *reductions* in island effects from ISLAND VIOLATION A to ISLAND VIOLATION B. A positive DC value, as noted above, indicates that ISLAND VIOLATION A is greater than ISLAND VIOLATION B, and entered into one of the formulas in (54), will result in a positive proportion which represents the percentage by which ISLAND VIOLATION B is reduced from ISLAND VIOLATION A. If the formulas in (54) have a negative outcome, ISLAND VIOLATION B was greater than ISLAND VIOLATION A, and the absolute value of the proportion represents the percentage by which ISLAND VIOLATION A is reduced from ISLAND VIOLATION B.

With the logic and limitations of the dependency by environment design established, let us review the interpretation of some hypothetical results. Imagine an experiment of this de-

Table 3.6: Mock results for a simple dependency by environment experiment

Dependency	Environment	
	definite	indefinite
pronominal	5.2	4.5
movement	2.1	1.3

sign is run with items modeled after (49) and that we acquire the mean ratings shown in Table 3.6 and visualized in Figure 3.3.

Using these average ratings, we can calculate the difference in island violation penalties between the two tested environments in the manner described above. In (55) and (56), the two difference scores are calculated for the respective environments, and in (57), the difference in island violation penalties is calculated.

(55) Length + island violation A penalty

	5.2	(pronominal | definite)
–	2.1	(movement | definite)
=	3.1	(DA)

(56) Length + island violation B penalty

	4.5	(pronominal | indefinite)
–	1.3	(movement | indefinite)
=	3.2	(DB)

(57) Island violation penalty difference score

	3.1	(DA)
–	3.2	(DB)
=	–0.1	(DC)

The value produced by (57) is negative, which means that island violation B is greater than island violation A, although only marginally. Using (54b) and (54a) provides us with a range of proportional reductions in island violation penalties from -3.125% to -100%, which indicates that the value for DC is compatible with a 3.125% reduction in island violation penalty from island violation B to island violation A up to a 100% reduction. This wide range is not terribly meaningful, however, since DC is so small to begin with. In practice, the ranges should be taken with a grain of salt; they should always be considered with respect to inferential statistics which provide some insight into the statistical significance of DC. A statistically

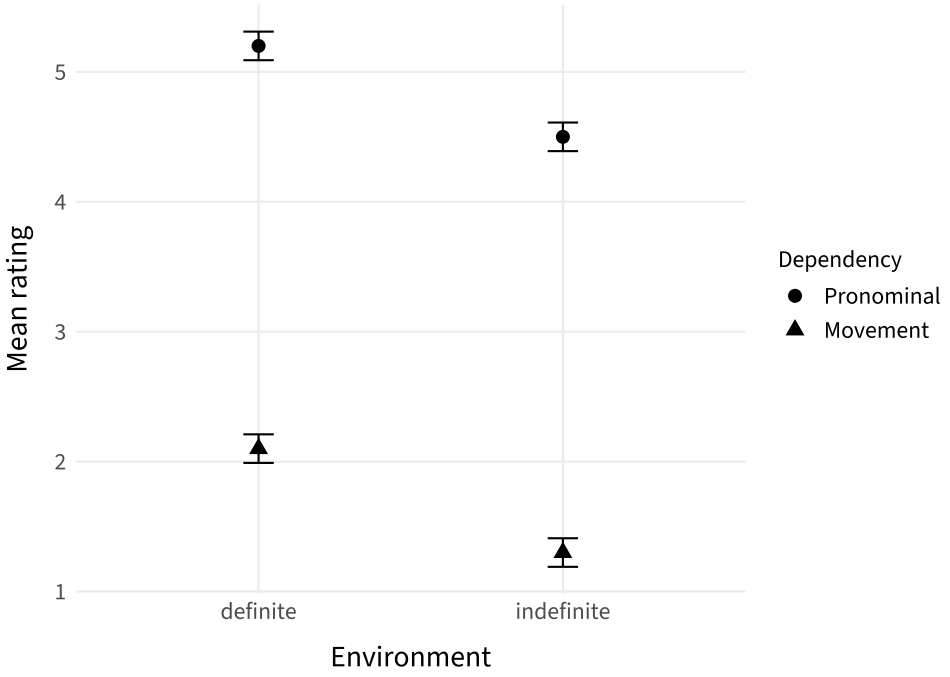


Figure 3.3: Mock results for a simple dependency by environment experiment, arranged by ENVIRONMENT

significant value for DC means there is a significant interaction between DEPENDENCY and ENVIRONMENT. If the interaction is not significant, the range of possible reductions should not be considered relevant. If the results in Table 3.6 and Figure 3.3 were based on real data, the interaction between DEPENDENCY and ENVIRONMENT would in all likelihood be insignificant since the error bars in Figure 3.3 have a span that is greater than the absolute value of DC.

3.3.1 Interim summary

The dependency by environment experiment design is useful for gauging relative differences in island effects, but its power is limited by the fact that it does not utilize the full factorial definition of island effects. As described, it does not permit complete isolation of the penalty to ratings associated with violation of an island constraint. In principle, the design could be extended to include a non-island environment with short and long conditions, which would allow for the length penalty to be isolated and subsequently subtracted from DC (much like the length by structure design). However, if the reason for using the dependency by environment design is that there are challenges identifying an appropriate baseline, this may not be possible. In the current work, the dependency by environment design is only utilized in situations where the length by structure design faces limitations.

3.4 Mixture modeling

In some situations, descriptive and inferential statistics do not reveal potentially useful information about the distribution of a set of observed ratings.[2] Consider a scenario in which one condition in an acceptability judgment experiment receives a mean rating of 3.5 on a 6-point scale. In principle, this intermediate mean rating could be the result of averaging intermediate responses, or it could be the result of averaging a roughly equal number of responses clustered around two poles. When the hypotheses under consideration make different predictions about the overall distribution of responses, it is of interest to the researcher to be

2. The descriptive statistics relied on most heavily in this work are the arithmetic mean (a measure of central tendency)

able to accurately determine which of these possibilities best describes the ratings data. One such set of hypotheses is described in (58).

(58) Sentences of some configuration XYZ have intermediate acceptability because…

a. …they are fully grammatical but difficult to parse, which results in individuals assigning a rating on the lower end of 'acceptable'.

b. …they have a local structural ambiguity that under one parse results in a grammatical sentence and under the other parse results in a non-sentence. Roughly half of the individuals who read these sentences select the former parse and give a rating in the 'acceptable' range, but the other half select the latter, usually failing to see the licit parse, motivating a rating in the 'unacceptable' range.

Following Dillon et al. (2017), we can refer to the behavioral process giving rise to the response distribution predicted by (58a) as a GRADIENT process, and the processes giving rise to the response distribution predicted by (58b) as DISCRETE processes. Identifying which sort of process underlies the observed response distribution is not a trivial matter, a point which is convincingly made with visualizations.

Let us suppose that individual participants in an acceptability judgment experiment will ultimately select a rating in a given trial from one of two ranges: the range of basically acceptable ratings, and the range of basically unacceptable ratings. The ratings in each range overlap to some degree—one might imagine the "unacceptable" range to span from 1 to 4 and the "acceptable" range to span from 3 to 6. In an actual experiment, the ratings in each span vary by participant. With this in mind, the experimenter can't necessarily tell which range a rating came from based on its value.

Imagine that Hypothesis (58a) is correct. All participants have drawn their ratings from the acceptable range but tended to choose ratings on the lower end of acceptable because of the processing difficulty they experienced. This can be emulated computationally by drawing a sample of 500 ratings with a pre-specified mean and standard deviation. A short programming script written in the statistical programming language R (R Core Team 2021) is provided in Figure B.2 that follows this procedure and generates a histogram to illustrate the distribution of ratings. Suppose the ratings have a mean of 3.5 and a standard deviation of 1.25. A

histogram illustrating the count of ratings shows that the ratings are roughly normally distributed around the mean (Figure 3.5).

```
# Save ratings scale (1 through 6) under variable
scale <- 1:6

# Generate vector of probabilities for a normal distribution
# over 6 quantiles w/ mean of 3.5 & SD of 1.25
probs <- dnorm(x = scale,
               mean = 3.5,
               sd = 1.25)

# Take 500 draws from scale using probabilities from dnorm()
data <- sample(x = scale,
               size = 500,
               prob = probs,
               replace = TRUE)

# Make a base R histogram
hist(data, breaks = rep(1:6, each = 2) + c(-0.45, 0.45))
```

Figure 3.4: Short script written in base R that creates a probability distribution over 6 quantiles, simulates an experiment in which ratings are randomly drawn from a distribution with the specified parameters, and creates a histogram to visualize the sample of ratings.

Now imagine that Hypothesis (58b) is correct. Different participants have drawn their ratings from different ranges, roughly half of them choosing from the acceptable range and the other half choosing from the unacceptable range, still averaging 3.5 in the aggregate. There are a number of ways that we can arrive at an average like this while participants are drawing from distinct ranges, and these possibilities can also be emulated. If we artificially generate a sample of 500 ratings drawn from two separate distributions, the counts quite clearly reveal two groups of ratings—as long as the means of each individual distribution is extreme. The closer together the individual means get, however, the more challenging it is to tell offhand that two distributions underlie the aggregated ratings. Using the script in Figure 3.6, we can emulate ratings being drawn from two discrete distributions and aggregated. Doing this sev-

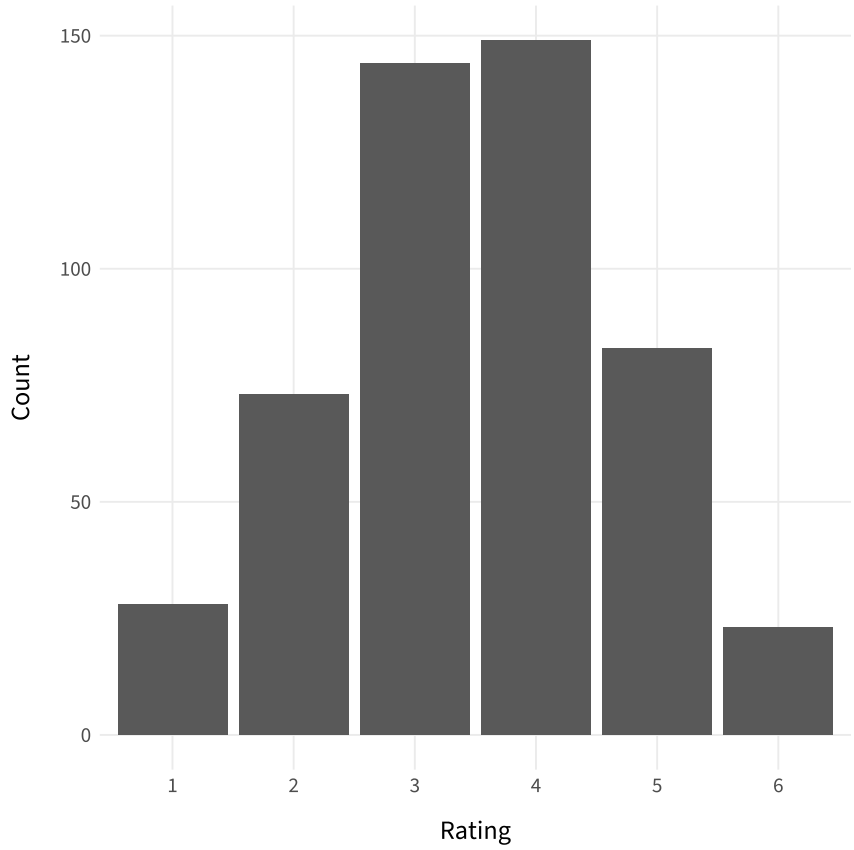


Figure 3.5: Artificially generated sample of 500 ratings drawn from a single distribution with a mean of 3.5

eral times with progressively closer individual means, we can see that the aggregated ratings appear more and more like a set of ratings drawn from a single distribution (as in Figure 3.5). This is illustrated in Figure 3.7.

Because it is not always possible to identify the nature of a response distribution intuitively, the researcher can make use of computational methods to model these two different possible sources for the observed mean and determine which source is most likely to underlie the observed mean. If the models that we construct are representative of the sorts of gradient and discrete processes underlying (58), and if our methods for calculating the similarity between two sets of responses (the observed set of ratings and the set of ratings simulated

by the model) are reliable, then we can essentially re-run our initial experiment as long as we have usable sources of data to represent the two ranges of ratings discussed above.

This kind of computational method is used by Dillon et al. (2017) to evaluate hypotheses in their study on spurious object agreement in *wh*-questions.[3] What follows is a description of their computational quantitative modeling method and an example of how it is used to gain insight into the possible sources of the intermediate rating they observe. This method has two main components:

(59) a. Model definition: explicitly defining a computational procedure to represent the procedure by which participants select ratings for a sentence

b. Model evaluation: evaluating the resulting models to determine which most accurately represents the procedure by which the actual ratings data was obtained

3.4.1 Model definition

Two kinds of models are defined, one for each process mentioned above: a DISCRETE model and a GRADIENT model. The goal of defining a model is to emulate the *result* of the different behavioral processes underlying each hypothesis. Crucially, it is not intended to emulate the conscious or unconscious mental processes by which a participant decides on a rating for a particular sentence; it is intended to emulate the *effects* of those processes (or what we can reasonably expect the effects of those processes to be). The mental processes are still involved in a model, but by way of reference to ranges of ratings that were provided by actual participants in an actual experiment. The ranges involved are a range of ratings given to reliably unacceptable sentences—or an ungrammatical reference distribution—and a range of ratings given to reliably acceptable sentences—or a grammatical reference distribution. The

3. Dillon et al. aim to gain insight into the ratings distribution underlying several intermediate mean ratings in their study on spurious object agreement in object *wh*-questions. They hypothesize that the intermediate rating reflects a process in which a reader corrects an initial misparse, arrives at a grammatical parse of the sentence, but has a "lingering perception of unacceptability or difficulty from the reanalysis process" (p. 77). Under this implementation of the account, they expect the intermediate mean rating to reflect truly intermediate responses which are the result of an individual having a mixed perception of acceptability and unacceptability. In other words, they expect a particular distribution of responses—a unimodal response distribution. The predictions of this hypothesis ended up not being supported by the data, which was better described by a model in which ratings are drawn from two separate distributions.

models use these reference distributions in slightly different ways.

The DISCRETE model

Under the DISCRETE model, an overall proportion (π) of ratings is drawn from the ungrammatical reference distribution, and a complementary proportion ($1-\pi$) is drawn from the grammatical reference distribution. This is intended to simulate an experimental condition which some participants rate as genuinely unacceptable and some rate as genuinely acceptable.

The model was implemented by Dillon et al. as a function in R. An adaptation of their function definition in R is provided in Appendix B, as are all functions discussed here. The function takes four arguments that provide it with all the information needed to model the ratings under a discrete process. Two of these arguments are two separate data structures containing the ungrammatical and grammatical reference distributions. The third argument is a value for π, and the fourth is a number indicating the total number of draws it should take from these distributions. π is taken as a proportion, and it determines what percentage of the total number of draws will come from one reference distribution or the other.

The GRADIENT model

The gradient model is slightly more complicated, which one might say is because the mental processes underlying the ratings it is attempting to emulate are more complicated. Because this model aims to emulate the set of ratings given to a condition that is neither clearly acceptable nor clearly unacceptable, it assumes that every rating reflects a *mixture* of acceptability and unacceptability. To simulate mixed ratings, two ratings are drawn at a time, one from each reference distribution. Instead of a specified proportion of the total number of ratings being drawn from each distribution, specified proportions of each rating are mixed into a single rating.

This model is again implemented as a function in R. The function takes the same four arguments as the function representing the DISCRETE model, but it uses them in a different way. Because this model views each rating as a mixture of unacceptability and acceptability, a sin-

gle rating produced by the model is composed of *two* ratings, one drawn from each reference distribution and mixed together. This time, however, π does not represent how many draws come from each reference distribution, but how much *unacceptability* and *acceptability* each rating is composed of. If π is 0.25, then the rating drawn from the ungrammatical distribution is scaled by 0.25, the rating drawn from the grammatical distribution is scaled by 0.75 ($1-\pi$), and the products are added together.

The optimization of π

So far, I have made no reference to how the value of π is determined. An ideal value for π is one that results in a model simulating the mean of the observed data as closely as possible. In order to determine an optimal value for π, the means of both the simulated data and the observed data are needed, and a way of measuring the accuracy of the simulated mean, or its closeness to the observed mean, is needed. Assuming that we already have π and have used it to simulate the data, following Dillon et al., the closeness of the model mean to the observed mean is represented by the squared residual of the two means. [4] A single squared residual doesn't mean much on its own, but of two squared residuals, the one that is closer to zero is the result of a more optimal value of π.

The reader will notice that π is needed to simulate the data, but the simulated data is needed to optimize π. The way around this circular dependency is trial and error, which is accomplished using the `optimize()` function in R. `optimize()` tries multiple values for π within the range of possible values for π (between 0 and 1) and selects a value for it that results in the lowest squared residual.

Two specialized functions were written based on Dillon et al.'s R script, one that measures how good of a fit a particular value for π provides for a model, and one that performs multiple rounds of optimization of π. These functions are provided in Appendix B.2.1 and B.2.2, respectively.

4. *(Model mean – Observed mean)*^{2}. Squaring the residual results in a non-negative number so that positive and negative residuals can be properly compared.

3.4.2 Model evaluation

Once an optimal value of π is known for each kind of model, the simulations can be run. The next step is to determine which model did a better job of simulating the properties of the observed data. For this, Dillon et al. rely on the Bayesian Information Criterion (BIC) score, a method specifically for determining how well a model fits some data. A BIC score is calculated for each model, and the difference between these scores is known as the BIC difference score (ΔBIC). Assuming the gradient BIC score is subtracted from the discrete BIC score, a negative ΔBIC indicates a better fit for the discrete model, and a positive ΔBIC indicates a better fit for the gradient model.

The ΔBIC is not intended to directly reflect statistical significance. To ascertain whether the better fitting model has a significantly better fit, a measure known as the Bayes Factor (BF) is derived from the ΔBIC. Following Dillon et al. (who follow Kass and Raftery 1995), a BF that is greater than or equal to 100 is taken to indicate that the goodness of fit of the discrete model is "Decisive". Kass and Raftery consider a BF between 1 and 3.2 to be "Not worth more than a bare mention" (1995, p. 777). Erring on the conservative side, in this work I will consider a BF of less than 1 to indicate a decisive loss, or lack of evidence, for the discrete model. A separate function in R is defined to compare two models in the manner just described; see Appendix B.3.1.

With these explicit methods defined for modeling observed data, optimizing model parameters, and evaluating model fit, we can use them to simulate the data hundreds or thousands of times, which is known as Monte Carlo simulation. Because we are relying on random sampling from the reference distributions, each run is slightly different from the next, so performing repeated random sampling provides a better idea of what a typical outcome is and how much variation in outcomes there is. One more function is defined that utilizes all the functions mentioned so far to simulate the data a specified number of times and summarize the outcomes of the simulations. This function is provided in Appendix B.3.2.

3.4.3 A test case

As a spot test, this modeling method was used to simulate three data sets: a known "normal" distribution (the exact same data visualized in Figure 3.5), a known discrete distribution (the data plotted in the rightmost square of Figure 3.7), and a known gradient distribution (the data plotted in the right most square of Figure 3.7 combined according to the GRADIENT model using a π value of 0.39). The data plotted in light gray in the leftmost square of Figure 3.7 (with a mean of 1.0) was used as the ungrammatical reference distribution, and the data plotted in dark gray in the same square (with a mean of 6.0) was used as the grammatical reference distribution.

1000 simulations were performed for each test distribution. In the set of simulations run for the normal test distribution, there were 213 decisive wins for the DISCRETE model and 759 decisive losses for it (or 759 decisive wins for the gradient model). Overall, this indicates that the GRADIENT model provides a better fit for the data plotted in Figure 3.5. In the set of simulations run for the known discrete test distribution, the discrete model was favored 1000 times, and of these 1000 times, all of them were significant (with a BF > 100). In other words, 1000 of those discrete wins were decisive wins. The simulations for the known gradient test distribution were unsurprisingly inverted, with 1000 decisive wins for the GRADIENT model. A summary of these simulations is provided in the DISCRETE row of Table 3.7.

Table 3.7: Results of 100 simulations run on the test distribution plotted in Figure 3.5, the DISCRETE test distribution plotted in the rightmost square of Figure 3.7, and a GRADIENT distribution simulated from two discrete distributions. ΔBIC = BIC difference score. Values in parentheses indicate decisive wins.

Test source	Test mean(, π)	Average discrete mean, π	Average gradient mean, π	Mean ΔBIC	Mean BF	Discrete wins	Gradient wins
NORMAL	3.51	3.51, *0.5*	3.48, *0.51*	74.48	9.51×10^{83}	241 (213)	759 (759)
DISCRETE	3.48	3.52, *0.5*	3.67, *0.46*	–394.94	1.63×10^{170}	1000 (1k)	0 (0)
GRADIENT	3.72, *0.39*	3.69, *0.43*	3.77, *0.43*	937.87	<1	0 (0)	1000 (1k)

It is notable that this method correctly determined that the distribution composed of

the aggregated data visualized in the rightmost panel of Figure 3.7 was extremely likely to be composed of two discrete ratings distributions, despite the aggregated data appearing much like the normal distribution in Figure 3.5. This method may therefore be very useful for distinguishing between hypotheses when one of those hypotheses predicts that a subset of participants will find an experimental condition genuinely acceptable while another subset finds the same condition genuinely unacceptable. The relevance of this method to the present study relates to the notion that relative clauses are systematically structurally ambiguous between a head-raising and a matching derivation (Hulsey and Sauerland 2006). Sichel (2018) argues that the only relative clauses that tolerate extraction are raising relative clauses. Combined with Hulsey and Sauerland's ambiguity hypothesis and the assumption that either relative clause derivation is generally freely available, we expect to find ratings for experimental condition to be DISCRETE in the sense discussed here as long as there are no other confounding factors. This will be discussed more thoroughly in the following chapter.

3.5 Interim conclusion

This chapter has presented the logic of the length by structure experiment design, as well as how it can be extended to investigate the strength of an island in different definiteness environments. Experiment 1 found that the definiteness of a DP containing a relative clause has no significant impact on the relative clause's porosity, at least when those DPs are the objects of the transitive verbs in (47). The experiments in the following chapter were designed to address the issue of the presuppositionality of the DP containing the relative clause.

Somewhat more briefly than for the length by structure design, the chapter also presented the logic of the alternative design that I refer to as the dependency by environment design. This design is not as strong as the length by structure design but is useful for measuring relative island effects when issues arise identifying an appropriate structure for the NON-ISLAND baseline in the length by structure design.

Lastly, the chapter has described in detail the computational quantitative modeling meth-

od which is used following Dillon et al. (2017)

```r
# Save ratings scale (1 through 6) under variable
scale <- 1:6

# Generate four pairs of vectors of probabilities
# over 6 quantiles, each pair having an average of 3.5
# 1st pair: ungram mean 1 & gram mean 6; agg mean 3.5
probs_a <- list(ungram = dnorm(scale, 1, 1.25),
                gram = dnorm(scale, 6, 1.25))
data_a <- c(sample(scale, 250, probs_a$ungram, replace = TRUE),
            sample(scale, 250, probs_a$gram, replace = TRUE))

# 2nd pair: ungram mean 1.5 & gram mean 5.5; agg mean 3.5
probs_b <- list(ungram = dnorm(scale, 1.5, 1.25),
                gram = dnorm(scale, 5.5, 1.25))
data_b <- c(sample(scale, 250, probs_b$ungram, replace = TRUE),
            sample(scale, 250, probs_b$gram, replace = TRUE))

# 3rd pair: ungram mean 2 & gram mean 5; agg mean 3.5
probs_c <- list(ungram = dnorm(scale, 2, 1.25),
                gram = dnorm(scale, 5, 1.25))
data_c <- c(sample(scale, 250, probs_c$ungram, replace = TRUE),
            sample(scale, 250, probs_c$gram, replace = TRUE))

# 4th pair: ungram mean 2.5 & gram mean 4.5; agg mean 3.5
probs_d <- list(ungram = dnorm(scale, 2.5, 1.25),
                gram = dnorm(scale, 4.5, 1.25))
data_d <- c(sample(scale, 250, probs_d$ungram, replace = TRUE),
            sample(scale, 250, probs_d$gram, replace = TRUE))

# Make four base R histograms
par(mfrow = c(1, 4))
hist(data_a, breaks = rep(1:6, each = 2) + c(-0.45, 0.45))
hist(data_b, breaks = rep(1:6, each = 2) + c(-0.45, 0.45))
hist(data_c, breaks = rep(1:6, each = 2) + c(-0.45, 0.45))
hist(data_d, breaks = rep(1:6, each = 2) + c(-0.45, 0.45))
```

Figure 3.6: Script written in base R that creates four sets of two probability distribution over 6 quantiles, simulates four experiments in which ratings are randomly drawn from distributions with the specified parameters, and creates histograms to visualize the samples of ratings.

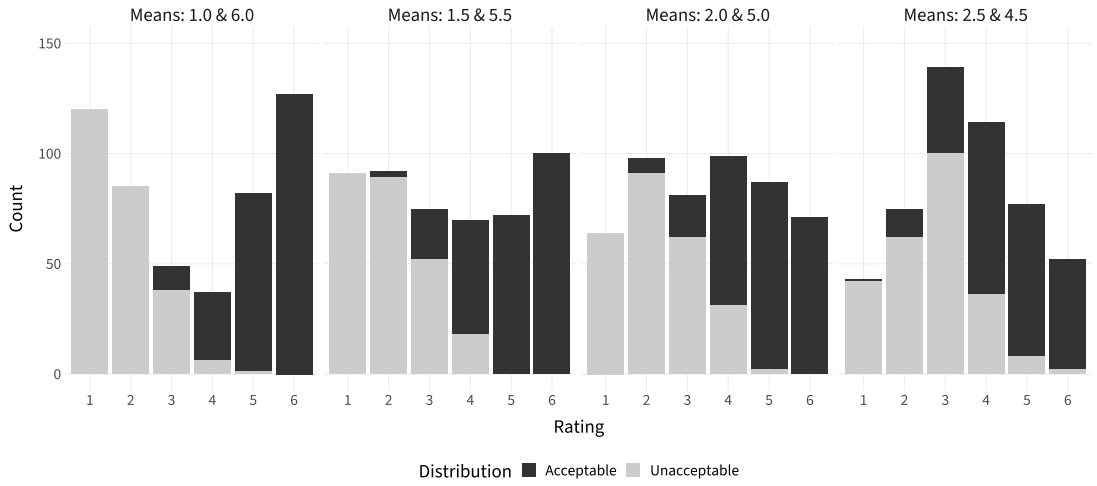


Figure 3.7: Four sets of artificially generated samples of 500 ratings, half in each set drawn from an unacceptable distribution and half drawn from an acceptable distribution, all with aggregated means of 3.5 and individual means from 1.0 and 6.0 (left) to 2.5 and 4.5 (right).

Chapter 4

Finite relative clauses are selective islands in English

4.1 Experiment 2: Relative clause environment (dependency by environment)

The main goal of Experiment 2 was to directly introduce a factor relating to both the presuppositionality of the DP containing the relative clause and whether that DP occupied a derived position or not. For the non-presupposed, non-derived-position level, the English existential construction (sentences with the expletive *there*) was used, in which the DP containing the relative clause is in the pivot of the existential. This was compared to both definite and indefinite DPs in the high subject position (Spec, TP), on the logic that the pivot of an existential is a non-presupposed subject in a non-derived (low) position, and high subjects occupy a derived position that may be presupposed.

The length by structure design was abandoned for this experiment. This choice was made because it was thought that comparing derived and non-derived positions for the DP containing the relative clause would result in an item having conditions with substantially different sentence structures. This was likely to introduce too many confounding factors that would

be difficult to control for, so a different factorial design was used that compared a movement dependency to a pronominal dependency, both of which were resolved in the relative clause island.

4.1.1 Participants

45 individuals participated in Experiment 2, all of which were UC Santa Cruz undergraduates who received course credit for their participation. Eight of these participants self-reported in debriefing that they were non-native speakers of English, and their data was excluded, for a total of 37 participants whose data is considered here.

A replicate dataset was collected online using Amazon Mechanical Turk. 37 individuals participated in this version, and they were paid six dollars for participating. The participants ranged from 23 to 66 years of age, with a mean age of 37.2 and a median age of 32. No participants' data was excluded.

4.1.2 Materials & methods

Experiment 2 employed a 3×2 factorial design that used a non-island-sensitive pronominal dependency for the baseline conditions, which allowed all conditions to contain an relative clause (there were no conditions with embedded *that*-clauses). No CP complements to N were used, in contrast to Experiment 1. As mentioned above, the environment of the DP out of which subextraction occurs was controlled for to investigate whether DP position and presuppositionality affected transparency to extraction. This was coded as a three-level factor called SUBJECT. The levels were coded as THERE (for conditions in which the expletive *there* occupied the subject position), INDEFINITE (for high indefinite subjects), and DEFINITE for (high definite subjects). In the DEFINITE and INDEFINITE conditions, the tail of the dependency was located in the high subject position (Spec, TP). What is relevant for this factor is the comparison between extraction from a high subject (Spec, TP) and extraction from what might be called a low subject (see e.g. Deal 2009, p. 313). The other factor, DEPENDENCY TYPE, manipulated the type of long-distance dependency, comparing one that is typically

considered to trigger island effects (MOVEMENT) to one that does not trigger island effects (PRONOMINAL).

All experimental sentences in Experiment 2 were declarative sentences. Across all conditions, the first subject was either a name or a title that was expected to be familiar to a college student (Lady Gaga, the Pope, etc.). This was done to avoid any potential additional processing costs of accommodating the existence of a referent that might be unfamiliar to the participant. In the MOVEMENT conditions, the matrix predicate was the present tense copula *is*, and its object was invariably the indefinite *someone*, within which a relative clause was embedded. Inside this relative clause was another relative clause into which the long-distance dependency was constructed. This structure was chosen to establish the kind of topic–comment relation between the highest subject and the relative clause discussed by Erteschik-Shir and Lappin (1979) and mentioned in §2.1.2.

In the PRONOMINAL conditions, matrix verbs were chosen that are compatible with CP complements. Care was taken not to choose matrix verbs that were too semantically complex. The verbs *know*, *believe*, *think*, *claim*, *say*, and *hope* were each used in four different items. Using CP-embedding matrix verbs eliminated the need for the long-distance movement dependency found in the MOVEMENT conditions, allowing the replacement of the MOVEMENT conditions' gap with a pronoun that is co-referent with the matrix subject. A sample item is presented in (60).

(60) EXPERIMENT 2 SAMPLE ITEM

a. The president is someone that there are many Americans who supported in the election living in rural areas. THERE | MOVEMENT

b. The president thinks that there are many Americans who supported him in the election living in rural areas. THERE | PRONOMINAL

c. The president is someone that many Americans who supported in the election are living in rural areas. INDEFINITE | MOVEMENT

d. The president thinks that many Americans who supported him in the election are living in rural areas. INDEFINITE | PRONOMINAL

e. The president is someone that the Americans who supported in the election are

living in rural areas. DEFINITE | MOVEMENT

f. The president thinks that the Americans who supported him in the election are living in rural areas. DEFINITE | PRONOMINAL

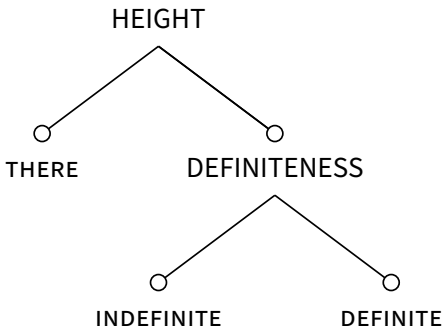
Twenty-four items were created, for a total of 144 experimental sentences. These were distributed among six lists using a Latin Square. This allowed for four observations per condition per participant (for a total of twenty-four experimental observations per participant). Sixty-four filler sentences were adapted from the same source as Experiment 1 (Sprouse et al. 2013a). Participants therefore judged a total of eighty-eight sentences. The filler sentences were modified from the source so that their average length (14 words, vs. 10.6 words unmodified) was closer to the average length of the experimental sentences (17 words). Although the average filler length was 14 words, they ranged from 9 words to 21 words. Filler sentences were selected so that, including the experimental sentences, participants saw an equal number of expected grammatical sentences and expected ungrammatical sentences (forty-four of each). Sixty-nine of the sentences were declarative, and nineteen were questions. For each list, the experimental sentences and filler sentences were randomized separately, shuffled together, and randomized again. The experiment was hosted and administered on IBEX Farm (Drummond n.d.).

4.1.3 Analysis

A mixed effects ordinal regression model was fit to the data using a cumulative link. Ratings were used as the dependent variable, and fixed effects were set as the SUBJECT factor, DEPENDENCY TYPE factor, and their interaction. A maximal random effects structure was used. Contrast coding for the three-level SUBJECT was modified to Helmert contrast coding since extraction from a low subject (in the THERE condition) was being compared to two different cases of extraction from a high subject (in the INDEFINITE and DEFINITE conditions). The INDEFINITE and DEFINITE conditions were compared directly to each other, which is referred to as the DEFINITENESS comparison here; and the THERE condition was compared to the combination of the other two, which is called the HEIGHT comparison here. This schema is illustrated

in (61).

(61)



4.1.4 Predictions

If only non-presuppositional DPs in non-derived positions are transparent to extraction, we expect to observe less of a penalty for extraction out of relative clauses in low subjects (in the THERE conditions) than for extraction out of relative clauses in high subjects (in the INDEFINITE and DEFINITE conditions), relative to the baseline (pronominal) conditions. In the statistical analysis, this would surface as an interaction between DEPENDENCY TYPE and the HEIGHT comparison (THERE vs. the two high subject conditions).

If high subjects don't tolerate subextraction no matter their definiteness, then we expect to see an equally-sized penalty for extracting out of high indefinite subject and extracting out of high definite subjects, relative to their baseline conditions. Statistically, this would result in a non-significant interaction between DEPENDENCY TYPE and the DEFINITENESS comparison (INDEFINITE VS. DEFINITE).

We expect to see main effects of DEPENDENCY TYPE, since the type of dependency involved in the formation of relative clauses is more complex than a long-distance pronominal dependency. We do not expect to see a main effect of SUBJECT, as there is no reason that comes to mind why these slightly different types of declarative sentences would consistently differ in their acceptability.

4.1.5 Results

Version 1 (Lab)

All MOVEMENT conditions were rated substantially lower than the baseline PRONOMINAL conditions, no matter which level of the SUBJECT factor is considered. This degradation is unsurprising, since all of the MOVEMENT conditions involved movement out of a relative clause. The INDEFINITE and DEFINITE conditions received nearly identical ratings to each other, regardless of dependency type. Perhaps the most notable result is that the baseline THERE | PRONOMINAL condition was rated over one point lower than both the INDEFINITE | PRONOMINAL and DEFINITE | PRONOMINAL conditions, which was unexpected.[1] However, the THERE | MOVEMENT condition is much closer to the baseline PRONOMINAL condition compared to the two high subject conditions. These results are visualized in Figure 4.1.

Although there was a significantly lower degradation of the THERE | MOVEMENT conditions relative to the baseline PRONOMINAL condition, there is a possibility that the low average rating of the THERE | MOVEMENT conditions is at floor—participants on average might not have been willing to give ratings lower than 2. The concern that we may be observing a floor effect is not diffused by looking at the average ratings of the filler sentences, either. See Figure 4.2, which is identical to Figure 4.1 except that the average rating for each filler is represented as a gray horizontal line in the background of the plot. The filler ratings span a range slightly larger than the average ratings for the experimental conditions, but there are only two filler sentences with an average rating lower than the THERE | MOVEMENT conditions. Information about these filler sentences is shown in Table 4.1.

1. One possibility that seems likely is that the THERE conditions required a costly reanalysis. In English, it is common for existential sentences to have only a DP with a relative clause following the verb (i.e. *there be* DP+relative clause), or only a DP with a VP following the verb (*there be* DP V-*ing* …). It may be that this post-DP material is usually interpreted as a predication on the DP, even when the post-DP material is a relative clause. Upon reading a sentence like one of the THERE | PRONOMINAL sentences in the present experiment, participants may have been garden-pathed, parsing the relative clause following the DP as a predicate, but having to reanalyze it as a restrictor within the DP when they identify a VP predicate following the material in the relative clause.

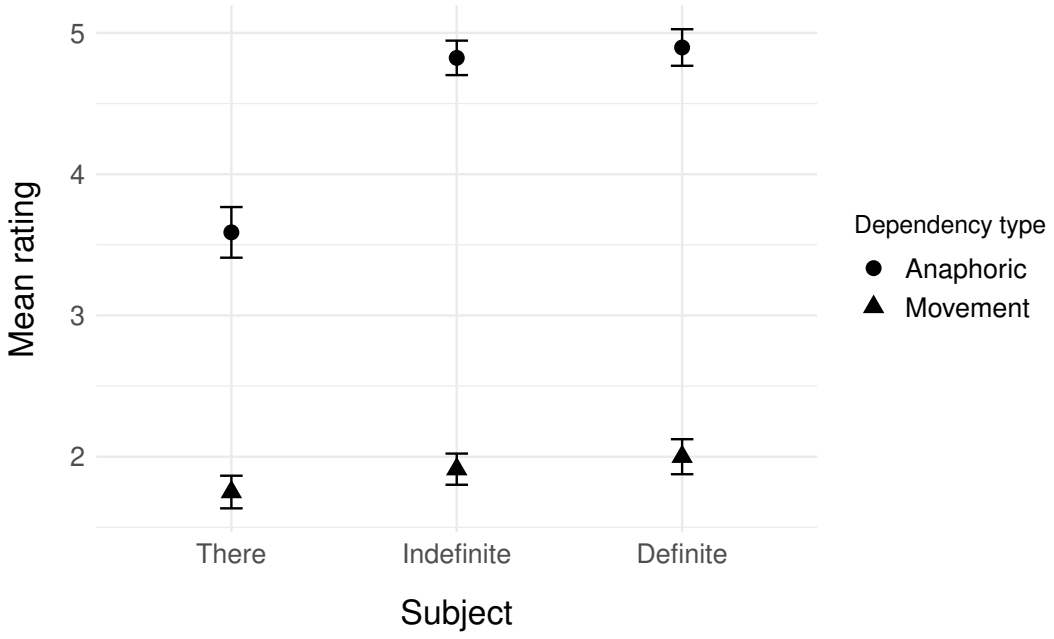


Figure 4.1: Experiment 2, Version 1 ratings by DEPENDENCY TYPE

Table 4.1: Fillers rated below THERE | MOVEMENT (Version 1)

Filler no.	Mean rating	SD	n	SE	Filler sentence
32	1.58	0.69	45	0.10	I expect that everyone will visit Mary that you do will.
53	1.71	0.76	45	0.11	At that battle were given the generals who lost hell.

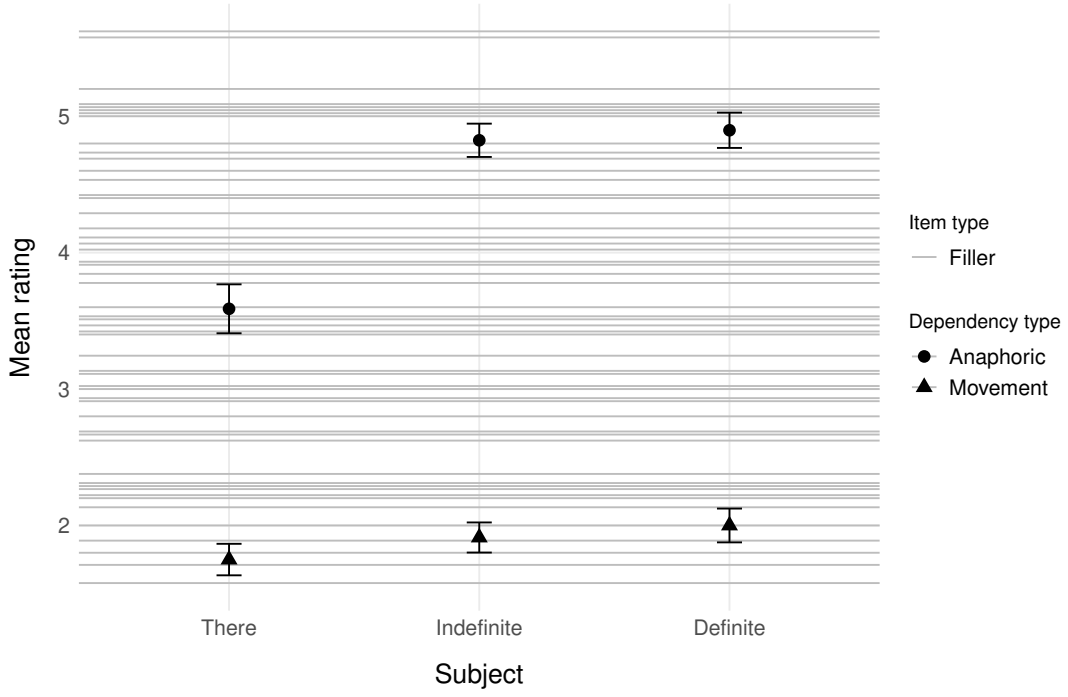


Figure 4.2: Ratings by dependency type with filler ratings (Experiment 2)

Version 2 (Mechanical Turk)

The results of a second version of this experiment run on Amazon Mechanical Turk are presented in Figure 4.3, as it is not entirely clear from the filler ratings whether the low ratings of the THERE | MOVEMENT conditions were artificially high due to a floor effect. The materials of Version 2 were identical to those of Version 1. A rather similar ratings pattern emerged, with the INDEFINITE and DEFINITE conditions not substantially differing from each other, and with the THERE | PRONOMINAL condition receiving a relatively low rating compared to the INDEFINITE | PRONOMINAL and DEFINITE | PRONOMINAL conditions. The average ratings for each filler sentence in Version 2 make it clear that the rating of the THERE | MOVEMENT condition is not at floor. The average rating of the lowest filler in Version 2 was 1.63, and the average rating of the THERE | MOVEMENT condition was 2.53.

A mixed effects analysis (see Appendix A.2.1 for model information) revealed a significant main effect of HEIGHT ($p < 0.001$), which is perhaps unsurprising given the low baseline rating received by the THERE | PRONOMINAL condition. There was also a significant main effect of DEPENDENCY TYPE ($p < 0.001$), indicating a general island effect. Lastly, there was a significant interaction ($p < 0.001$) between HEIGHT and DEPENDENCY TYPE, indicating that DEPENDENCY TYPE had an effect on ratings that was significantly modulated by the height of the DP into which the dependency was constructed.

Interestingly, it doesn't appear to be the case that the individuals who participated via Mechanical Turk used a wider range of the scale, as the two lowest filler sentences (which were the same sentences in both versions) were rated nearly the same across versions. Instead, it appears that most of the experimental conditions were rated slightly higher on average compared to Version 1. It is not clear why this difference would emerge, but I take the abundance of filler sentences rated below the THERE | MOVEMENT condition in Version 2 to indicate that there is no floor effect.

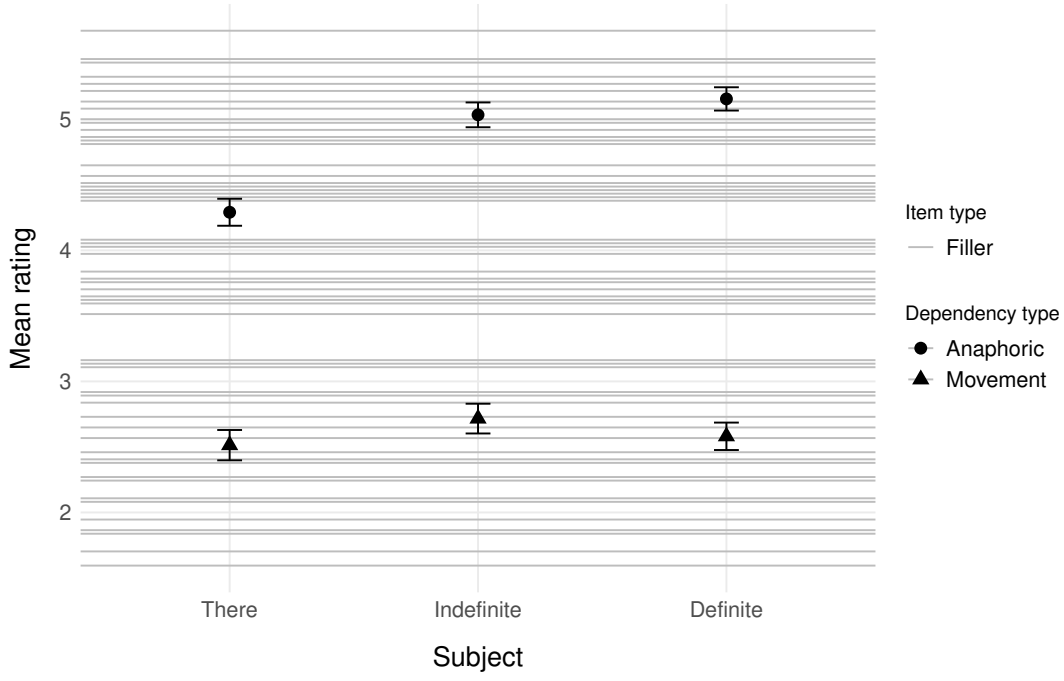


Figure 4.3: Experiment 2, Version 2 ratings by DEPENDENCY TYPE

4.1.6 Discussion

If there is no floor effect in either version of Experiment 2, the significant interaction between DEPENDENCY TYPE and HEIGHT supports rejecting the null hypothesis that the height of the subject (which I assume relates to the DP's presuppositionality and the derivedness of its position in this experiment) has no impact on the acceptability of forming a MOVEMENT dependency. The results are compatible with the hypothesis that relative clauses in existential environments are more transparent to extraction than relative clauses in non-existential environments. This result is surprising on the view that English bans extraction from relative clauses across the board. But on the view that English is like the languages discussed earlier in selectively allowing extraction from relative clauses, these results are not unexpected. The fact that it appears to tolerate relative clause subextraction in existential environments, much like the languages surveyed above, is another point in favor of a cross-linguistic explanation for this extraction pattern.

Although the results of Experiment 2 are compatible with the hypothesis that relative clauses in existential environments are more transparent to extraction, the design of this experiment prevents us from determining if the observed effects could be due to the presence and absence of freezing effects. It is well-known that DPs that have undergone movement become "frozen"—subextraction is no longer possible from moved DPs (see Jurka 2009, and citations therein). Since the HEIGHT comparison in this Experiment also corresponds to whether the DP in question has moved (subjects in non-existential environments raise to Spec, TP in English), it is possible that there is less of a penalty for extracting out of a relative clause in existential environments simply because the DP containing that relative clause is not frozen. Therefore, it is important to compare extraction from relative clauses in existential environments to extraction from relative clauses in other in-situ environments, such as the objects of transitive verbs. Experiment 3 attempts to fill that gap.

4.2 Experiment 3: Relative clause environment (length by structure)

Experiment 3 was designed to eliminate the potential confounds of the previous design by comparing extraction from relative clauses in three different types of in-situ DPs: DPs in existential environments, DP predicates (complement of the copula), and DP objects of transitive verbs (transitive objects). This experiment returned to the length by structure design, which allows us to calculate island effects by factoring out independent degradation caused by extraction length and the structure of the embedded clause (island vs. non-island).

4.2.1 Participants

48 individuals participated in Experiment 3 via Mechanical Turk. Each participant was paid $5.00 for their participation. Two participants' data was excluded because their average rating for ungrammatical fillers was greater than or equal to their average rating for grammatical fillers. This resulted in a total of 46 participants' data being considered.

4.2.2 Materials & methods

Experiment 3 used a 2×2×3 factorial design similar to the design used in Experiment 1. As in Experiment 1, the first two factors used in Experiment 3 are STRUCTURE (NON-ISLAND, ISLAND) and LENGTH (SHORT, LONG). The third factor introduced a comparison between three different syntactic-semantic environments for the DP out of which relative clause subextraction occurs: a transitive object environment (OBJECT), a non-verbal predicate environment (PREDICATE), and an existential environment (EXISTENTIAL). Using the NON-ISLAND | SHORT conditions as baselines, we can calculate island violation penalties independently from penalties for extraction length and structure, as discussed in Chapter 3 §3.1.

The combination of these factors results in a total of 12 conditions per item. 36 items were created, one of which is given in (62). All item conditions were *wh*-questions. Across all conditions, one of six CP-embedding matrix verbs was used (*think*, *say*, *hope*, *believe*, *claim*,

or *know*). The CP complement of the matrix verb contained one of the three different environments tested. It was necessary to embed these environments in a CP for maximum comparability across environments; were this not done, there would be no SHORT conditions for the EXISTENTIAL environment, since the expletive DP *there* would occupy the matrix subject position and could not undergo *wh*-movement for question formation.

(62) EXPERIMENT 3 SAMPLE ITEM

a. Who thinks that Courtney saw that only one art collector bid on this painting?
OBJECT | NON-ISLAND | SHORT

b. Which painting do you think that Courtney saw that only one art collector bid on?
OBJECT | NON-ISLAND | LONG

c. Who thinks that Courtney saw the only art collector who bid on this painting?
OBJECT | ISLAND | SHORT

d. Which painting do you think that Courtney saw the only art collector who bid on?
OBJECT | ISLAND | LONG

e. Who thinks that Courtney believes that only one art collector bid on this painting?
PREDICATE | NON-ISLAND | SHORT

f. Which painting do you think that Courtney believes that only one art collector bid on?
PREDICATE | NON-ISLAND | LONG

g. Who thinks that Courtney believes that she is the only art collector who bid on this painting?
PREDICATE | ISLAND | SHORT

h. Which painting do you think that Courtney believes that she is the only art collector who bid on?
PREDICATE | ISLAND | LONG

i. Who thinks that there is only one art collector bidding on this painting?
EXISTENTIAL | NON-ISLAND | SHORT

j. Which painting do you think that there is only one art collector bidding on?
EXISTENTIAL | NON-ISLAND | LONG

k. Who thinks that there is only one art collector who bid on this painting?
EXISTENTIAL | ISLAND | SHORT

l. Which painting do you think that there is only one art collector who bid on?
EXISTENTIAL | ISLAND | LONG

In all PREDICATE conditions (62e-62h), the main verb of the first embedded clause had an-

other CP complement. In the PREDICATE | NON-ISLAND conditions, this was the final embedded clause, but in the PREDICATE | ISLAND conditions, this second embedded clause contained a non-verbal (DP) predicate that contained a relative clause. Although this resulted in the PREDICATE | ISLAND conditions containing three embedded clauses (two CP complements to V, and one relative clause) and the PREDICATE | NON-ISLAND conditions containing only two embedded clauses (two CP complements to V), it allowed the predication in the embedded clause to remain relatively similar across the ISLAND and NON-ISLAND PREDICATE conditions. This was based on the assumption that the copula *be* is trivial to compute as a predicate compared to a CP-embedding verb like *believe*. Without balancing the predication relations in this way, the PREDICATE | ISLAND conditions would be less comparable to the PREDICATE | NON-ISLAND conditions due to the more trivial computation required for the embedded verb. The predication relations for these conditions are illustrated schematically in (63); compare to (64), which shows the predication relations that would be involved if a second embedded clause were not used in the PREDICATE | ISLAND conditions.

(63) Balanced predication (PREDICATE condition)

a. ISLAND [WH … *think* [$_{CP}$ … *believe* [$_{CP}$ [$_{DP}$] *be* [$_{DP}$ [$_{relative\ clause}$]]]]]

b. NON-ISLAND [WH … *think* [$_{CP}$ … *believe* [$_{CP}$ [$_{DP}$] V [$_{DP}$]]]]

(64) Unbalanced predication (PREDICATE condition)

a. ISLAND [WH … *think* [$_{CP}$ … *be* [$_{DP}$ [$_{relative\ clause}$]]]]

b. NON-ISLAND [WH … *think* [$_{CP}$ … *believe* [$_{CP}$ [$_{DP}$] V [$_{DP}$]]]]

In the EXISTENTIAL conditions (62l-62i), the same CP-embedding matrix predicate was used, and this embedded clause contained the existential *there* construction. In the EXISTENTIAL | NON-ISLAND conditions, the pivot of the existential is the external argument of a (present participial) verb. In the EXISTENTIAL | ISLAND conditions, the pivot of the existential is a DP followed by a relative clause which hosts the same verb as the NON-ISLAND version. These conditions are presented schematically in (65), abstracting away from the extraction length factor.

(65) EXISTENTIAL conditions

a. ISLAND [WH …*think* [$_{CP}$ *there be* [$_{DP}$ [$_{relative\ clause}$ *who* V [$_{DP}$]]]]]

b. NON-ISLAND [WH …*think* [$_{CP}$ *there be* [$_{DP}$] V-*ing* [$_{DP}$]]]

For the OBJECT conditions (62a-62d), main verbs were chosen for the first embedded clause that are compatible with either CP or DP complements and don't seem to be too biased towards one complement type. In the OBJECT | ISLAND conditions, this verb had a DP complement that contained a relative clause, and in the OBJECT | NON-ISLAND conditions, the verb had a CP complement.

Every experimental condition contained the word *only* as part of the DP used as the head of the relative clause in the ISLAND conditions. This was done because the presence of *only* seems to improve extraction from relative clauses and may ensure a non-presuppositional reading (Ivy Sichel, p.c.). The use of the definite article alone is typically taken to presuppose that there is a unique, contextually salient individual that satisfies the NP restrictor. Adding *only* to a *the*-DP raises the presupposition that there exists a unique individual that satisfies the NP restrictor to an assertion (at-issue entailment), making the DP non-presupposed. In the ISLAND conditions except for those in the EXISTENTIAL environment, the DP contained the definite article followed by *only* (*the only*+NP). In all other conditions, the DP consisted of *only one*+NP.

The use of *only one*+NP in certain conditions was necessary to ensure grammaticality in the EXISTENTIAL conditions (due to the definiteness restriction: Milsark 1974) and to ensure naturalness in the NON-ISLAND conditions. When *the only*+NP is not followed by a relative clause, it seems to lose its non-presuppositional status and becomes somewhat infelicitous. Furthermore, maintaining *the only*+NP across both ISLAND and NON-ISLAND conditions results in the NON-ISLAND conditions having different entailments (66), but switching to *only one*+NP in the NON-ISLAND conditions allows the entailments to remain constant (67).

(66) Unbalanced entailments ($a \neq b$)

a. …she is the only art collector who bid on this painting. $\rightarrow$ out of potentially many art collectors, there is one who bid on the painting

b. …the only art collector bid on this painting. → there is only one art collector, and that art collector bid on the painting

(67) Balanced entailments ($a = b$)

a. …she is the only art collector who bid on this painting. → out of potentially many art collectors, there is one who bid on the painting

b. …only one art collector bid on this painting. → out of potentially many art collectors, there is one who bid on the painting

The decision to include *only* in every condition is not necessarily a decision without consequences, especially because two distinct types of *only* are used: DP-internal *only*, which seems to function as an adjective, and associating *only*, which occurs outside the immediate domain of N and has an associate (Rooth 1985). The impact of these different versions of *only* is unknown and will have to be left to future inquiry.

Filler sentences

Filler sentences for Experiment 3 were again taken from the same source as Experiments 1 and 2 (Sprouse et al. 2013a). A total of 72 filler sentences were used. Sentences were adjusted for length as before, and some new sentences were created for an appropriate balance of ungrammatical and grammatical sentences, and questions and declaratives. Considering both experimental and filler sentences, each participant rated 108 sentences, half of which were questions, half of which were declaratives. Half of the total number of sentences were expected to be grammatical, and half were expected to be grammatical. Since all of the experimental sentences contained the word *only*, half of the fillers were modified to contain *only*, so that out of the 108 sentences each participant rated, 72 sentences contained *only* and 36 did not.

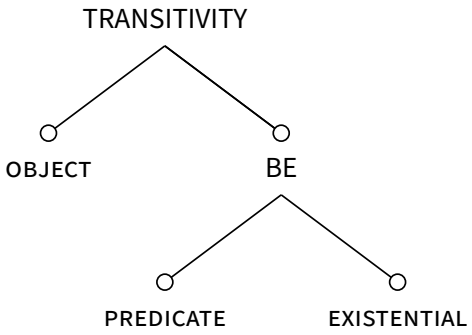
4.2.3 Analysis

A mixed effects ordinal regression model with a cumulative link was fit to the data. The dependent variable was set to rating, and the ENVIRONMENT, STRUCTURE, and LENGTH factors,

as well as their interactions, were set as fixed effects. A maximal random effects structure was used.

For the three-level ENVIRONMENT factor, contrast coding was modified to Helmert contrast coding. This was done because of the expectation that the EXISTENTIAL and PREDICATE conditions would display similar patterns, since previous work identified these two environments as being compatible with non-presuppositional DPs. Thus, the EXISTENTIAL and PREDICATE conditions were compared directly to each other. This comparison is referred to as the BE comparison, since both of these conditions have the copula *be* immediately before the DP containing the relative clause. The mean of these conditions was compared to the OBJECT condition, which is referred to as the TRANSITIVITY comparison. These comparisons are illustrated with the graphic in (68).

(68)



Three separate mixed effects ordinal regression cumulative link models were fit using data from each environment (OBJECT, PREDICATE, and EXISTENTIAL). The rating was set as the dependent variable, and STRUCTURE and LENGTH, as well as their interactions, were set as fixed effects. A maximal random effects structure was used for each separate model.

4.2.4 Predictions

Since the ISLAND | LONG conditions involve extraction out of a relative clause and this is generally known to result in degradation, these conditions are expected to be rated significantly lower than the other conditions. In the statistical analysis, this would show up as an interaction between LENGTH and STRUCTURE.

On the hypothesis that both the EXISTENTIAL and PREDICATE conditions are more tolerant of relative clause subextraction than the OBJECT condition, we expect to see a significant three-way interaction between STRUCTURE, LENGTH, and the TRANSITIVITY comparison (refer to (68)). If the EXISTENTIAL and PREDICATE environments tolerate relative clause subextraction completely, we expect not to find a significant interaction between LENGTH and STRUCTURE for those environments individually. We expect the OBJECT environment not to tolerate relative clause subextraction, so for that environment, we predict a significant interaction between LENGTH and STRUCTURE.

If either the EXISTENTIAL or PREDICATE conditions is more tolerant of relative clause subextraction than the other, we expect to see a significant three-way interaction between LENGTH, STRUCTURE, and the BE comparison. We have no reason to find one of these environments more transparent than the other.

Finally, if relative clauses are completely tolerant of subextraction in existential and predicate nominal environments, we expect not to find a statistically significant interaction between length and structure in separate analyses run on data from each individual environment.

4.2.5 Results

Overall, the collection of OBJECT conditions received the lowest ratings, followed by the PREDICATE conditions, followed by the EXISTENTIAL conditions. Each environment had a significant effect on ratings, as the analysis revealed significant main effects of both the BE comparison and the TRANSITIVITY comparison ($ps < 0.001$). Aside from this, each environment has a roughly similar ratings pattern that is more or less familiar from Experiment 1: the ISLAND | LONG conditions are rated the lowest for each environment, followed by the NON-ISLAND | LONG conditions. Both length and structure had significant main effects ($ps < 0.001$).

In both OBJECT | SHORT conditions, STRUCTURE appears to have had no impact on ratings, as is also the case in the PREDICATE | SHORT conditions. In the EXISTENTIAL | SHORT conditions, however, the NON-ISLAND and ISLAND levels pull apart in the expected way, with the NON-

ISLAND | SHORT condition being rated slightly higher than the ISLAND | SHORT condition. The means for each condition are presented in Figure 4.4. The error bars in the plot represent standard error.

The ISLAND | LONG conditions are rated lowest for each environment, and they are rated much lower than the NON-ISLAND | LONG conditions relative to the SHORT conditions. This is the expected island effect, and in the mixed effects analysis, it showed up as a significant interaction between STRUCTURE and LENGTH ($p < 0.001$).

Considering the noticeable island effect for each ENVIRONMENT, one will also notice that the island effect appears to be more pronounced in the OBJECT environment relative to the other two environments. Compared to the other environments, the ISLAND | LONG condition is rated much lower. To more easily observe the island effect observed for each environment, a difference-in-differences (DD) score is calculated for each environment and presented in Table 4.2. The DD scores are calculated based on *z*-scores for maximum comparability across participants.[2] The DD score is calculated as laid out in Chapter 3, §3.1.

As can be seen in Table 4.2, the DD score for the OBJECT environment is substantially higher than those for the PREDICATE and EXISTENTIAL environments. This difference between environments was statistically significant in the mixed effects analysis, showing up as an interaction between the TRANSITIVITY comparison, STRUCTURE, and LENGTH ($p = 0.0104$).

In the mixed effects analysis run on separated data from each environment, the interaction between LENGTH and STRUCTURE was significant for the OBJECT environment ($p < 0.001$) and EXISTENTIAL environment ($p = 0.0375$), but not significant for the PREDICATE environment ($p = 0.1241$).

2. Z-scores were calculated using the following procedure. All ratings data (including experimental sentences and fillers) was separated by participant, and z-scores were calculated for each rating. The data was recombined and then grouped by item and condition, and a mean z-score was calculated for each item and condition. Based on this mean, another mean z-score was calculated for each condition, averaging across items.

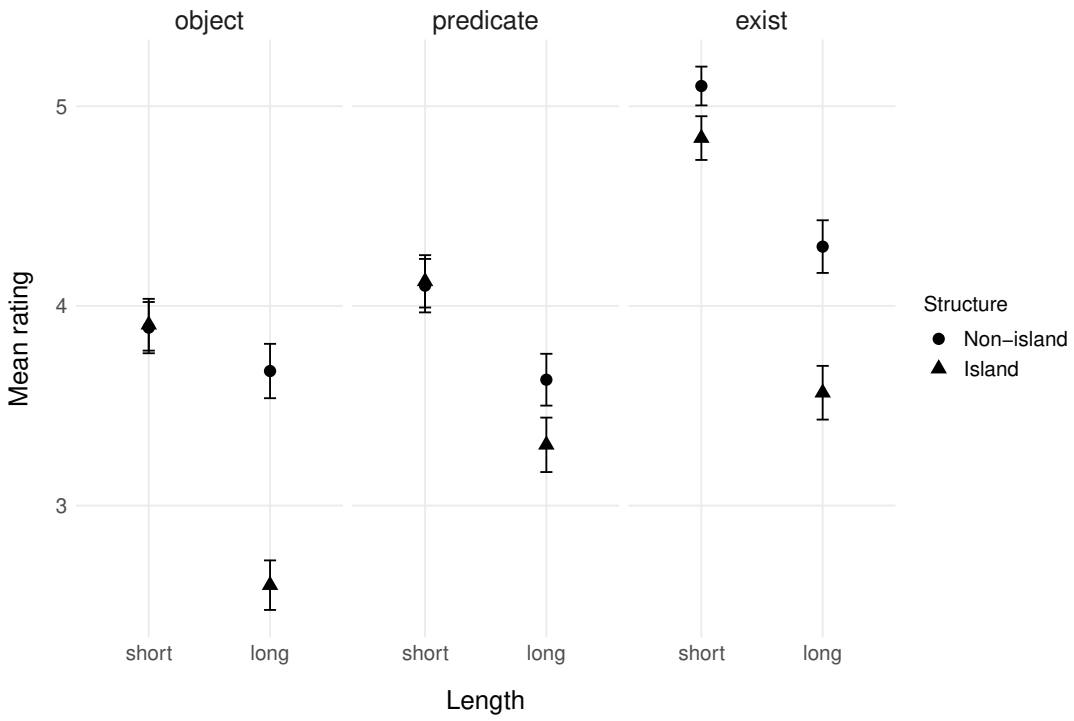


Figure 4.4: Mean ratings faceted by ENVIRONMENT, arranged in columns by LENGTH

Table 4.2: Calculating DD scores (Island scores) for each environment

ENVIRONMENT	NON-ISLAND | SHORT	NON-ISLAND | LONG	ISLAND | SHORT	ISLAND | LONG	D1 (STRUCTURE + ISL. VIOL.)	D2 (STRUCTURE)	DD (ISL. VIOL.)
OBJECT	0.17	0.09	0.17	−0.53	0.62	0.00	**0.62**
PREDICATE	0.30	0.04	0.29	−0.13	0.18	0.02	**0.16**
EXISTENTIAL	0.85	0.42	0.71	0.02	0.40	0.14	**0.26**

4.2.6 Mixture modeling

Two separate simulation sets were performed, one set each for the LONG × ISLAND × EXISTENTIAL and LONG × ISLAND × PREDICATE conditions, using the methods described in §3.4. For comparison, one set of simulations was run for all other experiment conditions, including those used as reference distributions. The ungrammatical reference distribution was the ratings for the LONG × ISLAND × OBJECT conditions, which should be uncontroversially unacceptable. The grammatical reference distribution was the ratings for the SHORT × NON-ISLAND × EXISTENTIAL conditions since the existential conditions were rated highest overall and the SHORT × NON-ISLAND conditions were the highest-rated of each environment. Summaries of the simulations are provided in Table 4.3.

The first set of simulations aimed to model the judgment data for the LONG × ISLAND × EXISTENTIAL conditions. In a series of 10,000 simulations for each model (GRADIENT and DISCRETE), the discrete model was decisively favored 9,982 times (99.8% of the time). The mean optimal value for π in the discrete model was 0.62, which means that on average, the best-fitting model drew 62% of ratings in a given run from the ungrammatical reference distribution and 38% of the ratings from the grammatical reference distribution.

The second set of simulations modeled the judgment data for the LONG × ISLAND × PREDICATE conditions. The discrete model was favored again, this time over 9,967 times (99.7% of the time). The mean optimal value for π in the discrete model was 0.73, which indicates that the best-fitting model drew from the ungrammatical reference distribution 73% of the time, with 27% of the ratings being drawn from the grammatical reference distribution.

The results indicate that these two critical conditions were rated categorically, with a significant number of participants rating them as basically grammatical and a significant number rating them as basically ungrammatical.

When the reference distributions were used as the test distribution, the gradient model appears to be favored. Unsurprisingly, the gradient model that best describes the grammatical reference distribution mixes 93% of each grammatical rating drawn with 7% of each ungrammatical rating drawn. The ungrammatical reference distribution was best described by

Table 4.3: Results of 10000 simulations per model. Run with the LONG × ISLAND × EXISTENTIAL condition's ratings (row 1) and the LONG × ISLAND × PREDICATE condition's ratings (row 2) set as the test distribution. For comparison, the remaining conditions not used as reference distributions were also used as test distributions. ΔBIC = BIC difference score. Values in parentheses indicate decisive wins. Abbreviations: SH = SHORT; LO = LONG; NI = NON-ISLAND; IS = ISLAND; EX = EXISTENTIAL; PR = PREDICATE; OB = OBJECT.

Test source	Test mean	Average discrete mean, π	Average gradient mean, π	Mean ΔBIC	Mean BF	Discrete wins	Discrete losses
			TEST DISTRIBUTIONS				
LO × IS × EX	3.57	3.56, *0.62*	3.61, *0.59*	−67.59	5.15×10^{34}	9995 (9982)	5
LO × IS × PR	3.30	3.28, *0.73*	3.29, *0.73*	−61.22	2.29×10^{32}	9997 (9967)	3
			REFERENCE DISTRIBUTIONS AS TEST DISTRIBUTIONS				
SH × NI × EX	5.10	4.91, *0.05*	5.03, *0.07*	4.23	2.23×10^{10}	2074 (275)	7926
LO × IS × OB	2.60	2.79, *0.94*	2.65, *0.92*	0.38	2.30×10^{21}	3801 (932)	6199
			REMAINING CONDITIONS AS TEST DISTRIBUTIONS				
LO × NI × EX	4.30	4.30, *0.31*	4.25, *0.32*	−94.39	5.79×10^{53}	10000 (10000)	0
SH × IS × EX	4.82	4.81, *0.10*	4.73, *0.14*	−31.38	4.73×10^{25}	9812 (9256)	188
SH × NI × PR	4.10	4.11, *0.39*	4.04, *0.41*	−90.22	1.43×10^{44}	10000 (10000)	0
LO × NI × PR	3.63	3.61, *0.60*	3.63, *0.58*	−60.49	7.99×10^{29}	9980 (9920)	20
SH × IS × PR	4.12	4.12, *0.38*	4.05, *0.41*	−78.24	1.59×10^{39}	10000 (10000)	0
SH × NI × OB	3.89	3.89, *0.48*	4.00, *0.45*	−58.12	1.70×10^{34}	9985 (9958)	15
LO × NI × OB	3.67	3.65, *0.58*	3.63, *0.58*	−80.33	2.04×10^{41}	10000 (9997)	0
SH × IS × OB	3.91	3.91, *0.47*	4.02, *0.44*	−61.00	3.16×10^{43}	9975 (9890)	25

a gradient model in which the ratings are 92% ungrammatical and 8% grammatical. Because these conditions were best described by a gradient model, their acceptability ratings were relatively uniform across participants.

When the remaining distributions were used as test distributions, the discrete model was always favored, which indicates that participants' ratings for these conditions were largely categorical. None of these conditions were predicted to be ungrammatical, and their relative acceptability is reflected by the values for π being on the lower end (with a mean of 0.41). Although this value is lower than the π values for the critical conditions, it is still much higher than for the uncontroversially acceptable condition used for the grammatical reference distribution.

4.2.7 Discussion

The results of Experiment 3 suggest that relative clauses are significantly more transparent to extraction in both existential and predicate nominal environments as compared to transitive object environments. As seen in the DD table, the island score for the OBJECT environment is markedly higher than the other two environments, which is expected under the hypothesis that relative clauses in existential and predicate nominal environments are more transparent to extraction than those in transitive object environments.

The DD scores from Experiments 1 and Experiments 3 are combined in Table 4.4 for comparison with DD scores for a number of other length by structure studies on *wh*-islands (visualized in Figure 4.5) Note that the predicate nominal DD score from Experiment 3 is one of the lowest DD scores in the table, even among DD scores from languages whose *wh*-constructions are claimed not to be islands.

Although the DD scores of the predicate nominal and existential environments are among the lowest of the DD scores in Table 4.4, the DD scores are not zero, which indicates that there is still an interaction between length and structure—an island effect, even if it is small. Although the interaction between LENGTH and STRUCTURE was not significant for the PREDICATE environments ($p = 0.1241$), indicating no significant island effect, the interaction was significant for the EXISTENTIAL environments ($p = 0.0375$). This suggests that an island effect may remain, but it is possible that the interaction is due to another factor.

The possibility I would like to consider here follows certain assumptions made in Dependency Locality Theory (Gibson 2000). Processing new discourse referents is costly, since a new representation needs to be formed for the discourse referent, and this discourse referent needs to be integrated into the partially completed parse of the sentence. Events denoted by verbs are assumed to be new discourse referents, and the tense of the verb may also be an independent discourse referent (e.g. under views in which tense is an anaphor). Unresolved dependencies (such as the dependency of a filler phrase and its gap) must be kept active in memory, and integrating new discourse referents while maintaining an active dependency can strain the available resources, resulting in processing difficulty and possibly degradation

Table 4.4: Combined DD scores for Experiments 1 and 3, and other length × structure work on *wh*-islands as cited in Keshev and Meltzer-Asscher (2018)

Language	Source	ISLAND | LONG rating	DD	*p*
English	Exp. 1: Def. trans. object	−0.96	0.83	
	Exp. 1: Indef. trans. object	−1.14	0.70	
	Exp. 3: Transitive obj.	−0.53	0.62	
	Exp. 3: Predicate nominal	−0.13	0.16	
	Exp. 3: Existential	0.02	0.26	
English	Sprouse (2015)	−0.79	0.40	0.022
Italian	Sprouse (2015)	−0.53	0.67	0.023
Swedish	Kush et al. (2015)	∼0.25	n.a.	<0.001
Norwegian	Kush et al. (2018)			
	Exp. 1: Bare *wh*	0.25	0.69	<0.001
	Exp. 2: Bare *wh*	0.40	0.44	<0.01
	Exp. 3: Complex *wh*	0.60	0.27	<0.01
Br. Portuguese	Almeida (2014) (Exp. 1)	∼−0.1	n.a.	0.0012
Slovenian (object extraction)	Stepanov et al. (2018)	−0.33	−0.02	0.84
Slovenian (subject extraction)	Stepanov et al. (2018)	−0.94	−0.42	0.009
Hebrew (object extraction)	Keshev et al. (2018) (Exp. 1)	−0.29	0.47	<0.001
Hebrew (subject extraction)	Keshev et al. (2018) (Exp. 5)	−0.27	0.05	0.7

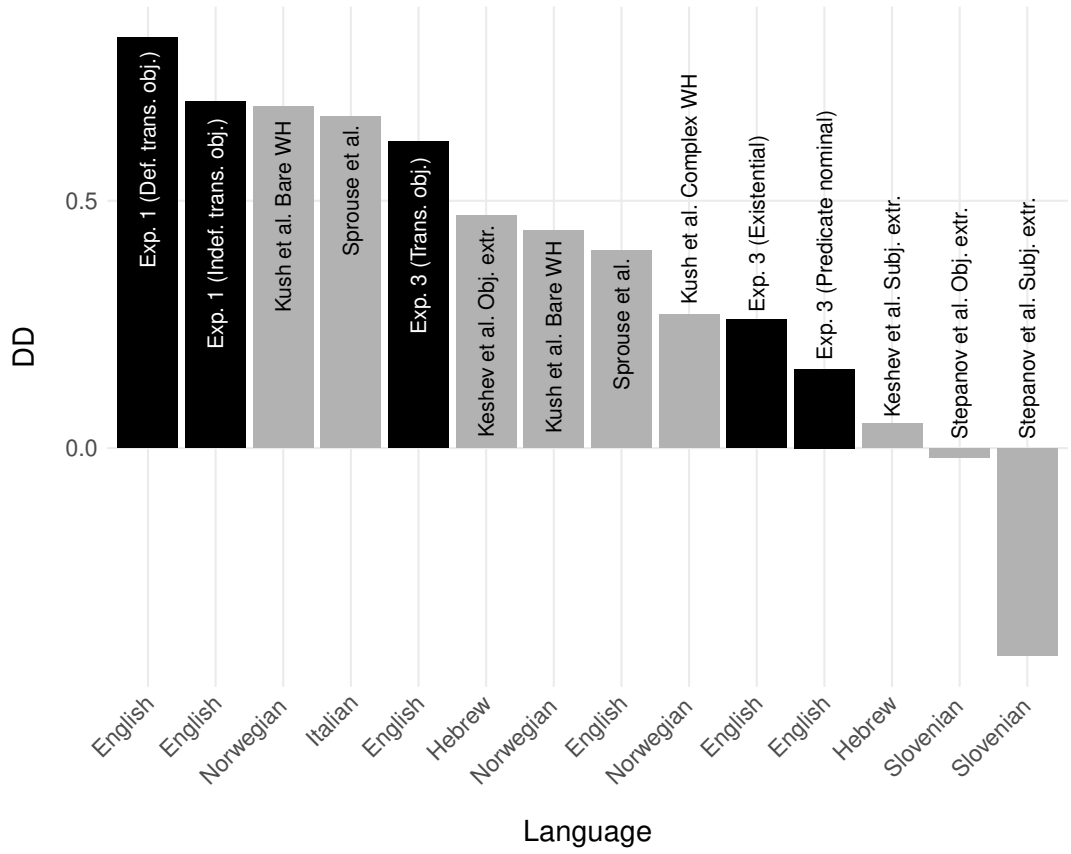


Figure 4.5: Graphical representation of DD scores shown in Table 4.4 (black bars represent present experiments)

that could be detected in an acceptability judgment task like the one used here.

The following experiment replaces finite relative clauses with infinitival relative clauses in an effort to reduce potential processing difficulty arising from maintaining a dependency while processing the tense of a finite relative clause. If the interaction between LENGTH and STRUCTURE in the EXISTENTIAL conditions is due to grammatical island constraints and not to the sort of processing challenges just hypothesized, the same kind of interaction between LENGTH and STRUCTURE is predicted.

Chapter 5

Asymmetries between and within finite relatives and infinitival relatives

It may be useful to contrast finite relative clauses (as discussed above) with infinitival relative clauses (69), which Chomsky and Lasnik (1977, p. 470) write "are rarely found in anything like the variety exhibited in English […]." A few naturally occurring examples of infinitival relatives found in the Corpus of Contemporary American English (COCA; Davies 2008) are provided in (69).

(69) a. What was wanted was some strong authoritarian medicine to purge the country of its moral relativism, and Perot was the man [___ to write the prescription].
(*Harpers Magazine*, 1993, via COCA)

b. The main thing [for you to remember ___ in a storm event] is to get out of the way.
(modified from *Denver Post*, 2013, via COCA)

c. Trump has to get lucky to have the money [with which to pay his banks ___].
(ABC's *Nightline*, 1990, via COCA)

First of all, under certain frameworks such as Dependency Locality Theory (DLT; Gibson 2000), even elements such as tense introduce a new discourse referent, which may affect the re-

sources available to the parser when it is actively integrating a dependency that crosses over the new discourse referent. Following this idea, it may be the case that the relatively small DD score that remains for the EXISTENTIAL and PREDICATE conditions in Experiment 3 could be due to processing challenges that were not controlled for, such as the load caused by integrating a tense discourse referent while a long-distance dependency is under active formation.

Infinitival relative clauses lack a tense discourse referent, so if part of the remaining super-additivity observed in Experiment 3 is due to processing penalties that were not controlled for, we expect to see the remaining super-additivity evaporate when the source of these additional processing penalties is removed.

It turns out that not only may there be an asymmetry between finite and infinitival relative clauses, but there is also an asymmetry within infinitival relatives: infinitival relatives with a subject gap are not islands, but those with non-subject gaps are. Both of these asymmetries are worth investigation. However, the current chapter is devoted mainly to investigating whether island effects arise from extracting from subject infinitival relatives. Although such an investigation does not directly help to address the question about whether tense discourse referents could be part of the remaining super-additivity observed in Experiment 3, the findings of the experiments presented in this chapter are a useful point of comparison to the findings about extraction from finite relatives.

This chapter begins with an overview of infinitival relatives (§5.1). The section summarizes previous work (primarily that of Bhatt 1999) and proposes that the empirical predictions regarding the islandhood of subject infinitival relatives are borne out. The remaining sections present Experiments 4 and 5, the results of which support the proposal that subject infinitival relatives are not islands in any environment.

5.1 Background: Infinitival relative clauses

5.1.1 What are they?

Infinitival relative clauses are the lesser-used relative of finite relative clauses. Much like clausal complements can be finite or non-finite (70), relative clauses can also vary in finiteness (71).

(70) a. Garrett knew [$_{+\text{FIN}}$ that the pallid child would frighten Glenn].

b. Garrett arranged [$_{-\text{FIN}}$ for the pallid child to frighten Glenn].

(71) a. As far as I know, this is [$_{\text{DP}}$ the only child [$_{+\text{FIN}}$ that ___ has ever frightened Glenn]].

b. As far as I know, this is [$_{\text{DP}}$ the only child [$_{-\text{FIN}}$ ___ to have ever frightened Glenn]].

Gaps

Infinitival relative clauses come in the varieties expected of relative clauses: the head NP may be associated with a subject gap (72), a direct object gap (73), a prepositional complement gap with or without pied-piping (74), etc.

(72) SUBJECT GAP INFINITIVAL RELATIVES

a. He is not a man$_i$ [___ $_i$ to let his friends down]. (Kjellmer 1975, p. 325)

b. The one person$_i$ [___ $_i$ to voice any misgivings] is his own brother. (Kjellmer 1975, p. 325).

c. He is the fourth Democrat$_i$ [___ $_i$ to turn down Senator McGovern's offer]. (Kjellmer 1975, p. 325)

d. The individual provided no evidence$_i$ [___ $_i$ to support the claim]. (*Ars Technica*, 2012, via COCA)

e. We wandered through Ingram Park, named after the first human$_i$ [___ $_i$ to set foot on Mars], Dorothy Ingram. (*Moving Mars*, 1993, via COCA)

(73) OBJECT GAP INFINITIVAL RELATIVES

a. Now, he is the man$_i$ [for you to see ___ $_i$] if you want to know about pencils. (modified from *Smithsonian Mag*, 1991, via COCA)

b. This is the best book$_i$ [for you to read ___ $_i$]. (modified from Bhatt 1999, p. 43)

c. Gary's got the papers$_i$ [for you to sign ___$_i$]. (*Dinner Rush*, 2000, via COCA)

d. As a staunch rail advocate this is a difficult thing$_i$ [for me to say ___$_i$], but… (*Seattle Transit Blog*, 2011, via COCA)

(74) PP (OR COMPLEMENT OF P) GAP INFINITIVAL RELATIVES

a. Here's a knife$_i$ [for you to cut up the onions with ___$_i$]. (Ross 1967, p. 388)

b. Here's a knife [with which$_i$ to cut up the onions ___$_i$].

c. …if the Florida law says that intent is the thing$_i$ [for us to judge by ___$_i$], then I have a question… (modified from CNN's *Talkback*, 2000, via COCA)

d. …they have no money [with which$_i$ to pay a jury award ___$_i$]. (*Houston Chronicle*, 1992, via COCA)

Another empty category

As perhaps might be expected of infinitival clauses in English, the subject of an infinitival relative clause can be realized as the empty category PRO. PRO can be arbitrary (see the unmodified versions of (73a), (73b), and (74c) in (75)), or it can be controlled by a possessor (Douglas 2017), as in (76). Since PRO is of course distinct from a relative clause gap, infinitival relatives with a PRO subject will additionally have a non-subject gap corresponding to the head NP.

(75) ARBITRARY PRO

a. Now, he is the man$_i$ [PRO$_{arb}$ to see ___$_i$] if you want to know about pencils. (*Smithsonian Magazine*, 1991, via COCA)

b. This is the best book$_i$ [PRO$_{arb}$ to read ___$_i$]. (Bhatt 1999, p. 43)

c. …if the Florida law says that intent is the thing$_i$ [PRO$_{arb}$ to judge by ___$_i$], then I have a question… (CNN's *Talkback*, 2000, via COCA)

(76) CONTROLLED PRO

a. This is John$_i$'s book$_j$ [PRO$_i$ to read ___$_j$]. (Douglas 2017, p. 469)

b. That is the school$_i$'s decision$_j$ [PRO$_i$ to make ___$_j$]. (Douglas 2017, p. 469)

c. That is her$_i$ game$_j$ [PRO$_i$ to lose ___$_j$]. (Douglas 2017, p. 469)

d. It is your$_i$ burden$_j$ [PRO$_i$ to bear ___$_j$], so make the best of it.

(*Little Women and Werewolves*, 2010, via COCA)

Left periphery

Infinitival relatives sometimes permit overt material in the clausal periphery. As in finite relative clauses, it is never the case that a complementizer and a relative pronoun can co-occur (77) (Doubly Filled COMP Filter; van Riemsdijk and Williams 1986, p. 158), but there are plenty of examples that have just the nonfinite complementizer *for* (as in all of (73)), and plenty more that have just a *wh*-phrase in the clausal periphery (as in (74b), (74d), and (78)).

(77) a. * a topic [which for Bill to work on ___]

b. a topic [for Bill to work on ___]

c. * a topic [which Bill to work on ___] (Chomsky and Lasnik 1977, p. 462)

(78) a. Trump has to get lucky to have the money [with which$_i$ to pay his banks ___$_i$]. (=69c)

b. …a window into a musician's mind takes shape—a lens [through which$_i$ to view the construction of an art form ___$_i$]. (*The Creators Project* blog, 2012, via COCA)

c. They may even acknowledge the existence of foolproof criteria [by which$_i$ to determine whether or not a statement is true ___$_i$].
(*Moyers & Company*, 2012, via COCA)

Beyond these basic properties, the left periphery of infinitival relatives is notably inflexible as compared to that of finite relatives clauses.[1] A relative pronoun never occurs at the left edge of the clause alone; it only occurs under pied piping (79).

(79) a. * a topic [which$_i$ Bill to work on ___$_i$] (Chomsky and Lasnik 1977, p. 462)

b. * John brought a chair [which$_i$ to sit on ___$_i$]. (Green 1973, p. 12)

Furthermore, such pied piping can only occur if the subject of the relative clause is the aforementioned PRO (80–81).

(80) a. John bought a pen [with which$_i$ PRO to write ___$_i$]. (Hasegawa 1998, p. 2)

b. * John bought a pen [with which$_i$ Bill to write ___$_i$].

1. This inflexibility appears to be the focus of much of the literature that is devoted to or touches on infinitival relatives. See, for instance, Ross (1967, pp. 388–390), Green (1973), Chomsky and Lasnik (1977, pp. 460–470), and Chomsky (1980, pp. 20–28).

(81) a. He brought a chair [on which$_i$ PRO to sit ___$_i$].

b. *He brought a chair [on which$_i$ his mom to sit ___$_i$].

Covert modality

As discussed thoroughly in Bhatt (1999) and Kjellmer (1975), modal semantics is a common feature of infinitival relatives. Subject infinitival relative clauses may be modal or non-modal, and those with a modal interpretation take on either a purposive reading, in which the relative clause specifies the purpose or goal of whatever the head NP describes, or a future-oriented reading, in which the relative clause specifies a scheduled situation in which whatever the head NP describes is expected to be a participant. Both of these readings are possible in (82a), and only the future-oriented reading is available in (82b), as Bhatt, p. 46 suggests is generally the case in passive subject infinitival relatives. Some non-modal examples of subject infinitival relatives are provided in (83); also see the examples in (72), all of which are non-modal.

(82) MODAL SUBJECT INFINITIVAL RELATIVE CLAUSES

a. The man$_i$ [___$_i$ to fix the sink] is here. (Bhatt 1999, p. 9)

b. The book$_i$ [___$_i$ to be read for tomorrow's class] is kept on the table]. (Bhatt 1999, p. 9)

(83) NON-MODAL SUBJECT INFINITIVAL RELATIVE CLAUSES

a. The first man$_i$ [___$_i$ to walk on the moon] visited my school yesterday. (Bhatt 1999, p. 9)

b. This is the best book$_i$ [___$_i$ to appear] until now. (Kjellmer 1975, p. 323)

Non-subject infinitival relatives are necessarily modal. According to Bhatt, p. 16, non-subject infinitival relative clauses share the same modality as infinitival *wh*-questions, which carry a deontic modality, bouletic modality, or sometimes a circumstantial modality. [2] Examples of the two former modalities in infinitival relatives are provided in (84) and (85), which are repeated from above.

2. Deontic: in accordance with some set of guiding laws; Bouletic: in accordance with one's wishes; Circumstantial: in accordance with what is possible in a particular circumstance.

(84) …if the Florida law says that intent is the thing$_i$ [to judge by ___$_i$], then I have a question… (=75c)

(85) Now, he is the man$_i$ [to see ___$_i$] if you want to know about pencils. (=75a)

What aren't they?

Infinitival relative clauses are superficially similar to other sorts of infinitival clauses, including rationale clauses (called *in order* clauses in Jones 1991) and purpose clauses. The former differ from relative clauses in that they lack a gap and are optionally introduced by *in order* (86).

(86) RATIONALE CLAUSES

a. Some went so far as to fudge existing data [(in order) to deny that vitamin C helps prevent the common cold]… (*Total Health* magazine, 2008, via COCA)

b. "Working memory" is a type of short-term memory in which people hold information in mind [(in order) to perform a specific task or response].
(*Canadian Journal of Experimental Psychology*, 2018, via COCA)

c. You got ta be willing to make big moves in this game [(in order) to win].
(*Survivor*, 2009, via COCA)

d. …students need to feel caring and empathy [(in order) for them to have a sense of satisfaction with an online course].
(*Quarterly Review of Distance Education*, 2014, via COCA)

Rationale clauses whose subject is PRO (cf. 86d) are sometimes ambiguous: they may also have a subject infinitival relative clause parse. However, these structures have different interpretations. For instance, if *in order* is unpronounced in (86c), the bracketed part has a rationale clause interpretation (paraphrased in 87a) and an infinitival relative clause interpretation (paraphrased in 87b).

(87) You got ta be willing to make big moves in this game (in order) to win. (=86c)

a. A necessary condition of winning this game is having the willingness to make big moves. (RATIONALE CLAUSE READING)

b. One must be willing to make big moves in this game—a game which is desirable to win. (RELATIVE CLAUSE READING)

Purpose clauses share even more properties with infinitival relatives than rationale clauses do because they have a gap (88).

(88) PURPOSE CLAUSES

a. I bought John's/the book [to read ___]. (Douglas 2017, p. 470)

b. …most farmers market customers buy the eggplant [to eat ___]. (*Sunset*, 1996, via COCA)

c. Mary brought John along [to talk to ___]. (Jones 1991, p. 25)

d. Carol bought a rack [to hang coats on ___]. (Faraci 1974, p. 7)

e. Paulo won't be bored at the pool since he brought a friend [to swim with ___].

All examples in (88) are ambiguous between a purpose clause parse and an infinitival relative clause parse except for (88c). These two parses differ in interpretation, as shown by the paraphrases provided in (89–92).

(89) I bought the book to read. (=88a)

a. I bought the book intending to read it. (PURPOSE CLAUSE READING)

b. I bought the book meant for reading (instead of e.g. the book that only contains pictures). (RELATIVE CLAUSE READING)

(90) …most farmers market customers buy the eggplant to eat. (=88b)

a. Most farmers market customers buy the eggplant intending to eat it. (PURPOSE CLAUSE READING)

b. Most farmers market customers buy the eggplant meant for eating (instead of e.g. the decorative eggplant). (RELATIVE CLAUSE READING)

(91) Carol bought a rack to hang coats on. (=88d)

a. Carol bought a rack intending to hang coats on it. (PURPOSE CLAUSE READING)

b. Carol bought a rack meant for hanging coats on. (RELATIVE CLAUSE READING)

(92) Paulo won't be bored at the pool since he brought a friend to swim with. (=88e)

a. …he brought a friend intending to swim with them. (PURPOSE CLAUSE READING)

b. …he brought a friend meant for swimming with/who is good to swim with. (RELATIVE CLAUSE READING)

Although many purpose clauses are string-identical to infinitival relatives, their syntax is different enough from infinitival relative clauses that some simple diagnostics can be used to tell them apart. Purpose clauses are not part of the same syntactic constituent as what might appear to be a head noun (e.g. *book* in (88a), *eggplant* in (88b), *rack* in (88d), and *friend* in (88e)); indeed, they need not appear adjacent to a noun at all, as in (88c). Because of this, names and pronouns, which cannot be modified by a restrictive relative clause, can nonetheless be adjacent to the left edge of a purpose clause—consider (93), modified from (88).

(93) a. I bought it [to read ___].

b. …most farmers market customers buy it [to eat ___].

c. Carol bought it [to hang coats on ___]. (Faraci 1974, p. 18)

d. Paulo won't be bored at the pool since he brought Raúl [to swim with ___].

Furthermore, Jones (1991, p. 49) observes that when stacked with a finite relative clause, genuine infinitival relatives must be the first to follow the head NP (94), whereas purpose clauses are able to follow the finite relative clause (95). Since finite relative clauses can generally extrapose, a purpose clause can precede an extraposed finite relative clause; the key to using this as a diagnostic is to keep in mind that infinitival relatives will not be able to follow the finite relative.

(94) a. A pan [to fry eggs in][that's stainless] is in the sink. (Jones 1991, p. 49)

b. *A pan [that's stainless][to fry eggs in] is in the sink. (Jones 1991, p. 49)

(95) a. I brought a pan [that's stainless][to fry eggs in]. (Jones 1991, p. 49)

5.1.2 The syntax of infinitival relative clauses

Bhatt (1999) proposes two different structures for subject and nonsubject infinitival relatives, respectively, which are described in turn below.

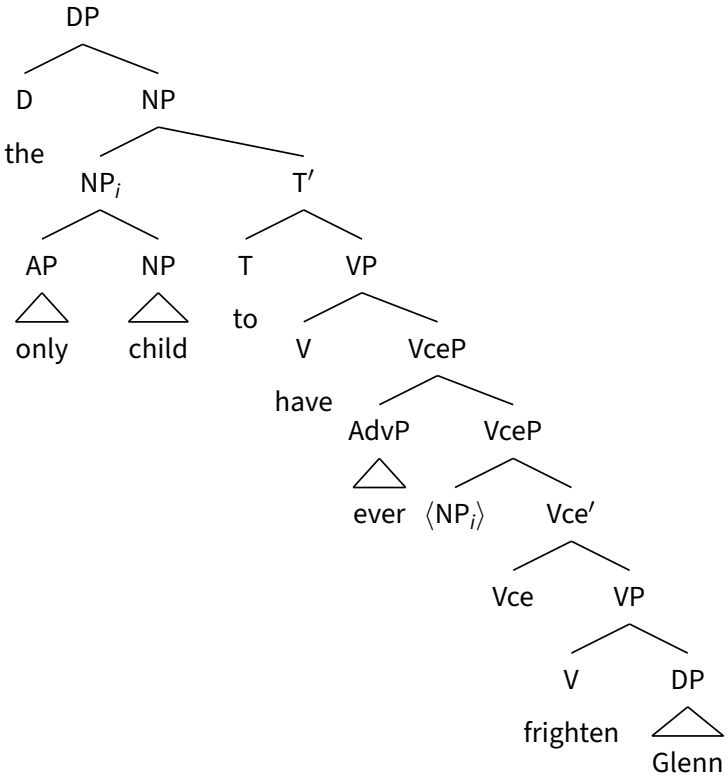
Subject infinitival relatives

Bhatt's (1999) proposal for infinitival relative clauses that are formed on the relative clause subject is that they are always reduced relative clauses. In other words, they are relative

clauses without a CP layer in their phrase structure. This is supported by the fact that the non-finite complementizer *for* can never occur in an infinitival relative formed on the subject. As described above, a modal interpretation is optional in subject infinitival relatives. Bhatt argues that mandatory modal readings are induced by the C^0, and since modal interpretation is not mandatory for subject infinitival relatives, there must not be a C^0. The option for modal interpretation is due to T^0, or if not T^0, then to whatever permits (optional) modal interpretations in non-relative infinitival clauses.

In an effort to unite infinitival relatives with other reduced relatives, Bhatt's proposal is that the relative clause subject (the location of the gap) is the subject of a participial phrase (PrtP). However, instead of Prt projecting, the head NP reprojects (Georgi and G. Müller 2010; Hornstein and Uriagereka 2002), which the determiner accepts as its complement. The analysis is illustrated in (96). For simplicity, Prt is left out.

(96)



It should be pointed out that the derivation (96) represents does not involve any A′ movement whatsoever. In the compositional semantics, the semantic value of the NP reprojection is the

result of Predicate Modification (semantic conjunction of the predicate denoted by the lower NP projection and PrtP/T′).

Non-subject infinitival relatives

As for non-subject infinitival relatives, Bhatt argues that they are derived in the same way as finite relative clauses (i.e. via A′ movement of the head NP to Spec, CP). This is supported by the fact that non-subject infinitival relatives can have the non-finite C^0 *for*, as well as the fact that they are obligatorily modal in interpretation, which is arguably due to the mandatory presence of a non-finite C^0, which has both null and overt forms.

5.1.3 Are they islands?

Infinitival relative clauses have in many ways been assumed to fall under the same general umbrella as finite relative clauses. Chomsky and Lasnik (1977, pp. 460–470), for instance, assume that they are base-generated with a complementizer (*for*) and have a *wh*-phrase that obligatorily undergoes *wh*-movement. Reviewing the literature shows that although there has been a fair amount of discussion about the derivation of infinitival relative clauses (Bhatt 1999; Chomsky and Lasnik 1977, pp. 460–470; Chomsky 1980, pp. 19–28; Green 1973; Hasegawa 1998; Ross 1967, pp. 388–390), their islandhood is not as thoroughly investigated as that of finite relative clauses. Under the assumption that their internal structure and derivation involves a CP and movement of a relative pronoun to Spec, CP, infinitival relative clauses must be islands like any other relative clause. This would seem to be borne out; Chomsky (1977) uses the ungrammaticality of (97) to argue that infinitival relative clauses are islands.

(97) * Who$_i$ did he find a book$_j$ [___$_i$ to read ___$_j$]? (Chomsky 1977, p. 99)

However, consideration of examples involving extraction from infinitival relatives suggests a split between subject infinitival relatives and non-subject infinitival relatives, the former tolerating extraction of a relative clause-internal argument to some extent and the latter banning extraction. Consider the examples in (98), which involve extraction from a subject

infinitival relative, as compared to the examples in (99–100), which involve extraction from a non-subject infinitival relative.

(98) Extraction from subject infinitival relative

a. Which mountain$_j$ did you take a picture of the first person$_i$ [___ $_i$ to climb ___ $_j$ last year]?

b. Which statute$_j$ is Mr. Gravitt one of the few citizens$_i$ [___ $_i$ to have used ___ $_j$]?

c. What$_j$ is she one of the few chefs$_i$ here [___ $_i$ to make ___ $_j$ with a mortar and pestle]?

d. Which award$_j$ is she the first woman$_i$ [___ $_i$ to win ___ $_j$]?

e. Which appliance$_j$ is he the man$_i$ [___ $_i$ to fix ___ $_j$]?

f. Which prescription$_j$ was she the doctor$_i$ [___ $_i$ to write ___ $_j$]?

g. Who$_j$ have we acquired the evidence$_i$ [___ $_i$ to vindicate ___ $_j$]?

(99) Extraction from object infinitival relative

a. *Who$_j$ did you say that this is the best book$_i$ [PRO$_{arb}$ to give ___ $_i$ to ___ $_j$]?

b. *Which kind of artist$_i$ is this tool the important thing$_j$ [___ $_i$ to have ___ $_j$]?

c. *Which student$_k$ is this John$_i$'s book$_j$ [PRO$_i$ to give ___ $_j$ to ___ $_k$]?

d. *This is the student$_i$ that we have a brief video$_j$ [___ $_i$ to watch ___ $_j$].

e. ?Which things$_j$ is the captain not the man$_i$ [PRO$_{arb}$ to bother ___ $_i$ about ___ $_j$]?

(100) Extraction from prepositional object infinitival relative

a. ?Which vegetable$_i$ is this a knife$_j$ [for me to cut up ___ $_i$ with ___ $_j$]?

b. *Who$_i$ does Trump have to get lucky to have the money [with which$_j$ to pay ___ $_i$ ___ $_j$]?

c. ?Which fine$_i$ do they have no money [with which$_j$ PRO$_{arb}$ to pay ___ $_i$ ___ $_j$?]

d. *Who$_i$ does the minister say that these words are the thing$_j$ [___ $_i$ to live by ___ $_j$]?

e. *What phenomenon$_i$ does this method provide a lens$_j$ [PRO$_{arb}$ to view ___ $_i$ through ___ $_j$]?

f. ??What phenomenon$_i$ does this method provide a lens [through which$_j$ PRO$_{arb}$ to view ___ $_i$ ___ $_j$]?

Although the judgments provided in (98–100) were collected informally, my personal impression is that they are accurate, at least relative to each other (i.e. the examples in (98) are

better than those in (99) and 100). If they are accurate, a plausible source for the contrast is the structural differences between subject and non-subject infinitival relatives that Bhatt draws attention to.

The apparent contrast shown above is worth investigating more systematically for at least a couple of reasons.

5.2 Experiment 4: Infinitival relatives I

Experiment 4 uses the length by structure design to investigate the porosity of infinitival relative clauses. Although the length by structure design is maintained, the transitive object environment is dropped due to ambiguity confounds that arise for the baseline condition. The transitive object conditions are not required to calculate DD scores for the predicate nominal and existential conditions, but without the transitive object environment, we cannot tell whether any porosity observed is a function of the environment in which an infinitival relative occurs (as observed in Experiment 3) or a function of infinitival relatives in general. Thus, another experiment that utilizes the dependency by environment design was run concurrently (Experiment 5). This allows some measurement of the degradation of relative clause subextractions from infinitival relative clauses in the transitive object environment. Experiment 5 is discussed in §5.3.

5.2.1 Participants

59 undergraduate students in lower-division linguistics classes participated in Experiment 4. They received course credit for their participation. Thirteen participants' data was excluded because they self-reported as non-native English speakers. An additional participant self-reported as a non-native English speaker but indicated in the language questionnaire portion that they started learning both English and Spanish at 2–3 years old, so this participant's data was included. A total of 46 participants' data was used in the analysis.

5.2.2 Materials & methods

Experiment 4 used a 2×2×2 factorial length by structure design. As such, the first two factors are STRUCTURE (NON-ISLAND, ISLAND) and LENGTH (SHORT, LONG). The ENVIRONMENT factor had PREDICATE and EXISTENTIAL as its levels. As before, with ratings for each condition in each environment, island violation penalties can be calculated for relative clauses in each environment.

This design results in 8 conditions per item. 32 items were created; a sample item is given in (101). As in the previous experiment, all experimental conditions were *wh*-questions. The same CP-embedding verbs matrix verbs that were used in Experiment 3 were re-used here. The predicate nominal or existential environment occurred within the embedded CP for the same reason as in Experiment 3—placing the relevant environment in the matrix clause would bar the creation of a SHORT condition for the existential environment since the existential expletive *there* cannot undergo *wh*-movement.

(101) EXPERIMENT 4 SAMPLE ITEM

a. Who thinks that Mary believes only one senator to have watched this show?
SHORT | NON-ISLAND | PREDICATE

b. Which show do you think that Mary believes only one senator to have watched?
LONG | NON-ISLAND | PREDICATE

c. Who thinks that Mary believes that she is the only senator to have watched this show?
SHORT | ISLAND | PREDICATE

d. Which show do you think that Mary believes that she is the only senator to have watched?
LONG | ISLAND | PREDICATE

e. Who thinks that Mary believes that there is only one senator watching this show?
SHORT | NON-ISLAND | EXISTENTIAL

f. Which show do you think that Mary believes that there is only one senator watching?
LONG | NON-ISLAND | EXISTENTIAL

g. Who thinks that Mary believes that there is only one senator to have watched this show?
SHORT | ISLAND | EXISTENTIAL

h. Which show do you think that Mary believes that there is only one senator to have watched?
LONG | ISLAND | EXISTENTIAL

In all conditions, a second CP-embedding verb was added that is compatible with either a finite or non-finite (ECM) clause complement (either *declare*, *find*, *prove*, *believe*, *allege*, *imagine*, *assume*, or *expect*, each used in four different items). In the NON-ISLAND | PREDICATE conditions, this verb had an ECM complement, and in the ISLAND | PREDICATE conditions, the verb had a finite CP complement with an infinitival relative clause inside it.

As in Experiment 3, the ISLAND | PREDICATE conditions had an additional clause boundary compared to their corresponding NON-ISLAND conditions. The number of sentential complements was maintained in these conditions, but the ISLAND conditions also contained a relative clause, increasing the number of clause boundaries by one compared to the NON-ISLAND conditions. The motivation for this was that the computation of the ISLAND conditions' copular clause would be trivial to compute, so maintaining the second CP-embedding verb (*believe* in the sample item in (101)) would keep the number of event discourse referents to construct roughly equivalent across the ISLAND and NON-ISLAND conditions (refer back to §4.2.2 for a more in-depth explanation).

In the EXISTENTIAL conditions, the same CP-embedding predicates were used, and the existential environment was in the most embedded CP complement. The EXISTENTIAL conditions had one more CP layer than the EXISTENTIAL conditions in Experiment 3. The mean length for Experiment 4's conditions was 15.5 words.

When constructing the items for Experiment 4, items were recycled from Experiment 3 if they sounded natural with infinitival relative clauses, but some items were created from scratch. Non-finite clauses were all constructed with the perfect auxiliary *have*, as this seemed to improve the naturalness of all non-finite clauses, facilitating ECM interpretations for the PREDICATE | NON-ISLAND conditions and removing the potential for purpose readings of the non-finite relative clauses.[3] With the predicate *find*, using the perfect aspect prevented

3. In the Reichenbachian view of tense and aspect (Reichenbach 1947), aspect locates an event time relative to a reference time, and tense locates a reference time relative to an utterance time. None of the experimental sentences used future tense in the clauses above the non-finite clause, so the reference time was always placed at or before the time of utterance. Perfect aspect locates the event time prior to the reference time, and since the reference time was always at or prior to utterance time, the event time was necessarily prior to the time of utterance. Since purpose relative clauses are future-oriented, using the perfect aspect in the infinitival relative clauses made a purpose reading implausible. Consider (i) for example and the infelicity of (ib) relative to (ia).

an ambiguity between an ECM reading and purpose reading and forced the ECM reading.

Aside from the changes noted, the materials for Experiment 4 were the same as those for Experiment 3.

Filler sentences

A total of 72 filler sentences were used. Most of these were identical to the filler sentences in Experiment 3, but 14 of them were modified for clause type and/or grammaticality so that the total number of acceptable interrogatives, unacceptable interrogatives, acceptable declaratives, and unacceptable declatives seen by any participant was even (32 of each, including sentences from Experiment 5, which was run concurrently). See §4.2.2 for more information on the fillers carried over from Experiment 3.

Figure 5.1 shows how the same fillers were rated in the Experiment 3 run versus the Experiment 4 and 5 run. As the figure shows, the ratings were roughly equivalent.

5.2.3 Analysis

A mixed effects ordinal regression model with a cumulative link was fit to the data. The dependent variable was set to rating, and the ENVIRONMENT, STRUCTURE, and LENGTH factors and their interactions were set as fixed effects. A maximal random effects structure was used.

A separate mixed effects ordinal regression cumulative link model was fit using data only from the existential environment. This model was otherwise the same as the first model.

5.2.4 Predictions

As before, we expect the LONG|ISLAND conditions to be rated lowest, since the combined length and structure factor levels are likely to make these conditions the most challenging

(i) a. We hired a plumber to fix the sink.

b. #We hired a plumber to have fixed the sink. (On the purpose reading.)

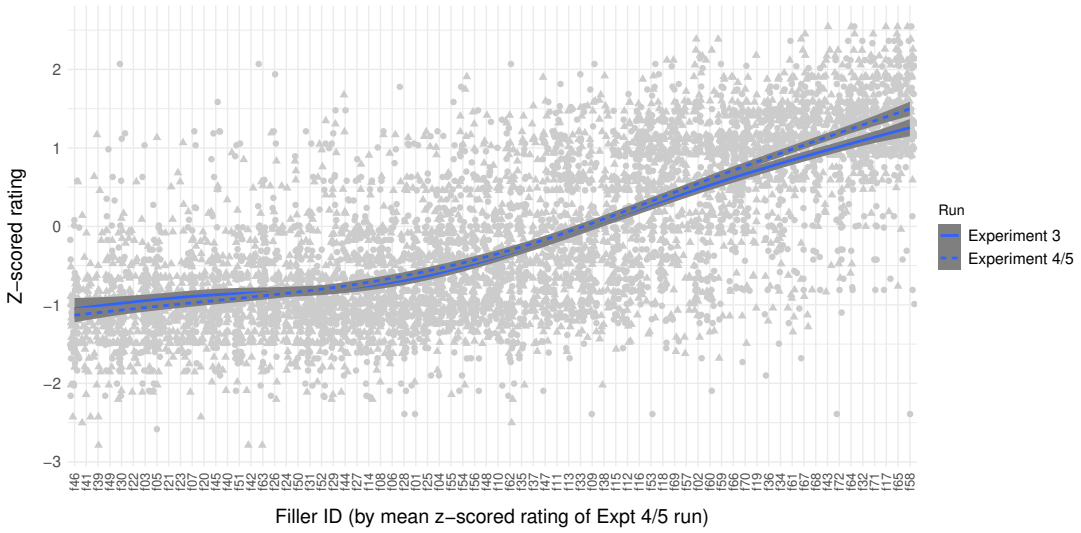


Figure 5.1: Ratings of fillers by filler ID, arranged on the x-axis by the mean z-scored rating the filler received in the Experiment 4/5 run. Each blue curve represents ratings for fillers in one run. Gray shading around blue curves represents standard error.

to process. If relative clauses in predicate nominal and existential environments are not islands and if the presence of tense in the relative clauses in Experiment 3 was enough to make the interaction between STRUCTURE and LENGTH significant, then we predict the absence of tense in the infinitival relative clauses in the current experiment to minimize the interaction between STRUCTURE and LENGTH in either a combined or separated analysis.

5.2.5 Results

Overall, the PREDICATE and EXISTENTIAL conditions were roughly equivalent, and there was not a significant main effect of ENVIRONMENT ($p = 0.458$). The LONG conditions were unsurprisingly rated lower than the SHORT conditions. The effect of length was significant ($p < 0.001$) and was not influenced by ENVIRONMENT.

Unexpectedly, the mean rating for the baseline SHORT | NON-ISLAND | PREDICATE condition was lower than that for the corresponding ISLAND condition. In the analysis, there was a significant interaction between STRUCTURE and LENGTH ($p = 0.047$). Because the baseline con-

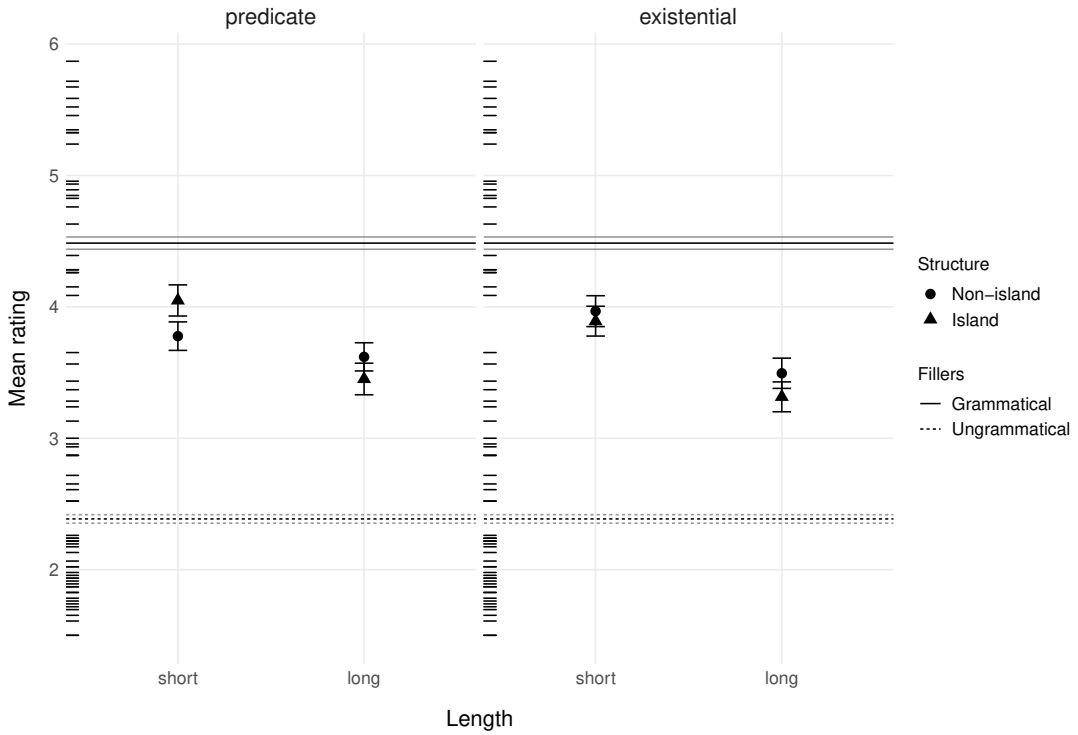


Figure 5.2: Mean rating by LENGTH and STRUCTURE, faceted by ENVIRONMENT. Error bars represent standard errors. Margin ticks represent mean ratings for each filler. Horizontal lines represent mean ratings for grammatical and ungrammatical fillers, with standard errors given as lighter horizontal lines.

dition in the PREDICATE conditions was lower than expected, an analysis was run separately on only the data from the EXISTENTIAL environment. In this analysis, there was a main effect of LENGTH ($p < 0.001$), but there was not a main effect of STRUCTURE ($p = 0.486$), and the interaction between LENGTH and STRUCTURE was not significant ($p = 0.563$). Coefficient estimates for both models are given in Appendix A.4.1. The mean ratings are shown in Figure 5.2.

The DD scores are presented in Table 5.1 for both environments, and plotted against the Experiment 3 DD scores in Figure 5.3. The DD score from the EXISTENTIAL environment in the current experiment is the lowest of all the environments tested so far and is just above the Hebrew subject extractions tested in Keshev and Meltzer-Asscher (2018). The DD score for the PREDICATE environment in the current experiment is basically on par with the EXISTENTIAL

Table 5.1: Calculating DD scores (Island scores) for each environment (Experiment 4)

Environment	short | non-island	long | non-island	short | island	long | island	D1 (structure + isl. viol.)	D2 (structure)	DD (isl. viol.)
predicate	0.20	0.10	0.34	–0.03	0.13	–0.15	**0.28**
existential	0.31	0.02	0.26	–0.11	0.13	0.05	**0.08**

environment in Experiment 3; however, this score may be inflated because of the nature of the baseline construction used for the predicate conditions. This will be discussed further in §5.2.6.

5.2.6 Discussion

For infinitival relative clauses in the existential environment, it appears difficult to maintain the hypothesis that relative clause subextraction is banned. The DD score is quite low, and the interaction between Structure and Length was found to be insignificant ($p = 0.563$). For the existential environment in Experiment 3, the interaction was significant. Since the crucial change that was made in Experiment 4 was the conversion of finite relative clauses to infinitival relative clauses, this result suggests that the absence of tense in infinitival relative clauses may reduce some of the processing that occurs while a dependency is still actively being maintained (after the filler phrase is encountered and before it has been integrated with the gap location). On the assumption that this effect is a separate phenomenon from grammatical island constraints, this result suggests that relative clauses in existential environments are not islands.

As mentioned in the previous subsection, the DD for the predicate environment in Experiment 4 (0.28) was higher than the DD for the same environment in Experiment 3 (0.16). The likely explanation for this is that the baseline condition for this environment (the short | non-

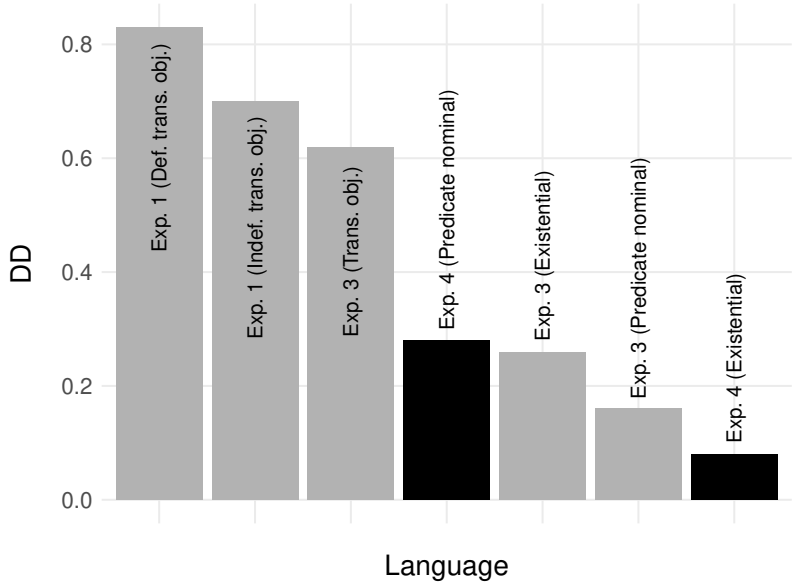


Figure 5.3: DD scores of Experiment 4 environments (black bars) vs. Experiment 1 and 3 environments (gray bars)

ISLAND condition) received a mean rating that was lower than the SHORT | ISLAND condition. The baseline condition sinking below the other SHORT condition would cause an increase in the overall DD score.

The difference between the SHORT | NON-ISLAND and SHORT | ISLAND conditions (also called D2 here) is intended to give an estimate of the cost of processing the island structure without considering extraction from it. Since the NON-ISLAND baseline was lower then the corresponding ISLAND condition, the structure chosen as the baseline for the PREDICATE conditions was probably not a good baseline. Selecting an appropriate baseline is the most challenging for the PREDICATE environment because there is not a good non-island alternative to a relative clause in a nominal predicate. In this case, a decent non-island counterpart to an infinitival relative clause is the non-finite clausal complement of an ECM verb, as shown in the two SHORT | PREDICATE conditions in (102), repeated from (101). However, the relatively low rating of the ECM baseline suggests that there is something marked about the construction, perhaps related to frequency of use or the availability of a finite clause alternative.

(102) a. Who thinks that Mary believes only one senator to have watched this show?
SHORT | NON-ISLAND | PREDICATE

b. Who thinks that Mary believes that she is the only senator to have watched this show?
SHORT | ISLAND | PREDICATE

Even though there is some uncertainty due to the baseline issue, the DD for the PREDICATE environment is still relatively low, and the baseline issue means that the strength of an relative clause island in this environment (as estimated by the DD score) is overestimated, but it is not possible to say how much it is overestimated.

In summary, it appears that removing tense from an relative clause, at least in an existential environment, may reduce processing-related penalties enough that there is no longer a significant interaction between STRUCTURE and LENGTH—little to no super-additivity that can be pinpointed as an island effect. However, this conclusion may be of little significance if it only pertains to one environment. The results from Experiment 3 suggested that relative clauses only become more porous in certain environments, and these findings were in line with research on other languages like Hebrew and the Scandinavian languages. Since we were unable to consider how infinitival relative clauses in EXISTENTIAL and PREDICATE environments compare to transitive OBJECT environments, this experiment can't tell us if infinitival relatives are simply never islands or if they are only non-islands in certain environments. Experiment 5, which was run concurrently with Experiment 4, aims to address this question by examining infinitival relatives using the dependency by environment design discussed in §3.3.

5.3 Experiment 5: Infinitival relatives II

The transitive object environment couldn't be fit into Experiment 4 due to ambiguities that arose in the ISLAND conditions,[4] so Experiment 4 was unable to tell us whether infinitival rel-

4. Much like in the OBJECT conditions for Experiment 3, the initial goal for the OBJECT conditions in Experiment 4 was to select verbs that could take either a clausal complement or a DP complement. The ambiguity that arose was that when the indended parse had a DP complement with an infinitival relative clause inside of it, there was almost always an ECM interpretation available. Consider the two possible readings of (i), for instance.

ative clauses are non-islands in certain environments or whether they are non-islands everywhere. So that we could get some idea of how infinitival relative clauses tolerate subextraction in transitive object environments compared to another environment, Experiment 5 was designed according to the dependency by environment design to compare infinitival relative clauses in the OBJECT environment to those in a PREDICATE environment.

5.3.1 Participants

Experiment 5 was given at the same time as Experiment 4 to the same 59 ungergraduate students. Thirteen participants' data was excluded because the participant self-reported as a non-native English speaker. 46 participants' data was used in the analysis.

5.3.2 Materials & methods

Experiment 5 employed a 2×2 factorial design, a version of which was first used in Experiment 2. This design uses a referential dependency for the baseline conditions, and these were compared to a long-distance movement dependency. The nature of the design allows all conditions to contain relative clauses (there are no ISLAND conditions). The DEPENDENCY factor's levels were PRONOMINAL and MOVEMENT, and the ENVIRONMENT factor's levels were OBJECT and PREDICATE. All of these conditions were declarative sentences, and their mean length was 13.3—about 2.3 words shorter than the mean length for Experiment 4's conditions.

In the MOVEMENT dependency conditions, subextraction was triggered for relative clause formation, instead of for WH-question formation as in Experiment 4. The matrix verb was the copula, and its DP complement contained the first relative clause layer. In the PRONOMINAL

(i) Who thinks that Mary believes the only senator to have watched this show?

a. Relative clause parse ≈ …believes the only senator that has watched this show.

b. ECM parse ≈ …believes about the only senator$_i$ that he$_i$ has watched this show.

When the DP begins with *the only senator*, an relative clause parse seems to be favored, and when it begins with *only one senator*, an ECM parse seems to be favored, but because there is still an alternative parse with a different meaning, it didn't seem to be a good idea to include the OBJECT environment.

dependency conditions, the matrix copula was replaced with a CP-complement-taking verb. This eliminated the highest relative clause layer, allowing the gap in the MOVEMENT conditions to be replaced with a pronoun that is intended to be co-referent with the matrix subject. A sample item is given in (103)

(103) EXPERIMENT 5 SAMPLE ITEM

a. Bill Nye is someone that Vivian is the only scientist to have condemned.
MOVEMENT | PREDICATE

b. Bill Nye claims that Vivian is the only scientist to have condemned him.
PRONOMINAL | PREDICATE

c. Bill Nye is someone that Vivian interviewed the only scientist to have condemned.
MOVEMENT | OBJECT

d. Bill Nye claims that Vivian interviewed the only scientist to have condemned him.
PRONOMINAL | OBJECT

Filler sentences

Since it was run simultaneously with Experiment 4, Experiment 5 had the same fillers as Experiment 4.

5.3.3 Analysis

A mixed effects ordinal regression model with a cumulative link was fit to the data from Experiment 5. The dependent variable was set to rating, and the ENVIRONMENT and DEPENDENCY factors and their interactions were set as fixed effects. A maximal random effects structure was used. The coefficient estimates are given in Appendix A.5.1.

5.3.4 Predictions

We expect to see an island effect for the OBJECT conditions but not for the PREDICATE conditions. In this design, an island effect would occur as a main effect of DEPENDENCY. If relative clauses the OBJECT and PREDICATE environments are substantially different in porosity, this

would surface as an interaction between DEPENDENCY and ENVIRONMENT. Given the lower overall ratings that OBJECT conditions have received compared to PREDICATE and EXISTENTIAL conditions, we also expect to find a main effect of ENVIRONMENT.

5.3.5 Results

Mean ratings for Experiment 5 are shown in Figure 5.4. Regardless of DEPENDENCY, the OBJECT conditions were rated lower then the PREDICATE conditions. This was significant as a main effect of ENVIRONMENT ($p = 0.001$). As expected, MOVEMENT conditions were rated lower overall than PRONOMINAL conditions. This difference was significant as a main effect of DEPENDENCY ($p < 0.001$).

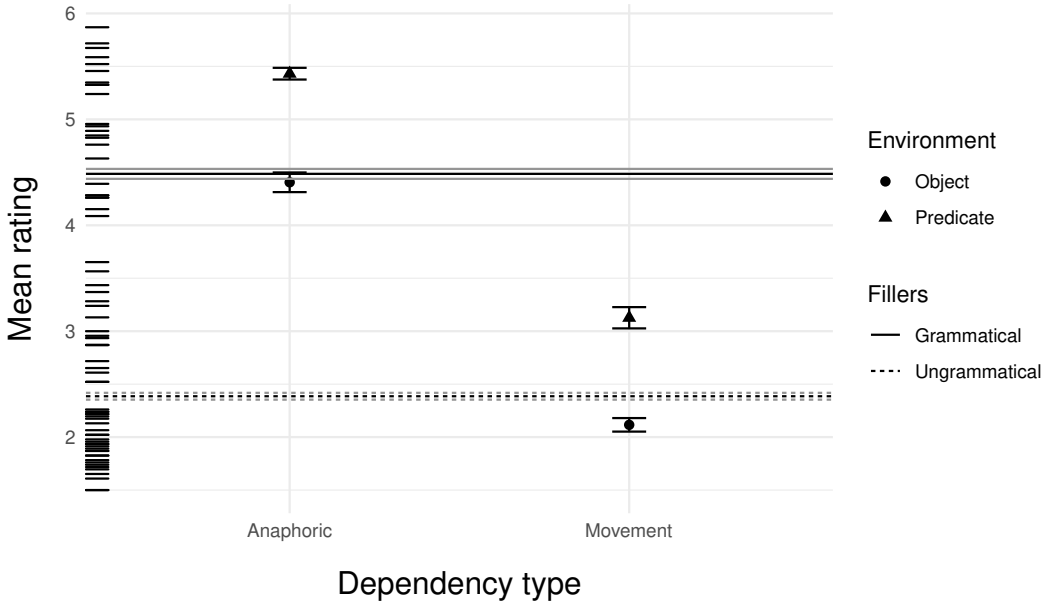


Figure 5.4: Experiment 5 ratings by DEPENDENCY and ENVIRONMENT. Error bars represent standard errors. Margin ticks represent mean ratings for each filler. Horizontal lines represent mean ratings for grammatical and ungrammatical fillers, with standard errors given as lighter horizontal lines.

The prediction that the OBJECT conditions would exhibit an island effect but the PREDICATE conditions wouldn't was not borne out, as there was no significant interaction between

DEPENDENCY and ENVIRONMENT ($p = 0.673$). Coefficient estimates for the model are given in Appendix A.5.1.

The experimental conditions for Experiment 5 evidently received a wider range of ratings than those for Experiment 4. The Experiment 4 conditions received mean ratings in between the mean ratings of the ungrammatical and grammatical fillers, but the PRONOMINAL | PREDICATE condition of Experiment 5 was rated substantially higher than the average grammatical filler sentence, and the MOVEMENT | OBJECT condition was rated slightly below the average ungrammatical filler. Since Experiments 4 and 5 were run concurrently with the same filler sentences, the mean filler ratings shown in Figures 5.2 and 5.4 are in the same position.

Although there were some individual filler sentences whose mean ratings were higher than the PRONOMINAL | PREDICATE condition's mean rating and some whose mean ratings were lower than the MOVEMENT | OBJECT condition's mean rating (as shown by the margin ticks in Figure 5.4), the extremeness of the highest- and lowest-rated conditions in Experiment 5 raises a concern about possible ceiling and floor effects. If some or all participants were unwilling to use all of the scale, it is possible that an interaction between ENVIRONMENT and DEPENDENCY was present but could not be detected in the ratings.

To gain insight into the relationship between the scale used by a participant and the degree of interaction between ENVIRONMENT and DEPENDENCY, two measures were derived and plotted against each other. First, a filler difference score was calculated by subject. This score was the difference between a participant's average grammatical filler rating and average ungrammatical filler rating. Next, an interaction score was calculated by subject, which was a difference in two differences—the difference between the two MOVEMENT conditions and the difference between the two PRONOMINAL conditions. The reader will note that this is the value referred to as DC in §3.3. An interaction of the predicted type (in which the difference between the two MOVEMENT conditions is greater than the difference between the two PRONOMINAL conditions) would result in a positive interaction score. This is not the only

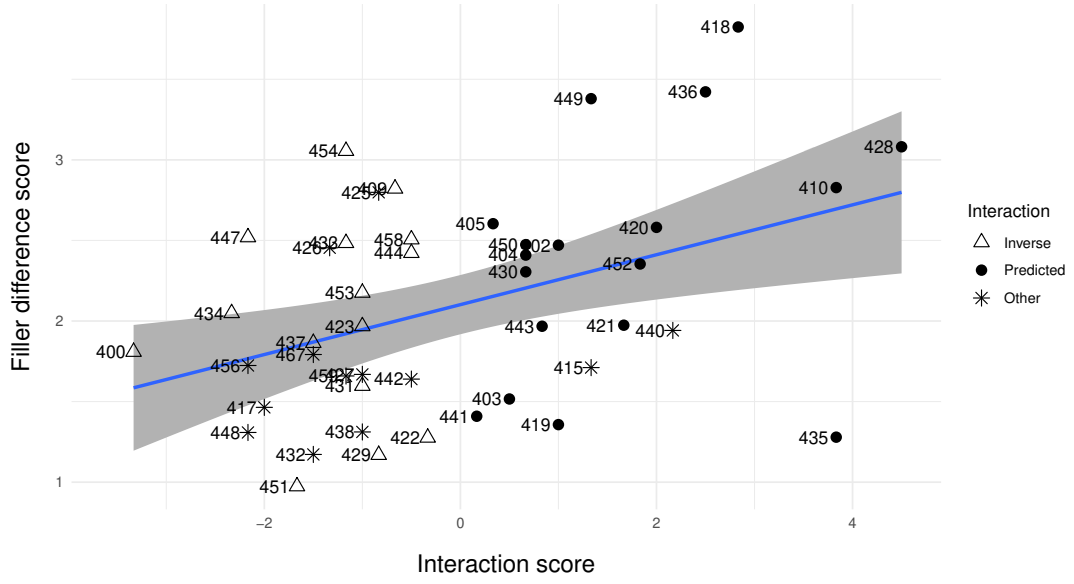


Figure 5.5: Correlation between the difference of a subject's grammatical and ungrammatical sentences and the degree of interaction in the subject's ratings.

type of interaction that would result in a positive interaction score,[5] so interactions of the predicted type (positive difference between MOVEMENT conditions greater than positive difference between PRONOMINAL conditions) were coded by subject as "predicted", those of the inverse type (positive difference between PRONOMINAL conditions greater than positive difference between MOVEMENT conditions) were coded as "inverse", and other interactions were coded as "other".[6] These are plotted by subject in Figure 5.5.

Figure 5.5 shows that participants that use a wider range of the scale (as determined by the filler difference score) tend to have the expected kind of interaction between ENVIRON-

5. For instance, if each OBJECT condition were rated higher than its corresponding PREDICATE condition, the two differences used to calculate the interaction score would be negative. If this was the case, and the difference between the two PRONOMINAL conditions was greater than the difference between the two MOVEMENT conditions, the interaction score would be positive even though the interaction is not the predicted type.

6. The interaction scores were sorted according to the slope of a line determined by solving $y = mx+b$ for m, for $b =$ the difference between the PRONOMINAL conditions, $x =$ the difference between the MOVEMENT conditions, and $y = 0$. Interactions of the predicted type resulted in slopes greater than -1 and less than or equal to 0. Interactions of the inverse type resulted in slopes less than -1. "Other" interactions had slopes greater than zero or slopes equal to zero if x was negative. Figure A.1 in Appendix A.5.1 shows these parameters by subject and organizes them by the slope of the line drawn through the x- and y-intercepts of the lines that meet at the plotted points.

MENT and DEPENDENCY, while those that use a narrower range of the scale tend to have the inverse of the expected kind of interaction.

5.3.6 Discussion

The lack of a significant interaction between ENVIRONMENT and DEPENDENCY suggests that infinitival relative clauses in both PREDICATE and OBJECT environments are equally porous. This casts doubt on the assumption that infinitival relative clauses are exactly parallel to finite relative clauses except for their lack of tense—infinitival relative clauses could be structurally different in a way that facilitates subextraction in any environment, in contrast to the findings for finite relative clauses.

Chapter 6

The role of the discourse function of the relative clause

We now return to some remaining questions about finite relative clauses. So far, we have observed a marked difference in a finite relative clause's porosity depending on the immediate environment of the relative clause's head NP. The dividing line appears to be between environments which trigger an existence presupposition (a definite object of a transitive verb) and those that do not (canonical existentials and predicate nominals), the latter being more permissive of extraction.

6.1 Background: Evidential existentials

Rubovitz-Mann (2012, p. 24) defines EVIDENTIAL EXISTENTIALS as "constructions whose discourse function can be characterized as providing information that establishes the existence of an entity by providing evidence for its existence." Because it is a pragmatic notion, the class of syntactic constructions that can have this discourse function is diverse, but one such "construction" involves the use of a transitive verb that denotes a situation in which the speaker has acquired evidence for the existence of the thing or kind of thing denoted by the direct object of that transitive verb. Given this description, it is expected that evidential existen-

tials such as this have a first-person subject. Consider (104), in which a negative existential (uttered by A) is countered with a sentence which is clearly not a canonical existential but which serves a similar purpose to one.

(104) A: There are no cars with three wheels.
B: Well, yesterday I saw a car with three wheels. (Rubovitz-Mann 2012, p. 24)

Rubovitz-Mann proposes the notion EVIDENTIAL EXISTENTIAL in part to unite the seemingly disparate environments that facilitate extraction from relative clauses in Hebrew, and ideally other languages, such as the Mainland Scandinavian languages. The idea is useful to the present work for a number of reasons. First of all, a construction's successfulness in serving this discourse function (or its *existentiality*) can be tested experimentally. Combined with further experimentation utilizing the factorial definition of islands, we can see whether there is a correlation between an environment's existentiality and the porosity of a relative clause within that environment. Erteschik-Shir (1973) and Rubovitz-Mann (2012) both argue that these two things are correlated (at least for Hebrew and Danish), so determining whether they are correlated for English helps contextualize extraction from relative clauses in English within the set of languages discussed in Chapter 2.

The idea is also useful because it reveals a way of making a first-pass attempt at determining what the source(s) of the effects observed thus far for English could be. Because EVIDENTIAL EXISTENTIAL is a pragmatic notion, there is not a natural syntactic class of transitive verbs that could serve in an evidential existential. If a relative clause's porosity has little to do with its surrounding or internal structure and has more to do with its discourse function—or the discourse function of whatever it is embedded in—then we expect a relative clause's porosity to vary *continuously* with the existentiality of the construction it is a part of, assuming that existentiality also varies continuously. On the other hand, if the effect is primarily structural, we expect to see rigidity in island effects across all levels of existentiality

6.2 Experiment 6: Evidential existential verbs

The first experiment in this chapter aims to measure the relative existentiality of a set of transitive verbs, or the success of a set of verbs in serving in an evidential existential utterance.

6.2.1 Participants

121 undergraduate students participated in Experiment 6 for course credit. Data collection took place in the "virtual lab" during the COVID-19 pandemic. Participants signed up to participate in the usual way but were instructed to attend a Zoom meeting at their scheduled time slot. At the Zoom meetings, which averaged three to four students, participants were given a subject number, a web address for the experiment, and instructions to come back to the meeting if they had issues, questions, or were finished with the experiment. 30 participants' data was excluded from observation. 27 of those participants self-reported as non-native English speakers. The remaining three excluded participants met one of the two following exclusion criteria.

1. At least 25% of the participant's response times were shorter than one second.
2. The participant's mean ratings for infelicitous fillers and felicitous fillers are either inverted or are too close. *Too close* is defined on normalized ratings, where a difference that is more than two standard deviations below the mean difference is too close.

One of the remaining three met the first criterion, and two of the remaining three met the second. Three of the non-native speakers also met at least one of the exclusion criteria. In total, 91 participants' data was included in the analysis. These participants ranged from 18 to 33 years of age; the mean age was 20.

6.2.2 Materials & methods

Experiment 6 required participants to read what appeared to be a text message conversation between themselves and a friend. Each conversation consisted of two messages. The first

was a question that the participant was to envision themselves asking the friend in the conversation, and the response from the friend was a declarative sentence. Participants were asked how natural their friend's response was. To answer the question, they selected a number on a 6-point Likert scale, where 1 was described as *unnatural* and 6 was described as *natural*. A screenshot of the conversation and the rating interface is given in Figure 6.1.

This was a single-factor experiment in which the kind of RESPONSE to the question was manipulated. All questions were polar questions inquiring about the existence of an individual matching a description. Within each item, these questions were invariant. The responses were all intended to be affirmative but varied in felicitousness, falling into one of three response types: *there* EXISTENTIAL, in which the existence of an individual meeting the description was affirmed using a canonical existential construction; EVIDENTIAL EXISTENTIAL, in which the existence of an individual meeting the description was affirmed using an evidential existential verb; or TRANSITIVE VERB, in which the existence of an individual meeting the description was affirmed using an ordinary transitive verb.

24 items were created (in addition to 12 burn-in items); see the sample item in (105). The full list of items is provided in Appendix A.6.

(105) EXPERIMENT 6 SAMPLE ITEM
Question: Is there anyone who can decode this script?

a. Yeah, I'm sure there's someone who can decode it. — *there* EXISTENTIAL

b. Yeah, I talked to someone who can decode it. — EVIDENTIAL EXISTENTIAL

c. Yeah, I criticized someone who can decode it. — TRANSITIVE VERB

6.2.3 Analysis

A mixed effects ordinal regression model with a cumulative link was fit to the data. The dependent variable was set to RATING, and the RESPONSE factor was set as a fixed effect. A maximal random effects structure was used. The RESPONSE factor was given Helmert contrast coding, which allowed for two direct comparisons: one between the *there* EXISTENTIAL and EVIDENTIAL EXISTENTIAL conditions, and one between the TRANSITIVE VERB conditions and the

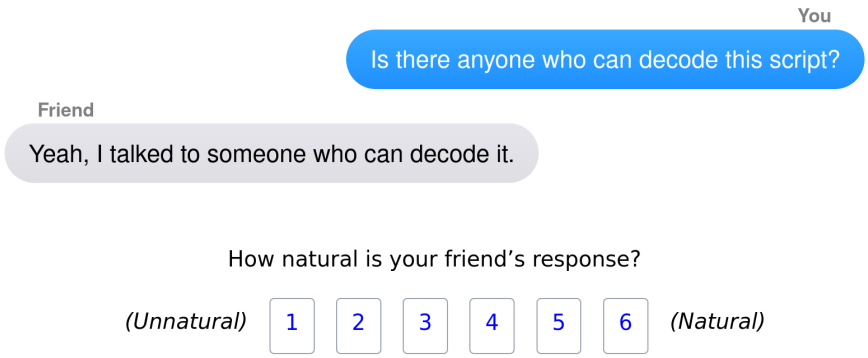


Figure 6.1: Screenshot of in-experiment text message conversation

mean of the other two conditions.

6.2.4 Predictions

Given that the sentence has only a single factor (RESPONSE), we expect there to be a main effect. In terms of mean ratings, we expect the TRANSITIVE VERB condition to be rated least natural in the provided context, the *there* EXISTENTIAL condition to be rated most natural, and the EVIDENTIAL EXISTENTIAL condition to be rated between the other two conditions, on average.

6.2.5 Results

Descriptive statistics

Descriptive statistics for Experiment 6 are shown in Table 6.1, and the mean ratings are visualized in Figure 6.2. The mean ratings bear out the predictions made above: ordinary transitive verbs are rated the least natural in an evidential existential-supporting context, the canonical *there*-existential is rated the most natural, and the verbs that were chosen to represent the evidential existential level were rated in between the two other levels. What was not predicted, however, was how close the latter conditions would be rated to the *there* existential condition.

Table 6.1: Experiment 6, mean ratings, standard deviation, and standard error for each condition

Response	Mean	SD	n	SE
there existential	4.8	1.4	728	0.0519
evidential existential	4.7	1.4	728	0.0528
transitive verb	3.2	1.6	728	0.0608

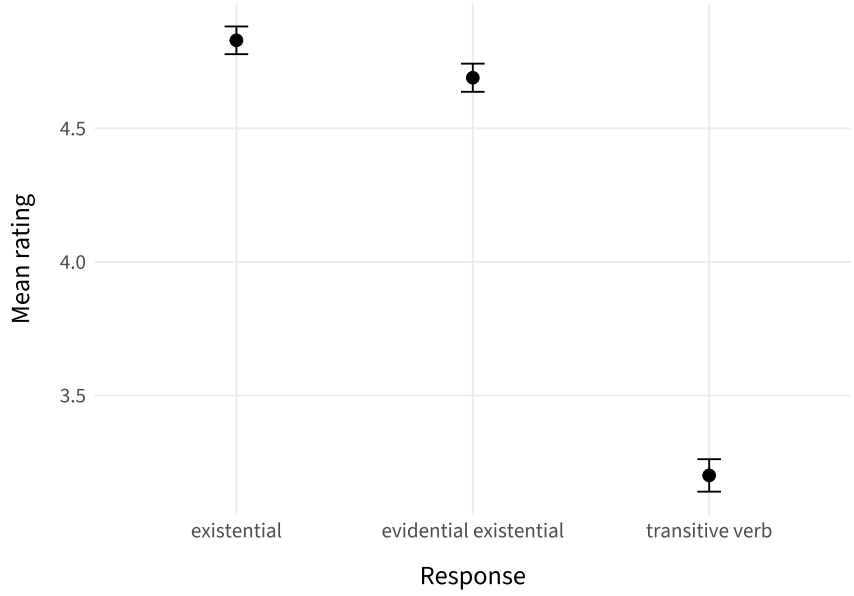


Figure 6.2: Mean rating by Response type. Error bars represent standard errors.

Since the relative existentiality of the verbs used is of interest, the ratings were *z*-scored by subject and broken down by verb. This information is provided in Table 6.2 and is visualized in Figure 6.3.

Inferential statistics

In the ordinal regression model that was fit to the data, a significant difference ($p = 0.031$) was found between the *there* existential and evidential existential levels, as well as between the combined existential levels and the transitive verb level ($p < 0.001$). The full details of

Table 6.2: Normalized ratings by verb

Verb	RESPONSE	z-score rating	n	SD	SE
there is	*there* EXISTENTIAL	0.694	728	0.766	0.0284
talk to	EVIDENTIAL EXISTENTIAL	0.885	114	0.624	0.0585
hear of	EVIDENTIAL EXISTENTIAL	0.744	119	0.619	0.0567
know	EVIDENTIAL EXISTENTIAL	0.652	131	0.902	0.0788
find	EVIDENTIAL EXISTENTIAL	0.587	114	0.828	0.0775
meet	EVIDENTIAL EXISTENTIAL	0.480	131	0.857	0.0749
run into	EVIDENTIAL EXISTENTIAL	0.388	119	0.720	0.0660
date	TRANSITIVE VERB	0.368	86	0.822	0.0886
call	TRANSITIVE VERB	0.313	91	0.760	0.0797
praise	TRANSITIVE VERB	0.0212	91	0.910	0.0953
advise	TRANSITIVE VERB	-0.0720	91	0.850	0.0891
criticize	TRANSITIVE VERB	-0.579	91	0.827	0.0867
describe	TRANSITIVE VERB	-0.721	96	0.678	0.0692
imitate	TRANSITIVE VERB	-0.790	96	0.654	0.0668
slap	TRANSITIVE VERB	-0.990	86	0.716	0.0772

the mixed effects model can be found in Appendix A.6.1.

6.2.6 Discussion

The results bear out both of the predictions made above. There is a stark effect of RESPONSE type, especially between those with ordinary TRANSITIVE VERBS and both of the existential conditions (*there* existentials and EVIDENTIAL EXISTENTIALS).

Considering the remarks made in §6.1, the cline observed in Figure 6.3 suggests that further experimentation in this area may provide insight into the sources (or non-sources) of reduced island effects in English relative clauses.

6.3 Experiment 7: Evidential existentials without context

The goal of Experiment 7 was to measure the porosity of relative clauses contained within a direct object of the verbs used in Experiment 6. Experiments 7 and 8 were designed at the same time and overlap in materials, but data collection occurred sequentially with different

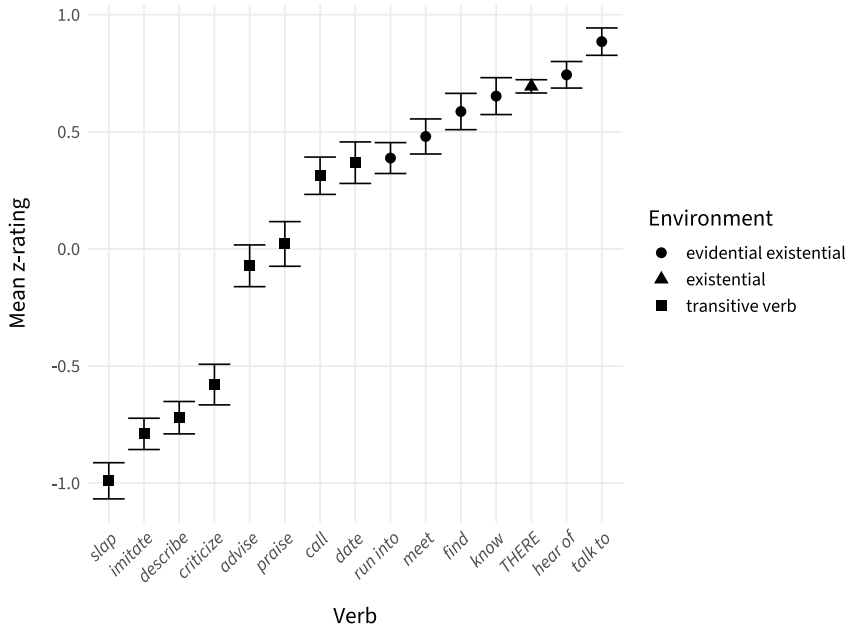


Figure 6.3: Mean z-score ratings for each verb; verbs ordered by rating. Error bars represent standard error.

participants. Because the existentiality of evidential existentials is contextually determined, measuring the porosity of the relative clause both with and without a supporting context is potentially very useful. Experiment 7 was designed without a supporting context; sentences that may be successful as evidential existentials in some context were presented out of the blue.

6.3.1 Participants

33 individuals participated in Experiment 7 via *Prolific* (2021). Each participant was paid $6.00 for their participation. Participants were pre-screened using Prolific's pre-screening facilities. The experiment was only made available to native English speakers born and residing in the United States without any literacy difficulties, language-related disorders, cognitive impairment, or uncorrected vision problems. They were required to be between the ages of 19 and 91 (inclusive) and to have a minimum approval rate of 85% on the platform.

Three participants' data was excluded. One of these failed an attention check, and the other two participants rated grammatical filler sentences and ungrammatical filler sentences too similarly on average. "Too similar" is defined as for Experiment 6, but here the filler sentences used to judge this were pre-sorted for grammaticality, rather than felicitousness. This resulted in 30 participants' data being considered.

6.3.2 Materials & methods

Experiment 7's design was a slightly reduced version of the length by structure design. Recall that for each (SHORT, LONG) set of island conditions in an experiment that utilizes the length by structure design, there is a corresponding set of non-island conditions that serve as a baseline. A full implementation of the design for the goals of the current experiment would have required a 2×2×2 factorial design, which would result in eight abstract conditions (LENGTH | STRUCTURE | VERB TYPE; see Table 6.3).

Table 6.3: Conditions for a full length by structure experiment manipulating verb type, which was not fully possible in Experiment 7

LENGTH	STRUCTURE	VERB TYPE
SHORT	NON-ISLAND	EVIDENTIAL EXISTENTIAL
LONG	NON-ISLAND	EVIDENTIAL EXISTENTIAL
SHORT	ISLAND	EVIDENTIAL EXISTENTIAL
LONG	ISLAND	EVIDENTIAL EXISTENTIAL
SHORT	NON-ISLAND	TRANSITIVE VERB
LONG	NON-ISLAND	TRANSITIVE VERB
SHORT	ISLAND	TRANSITIVE VERB
LONG	ISLAND	TRANSITIVE VERB

The full design utilizing the conditions in Table 6.3 was not feasible for Experiment 7. Considering Experiment 3's materials as an example, we strived to identify NON-ISLAND conditions for each environment (OBJECT, PREDICATE, EXISTENTIAL) that were as close a match as possible to the corresponding ISLAND conditions. For the OBJECT conditions, we used transitive verbs like *see* that could accept either a CP complement (for the NON-ISLAND CONDI-

TIONS) or a DP complement (for the ISLAND conditions). Because the goal of Experiment 7 was to hone in on transitive object environments using a specific set of verbs, identifying a close NON-ISLAND match was not nearly as possible; few of the verbs from Experiment 6 (reproduced in (106–107) for reference) will naturally accept both a CP and a DP complement.

(106) "EVIDENTIAL EXISTENTIAL" VERBS
run into, *meet*, *find*, *know*, *hear of*, *talk to*

(107) ORDINARY TRANSITIVE VERBS
slap, *imitate*, *describe*, *criticize*, *advise*, *praise*, *call*, *date*

Since the option to use these verbs for both the ISLAND and NON-ISLAND conditions was unavailable, the CP-embedding verbs shown in (108) were paired arbitrarily with the transitive verbs (106–107) for the NON-ISLAND conditions. Because the baseline conditions were not meaningfully (lexically) related to the VERB TYPE conditions as they were for Experiment 3, it was decided to separate the baseline conditions from the VERB TYPE conditions and include it as its own level under VERB TYPE, CP-EMBEDDING, only including one pair of sentences per item instead of one pair for each VERB TYPE level (Table 6.4). The reduced design complicates the analysis somewhat; more information is provided in §6.3.3. A sample item is provided in 109.

(108) CP-EMBEDDING VERBS USED IN EXPERIMENT 7
believe, *claim*, *imagine*, *suggest*, *suspect*, *think*

Table 6.4: Conditions for Experiment 7, a reduced length by structure experiment

LENGTH	STRUCTURE	VERB TYPE
SHORT	NON-ISLAND	CP-EMBEDDING
LONG	NON-ISLAND	CP-EMBEDDING
SHORT	ISLAND	EVIDENTIAL EXISTENTIAL
LONG	ISLAND	EVIDENTIAL EXISTENTIAL
SHORT	ISLAND	TRANSITIVE VERB
LONG	ISLAND	TRANSITIVE VERB

(109) EXPERIMENT 7 SAMPLE ITEM

a. This is the person that claimed that the politician can fix this issue. SH | NO | CP

b. This is an issue that I claimed that the politician can fix. LO | NO | CP

c. This is the person that met the politician who can fix this issue. SH | IS | EV

d. This is an issue that I met the politician who can fix. LO | IS | EV

e. This is the person that advised the politician who can fix this issue. SH | IS | TR

f. This is an issue that I advised the politician who can fix. LO | IS | TR

6.3.3 Analysis

A mixed effects ordinal regression model with a cumulative link was fit to the data using the `clmm()` function provided by the `ordinal` package (Christensen 2019) in R (R Core Team 2021). The dependent variable was set to rating, and the LENGTH and VERB TYPE factors, as well as their interactions, were set as fixed effects. A maximal random effects structure was used. The reader will notice the absence of the STRUCTURE factor in the analysis. Because the experiment design was reduced, STRUCTURE is completely predictable from VERB TYPE, and the inclusion of that factor in the formula provided to `clmm()` causes an error.

The VERB TYPE factor was given treatment contrast coding, treating the CP-EMBEDDING level as the baseline condition for that factor. The effect of this is that each of the non-baseline conditions is only compared directly to the baseline condition, rather than to each other. A main effect of VERB TYPE would therefore mean that there is a significant difference between the CP-EMBEDDING and EVIDENTIAL EXISTENTIAL conditions or the CP-EMBEDDING and TRANSITIVE VERB conditions.

The LENGTH factor was given sum contrast coding. Additional details are provided in Appendix A.7.

6.3.4 Predictions

In the absence of a context to facilitate the use or comprehension of an evidential existential as such, we expect not to see significantly different island effects between the EVIDENTIAL EXISTENTIAL and TRANSITIVE VERB verb types. In other words, the strength of the interactions between VERB TYPE and LENGTH should be roughly on par with each other.

6.3.5 Results

Descriptive statistics

The descriptive statistics are provided in Table 6.5, and they are visualized in Figure 6.4. One notable fact about the ratings is that in the baseline (CP-EMBEDDING) conditions, the SHORT and LONG levels are roughly on par with each other. This is unusual given the previous experiments, which in all conditions show a substantial difference between the ratings of the SHORT and LONG conditions. This surely had something to do with the way the items were written. One possibility why the CP-EMBEDDING×SHORT condition was not rated higher is that the relative clause was introduced by *that*, which participants may have found somewhat unnatural (as opposed to *who*) because the head of the relative clause in that condition was always human.

Table 6.5: Ratings

LENGTH	STRUCTURE	VERB TYPE	Mean	SD	n	SE
SHORT	NON-ISLAND	CP-EMBEDDING	4.59	1.36	180	0.1010
LONG	NON-ISLAND	CP-EMBEDDING	4.79	1.29	180	0.0961
SHORT	ISLAND	EVIDENTIAL EXISTENTIAL	4.59	1.30	180	0.0967
LONG	ISLAND	EVIDENTIAL EXISTENTIAL	2.56	1.17	180	0.0871
SHORT	ISLAND	TRANSITIVE VERB	4.14	1.51	180	0.1130
LONG	ISLAND	TRANSITIVE VERB	2.37	1.20	180	0.0891

Inferential statistics

In the mixed effects analysis, there was not a significant main effect of length ($p = 0.256$), likely due to the issue noted in §6.3.5. There was a main effect of VERB TYPE: the difference between CP-EMBEDDING and EVIDENTIAL EXISTENTIAL was significant ($p < 0.001$), as was the difference between CP-EMBEDDING and TRANSITIVE VERB ($p < 0.001$). The interactions between LENGTH and VERB TYPE were also significant for both VERB TYPE comparisons ($ps < 0.001$). The full details of the mixed effects model can be found in Appendix A.7.1.

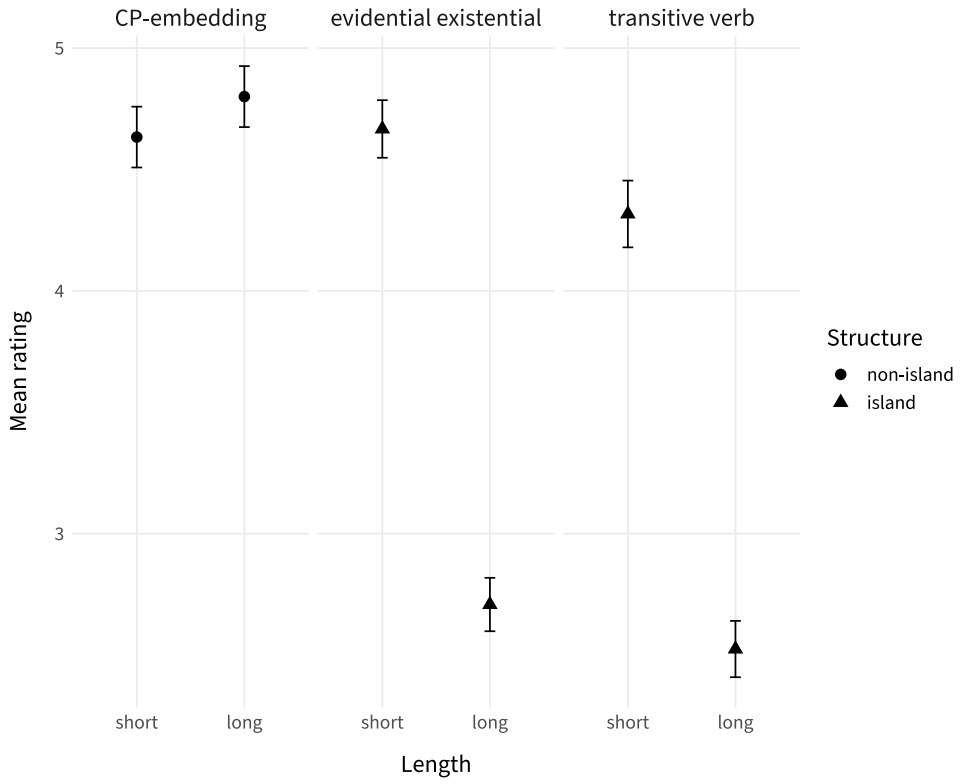


Figure 6.4: Experiment 7 mean ratings, faceted by VERB TYPE. Error bars represent standard errors.

6.3.6 Discussion

The significant main effect of VERB TYPE indicates that participants found the EVIDENTIAL EXISTENTIAL conditions slightly more acceptable overall than TRANSITIVE VERB conditions. The significant interactions between LENGTH and VERB TYPE reflect the expected island effect.

6.4 Experiment 8: Evidential existentials with context

Experiment 8 utilized all the same items with the same conditions as Experiment 7, but a context-setting question was included to facilitate an evidential existential discourse function as much as possible.

6.4.1 Participants

98 undergraduate students participated in Experiment 8 for course credit. Data collection took place in the "virtual lab" during the COVID-19 pandemic. Participants signed up to participate in the usual way but were instructed to attend a Zoom meeting at their scheduled time slot. The exclusion criteria were the same as for Experiment 6.

44 participants' data was excluded from the study, all of whom self-reported as non-native English speakers. This resulted in 54 participants' data being included in the analysis.

6.4.2 Materials & methods

The materials for Experiment 8 were the same as for Experiment 7, but a question was constructed for each item to create a context that would facilitate direct or indirect existential assertions. A sample item is provided in (110). The full list of items is provided in Appendix A.8.

(110) EXPERIMENT 8 SAMPLE ITEM
Question: Is there anyone who can fix this issue?

a. This is the person that claimed that the politician can fix this issue. SH | NO | CP
b. This is an issue that I claimed that the politician can fix. LO | NO | CP
c. This is the person that met the politician who can fix this issue. SH | IS | EV
d. This is an issue that I met the politician who can fix. LO | IS | EV
e. This is the person that advised the politician who can fix this issue. SH | IS | TR
f. This is an issue that I advised the politician who can fix. LO | IS | TR

The task in Experiment 8 was distinct from both Experiment 6 and Experiment 7, but it was more similar to Experiment 6. Like Experiment 6, participants were viewing a text message-like conversation. To ensure that participants were rating sentences based primarily on their acceptability, they were asked to provide an acceptability rating, rather than a naturalness rating, as in Experiment 6. The context-setting questions and their corresponding answers were presented asynchronously in attempt to prevent distraction from the question when rating the acceptability of the sentence. In the experimental (non-filler) conditions, the par-

ticipants were presented with the context-setting question to read only. That is, they were not asked any questions about the context-setting question; they were merely shown the sentence and asked to click "Next" once they were done reading the question. After clicking "Next", participants were shown one of the sentences exemplified by (110a–110f) and asked to rate it. Our aim was to cause unconscious influence from the immediately preceding context-setting question so that participants would rate the acceptability of the target conditions within that context without explicitly being asked to consider context.

Because the questions were presented separately from the target sentence, there was some concern that efficient participants would realize that they could skip through the question part without reading it. To prevent this possibility, about a third of the judgments they were asked to provide were for questions. The questions they provided acceptability judgments for were part of the fillers, rather than the experimental conditions. With this safeguard in place, we thought that participants would be less likely to quickly read or skip through the question screen since they might have to answer a judgment question about it.

6.4.3 Analysis

The analysis for Experiment 8 was the same as for Experiment 7.

6.4.4 Predictions

As for Experiment 7, we expect to see main effects of both LENGTH and VERB TYPE, but the LENGTH effect may not reach significance because of the *that*-relative clause issue noted in §6.3.5, which was still present in the Experiment 8 items.

Because the context facilitates an evidential existential discourse function, we expect extraction from relative clauses in this context to be more acceptable and for the island effect to be reduced. Because of the variability in the existentiality of the verbs used (see Figure 6.3), we expect to see at least two levels of island effect. If the effect of context results in a genuinely *grammatical* extraction in the EVIDENTIAL EXISTENTIAL conditions, we expect to see a significant island effect for the TRANSITIVE VERB conditions and a significantly reduced or ab-

sent island effect for the EVIDENTIAL EXISTENTIAL conditions. On the other hand, if the effect is not grammatical but strictly contextual (or related to processing facilitation of some sort), we expect to see a continuous difference in island effects that reflects the cline observed in Figure 6.3.

A significant island effect would show up as a significant interaction between LENGTH and VERB TYPE.

6.4.5 Results

Descriptive statistics

The descriptive statistics are reported in Table 6.6, and these are visualized in Figure 6.5. A visual scan of Figure 6.5 reveals a strikingly similar ratings pattern to that found in Experiment 7. Two main differences from Experiment 7's results are noted. First, the mean ratings for SHORT/LONG | CP-EMBEDDING appear to fall below the mean rating for the SHORT | EVIDENTIAL EXISTENTIAL condition, although the standard error bars only suggest that the SHORT | CP-EMBEDDING condition is reliably below the SHORT | EVIDENTIAL EXISTENTIAL.

Second, the ceiling appears to be lower in Experiment 8, but the floor appears to be stable. That is, the LONG | EVIDENTIAL EXISTENTIAL/TRANSITIVE VERB conditions remained roughly between 2 and 2.5. However, all of the conditions rated highly, including the LONG | CP-EMBEDDING condition, exhibited a compression in ratings that almost reached a whole point (the average difference across experiments for those conditions was 0.835). I am uncertain about the interpretation of this particular aspect of the result, but it it is possible that the difference in procedures between these two experiments was an influence.

Inferential statistics

In the mixed effects analysis described in §6.4.3, we observed a significant main effect of length ($p < 0.001$), and both main effects of VERB TYPE were significant ($p = 0.002$ for the CP COMPLEMENT–EVIDENTIAL EXISTENTIAL comparison; $p < 0.001$ for the CP COMPLEMENT–TRANSIT-

Table 6.6: Ratings

Verb type	Length	Structure	Mean	SD	n	SE
CP-embedding	short	non-island	3.70	1.37	594	0.0564
CP-embedding	long	non-island	3.72	1.43	594	0.0587
evidential existential	short	island	3.80	1.37	594	0.0561
evidential existential	long	island	2.45	1.25	594	0.0511
transitive verb	short	island	3.55	1.35	594	0.0554
transitive verb	long	island	2.25	1.18	594	0.0486

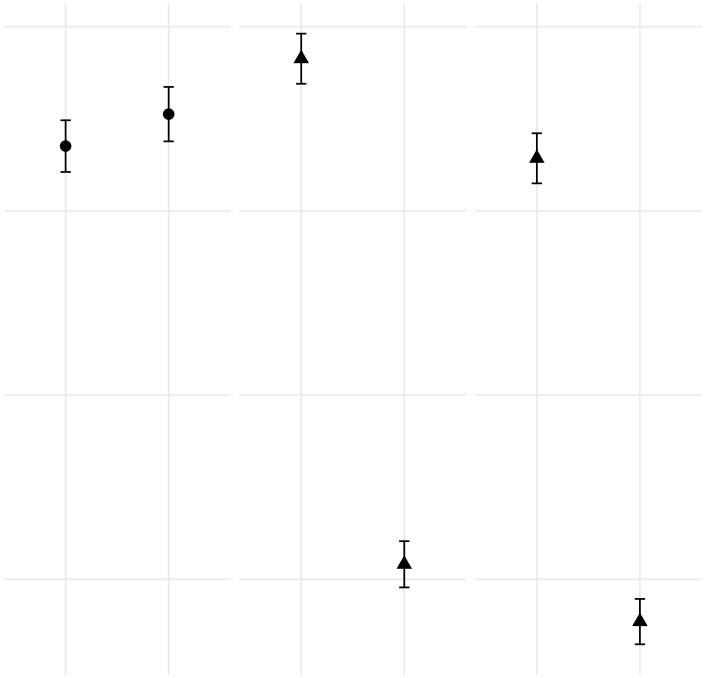


Figure 6.5: Experiment 8 mean ratings by Verb type. Error bars represent standard errors.

ive verb comparison).

The interactions between the Verb type comparisons and Length were significant (ps < 0.001). The full details of the mixed effects model are provided in Appendix A.8.1.

6.4.6 Discussion

Although there is once again a main effect of ENVIRONMENT, with the EVIDENTIAL EXISTENTIAL conditions being slightly higher-rated overall, there is a significant island effect in both environments. Because of this, it is not possible to conclude that the presence of a context that supports an evidential existential use facilitates extraction in any way.

An informal scan of Figure 6.5 suggests that the island effects relative clauses give rise to under both VERB TYPES is on par with those observed in Experiment 7. In other words, the supporting context provided in Experiment 8 appears *not* to have facilitated extraction from the relative clause for either VERB TYPE.

6.5 General discussion

In order to get a better idea of how the presence or absence of context affected relative clause porosity, we need to consider how the relationships between coefficient estimates for the LENGTH | VERB TYPE interactions within each experiment compare to each other across experiments. In the ordinal regression for the Experiment 7 data, the coefficient representing the island effect interaction for EVIDENTIAL EXISTENTIAL was -0.955, and that for TRANSITIVE VERB was -0.908. The coefficient for EVIDENTIAL EXISTENTIAL was 105.2% of the coefficient for TRANSITIVE VERB.

In the ordinal regression for the Experiment 8 data, the coefficient representing the island effect interaction for EVIDENTIAL EXISTENTIAL was -4.718, and that for TRANSITIVE VERB was -4.307. The coefficient for EVIDENTIAL EXISTENTIAL was 109.5% of the coefficient for TRANSITIVE VERB. This suggests that the introduction of supporting context actually exacerbated island effects, rather than reducing or eliminating them.

Chapter 7

Implications and conclusion

This chapter will first summarize the empirical findings of the dissertation. The summary is followed by a brief summary of the methodologies used in this work and a discussion of their usefulness as a tool set for investigating islands. Finally, the dissertation concludes with a discussion of the implications of this work for a theory of islands and directions for future work.

7.1 Summary

This work has three noteworthy findings. First, island effects are almost completely reduced in English relative clauses within the pivot of an existential statement (111a) or within the predicate of a sentence with a nominal predicate (111b).

(111) a. Context: A child is shopping for books with her babysitter, trying to find a short enough book that some adult would be willing to read it aloud to her in one sitting. After bringing multiple books that were too long, the child finally brings a book of reasonable length. The babysitter says:
This is a book which$_i$ I'm sure there's someone [who would read ___$_i$ aloud to you].

b. Context: Two friends who publish a literary magazine together accept anonymous submissions. One friend had gone through the submissions the previous day and thought that John had made one of them. As they go through the sub-

missions together, the first friend is looking for the one she believed John wrote. When she finds it, she says:
Here is the submission which$_i$ I bet John is the one [who wrote ___$_i$].

Island effect has been operationalized as a super-additive interaction between the following four conditions in a factorial acceptability judgment experiment.

(112) a. a short movement dependency and a non-island embedded clause
b. long movement dependency from a non-island embedded clause
c. short movement dependency and an embedded clause that is a predicted island
d. long movement dependency from an embedded clause that is a predicted island

The finding has both a relative sense and an absolute sense. Experiment 3 showed that as compared to relative clauses in a transitive object environment, the super-additive interaction is reduced for relative clauses in existential and predicate nominal environments. That is, relative clauses give rise to a *less substantial* island effect in these environments compared to transitive object environments. In addition, the very low DD scores derived from the ratings for the conditions in (112) support the claim that relative clauses in existential and predicate nominal environments basically don't give rise to island effects.

Second, island effects are essentially absent in subject-relativized infinitival relative clauses (113). Although this was not predicted, the finding can be taken as confirming Bhatt's (1999) analysis of subject infinitival relatives.

(113) Which mountain$_i$ were you the first person [to climb ___$_i$ last year]?

Third, island effects persist for relative clauses within the direct object of a transitive verb, regardless of whether that verb is more likely to be used in an existential way. Island effects are stable even when context is provided that strongly supports an existential use.

7.2 Theoretical implications and future work

Although this work has mainly focused on using experimental methodologies to measure relative clause island effects more precisely than is possible with informal judgments collected

in an uncontrolled experiment, I would like to conclude by taking a step back and considering how the results presented here fit into the theoretical landscape (in particular, into a theory of islands and island effects).

Let us start by taking for granted that there is a real difference in the acceptability of the class of extractions discussed here, something I hope to have convinced the reader of by now. Consider the two broad categories of explanation for this phenomenon shown in (114).

(114) a. Acceptable extraction from relative clauses is not so much a grammatical phenomenon as it is an acceptability–grammaticality mapping phenomenon. That is, it is a reflection of a complex interaction between unconscious grammatical knowledge and perception of acceptability.

b. Acceptable extraction from relative clauses is a grammatical phenomenon. That is, it is a reflection of grammatical knowledge, and an explanation ought to be put in generative syntactic terms.

We will consider these two classes of explanation separately.

7.2.1 An acceptability–grammaticality issue

Under the broad hypothesis that the phenomenon observed here is due to the interactions of grammatical knowledge and perception of acceptability, there are two sub-hypotheses relating to the role the grammar has in relative clause island effects.

One stance is that no cases of extraction from a relative clause are generated by the grammar. On this view, what must be explained is why some cases of extraction from a relative clause are acceptable. An explanation of this kind would likely take the effects to be the result of a grammatical illusion (see Phillips et al. 2011 for a survey of grammatical illusions). A grammatical illusion account is proposed by Kush et al. (2013) for cases of extraction from relative clauses in English which takes inspiration from reanalysis in the online processing of garden path sentences (Staub 2007).

Although the grammatical illusion hypothesis may have been consistent with the findings of Kush et al. (2013), it is incompatible with the results described here—those of Experiment 3 in particular, which show a nearly complete reduction in island effects. Although there

are certain highly acceptable illusions (e.g. the Moses illusion, which is semantico-pragmatic in nature, and comparative illusions), the illusion proposed by Kush et al. (2013) is only expected to result in partial amelioration of island effects, so the effect the hypothesis predicts is too small compared to what has been observed in the present work.

The alternative stance, of course, is that all cases of extraction from a relative clause are generated by the grammar. These accounts, which Sprouse et al. (2012) term "reductionist" accounts, must then find some way to explain why certain syntactic domains give rise to island effects. The relevant literature advocating for reductionist accounts includes Hofmeister et al. (2012), Hofmeister and Sag (2010), Kluender (1992, 1998), and Kluender and Kutas (1993); for a high-level overview, see Boeckx (2012).

There are good reasons to consider reductionist accounts of island effects. From a theory-internal perspective, reductionist accounts permit a more minimalist theory of syntax. They are also founded partly on the idea that many of the structures that are characterized as islands are relatively costly to process, an idea which online processing studies have validated (e.g. Wagers and Phillips 2014).

Despite their appeal, reductionist accounts of island effects face general challenges. First, they rely on the idea that processing costs are responsible for the often-severe degradation that results from extracting out of an island domain. As a central part of the hypothesis, the processing costs (and degradation) are predicted to be relatively constant, and processing hallmarks like the suspension of the Active Filler Strategy in island domains are predicted to show up reliably. This is not always borne out, however. For example, Phillips (2006) shows that when it comes to parasitic gaps, Active Filler Strategy is selectively suspended, but only in the set of islands and environments that cannot support parasitic gaps—a clear sign that grammatical knowledge is utilized when processing at least some island "violations".

The findings from the mixture modeling for Experiment 3, presented in §4.2.6, also suggests that processing costs are unlikely to underlie the reduction in island effects observed in Experiment 3. As discussed in Sprouse et al. (2012, 2013b), reductionist accounts predict variation in island effects to fall out from variation in individual participants' working mem-

ory capacity. This kind of account predicts that in the critical conditions (extraction from a relative clause in the EXISTENTIAL and PREDICATE environments), we would observe a GRADIENT of ratings that varies with participants' working memory capacity. However, the mixture modeling methods revealed that the ratings distributions for the critical conditions are not well described by a GRADIENT model. They are best described by a DISCRETE model, suggesting that a sizeable chunk of participants rates the critical conditions as they would rate a fully grammatical sentence, while another chunk rates the critical conditions as they would rate a genuinely ungrammatical sentence.

Although a theory of the mapping between grammaticality and acceptability is needed to really complete this argument, one of the possibilities that the discrete model's favorability suggests is that there is a certain parse of the critical conditions that is fully grammatical and a separate parse that turns out to be ungrammatical. This possibility is explored in §7.2.2. For a more thorough discussion of the arguments against reductionist accounts, see Phillips (2013) and Sprouse et al. (2012, 2013b), as well as the overviews in Chapter 2 of Boeckx (2012).

7.2.2 A grammatical (syntactic) issue

Departing from the idea that the phenomenon observed in the present work is not solely a grammaticality–acceptability mapping phenomenon, we will now consider the idea that the reduction in island effects observed in Experiment 3 is grammatical in nature. That is, the reduction in island effects is a function of grammatical island constraints and when and where these constraints are active. Within this broad idea are two kinds of hypothesis: the critical cases of extraction are grammatical because the domains extracted from are not "real" relative clauses (and hence not real islands); or the critical cases of extraction are grammatical because there is a grammatical path to extraction from relative clauses (which are still "real" islands in a relevant sense).

Only pseudo-relatives are porous

The hypothesis that acceptable cases of extraction from relative clauses do not actually involve relative clauses will be called the pseudo-relative hypothesis. Under this hypothesis, acceptable extraction never occurs from bona fide relative clauses, and the kinds of acceptable extraction observed in the present work is possible because the extraction did not occur from within a bona fide relative clause.

One analysis that falls into this camp is the analysis Kush et al. (2013) propose for extraction from relative clauses in Swedish. They propose that the apparent extractions from relative clauses in Swedish are actually extractions from small clauses introduced by an element that serves to introduce both relative clauses and small clauses. There is no parallel to this analysis for English, however, which never uses relative clause introducers to introduce small clauses; and additionally, the analysis has been convincingly argued against even for Swedish (Lindahl 2017; C. Müller 2014, 2015).

Another idea that falls into this camp is suggested by McCawley (1981), who actually observes that some relative clauses are relatively porous in English. He calls those relative clauses that occur in positive and negative existential environments "pseudo-relatives" (1981, p. 107), describing a number of intriguing facts that suggest differences between relative clauses in these environments and relative clauses in non-existential environments. As shown in (115), certain appositives, such as *as you know*, can acceptably interrupt a head NP and a relative clause in both cleft (115a) and existential (115b) environments, while the same relative clause in a different environment (115c) cannot be cleaved from its head NP in this way.

(115) a. It was Sam, as you know, that Lucy was talking to. (McCawley 1981, p. 106)

b. There are many Americans, as you know, who distrust politicians. (McCawley 1981, p. 106)

c. ?Rothbard and Royko are two Americans, as you know, who distrust politicians. (McCawley 1981, p. 106)

Although McCawley does present intriguing facts like those in (115), I doubt that the ef-

fect described is syntactic in nature. If the doubt is warranted, this calls into question the idea that the so-called pseudo-relatives are really anything other than bona fide relative clauses. I would like to suggest that the acceptability of interrupting a head NP and its associated relative clause with an appositive is due to a pragmatically induced garden path related to the felicitousness of the material preceding the appositive as an independent utterance. In (115a–115b), the material before the appositive is either so vague or so obvious that a reader or listener would doubt the utterance is complete (116). In an out-of-the-blue context, (116a) is infelicitous because of the unspecified context that is unneeded once the relative clause part of the cleft is uttered. And (116b) is infelicitous in most relevant contexts because the proposition *There are many Americans* is already a part of the common ground of most interlocutors; the assertion feels tautological without the content contributed by the relative clause in (115b). The addition of the appositive without the relative clause content would probably sound downright rude to most interlocutors, a sure sign that the pre-appositive part is uninformative as an independent utterance.

(116) a. #[Out of the blue:] It was Sam, as you know.

b. There are many Americans, as you know.

Because the part of the utterance preceding the appositive is not expected to exhaust the main content of the utterance, the reader/listener is primed to expect additional content and experiences no surprise when a relative clause appears after the appositive.

On the other hand, there is likely to be some surprise at the relative clause when the pre-appositive content can serve as a felicitous utterance on its own (as in (115c)) and the reader can envision the full utterance ending with the appositive (117).

(117) Rothbard and Royko are two Americans, as you know.

Because McCawley provides no actual analysis of pseudo-relatives and their difference from non–pseudo-relatives, and because the pattern shown above is unlikely to be structural in nature, I do not consider the pseudo-relative proposal a serious contender as a hypothesis.

True relatives are selectively porous

The family of hypotheses which I believe the findings of the present work generally support takes the stance that acceptable cases of extraction from relative clauses are genuine cases of extraction from genuine relative clauses. By this, I mean that the acceptable cases involve movement of an element base-generated within a non-interrogative, DP-internal, gapped CP to some position outside of the DP containing the CP.

The main challenge under this family of hypotheses is to determine what might be structurally different between cases that differ in acceptability but have no obvious differences in structural or interpretive properties. Sichel (2018) has put forth an account in this family of hypotheses that shows that the acceptable cases of extraction can be accounted for by bringing together independently needed assumptions.

A key component of her argument is that relative clauses are generally ambiguous between a raising type and a matching type. The systematic ambiguity of relative clauses is argued for in a number of works such as Bhatt (2002) and Hulsey and Sauerland (2006). Sichel argues the raising relative clause type to be more porous because it occurs as a complement to D, rather than as an adjunct to NP. With fewer intervening nodes for an extractee to cross over, extraction would not only be slightly less costly to process but would be grammatically licit if NP is ordinarily a phase, as Sichel argues. This assumes that some kind of "escape hatch" is available in raising relative clauses, whether that is analyzed in terms of an expanded CP projection with additional escape hatch specifiers (as in Sichel 2018) or a CP with multiple specifier positions available.

An additional necessary component of Sichel is the assumption that presupposed elements undergo movement that is string-vacuous or covert in languages like English and Hebrew. If presupposed phrases undergo movement, they are frozen (in the sense of e.g. Jurka 2009; see Sichel 2018, p. 355 for a more complete list of references on the Freezing Condition). This explains why it is less possible to extract from a relative clause in a definite DP, and why the cases of acceptable extraction from relative clauses generally seem to be existential or non-presupposed in nature.

Sichel's analysis draws no connection between the raising relative clause ingredient and the existential or non-presupposed ingredient; under her analysis, those are simply two factors that must coincide in order for extraction to be possible. However, there may be a connection between raising relatives and existential assertions about the head NP that would make this family of analyses even more plausible. This will be discussed in §7.2.3, which discusses paths for future research.

7.2.3 Where to go next

There are a number of open questions which warrant future research on the topic discussed here. More immediately on the horizon involve questions about the implementation of the experiments presented in this work. In order of recency of discussion, the first of these involves questions about the effects of context supporting an evidential existential interpretation (Experiments 7 and 8). The lack of an effect of context in Experiment 8 raises questions about the construction of the items. Indeed, examination of the items provides some possible explanations for the lack of effect observed. Considering the sample item for Experiment 8, repeated below as (118), the reader will notice that the DP embedding the relative clause in the LONG | ISLAND conditions was created with the definite determiner, as were all such DPs in the Experiment 8 items.

(118) EXPERIMENT 8 SAMPLE ITEM
Question: Is there anyone who can fix this issue?

a. This is the person that claimed that the politician can fix this issue. SH | NO | CP
b. This is an issue that I claimed that the politician can fix. LO | NO | CP
c. This is the person that met the politician who can fix this issue. SH | IS | EV
d. This is an issue that I met the politician who can fix. LO | IS | EV
e. This is the person that advised the politician who can fix this issue. SH | IS | TR
f. This is an issue that I advised the politician who can fix. LO | IS | TR

To adequately investigate the issues that Experiments 6, 7, and 8 set out to address, the items should be revised to give the best chances for acceptable extraction. A very simple

change such as changing the relevant determiner to an indefinite one that facilitates a non-presupposed interpretation would probably suffice, but another possible way to give the items the best chance is to implement some of the Discourse Locality Theory considerations that were discussed in Chapter 5. If additional factors such as processing a tense discourse referent could have an adverse impact on acceptability ratings of extraction cases for reasons unrelated to the current research questions, then one additional change worth considering is whether tense that occurs along the path of the long-distance extractee could be made infinitival. This may be part of the reason why examples such as (119) are so acceptable.

(119) This is a paper$_j$ that we really need to find someone [who$_i$ ___ $_i$ understands ___ $_j$]

Another issue related to the infinitival experiments presented in Chapter 5 is that they were only intended to test infinitival relatives that are formed on the relative clause subject. As was discussed in that chapter, these are probably not islands in any context, which is predicted by the analysis put forth in Bhatt (1999). Although the empirical findings resulting from those experiments are new, to my knowledge, the question about the impact of intervening discourse referents like tense on processing long-distance dependencies cannot be fully addressed until a similar set of experiments is created whose items involve non-subject infinitival relatives. An experiment that makes these changes would perhaps also benefit from the changes suggested in the previous paragraph about tense outside of the relative clause. These issues must be left to future work.

Finally, it would be useful to investigate whether there is a connection between existential assertions about a head NP and raising relative clauses. As mentioned above, Sichel's structural analysis of extraction from relative clauses in Hebrew does not link these two properties together. However, there is some evidence to suggest that they may be linked. In Chamorro (Austronesian; Micronesia), canonical existential statements which modify the pivot with a relative clause must do so using a raising relative clause, as argued by Chung (1987, p. 219). Relative clauses in Chamorro existentials have a handful of characteristics that distinguish them from non-existential relative clauses: they involve the same complementizers as embedded questions, they cannot be stacked, and they require the same kind of *wh*-

agreement as questions. Chung (1987) argues that these properties must hold of relative clauses embedded in the existential pivot because such relative clauses must be raising relatives. Although the present investigation centers around extraction patterns in English, the observation that existentiality and raising relative clauses may be linked in other languages is highly relevant and deserves a thorough cross-linguistic investigation into this potential connection.

Appendix A

Supplementary experiment materials

A.1 Experiment 1: Definiteness

A.1.1 Model

A mixed effects analysis (with random effects for subjects and items) was performed in R using the `clmm()` function provided by the `Ordinal` package (Christensen 2019).

Table A.1: Coefficients for Experiment 1 Mixed Effects Model

	β	SE	z	p	<0.05?
Definiteness	-0.7634	0.1757	-4.345	$1.39*10^{-05}$	✓
Structure	-1.9688	0.2523	-7.802	$6.10*10^{-15}$	✓
Length	-3.2657	0.3306	-9.877	$<2*10^{-16}$	✓
Definiteness × Structure	0.1490	0.4126	0.361	0.718	
Definiteness × Length	0.1955	0.3421	0.572	0.568	
Structure × Length	-2.2987	0.4679	-4.913	$8.97*10^{-07}$	✓
Definiteness × Structure × Length	-0.1072	0.6335	-0.169	0.866	

The contrasts for the DEFINITENESS factor were –0.5 and 0.5 for DEFINITE and INDEFINITE, respectively. The negative coefficient (β) for the DEFINITENESS effect indicates that definite DPs significantly improve ratings overall relative to indefinite DPs.

The contrasts for the STRUCTURE factor were –0.5 and 0.5 for NON-ISLAND and ISLAND, respectively. The significant effect of STRUCTURE has a negative coefficient, indicating that the presence of the NON-ISLAND structures significantly improve ratings relative to the ISLAND structures.

For the LENGTH factor, contrasts were set to –0.5 and 0.5 for SHORT and LONG, respectively, so the negative coefficient for LENGTH indicates that SHORT conditions were significantly better than LONG conditions.

STRUCTURE and LENGTH interact significantly, and the coefficient is negative. This indicates that long extraction from an island causes significant degradation to ratings relative to long extraction from a non-island.

A.1.2 CP complements to N

In the CP complement items, non-island conditions, matrix verbs that select for CP complements were chosen that also have noun homophones (e.g. *worry*) that select for CP complements. In the island conditions, a separate matrix verb was chosen that could take the noun homophone as its complement. This created a length differential between the island and non-island conditions in the CP complement items that is evident in the sample item below.

(120) SAMPLE ITEM: CP COMPLEMENT ISLAND (EXPERIMENT 1)

a. Who worried that the builder didn't seal the windows? SHORT | DEF | NON-ISLAND
b. Who worried that a builder didn't seal the windows? SHORT | IND | NON-ISLAND
c. What did Steve worry that the builder didn't seal? LONG | DEF | NON-ISLAND
d. What did Steve worry that a builder didn't seal? LONG | IND | NON-ISLAND
e. Who expressed the worry that the builder didn't seal the windows? SHORT | DEF | ISLAND
f. Who expressed a worry that the builder didn't seal the windows? SHORT | IND | ISLAND
g. What did Steve express the worry that the builder didn't seal? LONG | DEF | ISLAND
h. What did Steve express a worry that the builder didn't seal? LONG | IND | ISLAND

A.1.3 Items

Table A.2: Condition legend

STRUCTURE	LENGTH	DEFINITENESS (of head NP)
NO = NON-ISLAND	SH = SHORT	DE = DEFINITE
IS = ISLAND	LO = LONG	IN = INDEFINITE

(121) ITEM 1

a. Who noticed that the teacher wears a bowtie? NO | SH | DE
b. Who noticed that a teacher wears a bowtie? NO | SH | IN
c. What did Delilah notice that the teacher wears? NO | LO | DE
d. What did Delilah notice that a teacher wears? NO | LO | IN
e. Who noticed the teacher who wears a bowtie? IS | SH | DE
f. Who noticed a teacher who wears a bowtie? IS | SH | IN
g. What did Delilah notice the teacher who wears? IS | LO | DE
h. What did Delilah notice a teacher who wears? IS | LO | IN

(122) ITEM 2

a.	Who trusts that the senator cares about the constitution?	NO | SH | DE
b.	Who trusts that a senator cares about the constitution?	NO | SH | IN
c.	What does Sarah trust that the senator cares about?	NO | LO | DE
d.	What does Sarah trust that a senator cares about?	NO | LO | IN
e.	Who trusts the senator who cares about the constitution?	IS | SH | DE
f.	Who trusts a senator who cares about the constitution?	IS | SH | IN
g.	What does Sarah trust the senator who cares about?	IS | LO | DE
h.	What does Sarah trust a senator who cares about?	IS | LO | IN

(123) ITEM 3

a.	Who respected that the citizens dislike being photographed?	NO | SH | DE
b.	Who respected that citizens dislike being photographed?	NO | SH | IN
c.	What did Briana respect that the citizens dislike?	NO | LO | DE
d.	What did Briana respect that citizens dislike?	NO | LO | IN
e.	Who respected the citizens who dislike being photographed?	IS | SH | DE
f.	Who respected citizens who dislike being photographed?	IS | SH | IN
g.	What did Briana respect the citizens who dislike?	IS | LO | DE
h.	What did Briana respect citizens who dislike?	IS | LO | IN

(124) ITEM 4

a.	Who found that the newspaper reprinted false claims?	NO | SH | DE
b.	Who found that a newspaper reprinted false claims?	NO | SH | IN
c.	What did Peter find that the newspaper reprinted?	NO | LO | DE
d.	What did Peter find that a newspaper reprinted?	NO | LO | IN
e.	Who found the newspaper that reprinted false claims?	IS | SH | DE
f.	Who found a newspaper that reprinted false claims?	IS | SH | IN
g.	What did Peter find the newspaper that reprinted?	IS | LO | DE
h.	What did Peter find a newspaper that reprinted?	IS | LO | IN

(125) ITEM 5

a.	Who likes that the gardeners mow the lawn once a month?	NO | SH | DE
b.	Who likes that gardeners mow the lawn once a month?	NO | SH | IN
c.	What does Fred like that the gardeners mow once a month?	NO | LO | DE
d.	What does Fred like that gardeners mow once a month?	NO | LO | IN
e.	Who likes the gardeners who mow the lawn once a month?	IS | SH | DE
f.	Who likes gardeners who mow the lawn once a month?	IS | SH | IN
g.	What does Fred like the gardeners who mow once a month?	IS | LO | DE
h.	What does Fred like gardeners who mow once a month?	IS | LO | IN

(126) ITEM 6

a.	Who believes that the salesmen wash their car every weekend?	NO | SH | DE
b.	Who believes that salesmen wash their car every weekend?	NO | SH | IN
c.	What does Daniel believe that the salesmen wash every weekend?	NO | LO | DE
d.	What does Daniel believe that salesmen wash every weekend?	NO | LO | IN
e.	Who believes the salesmen who wash their car every weekend?	IS | SH | DE
f.	Who believes salesmen who wash their car every weekend?	IS | SH | IN
g.	What does Daniel believe the salesmen who wash every weekend?	IS | LO | DE
h.	What does Daniel believe salesmen who wash every weekend?	IS | LO | IN

(127) ITEM 7

a.	Who knew that the child plays chess in the park?	NO | SH | DE
b.	Who knew that a child plays chess in the park?	NO | SH | IN
c.	What did Wendell know that the child plays in the park?	NO | LO | DE
d.	What did Wendell know that a child plays in the park?	NO | LO | IN
e.	Who knew the child who plays chess in the park?	IS | SH | DE
f.	Who knew a child who plays chess in the park?	IS | SH | IN
g.	What did Wendell know the child who plays in the park?	IS | LO | DE
h.	What did Wendell know a child who plays in the park?	IS | LO | IN

(128) ITEM 8

a.	Who predicted that the lending crisis would trigger the recession?	NO | SH | DE
b.	Who predicted that a lending crisis would trigger the recession?	NO | SH | IN
c.	What did Peter predict that the lending crisis would trigger?	NO | LO | DE
d.	What did Peter predict that a lending crisis would trigger?	NO | LO | IN
e.	Who predicted the lending crisis that would trigger the recession?	IS | SH | DE
f.	Who predicted a lending crisis that would trigger the recession?	IS | SH | IN
g.	What did Peter predict the lending crisis that would trigger?	IS | LO | DE
h.	What did Peter predict a lending crisis that would trigger?	IS | LO | IN

(129) ITEM 9

a.	Who understands that the teachers dislike unstapled papers?	NO | SH | DE
b.	Who understands that teachers dislike unstapled papers?	NO | SH | IN
c.	What does Lorena understand that the teachers dislike?	NO | LO | DE
d.	What does Lorena understand that teachers dislike?	NO | LO | IN
e.	Who understands the teachers who dislike unstapled papers?	IS | SH | DE
f.	Who understands teachers who dislike unstapled papers?	IS | SH | IN
g.	What does Lorena understand the teachers who dislike?	IS | LO | DE
h.	What does Lorena understand teachers who dislike?	IS | LO | IN

(130) ITEM 10

a.	Who reported that the group had filed a lawsuit?	NO | SH | DE
b.	Who reported that a group had filed a lawsuit?	NO | SH | IN
c.	What did Rebecca report that the group had filed?	NO | LO | DE
d.	What did Rebecca report that a group had filed?	NO | LO | IN
e.	Who reported the group that filed a lawsuit?	IS | SH | DE
f.	Who reported a group that filed a lawsuit?	IS | SH | IN
g.	What did Rebecca report the group who filed?	IS | LO | DE
h.	What did Rebecca report a group who filed?	IS | LO | IN

(131) ITEM 11

a.	Who remembers that the students asked everyone in town for donations?	NO | SH | DE
b.	Who remembers that students asked everyone in town for donations?	NO | SH | IN
c.	What does Brian remember that the students asked everyone in town for?	NO | LO | DE
d.	What does Brian remember that students asked everyone in town for?	NO | LO | IN
e.	Who remembers the students who asked everyone in town for donations?	IS | SH | DE
f.	Who remembers students who asked everyone in town for donations?	IS | SH | IN
g.	What does Brian remember the students who asked everyone in town for?	IS | LO | DE
h.	What does Brian remember students who asked everyone in town for?	IS | LO | IN

(132) ITEM 12

a.	Who taught that the Americans started the war?	NO | SH | DE
b.	Who taught that Americans started the war?	NO | SH | IN
c.	What did Amanda teach that the Americans started?	NO | LO | DE
d.	What did Amanda teach that Americans started?	NO | LO | IN
e.	Who taught the Americans that started the war?	IS | SH | DE
f.	Who taught Americans that started the war?	IS | SH | IN
g.	What did Amanda teach the Americans that started?	IS | LO | DE
h.	What did Amanda teach Americans that started?	IS | LO | IN

(133) ITEM 13

a.	Who wrote that the character in the book is afraid of open spaces?	NO | SH | DE
b.	Who wrote that a character in the book had a fear of open spaces?	NO | SH | IN
c.	What did James write that the character in the book is afraid of?	NO | LO | DE
d.	What did James write that a character in the book is afraid of?	NO | LO | IN
e.	Who wrote the character in the book who is afraid of open spaces?	IS | SH | DE
f.	Who wrote a character in the book who is afraid of open spaces?	IS | SH | IN
g.	What did James write the character in the book who is afraid of?	IS | LO | DE
h.	What did James write a character in the book who is afraid of?	IS | LO | IN

(134) ITEM 14

a.	Who appreciated that the students finished the optional assignment?	NO | SH | DE
b.	Who appreciated that students finished the optional assignment?	NO | SH | IN
c.	What did Patty appreciate that the students finished?	NO | LO | DE
d.	What did Patty appreciate that students finished?	NO | LO | IN
e.	Who appreciated the students who finished the optional assignment?	IS | SH | DE
f.	Who appreciated students who finished the optional assignment?	IS | SH | IN
g.	What did Patty appreciate the students who finished?	IS | LO | DE
h.	What did Patty appreciate students who finished?	IS | LO | IN

(135) ITEM 15

a.	Who revealed that the Uber driver became an election candidate?	NO | SH | DE
b.	Who revealed that an Uber driver became an election candidate?	NO | SH | IN
c.	What did Stefan reveal that the Uber driver became?	NO | LO | DE
d.	What did Stefan reveal that an Uber driver became?	NO | LO | IN
e.	Who revealed the Uber driver who became an election candidate?	IS | SH | DE
f.	Who revealed an Uber driver who became an election candidate?	IS | SH | IN
g.	What did Stefan reveal the Uber driver who became?	IS | LO | DE
h.	What did Stefan reveal an Uber driver who became?	IS | LO | IN

(136) ITEM 16

a.	Who suggested that the artists used expired paint for the mural?	NO | SH | DE
b.	Who suggested that artists used expired paint for the mural?	NO | SH | IN
c.	What did Janet suggest that the artists used for the mural?	NO | LO | DE
d.	What did Janet suggest that artists used for the mural?	NO | LO | IN
e.	Who suggested the artists who used expired paint for the mural?	IS | SH | DE
f.	Who suggested artists who used expired paint for the mural?	IS | SH | IN
g.	What did Janet suggest the artists who used for the mural?	IS | LO | DE
h.	What did Janet suggest artists who used for the mural?	IS | LO | IN

(137) ITEM 17

a. Who claimed that the university wants to hire Stanley? NO | SH | DE
b. Who claimed that a university wants to hire Stanley? NO | SH | IN
c. Who did Salazar claim that the university wants to hire? NO | LO | DE
d. Who did Salazar claim that a university wants to hire? NO | LO | IN
e. Who heard the claim that the university wants to hire Stanley? IS | SH | DE
f. Who heard a claim that the university wants to hire Stanley? IS | SH | IN
g. Who did Salazar hear the claim that the university wants to hire? IS | LO | DE
h. Who did Salazar hear a claim that the university wants to hire? IS | LO | IN

(138) ITEM 18

a. Who worried that the builder didn't seal the windows? NO | SH | DE
b. Who worried that a builder didn't seal the windows? NO | SH | IN
c. What did Steve worry that the builder didn't seal? NO | LO | DE
d. What did Steve worry that a builder didn't seal? NO | LO | IN
e. Who expressed the worry that the builder didn't seal the windows? IS | SH | DE
f. Who expressed a worry that the builder didn't seal the windows? IS | SH | IN
g. What did Steve express the worry that the builder didn't seal? IS | LO | DE
h. What did Steve express a worry that the builder didn't seal? IS | LO | IN

(139) ITEM 19

a. Who complained that the mechanic didn't inspect the brakes? NO | SH | DE
b. Who complained that a mechanic didn't inspect the brakes? NO | SH | IN
c. What did Alicia complain that the mechanic didn't inspect? NO | LO | DE
d. What did Alicia complain that a mechanic didn't inspect? NO | LO | IN
e. Who filed the complaint that the mechanic didn't inspect the brakes? IS | SH | DE
f. Who filed a complaint that the mechanic didn't inspect the brakes? IS | SH | IN
g. What did Alicia file the complaint that the mechanic didn't inspect? IS | LO | DE
h. What did Alicia file a complaint that the mechanic didn't inspect? IS | LO | IN

(140) ITEM 20

a. Who hinted that the lawyer hopes to delay the trial? NO | SH | DE
b. Who hinted that a lawyer hopes to delay the trial? NO | SH | IN
c. What did Patty hint that the lawyer hopes to delay? NO | LO | DE
d. What did Patty hint that a lawyer hopes to delay? NO | LO | IN
e. Who overheard the hint that the lawyer hopes to delay the trial? IS | SH | DE
f. Who overheard a hint that the lawyer hopes to delay the trial? IS | SH | IN
g. What did Patty overhear the hint that the lawyer hopes to delay? IS | LO | DE
h. What did Patty overhear a hint that the lawyer hopes to delay? IS | LO | IN

(141) ITEM 21

a. Who argued that the new councilmember was supported by special interest groups? NO | SH | DE
b. Who argued that a new councilmember was supported by special interest groups? NO | SH | IN
c. What did Vivian argue that the new councilmember was supported by? NO | LO | DE
d. What did Vivian argue that a new councilmember was supported by? NO | LO | IN
e. Who made the argument that the new councilmember was supported by special interest groups? IS | SH | DE

f. Who made an argument that the new councilmember was supported by special interest groups? IS | SH | IN
g. What did Vivian make the argument that the new councilmember was supported by? IS | LO | DE
h. What did Vivian make an argument that the new councilmember was supported by? IS | LO | IN

(142) ITEM 22

a. Who dreamed that the local bakery would start selling donuts? NO | SH | DE
b. Who dreamed that a local bakery would start selling donuts? NO | SH | IN
c. What did Leah dream that the local bakery would start selling? NO | LO | DE
d. What did Leah dream that a local bakery would start selling? NO | LO | IN
e. Who had the dream that the local bakery would start selling donuts? IS | SH | DE
f. Who had a dream that the local bakery would start selling donuts? IS | SH | IN
g. What did Leah have the dream that the local bakery would start selling? IS | LO | DE
h. What did Leah have a dream that the local bakery would start selling? IS | LO | IN

(143) ITEM 23

a. Who requested that the employee undergo anger management counseling? NO | SH | DE
b. Who requested that an employee undergo anger management counseling? NO | SH | IN
c. What did Hector request that the employee undergo? NO | LO | DE
d. What did Hector request that an employee undergo? NO | LO | IN
e. Who resented the request that the employee undergo anger management counseling? IS | SH | DE
f. Who resented a request that the employee undergo anger management counseling? IS | SH | IN
g. What did Hector resent the request that the employee undergo? IS | LO | DE
h. What did Hector resent a request that the employee undergo? IS | LO | IN

(144) ITEM 24

a. Who lied that the committee used up the surplus funds? NO | SH | DE
b. Who lied that a committee used up the surplus funds? NO | SH | IN
c. What did Anton lie that the committee used up? NO | LO | DE
d. What did Anton lie that a committee used up? NO | LO | IN
e. Who exposed the lie that the committee used up the surplus funds? IS | SH | DE
f. Who exposed a lie that the committee used up the surplus funds? IS | SH | IN
g. What did Anton expose the lie that the committee used up? IS | LO | DE
h. What did Anton expose a lie that the committee used up? IS | LO | IN

(145) ITEM 25

a. Who confessed that the rival team planned to sabotage the event? NO | SH | DE
b. Who confessed that a rival team planned to sabotage the event? NO | SH | IN
c. What did Paul confess that the rival team planned to sabotage? NO | LO | DE
d. What did Paul confess that a rival team planned to sabotage? NO | LO | IN
e. Who recorded the confession that the rival team planned to sabotage the event? IS | SH | DE
f. Who recorded a confession that the rival team planned to sabotage the event? IS | SH | IN

g. What did Paul record the confession that the rival team planned to sabotage? IS | LO | DE

h. What did Paul record a confession that the rival team planned to sabotage? IS | LO | IN

(146) ITEM 26

a. Who suggested that the book could inspire the practice of witchcraft? NO | SH | DE

b. Who suggested that a book could inspire the practice of witchcraft? NO | SH | IN

c. What did Sonya suggest that the book could inspire? NO | LO | DE

d. What did Sonya suggest that a book could inspire? NO | LO | IN

e. Who challenged the suggestion that the book could inspire the practice of witchcraft? IS | SH | DE

f. Who challenged a suggestion that the book could inspire the practice of witchcraft? IS | SH | IN

g. What did Sonya challenge the suggestion that the book could inspire? IS | LO | DE

h. What did Sonya challenge a suggestion that the book could inspire? IS | LO | IN

(147) ITEM 27

a. Who speculated that the group would discover alien life? NO | SH | DE

b. Who speculated that a group would discover alien life? NO | SH | IN

c. What did Steven speculate that the group would discover? NO | LO | DE

d. What did Steven speculate that a team would discover? NO | LO | IN

e. Who supported the speculation that the group would discover alien life? IS | SH | DE

f. Who supported a speculation that the group would discover alien life? IS | SH | IN

g. What did Steven support the speculation that the group would discover? IS | LO | DE

h. What did Steven support a speculation that the group would discover? IS | LO | IN

(148) ITEM 28

a. Who warned that the government would take over the union? NO | SH | DE

b. Who warned that a government would take over the union? NO | SH | IN

c. What did Amelia warn that the government would take over? NO | LO | DE

d. What did Amelia warn that a government would take over? NO | LO | IN

e. Who sounded the warning that the government would take over the union? IS | SH | DE

f. Who sounded a warning that the government would take over the union? IS | SH | IN

g. What did Amelia sound the warning that the government would take over? IS | LO | DE

h. What did Amelia sound a warning that the government would take over? IS | LO | IN

(149) ITEM 29

a. Who threatened that the county worker could condemn the property? NO | SH | DE

b. Who threatened that a county worker could condemn the property? NO | SH | IN

c. What did Bobby threaten that the country worker could condemn? NO | LO | DE

d. What did Bobby threaten that a county worker could condemn? NO | LO | IN

e. Who issued the threat that the county worker could condemn the property? IS | SH | DE

f. Who issued a threat that the county worker could condemn the property? IS | SH | IN

g. What did Bobby issue the threat that the county worker could condemn? IS | LO | DE

h. What did Bobby issue a threat that the county worker could condemn? IS | LO | IN

(150) ITEM 30

a. Who guaranteed that the news story would reveal the president's secrets? NO | SH | DE
b. Who guaranteed that a news story would reveal the president's secrets? NO | SH | IN
c. What did Marissa guarantee that the news story would reveal? NO | LO | DE
d. What did Marissa guarantee that a news story would reveal? NO | LO | IN
e. Who repeated the guarantee that the news story would reveal the president's secrets? IS | SH | DE
f. Who repeated a guarantee that the news story would reveal the president's secrets? IS | SH | IN
g. What did Marissa repeat the guarantee that the news story would reveal? IS | LO | DE
h. What did Marissa repeat a guarantee that the news story would reveal? IS | LO | IN

(151) ITEM 31

a. Who felt that the company shouldn't oversee its employees' to-do lists? NO | SH | DE
b. Who felt that a company shouldn't oversee its employees' to-do lists? NO | SH | IN
c. What did Joshua feel that the company shouldn't oversee? NO | LO | DE
d. What did Joshua feel that a company shouldn't oversee? NO | LO | IN
e. Who conveyed the feeling that the company shouldn't oversee its employees' to-do lists? IS | SH | DE
f. Who conveyed a feeling that the company shouldn't oversee its employees' to-do lists? IS | SH | IN
g. What did Joshua convey the feeling that the company shouldn't oversee? IS | LO | DE
h. What did Joshua convey a feelings that the company shouldn't oversee? IS | LO | IN

(152) ITEM 32

a. Who demanded that the museum withdraw its offer? NO | SH | DE
b. Who demanded that a museum withdraw its offer? NO | SH | IN
c. What did Shelley demand that the museum withdraw? NO | LO | DE
d. What did Shelley demand that a museum withdraw? NO | LO | IN
e. Who mocked the demand that the museum withdraw its offer? IS | SH | DE
f. Who mocked a demand that the museum withdraw its offer? IS | SH | IN
g. What did Shelley mock the demand that the museum withdraw? IS | LO | DE
h. What did Shelley mock a demand that the museum withdraw? IS | LO | IN

A.1.4 Paper survey sample

Sentence Rating Experiment

Welcome to my experiment! This task involves reading English sentences and rating how acceptable each sentence sounds to you. What I mean by *acceptability* here is how natural or normal the sentence sounds to you as a sentence of English. I am interested in your **intuitive** judgments, which might be different from the judgments you'd expect an English teacher to give. After each sentence, you'll find a set of numbers from 1 to 6. Give your rating of the sentence by circling one of the numbers following that sentence. Use the following scale for reference, which is included at the top of each page.

1	2	3	4	5	6
clearly bad	*pretty bad*	*somewhat bad*	*somewhat good*	*pretty good*	*clearly good*

Using this scale, I might rate a sentence like *"Marianne asked the doctor to examine her knee"* as a ***6***, since it sounds like a normal sentence of English that I could imagine saying in the right circumstance. If I was presented with a sentence like *"Paul asked if such books Liz only reads at home,"* I might give it a ***3***—something's a little off about it to me, and I know I would say it differently. Finally, I might give a sentence like *"I seem eating sushi"* a ***1***—I'm not entirely sure what it would even mean, and it's definitely not something I could imagine myself or another fluent English speaker saying, even in the right situation. Okay, here are the sentences!

What did Peter predict a lending crisis that would trigger?	1 2 3 4 5 6
They all have left and they have done all so deliberately.	1 2 3 4 5 6
The fork is silver-plated and the bowl is enameled.	1 2 3 4 5 6
What did Stefan reveal the Uber driver who became?	1 2 3 4 5 6
How likely to win the race does Susan think John is?	1 2 3 4 5 6
John promised Mary to leave, and Sue did to write more poetry.	1 2 3 4 5 6
The students were punished by their parents and their teachers.	1 2 3 4 5 6
Bill asked if such books John only reads when at home.	1 2 3 4 5 6
I told you when we met that Bill will come to the party.	1 2 3 4 5 6
Who made the argument that the new council-member was supported by special interest groups?	1 2 3 4 5 6
Who discovered that story that painted Beatrice poorly?	1 2 3 4 5 6

1

1	2	3	4	5	6
clearly bad	*pretty bad*	*somewhat bad*	*somewhat good*	*pretty good*	*clearly good*

What did Amanda teach that Americans started?	1 2 3 4 5 6
Joe broke a cup, and Marianne did so with a saucer.	1 2 3 4 5 6
What did Janet suggest artists who used for the mural?	1 2 3 4 5 6
What did Patty hint that a lawyer hopes to delay?	1 2 3 4 5 6
What did a stranger give to which friend of Amanda's?	1 2 3 4 5 6
Who noticed that the teacher wears a bow-tie?	1 2 3 4 5 6
I told you when we met that Bill will come to the party.	1 2 3 4 5 6
Which book did Benjamin argue that Theo returned before reading?	1 2 3 4 5 6
What did Peter find that a newspaper reprinted?	1 2 3 4 5 6
Amanda went to Santa Cruz, and Bill thinks Claire to Monterey.	1 2 3 4 5 6
What the students believe is they will pass the exam.	1 2 3 4 5 6
Last night there was an attempt to shoot oneself.	1 2 3 4 5 6
What do you think that the lawyer forgot at the office?	1 2 3 4 5 6
Deciding which movie to see next makes John very happy.	1 2 3 4 5 6
When this column she started to write, I thought she would be fine.	1 2 3 4 5 6
At that battle the generals who lost were given hell.	1 2 3 4 5 6
Who claimed that the university wants to hire Stanley?	1 2 3 4 5 6
Who questioned that Tobias would finish the project?	1 2 3 4 5 6
What did Amelia warn that a government would take over?	1 2 3 4 5 6
Who did he give statues of to all the season-ticket holders?	1 2 3 4 5 6

1 *clearly bad*	2 *pretty bad*	3 *somewhat bad*	4 *somewhat good*	5 *pretty good*	6 *clearly good*

What did Briana respect that the citizens dislike?	1 2 3 4 5 6
Who understands that the teachers dislike unstapled papers?	1 2 3 4 5 6
Who appreciated that Sally gave gifts to all her teachers?	1 2 3 4 5 6
Lloyd Webber musicals are easy to condemn without even watching.	1 2 3 4 5 6
What did the president predict that Jeb wouldn't do?	1 2 3 4 5 6
Sandy plays the guitar better than Betsy the harmonica.	1 2 3 4 5 6
Who appreciated students who finished the optional assignment?	1 2 3 4 5 6
Lily will dance with the person the king chooses.	1 2 3 4 5 6
Who believes salesmen who wash their car every weekend?	1 2 3 4 5 6
If frankly he's unable to cope, we'll have to replace him.	1 2 3 4 5 6
Who confessed that the rival team planned to sabotage the event?	1 2 3 4 5 6
Sarah convinced Bill that he would go to the party.	1 2 3 4 5 6
I don't think that I will invite any linguists to the party.	1 2 3 4 5 6
What did Reggie believe that Peter fixed last week?	1 2 3 4 5 6
Who the hell did Brenda suggest is in love with who?	1 2 3 4 5 6
Max may have been studying, but Jason may have done so too.	1 2 3 4 5 6
What did Anton expose a lie that the committee used up?	1 2 3 4 5 6
What did Shelley mock a demand that the museum withdraw?	1 2 3 4 5 6
Jack asked Sally to be allowed to take care of himself.	1 2 3 4 5 6
The man that he gave the creeps last night to is over there.	1 2 3 4 5 6

1 *clearly bad*	2 *pretty bad*	3 *somewhat bad*	4 *somewhat good*	5 *pretty good*	6 *clearly good*

Who had a dream that the local bakery would start selling donuts?	1 2 3 4 5 6
The politician bribes very easily to avoid the draft.	1 2 3 4 5 6
Who suggested that a book could inspire the practice of witchcraft?	1 2 3 4 5 6
The cat and dog that were fighting all the time had to be separated.	1 2 3 4 5 6
What did the teacher say the student gave to whom?	1 2 3 4 5 6
Mary believed Peter finished school and Bill Peter got a job.	1 2 3 4 5 6
It will take from three five days for him to recover.	1 2 3 4 5 6
What did Alicia complain that the mechanic didn't inspect?	1 2 3 4 5 6
It will take three to five days for him to recover.	1 2 3 4 5 6
Vivian believes without a doubt her team will win.	1 2 3 4 5 6
There had all hung over the fireplace the portraits by Picasso.	1 2 3 4 5 6
What did Joshua convey the feeling that the company shouldn't oversee?	1 2 3 4 5 6
I told Mr. Smith that I am able to paint the fence together.	1 2 3 4 5 6
The tree grew a century's growth within only ten years.	1 2 3 4 5 6
He seems to that Kim might have solved the problems.	1 2 3 4 5 6
John wants for each person to have fun that you do.	1 2 3 4 5 6
I find it irritating that usually this street is closed.	1 2 3 4 5 6
At that battle were given the generals who lost hell.	1 2 3 4 5 6
They suspected and we believed Peter would visit the hospital.	1 2 3 4 5 6
At that time, what did they believe that Peter fixed?	1 2 3 4 5 6

1 *clearly bad*	2 *pretty bad*	3 *somewhat bad*	4 *somewhat good*	5 *pretty good*	6 *clearly good*

Who made the excuse that Gina made the homework hard to read?	1 2 3 4 5 6
Who repeated a guarantee that the news story would reveal the president's secrets?	1 2 3 4 5 6
Sherry met a man who she found herself very fond of.	1 2 3 4 5 6
That much the less you say, the smarter you will seem.	1 2 3 4 5 6
This is the man who I think will buy your house next year.	1 2 3 4 5 6
Into which room walked the three men that Daniel knows?	1 2 3 4 5 6
We students of physics are taller than you students of chemistry.	1 2 3 4 5 6
I expect that everyone will visit Mary that you do.	1 2 3 4 5 6
What did Steven speculate that the group would discover?	1 2 3 4 5 6
Who issued the threat that the county worker could condemn the property?	1 2 3 4 5 6
Who wrote the character in the book who is afraid of open spaces?	1 2 3 4 5 6
I talked to Mary, with whom you danced yesterday.	1 2 3 4 5 6
Who reported that a group had filed a lawsuit?	1 2 3 4 5 6
Who trusts that a senator cares about the constitution?	1 2 3 4 5 6
What does Brian remember that the students asked everyone in town for?	1 2 3 4 5 6
Who worried that a builder didn't seal the windows?	1 2 3 4 5 6
What did Hector resent the request that the employee undergo?	1 2 3 4 5 6
Who likes the gardeners who mow the lawn once a month?	1 2 3 4 5 6
One interpreter tried to be assigned to every visiting diplomat.	1 2 3 4 5 6

1 *clearly bad*	2 *pretty bad*	3 *somewhat bad*	4 *somewhat good*	5 *pretty good*	6 *clearly good*

Nadine made the argument that John is illegal to park here. 1 2 3 4 5 6

George overheard that last week Sarah saw pictures of. 1 2 3 4 5 6

What did Wendell know the child who plays in the park? 1 2 3 4 5 6

What the students believe is that they will pass the exam. 1 2 3 4 5 6

How many books were there claimed to be on the table? 1 2 3 4 5 6

I visited a city yesterday near the city that John did. 1 2 3 4 5 6

If you have time, please take a moment to answer a few questions.

1. What is your age? _____
2. What is your gender? _____
3. Was it clear what the instructions were asking you to do? _____
4. What did you think of the task? Was it hard to choose a rating for the sentences? _____

_____

5. Do you think you have an idea what the experiment was about? _____

_____

6. One of the things I'm interested in learning from this experiment is whether one of the following sentences is more acceptable to people than the other. Note that the only difference is that *"the"* in the first sentence is switched with *"a"* in the second.

- *What did Nancy make the guess that the dog ate?*
- *What did Nancy make a guess that the dog ate?*

Most people would say that the first sentence is pretty bad, but for some people, the second sentence is slightly better and easier to understand. Would you agree? _____

_____

7. Would you participate in an experiment like this again? _____

Thank you! :-)

A.2 Experiment 2: Existence presuppositions

A.2.1 Model

Simple effects analysis: Version 1

Table A.3: Coefficients for Experiment 2 (Version 1) Simple Effects Model

	β	SE	z	p	<0.05?
DEFINITENESS	-0.09858	0.06776	-1.455	0.146	
HEIGHT	-0.35041	0.04064	-8.623	$<2*10^{-16}$	✓
Dependency type	-3.57022	0.15521	-23.003	$<2*10^{-16}$	✓
DEFINITENESS × Dependency type	0.03399	0.13550	0.251	0.802	
HEIGHT × Dependency type	0.35407	0.08091	4.376	$1.21*10^{-05}$	✓

Helmert contrast coding was given to the SUBJECT factor, such that in the DEFINITENESS comparison, DEFINITE had a negative contrast value of –1 and INDEFINITE had a positive contrast value of 1. In the HEIGHT comparison, the combination of the high subject conditions was assigned a negative contrast value of –2, and the low subject condition was assigned a positive contrast value of 2. The HEIGHT comparison was found to be significant in the simple effects analysis, and the negative coefficient shown in Table A.3 indicates that the high subject conditions on the whole were significantly better than the low subject conditions, a pattern that is visible in Figure 4.2.

Within the DEPENDENCY TYPE factor, the ANAPHORIC level was assigned a negative contrast value of –0.5, and the MOVEMENT level was assigned a positive value of 0.5. The negative coefficient for the main effect of DEPENDENCY TYPE therefore indicates that the ANAPHORIC conditions received significantly better ratings than the MOVEMENT conditions, to no surprise.

The significant interaction of HEIGHT and Dependency type has a positive coefficient. This indicates that in the low subject conditions, ratings were significantly less degraded in the movement condition relative to the anaphoric condition compared to the high subject conditions.

Mixed effects analysis: Version 2 (Mechanical Turk)

Although the coefficients have different values in this mixed effects model, their signs are the same, and the same effects are found to be significant, so the interpretation remains the same as the interpretation for the model in A.2.1.

A.2.2 Items

Table A.4: Coefficients for Experiment 2 (Version 2) Mixed Effects Model

	β	SE	z	p	<0.05?
DEFINITENESS	-0.035	0.122	-0.285	0.776	
HEIGHT	-0.424	0.070	-6.037	$1.57*10^{-09}$	✓
Dependency type	-4.530	0.463	-9.788	$<2*10^{-16}$	✓
DEFINITENESS × Dependency type	0.244	0.231	1.056	0.291	
HEIGHT × Dependency type	0.625	0.156	4.008	$6.11*10^{-05}$	✓

Table A.5: Condition legend

SUBJECT	DEPENDENCY TYPE
TH = EXISTENTIAL *there*	MO = MOVEMENT DEPENDENCY
IN = INDEFINITE	AN = ANAPHORIC DEPENDENCY
DE = DEFINITE	

(153) ITEM 1

a. The president is someone that there are many Americans who supported in the election living in rural areas. TH | MO
b. The president thinks that there are many Americans who supported him in the election living in rural areas. TH | AN
c. The president is someone that many Americans who supported in the election are living in rural areas. IN | MO
d. The president thinks that many Americans who supported him in the election are living in rural areas. IN | AN
e. The president is someone that the Americans who supported in the election are living in rural areas. DE | MO
f. The president thinks that the Americans who supported him in the election are living in rural areas. DE | AN

(154) ITEM 2

a. The Rock is someone that there are two producers who fired from their movie reaching out to other actors. TH | MO
b. The Rock knows that there are two producers who fired him from their movie reaching out to other actors. TH | AN
c. The Rock is someone that two producers who fired from their movie are reaching out to other actors. IN | MO
d. The Rock knows that two producers who fired him from their movie are reaching out to other actors. IN | AN
e. The Rock is someone that the producers who fired from their movie are reaching out to other actors. DE | MO
f. The Rock knows that the producers who fired him from their movie are reaching out to other actors. DE | AN

(155) ITEM 3

a. The vice president is someone that there are many people who follow on social media disagreeing with Republicans. TH | MO
b. The vice president says that there are many people who follow him on social media disagreeing with Republicans. TH | AN
c. The vice president is someone that many people who follow on social media are disagreeing with Republicans. IN | MO
d. The vice president says that many people who follow him on social media are disagreeing with Republicans. IN | AN
e. The vice president is someone that the people who follow on social media are disagreeing with Republicans. DE | MO
f. The vice president says that the people who follow him on social media are disagreeing with Republicans. DE | AN

(156) ITEM 4

a. The queen is someone that there are some citizens who trust completely listening to the news. TH | MO
b. The queen believes that there are some citizens who trust her completely listening to the news. TH | AN
c. The queen is someone that some citizens who trust completely are listening to the news. IN | MO
d. The queen believes that some citizens who trust her completely are listening to the news. IN | AN
e. The queen is someone that the citizens who trust completely are listening to the news. DE | MO
f. The queen believes that the citizens who trust her completely are listening to the news. DE | AN

(157) ITEM 5

a. The first lady is someone that there are several reporters who meet during press events writing biographies. TH | MO
b. The first lady claims that there are several reporters who meet her during press events writing biographies. TH | AN
c. The first lady is someone that several reporters who meet during press events are writing biographies. IN | MO
d. The first lady claims that several reporters who meet her during press events are writing biographies. IN | AN
e. The first lady is someone that the reporters who meet during press events are writing biographies. DE | MO
f. The first lady claims that the reporters who meet her during press events are writing biographies. DE | AN

(158) ITEM 6

a. The pope is someone that there are countless worshippers who appreciate for all kinds of reasons attending church. TH | MO
b. The pope hopes that there are countless worshippers who appreciate him for all kinds of reasons attending church. TH | AN
c. The pope is someone that countless worshippers who appreciate for all kinds of reasons are attending church. IN | MO

d. The pope hopes that countless worshippers who appreciate him for all kinds of reasons are attending church. IN | AN
e. The pope is someone that the worshippers who appreciate for all kinds of reasons are attending church. DE | MO
f. The pope hopes that the worshippers who appreciate him for all kinds of reasons are attending church. DE | AN

(159) ITEM 7

a. The governor is someone that there are two staffers who accompany on trips working on the schedule. TH | MO
b. The governor says that there are two staffers who accompany him on trips working on the schedule. TH | AN
c. The governor is someone that two staffers who accompany on trips are working on the schedule. IN | MO
d. The governor says that two staffers who accompany him on trips are working on the schedule. IN | AN
e. The governor is someone that the staffers who accompany on trips are working on the schedule. DE | MO
f. The governor says that the staffers who accompany him on trips are working on the schedule. DE | AN

(160) ITEM 8

a. The Supreme Court is something that there are many experts who supported last year pushing for reform. TH | MO
b. The Supreme Court hopes that there are many experts who supported them last year pushing for reform. TH | AN
c. The Supreme Court is something that many experts who supported last year are pushing for reform. IN | MO
d. The Supreme Court hopes that many experts who supported them last year are pushing for reform. IN | AN
e. The Supreme Court is something that the experts who supported last year are pushing for reform. DE | MO
f. The Supreme Court hopes that the experts who supported them last year are pushing for reform. DE | AN

(161) ITEM 9

a. The Dalai Lama is someone that there are some Americans who saw in 2014 venturing into Buddhism. TH | MO
b. The Dalai Lama thinks that there are some Americans who saw him in 2014 venturing into Buddhism. TH | AN
c. The Dalai Lama is someone that some Americans who saw in 2014 are venturing into Buddhism. IN | MO
d. The Dalai Lama thinks that some Americans who saw him in 2014 are venturing into Buddhism. IN | AN
e. The Dalai Lama is someone that the Americans who saw in 2014 are venturing into Buddhism. DE | MO
f. The Dalai Lama thinks that the Americans who saw him in 2014 are venturing into Buddhism. DE | AN

(162) ITEM 10

a. Barack Obama is someone that there are numerous children who admired in 2008 getting involved in politics. TH | MO
b. Barack Obama believes that there are numerous children who admired him in 2008 getting involved in politics. TH | AN
c. Barack Obama is someone that numerous children who admired in 2008 are getting involved in politics. IN | MO
d. Barack Obama believes that numerous children who admired him in 2008 are getting involved in politics. IN | AN
e. Barack Obama is someone that the children who admired in 2008 are getting involved in politics. DE | MO
f. Barack Obama believes that the children who admired him in 2008 are getting involved in politics. DE | AN

(163) ITEM 11

a. Beyoncé is someone that there are many listeners who saw at the Super Bowl listening to other artists. TH | MO
b. Beyoncé knows that there are many listeners who saw her at the Super Bowl listening to other artists. TH | AN
c. Beyoncé is someone that many listeners who saw at the Super Bowl are listening to other artists. IN | MO
d. Beyoncé knows that many listeners who saw her at the Super Bowl are listening to other artists. IN | AN
e. Beyoncé is someone that the listeners who saw at the Super Bowl are listening to other artists. DE | MO
f. Beyoncé knows that the listeners who saw her at the Super Bowl are listening to other artists. DE | AN

(164) ITEM 12

a. Bernie Sanders is someone that there are several actors who endorsed in the elections starring in major movies. TH | MO
b. Bernie Sanders says that there are several actors who endorsed him in the elections starring in major movies. TH | AN
c. Bernie Sanders is someone that several actors who endorsed in the elections are starring in major movies. IN | MO
d. Bernie Sanders says that several actors who endorsed him in the elections are starring in major movies. IN | AN
e. Bernie Sanders is someone that the actors who endorsed in the elections are starring in major movies. DE | MO
f. Bernie Sanders says that the actors who endorsed him in the elections are starring in major movies. DE | AN

(165) ITEM 13

a. Oprah Winfrey is someone that there are multiple people who criticized for no good reason falling into bankruptcy. TH | MO
b. Oprah Winfrey believes that there are multiple people who criticized her for no good reason falling into bankruptcy. TH | AN
c. Oprah Winfrey is someone that multiple people who criticized for no good reason are falling into bankruptcy. IN | MO

d. Oprah Winfrey believes that multiple people who criticized her for no good reason are falling into bankruptcy. IN | AN
e. Oprah Winfrey is someone that the people who criticized for no good reason are falling into bankruptcy. DE | MO
f. Oprah Winfrey believes that the people who criticized her for no good reason are falling into bankruptcy. DE | AN

(166) ITEM 14

a. J.K. Rowling is someone that there are some writers who attack each year blogging about Harry Potter. TH | MO
b. J.K. Rowling claims that there are some writers who attack her each year blogging about Harry Potter. TH | AN
c. J.K. Rowling is someone that some writers who attack each year are blogging about Harry Potter. IN | MO
d. J.K. Rowling claims that some writers who attack her each year are blogging about Harry Potter. IN | AN
e. J.K. Rowling is someone that the writers who attack each year are blogging about Harry Potter. DE | MO
f. J.K. Rowling claims that the writers who attack her each year are blogging about Harry Potter. DE | AN

(167) ITEM 15

a. Bruno Mars is someone that there are many artists who appreciate enthusiastically working on new albums. TH | MO
b. Bruno Mars knows that there are many artists who appreciate him enthusiastically working on new albums. TH | AN
c. Bruno Mars is someone that many artists who appreciate enthusiastically are working on new albums. IN | MO
d. Bruno Mars knows that many artists who appreciate him enthusiastically are working on new albums. IN | AN
e. Bruno Mars is someone that the artists who appreciate enthusiastically are working on new albums. DE | MO
f. Bruno Mars knows that the artists who appreciate him enthusiastically are working on new albums. DE | AN

(168) ITEM 16

a. Hillary Clinton is someone that there are some people who adored last year focusing on local elections. TH | MO
b. Hillary Clinton thinks that there are some people who adored her last year focusing on local elections. TH | AN
c. Hillary Clinton is someone that some people who adored last year are focusing on local elections. IN | MO
d. Hillary Clinton thinks that some people who adored her last year are focusing on local elections. IN | AN
e. Hillary Clinton is someone that the people who adored last year are focusing on local elections. DE | MO
f. Hillary Clinton thinks that the people who adored her last year are focusing on local elections. DE | AN

(169) ITEM 17

a. Leonardo DiCaprio is someone that there are three pool players who beat in a competition picking up new hobbies. TH | MO
b. Leonardo DiCaprio hopes that there are three pool players who beat him in a competition picking up new hobbies. TH | AN
c. Leonardo DiCaprio is someone that three pool players who beat in a competition are picking up new hobbies. IN | MO
d. Leonardo DiCaprio hopes that three pool players who beat him in a competition are picking up new hobbies. IN | AN
e. Leonardo DiCaprio is someone that the pool players who beat in a competition are picking up new hobbies. DE | MO
f. Leonardo DiCaprio hopes that the pool players who beat him in a competition are picking up new hobbies. DE | AN

(170) ITEM 18

a. Stephen Hawking is someone that there are some scientists who know from college expanding on theories of physics. TH | MO
b. Stephen Hawking claims that there are some scientists who know him from college expanding on theories of physics. TH | AN
c. Stephen Hawking is someone that some scientists who know from college are expanding on theories of physics. IN | MO
d. Stephen Hawking claims that some scientists who know him from college are expanding on theories of physics. IN | AN
e. Stephen Hawking is someone that the scientists who know from college are expanding on theories of physics. DE | MO
f. Stephen Hawking claims that the scientists who know him from college are expanding on theories of physics. DE | AN

(171) ITEM 19

a. Janet Jackson is someone that there are several dancers who admire in some way appearing on TV shows. TH | MO
b. Janet Jackson hopes that there are several dancers who admire her in some way appearing on TV shows. TH | AN
c. Janet Jackson is someone that several dancers who admire in some way are appearing on TV shows. IN | MO
d. Janet Jackson hopes that several dancers who admire her in some way are appearing on TV shows. IN | AN
e. Janet Jackson is someone that the dancers who admire in some way are appearing on TV shows. DE | MO
f. Janet Jackson hopes that the dancers who admire her in some way are appearing on TV shows. DE | AN

(172) ITEM 20

a. Vladimir Putin is someone that there are numerous journalists who met last year writing new books. TH | MO
b. Vladimir Putin knows that there are several journalists who met him last year writing new books. TH | AN
c. Vladimir Putin is someone that several journalists who met last year are writing new books. IN | MO

d. Vladimir Putin knows that several journalists who met him last year are writing new books. IN | AN

e. Vladimir Putin is someone that the journalists who met last year are writing new books. DE | MO

f. Vladimir Putin knows that the journalists who met him last year are writing new books. DE | AN

(173) ITEM 21

a. Ruth Bader Ginsburg is someone that there are countless people who respect very much building on previous lawsuits. TH | MO

b. Ruth Bader Ginsburg thinks that there are countless people who respect her very much building on previous lawsuits. TH | AN

c. Ruth Bader Ginsburg is someone that countless people who respect very much are building on previous lawsuits. IN | MO

d. Ruth Bader Ginsburg thinks that countless people who respect her very much are building on previous lawsuits. IN | AN

e. Ruth Bader Ginsburg is someone that the people who respect very much are building on previous lawsuits. DE | MO

f. Ruth Bader Ginsburg thinks that the people who respect her very much are building on previous lawsuits. DE | AN

(174) ITEM 22

a. Bill Gates is someone that there are several senators who appreciate for being honest learning about foreign hackers. TH | MO

b. Bill Gates says that there are several senators who appreciate him for being honest learning about foreign hackers. TH | AN

c. Bill Gates is someone that several senators who appreciate for being honest are learning about foreign hackers. IN | MO

d. Bill Gates says that several senators who appreciate him for being honest are learning about foreign hackers. IN | AN

e. Bill Gates is someone that the senators who appreciate for being honest are learning about foreign hackers. DE | MO

f. Bill Gates says that the senators who appreciate him for being honest are learning about foreign hackers. DE | AN

(175) ITEM 23

a. Lady Gaga is someone that there are many admirers who add on Facebook thinking of new fashion statements. TH | MO

b. Lady Gaga believes that there are many admirers who add her on Facebook thinking of new fashion statements. TH | AN

c. Lady Gaga is someone that many admirers who add on Facebook are thinking of new fashion statements. IN | MO

d. Lady Gaga believes that many admirers who add her on Facebook are thinking of new fashion statements. IN | AN

e. Lady Gaga is someone that the admirers who add on Facebook are thinking of new fashion statements. DE | MO

f. Lady Gaga believes that the admirers who add her on Facebook are thinking of new fashion statements. DE | AN

(176) ITEM 24

a. The Grinch is someone that there are two women who liked long ago hoping for peace. TH | MO

b. The Grinch claims that there are two women who liked him long ago hoping for peace. TH | AN

c. The Grinch is someone that two women who liked long ago are hoping for peace. IN | MO

d. The Grinch claims that two women who liked him long ago are hoping for peace. IN | AN

e. The Grinch is someone that the women who liked long ago are hoping for peace. DE | MO

f. The Grinch claims that the women who liked him long ago are hoping for peace. DE | AN

A.3 Experiment 3: Environment

A.3.1 Model

A mixed effects ordinal regression model with a maximal random effects structure was fitted to the data using the `clmm()` function provided by the `Ordinal` package (Christensen 2019) in R (R Core Team 2021). The ratings were set as the dependent measure, and the other factors and their interactions were set as fixed effects. The random effects structure included random intercepts for subjects and items, as well as random slopes by both subjects and items for all factors and their interactions.

```
Formula:
rating ~ context * ec_type * dep_length +
(1 + context * ec_type * dep_length | subject) +
(1 + context * ec_type * dep_length | item_set)
```

Table A.6: Coefficients for Experiment 3 Mixed Effects Model

	β	SE	z	p	<0.05?
BE	-0.7346	0.1046	-7.03	$2.1*10^{-12}$	✓
TRANSITIVITY	-0.4327	0.0626	-6.92	$4.7*10^{-12}$	✓
Structure	0.7973	0.1411	5.65	$1.6*10^{-08}$	✓
Length	1.7243	0.2470	6.98	$2.9*10^{-12}$	✓
BE × Structure	-0.3824	0.1967	-1.94	0.052	
TRANSITIVITY × Structure	0.0966	0.1080	0.89	0.371	
BE × Length	-0.4487	0.1806	-2.49	0.013	✓
TRANSITIVITY × Length	-0.0781	0.0959	-0.81	0.415	
Structure × Length	-1.2935	0.2872	-4.50	$6.7*10^{-06}$	✓
BE × Structure × Length	0.2203	0.3764	0.59	0.558	
TRANSITIVITY × Structure × Length	-0.4544	0.2109	-2.15	0.031	✓

There were a number of significant main effects. BE, which was the comparison between PREDICATE (contrast value = 1) and EXISTENTIAL (contrast value = –1), received a negative coefficient, indicating that the EXISTENTIAL conditions were rated significantly higher than PREDICATE conditions.

TRANSITIVITY was also a significant main effect, which compared the OBJECT level (contrast value = 2) to the combination of the PREDICATE and EXISTENTIAL levels (contrast value = –2). The negative coefficient for indicates that the combination of PREDICATE and EXISTENTIAL had a significant positive effect on ratings compared to the OBJECT level.

There were also significant main effects of STRUCTURE and LENGTH. Structure received a positive coefficient, indicating that NON-ISLAND conditions (contrast value = 0.5) were significantly better than ISLAND conditions (contrast value = –0.5). LENGTH also received a positive coefficient, indicating that SHORT conditions (contrast value = 0.5) were significantly better than LONG conditions (contrast value = –0.5).

Apart from the main effects, there were three significant interactions. The BE × Length interaction received a negative coefficient, indicating that in the EXISTENTIAL level, SHORT extractions were significantly better than in the PREDICATE level, but that the reverse is true when considering LONG extractions.

There was a significant interaction between STRUCTURE and LENGTH, which was given a negative coefficient. As in the model shown for Experiment 1 (Table A.1), this indicates that when comparing NON-ISLAND and ISLAND conditions, the LONG extraction was rated significantly worse in the ISLAND conditions.

Finally, a significant three-way interaction was observed between TRANSITIVITY, STRUCTURE, and LENGTH. The coefficient provided by the analysis is negative. This indicates that there is a significant difference in the ratings for conditions involving extraction from islands, with the OBJECT conditions receiving more of a penalty, and the combination of PREDICATE and EXISTENTIAL conditions receiving less of a penalty.

A.3.2 Items

Table A.7: Condition legend

ENVIRONMENT	STRUCTURE	LENGTH
SH = SHORT	NO = NON-ISLAND	PR = PREDICATE
LO = LONG	IS = ISLAND	EX = EXISTENTIAL
		OB = OBJECT

(177) ITEM 1

a. Which show do you think that Mary claims that she is the only senator who watches? LO | IS | PR

b. Who thinks that Mary claims that she is the only senator who watches this show? SH | IS | PR

c. Which show do you think that Mary claims that only one senator watches? LO | NO | PR

d. Who thinks that Mary claims that only one senator watches this show? SH | NO | PR
e. Which show do you think that there is only one senator who watches? LO | IS | EX
f. Who thinks that there is only one senator who watches this show? SH | IS | EX
g. Which show do you think that there is only one senator watching? LO | NO | EX
h. Who thinks that there is only one senator watching this show? SH | NO | EX
i. Which show do you think that Mary heard the only senator who watches? LO | IS | OB
j. Who thinks that Mary heard the only senator who watches this show? SH | IS | OB
k. Which show do you think that Mary heard that only one senator watches? LO | NO | OB
l. Who thinks that Mary heard that only one senator watches this show? SH | NO | OB

(178) ITEM 2

a. Which article did you say that Michael thinks that he is the only journalist who read? LO | IS | PR
b. Who said that Michael thinks that he is the only journalist who read this article? SH | IS | PR
c. Which article did you say that Michael thinks that only one journalist read? LO | NO | PR
d. Who said that Michael thinks that only one journalist read this article? SH | NO | PR
e. Which article did you say that there is only one journalist who read? LO | IS | EX
f. Who said that there is only one journalist who read this article? SH | IS | EX
g. Which article did you say that there was only one senator reading? LO | NO | EX
h. Who said that there was only one senator reading this article? SH | NO | EX
i. Which article did you say that Michael remembered the only journalist who read? LO | IS | OB
j. Who said that Michael remembered the only journalist who read this article? SH | IS | OB
k. Which article did you say that Michael remembered that only one journalist read? LO | NO | OB
l. Who said that Michael remembered that only one journalist read this article? SH | NO | OB

(179) ITEM 3

a. Which new library do you believe that Janine said that she is the only architect who designed? LO | IS | PR
b. Who believes that Janine said that she is the only architect who designed the new library? SH | IS | PR
c. Which new library do you believe that Janine said that only one architect designed? LO | NO | PR
d. Who believes that Janine said that only one architect designed the new library? SH | NO | PR
e. Which new library do you believe that there is only one architect who designed? LO | IS | EX
f. Who believes that there is only one architect who designed the new library? SH | IS | EX
g. Which new library do you believe that there is only one architect designing? LO | NO | EX
h. Who believes that there is only one architect designing the new library? SH | NO | EX
i. Which new library do you believe that Janine noticed the only architect who designed? LO | IS | OB
j. Who believes that Janine noticed the only architect who designed the new library? SH | IS | OB
k. Which new library do you believe that Janine noticed that only one architect designed? LO | NO | OB

l. Who believes that Janine noticed that only one architect designed the new library?
SH | NO | OB

(180) ITEM 4

a. Which car do you hope that Ben said that he is the only family-member who drove?
LO | IS | PR

b. Who hopes that Ben said that he is the only family-member who drove your car?
SH | IS | PR

c. Which car do you hope that Ben said that only one family-member drove? LO | NO | PR

d. Who hopes that Ben said that only one family-member drove your car? SH | NO | PR

e. Which car do you hope that there is only one family-member who drove? LO | IS | EX

f. Who hopes that there is only one family-member who drove your car? SH | IS | EX

g. Which car do you hope that there is only one family-member driving? LO | NO | EX

h. Who hopes that there is only one family-member driving your car? SH | NO | EX

i. Which car do you hope that Ben recognized the only family-member who drove?
LO | IS | OB

j. Who hopes that Ben recognized the only family-member who drove your car?
SH | IS | OB

k. Which car do you hope that Ben recognized that only one family-member drove?
LO | NO | OB

l. Who hopes that Ben recognized that only one family-member drove your car?
SH | NO | OB

(181) ITEM 5

a. Which form do you know that Heather said that she is the only accountant who filed?
LO | IS | PR

b. Who knows that Heather said that she is the only accountant who filed this form?
SH | IS | PR

c. Which form do you know that Heather said that only one accountant filed? LO | NO | PR

d. Who knows that Heather said that only one accountant filed this form? SH | NO | PR

e. Which form do you know that there is only one accountant who filed? LO | IS | EX

f. Who knows that there is only one accountant who filed this form? SH | IS | EX

g. Which form do you know that there is only one accountant filing? LO | NO | EX

h. Who knows that there is only one accountant filing this file? SH | NO | EX

i. Which form do you know that Heather noticed the only accountant who filed?
LO | IS | OB

j. Who knows that Heather noticed the only accountant who filed this form? SH | IS | OB

k. Which form do you know that Heather noticed that only one accountant filed?
LO | NO | OB

l. Who knows that Heather noticed that only one accountant filed this form? SH | NO | OB

(182) ITEM 6

a. Which apartment did you say that Adam thinks that he is the only tenant who occupied?
LO | IS | PR

b. Who said that Adam thinks that he is the only tenant who occupied your apartment?
SH | IS | PR

c. Which apartment did you say that Adam thinks that only one tenant occupied?
LO | NO | PR

d. Who said that Adam thinks that only one tenant occupied your apartment? SH | NO | PR

e. Which apartment did you say that there is only one tenant who occupied? LO | IS | EX

f. Who said that there is only one tenant who occupied your apartment? SH | IS | EX
g. Which apartment did you say that there is only one tenant occupying? LO | NO | EX
h. Who said that there is only one tenant occupying your apartment? SH | NO | EX
i. Which apartment did you say that Adam found only one tenant who occupied? LO | IS | OB
j. Who said that Adam found only one tenant who occupied your apartment? SH | IS | OB
k. Which apartment did you say that Adam found that only one tenant occupied? LO | NO | OB
l. Who said that Adam found that only one tenant occupied your apartment? SH | NO | OB

(183) ITEM 7

a. Which painting do you think that Courtney believes that she is the only art collector who bid on? LO | IS | PR
b. Who thinks that Courtney believes that she is the only art collector who bid on this painting? SH | IS | PR
c. Which painting do you think that Courtney believes that only one art collector bid on? LO | NO | PR
d. Who thinks that Courtney believes that only one art collector bid on this painting? SH | NO | PR
e. Which painting do you think that there is only one art collector who bid on? LO | IS | EX
f. Who thinks that there is only one art collector who bid on this painting? SH | IS | EX
g. Which painting do you think that there is only one art collector bidding on? LO | NO | EX
h. Who thinks that there is only one art collector bidding on this painting? SH | NO | EX
i. Which painting do you think that Courtney saw the only art collector who bid on? LO | IS | OB
j. Who thinks that Courtney saw the only art collector who bid on this painting? SH | IS | OB
k. Which painting do you think that Courtney saw that only one art collector bid on? LO | NO | OB
l. Who thinks that Courtney saw that only one art collector bid on this painting? SH | NO | OB

(184) ITEM 8

a. Which mailbox did you claim that Javier said that he is the only neighbor who opened? LO | IS | PR
b. Who claimed that Javier said that he is the only neighbor who opened your mailbox? SH | IS | PR
c. Which mailbox did you claim that Javier said that only one neighbor opened? LO | NO | PR
d. Who claimed that Javier said that only one neighbor opened your mailbox? SH | NO | PR
e. Which mailbox did you claim that there is only one neighbor who opened? LO | IS | EX
f. Who claimed that there is only one neighbor who opened your mailbox? SH | IS | EX
g. Which mailbox did you claim that there is only one neighbor opening? LO | NO | EX
h. Who claimed that there is only one neighbor opening your mailbox? SH | NO | EX
i. Which mailbox did you claim that Javier heard the only neighbor who opened? LO | IS | OB
j. Who claimed that Javier heard the only neighbor who opened your mailbox? SH | IS | OB
k. Which mailbox did you claim that Javier heard that only one neighbor opened? LO | NO | OB

l. Who claimed that Javier heard that only one neighbor opened your mailbox? SH | NO | OB

(185) ITEM 9

a. Which hiding spot do you believe that Serena hopes that she is the only kid who found? LO | IS | PR
b. Who believes that Serena hopes that she is the only kid who found this hiding spot? SH | IS | PR
c. Which hiding spot do you believe that Serena hopes that only one kid found? LO | NO | PR
d. Who believes that Serena hopes that only one kid found this hiding spot? SH | NO | PR
e. Which hiding spot do you believe that there is only one kid who found? LO | IS | EX
f. Who believes that there is only one kid who found this hiding spot? SH | IS | EX
g. Which hiding spot do you believe that there is only one kid finding? LO | NO | EX
h. Who believes that there is only one kid finding this hiding spot? SH | NO | EX
i. Which hiding spot do you believe that Serena noticed the only kid who found? LO | IS | OB
j. Who believes that Serena noticed the only kid who found this hiding spot? SH | IS | OB
k. Which hiding spot do you believe that Serena noticed that only one kid found? LO | NO | OB
l. Who believes that Serena noticed that only one kid found this hiding spot? SH | NO | OB

(186) ITEM 10

a. Which drink do you hope that Paul believes that he is the only customer who ordered? LO | IS | PR
b. Who hopes that Paul believes that he is the only customer who ordered this drink? SH | IS | PR
c. Which drink do you hope that Paul believes that only one customer ordered? LO | NO | PR
d. Who hopes that Paul believes that only one customer ordered this drink? SH | NO | PR
e. Which drink do you hope that there is only one customer who ordered? LO | IS | EX
f. Who hopes that there is only one customer who ordered this drink? SH | IS | EX
g. Which drink do you hope that there is only one customer ordering? LO | NO | EX
h. Who hopes that there is only one customer ordering this drink? SH | NO | EX
i. Which drink do you hope that Paul heard the only customer who ordered? LO | IS | OB
j. Who hopes that Paul heard the only customer who ordered this drink? SH | IS | OB
k. Which drink do you hope that Paul heard that only one customer ordered? LO | NO | OB
l. Who hopes that Paul heard that only one customer ordered this drink? SH | NO | OB

(187) ITEM 11

a. Which park do you know that Leanne thinks that she is the only friend who recommended? LO | IS | PR
b. Who knows that Leanne thinks that she is the only friend who recommended this park? SH | IS | PR
c. Which park do you know that Leanne thinks that only one friend recommended? LO | NO | PR
d. Who knows that Leanne thinks that only one friend recommended this park? SH | NO | PR
e. Which park do you know that there is only one friend who recommended? LO | IS | EX
f. Who knows that there is only one friend who recommended this park? SH | IS | EX

g. Which park do you know that there is only one friend recommending? LO | NO | EX
h. Who knows that there is only one friend recommending this park? SH | NO | EX
i. Which park do you know that Leanne heard the only friend who recommended? LO | IS | OB
j. Who knows that Leanne heard the only friend who recommended this park? SH | IS | OB
k. Which park do you know that Leanne heard that only one friend recommended? LO | NO | OB
l. Who knows that Leanne heard that only one friend recommended this park? SH | NO | OB

(188) ITEM 12

a. Which bus do you think that Henry hopes that he was the only passenger who boarded? LO | IS | PR
b. Who thinks that Henry hopes that he was the only passenger who boarded this bus? SH | IS | PR
c. Which bus do you think that Henry hopes that only one passenger boarded? LO | NO | PR
d. Who thinks that Henry hopes that only one passenger boarded this bus? SH | NO | PR
e. Which bus do you think that there is only one passenger who boarded? LO | IS | EX
f. Who thinks that there is only one passenger who boarded this bus? SH | IS | EX
g. Which bus do you think that there is only one passenger boarding? LO | NO | EX
h. Who thinks that there is only one passenger boarding this bus? SH | NO | EX
i. Which bus do you think that Henry saw the only passenger who boarded? LO | IS | OB
j. Who thinks that Henry saw the only passenger who boarded this bus? SH | IS | OB
k. Which bus do you think that Henry saw that only one passenger boarded? LO | NO | OB
l. Who thinks that Henry saw that only one passenger boarded this bus? SH | NO | OB

(189) ITEM 13

a. Which shoes did you say that Wanda thinks that she is the only player who wears? LO | IS | PR
b. Who said that Wanda thinks that she is the only player who wears these shoes? SH | IS | PR
c. Which shoes did you say that Wanda thinks that only one player wears? LO | NO | PR
d. Who said that Wanda thinks that only one player wears these shoes? SH | NO | PR
e. Which shoes did you say that there is only one player who wears? LO | IS | EX
f. Who said that there is only one player who wears these shoes? SH | IS | EX
g. Which shoes did you say that there is only one player wearing? LO | NO | EX
h. Who said that there is only one player wearing these shoes? SH | NO | EX
i. Which shoes did you say that Wanda discovered the only player who wears? LO | IS | OB
j. Who said that Wanda discovered the only player who wears these shoes? SH | IS | OB
k. Which shoes did you say that Wanda discovered that only one player wears? LO | NO | OB
l. Who said that Wanda discovered that only one player wears these shoes? SH | NO | OB

(190) ITEM 14

a. Which tattoo did you claim that Karl says that he is the only artist who mentioned? LO | IS | PR
b. Who claimed that Karl says that he is the only artist who mentioned your tattoo? SH | IS | PR
c. Which tattoo did you claim that Karl says that only one artist mentioning? LO | NO | PR

d. Who claimed that Karl says that only one artist mentioned your tattoo? SH | NO | PR
e. Which tattoo did you claim that there is only one artist who mentioned? LO | IS | EX
f. Who claimed that there is only one artist who mentioned your tattoo? SH | IS | EX
g. Which tattoo did you claim that there is only one artist mentioning? LO | NO | EX
h. Who claimed that there is only one artist mentioning your tattoo? SH | NO | EX
i. Which tattoo did you claim that Karl noticed the only artist who mentioned? LO | IS | OB
j. Who claimed that Karl noticed the only artist who mentioned your tattoo? SH | IS | OB
k. Which tattoo did you claim that Karl noticed that only one artist mentioned? LO | NO | OB
l. Who claimed that Karl noticed that only one artist that mentioned your tattoo? SH | NO | OB

(191) ITEM 15

a. Which flight do you believe that Octavia claimed that she is the only doctor who boarded? LO | IS | PR
b. Who believes that Octavia claimed that she is the only doctor who boarded this flight? SH | IS | PR
c. Which flight do you believe that Octavia claimed that only one doctor boarded? LO | NO | PR
d. Who believes that Octavia claimed that only one doctor boarded this flight? SH | NO | PR
e. Which flight do you believe that there is only one doctor who boarded? LO | IS | EX
f. Who believes that there is only one doctor who boarded this flight? SH | IS | EX
g. Which flight do you believe that there is only one doctor boarding? LO | NO | EX
h. Who believes that there is only one doctor boarding this flight? SH | NO | EX
i. Which flight do you believe that Octavia found the only doctor who boarded? LO | IS | OB
j. Who believes that Octavia found the only doctor who boarded this flight? SH | IS | OB
k. Which flight do you believe that Octavia found that only one doctor boarded? LO | NO | OB
l. Who believes that Octavia found that only one doctor boarded this flight? SH | NO | OB

(192) ITEM 16

a. Which classroom do you hope that Philip believes that he is the only custodian who cleaned? LO | IS | PR
b. Who hopes that Philip believes that he is the only custodian who cleaned this classroom? SH | IS | PR
c. Which classroom do you hope that Philip believes that only one custodian cleaned? LO | NO | PR
d. Who hopes that Philip believes that only one custodian cleaned this classroom? SH | NO | PR
e. Which classroom do you hope that there is only one custodian who cleaned? LO | IS | EX
f. Who hopes that there is only one custodian who cleaned this classroom? SH | IS | EX
g. Which classroom do you hope that there is only one custodian cleaning? LO | NO | EX
h. Who hopes that there is only one custodian cleaning this classroom? SH | NO | EX
i. Which classroom do you hope that Philip noticed the only custodian who cleaned? LO | IS | OB
j. Who hopes that Philip noticed the only custodian who cleaned this classroom? SH | IS | OB
k. Which classroom do you hope that Philip noticed that only one custodian cleaned? LO | NO | OB

l. Who hopes that Philip noticed that only one custodian cleaned this classroom? SH | NO | OB

(193) ITEM 17

a. Which repair shop do you know that Jasmine hopes that she is the only customer who reviewed? LO | IS | PR
b. Who knows that Jasmine hopes that she is the only customer who reviewed this repair shop? SH | IS | PR
c. Which repair shop do you know that Jasmine hopes that only one customer reviewed? LO | NO | PR
d. Who knows that Jasmine hopes that only one customer reviewed this repair shop? SH | NO | PR
e. Which repair shop do you know that there is only one customer who reviewed? LO | IS | EX
f. Who knows that there is only one customer who reviewed this repair shop? SH | IS | EX
g. Which repair shop do you know that there is only one customer reviewing? LO | NO | EX
h. Who knows that there is only one customer reviewing this repair shop? SH | NO | EX
i. Which repair shop do you know that Jasmine saw the only customer who reviewed? LO | IS | OB
j. Who knows that Jasmine saw the only customer who reviewed this repair shop? SH | IS | OB
k. Which repair shop do you know that Jasmine saw that only one customer reviewed? LO | NO | OB
l. Who knows that Jasmine saw that only one customer reviewed this repair shop? SH | NO | OB

(194) ITEM 18

a. Which turtle do you think that Earl hopes that he is the only visitor who fed? LO | IS | PR
b. Who thinks that Earl hopes that he is the only visitor who fed this turtle? SH | IS | PR
c. Which turtle do you think that Earl hopes that only one visitor fed? LO | NO | PR
d. Who thinks that Earl hopes that only one visitor fed this turtle? SH | NO | PR
e. Which turtle do you think that there is only one visitor who fed? LO | IS | EX
f. Who thinks that there is only one visitor who fed this turtle? SH | IS | EX
g. Which turtle do you think that there is only one visitor feeding? LO | NO | EX
h. Who thinks that there is only one visitor feeding this turtle? SH | NO | EX
i. Which turtle do you think that Earl found the only visitor who fed? LO | IS | OB
j. Who thinks that Earl found the only visitor who fed this turtle? SH | IS | OB
k. Which turtle do you think that Earl found that only one visitor fed? LO | NO | OB
l. Who thinks that Earl found that only one visitor fed this turtle? SH | NO | OB

(195) ITEM 19

a. Which book did you say that Farrah thinks that she is the only student who read? LO | IS | PR
b. Who says that Farrah thinks that she is the only student who read this book? SH | IS | PR
c. Which book did you say that Farrah thinks that only one student read? LO | NO | PR
d. Who says that Farrah thinks that only one student read this book? SH | NO | PR
e. Which book did you say that there is only one student who read? LO | IS | EX
f. Who says that here is only one student who read this book? SH | IS | EX
g. Which book did you say that there is only one student reading? LO | NO | EX
h. Who says that there is only one student reading this book? SH | NO | EX

i. Which book did you say that Farrah noticed the only student who read? LO | IS | OB
j. Who says that Farrah noticed the only student who read this book? SH | IS | OB
k. Which book did you say that Farrah noticed that only one student read? LO | NO | OB
l. Who says that Farrah noticed that only one student read this book? SH | NO | OB

(196) ITEM 20

a. Which patient did you claim that Otto says that he is the only nurse who helped? LO | IS | PR
b. Who claimed that Otto says that he is the only nurse who helped this patient? SH | IS | PR
c. Which patient did you claim that Otto says that only one surgeon helped? LO | NO | PR
d. Who claimed that Otto says that only one nurse helped this patient? SH | NO | PR
e. Which patient did you claim that there is only one nurse who helped? LO | IS | EX
f. Who claimed that there is only one nurse who helps this patient? SH | IS | EX
g. Which patient did you claim that there is only one nurse helping? LO | NO | EX
h. Who claimed that there is only one nurse helping this patient? SH | NO | EX
i. Which patient did you claim that Otto saw the only nurse who helped? LO | IS | OB
j. Who claimed that Otto saw the only nurse who helped this patient? SH | IS | OB
k. Which patient did you claim that Otto saw that only one nurse helped? LO | NO | OB
l. Who claimed that Otto saw that only one nurse helped this patient? SH | NO | OB

(197) ITEM 21

a. Which town do you believe that Ursula claimed that she is the only tourist who visited? LO | IS | PR
b. Who believes that Ursula claimed that she is the only tourist who visited this town? SH | IS | PR
c. Which town do you believe that Ursula claimed that only one tourist visited? LO | NO | PR
d. Who believes that Ursula claimed that only one tourist visited this town? SH | NO | PR
e. Which town do you believe that there is only one tourist who visited? LO | IS | EX
f. Who believes that there is only one tourist who visited this town? SH | IS | EX
g. Which town do you believe that there is only one tourist visiting? LO | NO | EX
h. Who believes that there is only one tourist visiting this town? SH | NO | EX
i. Which town do you believe that Ursula found the only tourist who explored? LO | IS | OB
j. Who believes that Ursula found the only tourist who explored this town? SH | IS | OB
k. Which town do you believe that Ursula found that only one tourist explored? LO | NO | OB
l. Who believes that Ursula found that only one tourist explored this town? SH | NO | OB

(198) ITEM 22

a. Which album do you hope that Alicia believes that she is the only critic who listened to? LO | IS | PR
b. Who hopes that Alicia believes that she is the only critic who listened to this album? SH | IS | PR
c. Which album do you hope that Alicia believes that only one critic listened to? LO | NO | PR
d. Who hopes that Alicia believes that only one critic listened to this album? SH | NO | PR
e. Which album do you hope that there is only one critic who listened to? LO | IS | EX
f. Who hopes that there is only one critic who listened to this album? SH | IS | EX
g. Which album do you hope that there is only one critic listening to? LO | NO | EX

h. Who hopes that there is only one critic listening to this album? SH | NO | EX
i. Which album do you hope that Alicia recognized only one critic who listened to? LO | IS | OB
j. Who hopes that Alicia recognized only one critic who listened to this album? SH | IS | OB
k. Which album do you hope that Alicia recognized that only one critic listened to? LO | NO | OB
l. Who hopes that Alicia recognized that only one critic listened to this album? SH | NO | OB

(199) ITEM 23

a. Which ice cream flavor do you know that Yanny hopes that he is the only person who tasted? LO | IS | PR
b. Who knows that Yanny hopes that he is the only person who tasted this ice cream flavor? SH | IS | PR
c. Which ice cream flavor do you know that Yanny hopes that only one person tasted? LO | NO | PR
d. Who knows that Yanny hopes that only one person tasted this ice cream flavor? SH | NO | PR
e. Which ice cream flavor do you know that there is only one person who tasted? LO | IS | EX
f. Who knows that there is only one person who tasted this ice cream flavor? SH | IS | EX
g. Which ice cream flavor do you know that there is only one person tasting? LO | NO | EX
h. Who knows that there is only one person tasting this ice cream flavor? SH | NO | EX
i. Which ice cream flavor do you know that Yanny noticed the only person who tasted? LO | IS | OB
j. Who knows that Yanny noticed the only person who tasted this ice cream flavor? SH | IS | OB
k. Which ice cream flavor do you know that Yanny noticed that only one person tasted? LO | NO | OB
l. Who knows that Yanny noticed that only one person tasted this ice cream flavor? SH | NO | OB

(200) ITEM 24

a. Which ingredients do you think that Joshua hopes that he is the only chef who forgot? LO | IS | PR
b. Who thinks that Joshua hopes that he is the only chef who forgot the ingredients? SH | IS | PR
c. Which ingredients do you think that Joshua hopes that only one chef forgot? LO | NO | PR
d. Who thinks that Joshua hopes that only one chef forgot the ingredients? SH | NO | PR
e. Which ingredients do you think that there is only one chef who forgot? LO | IS | EX
f. Who thinks that there is only one chef who forgot the ingredients? SH | IS | EX
g. Which ingredients do you think that there is only one chef forgetting? LO | NO | EX
h. Who thinks that there is only one chef forgetting the ingredients? SH | NO | EX
i. Which ingredients do you think that Joshua mentioned the only chef who forgot? LO | IS | OB
j. Who thinks that Joshua mentioned the only chef who forgot the ingredients? SH | IS | OB
k. Which ingredients do you think that Joshua mentioned that only one chef forgot? LO | NO | OB

l. Who thinks that Joshua mentioned that only one chef forgot the ingredients?
SH | NO | OB

(201) ITEM 25

a. Which shirt did you say that Miriam thinks that she is the only team-member who wore?
LO | IS | PR
b. Who said that Miriam thinks that she is the only team-member who wore this shirt?
SH | IS | PR
c. Which shirt did you say that Miriam thinks that only one team-member wore?
LO | NO | PR
d. Who said that Miriam thinks that only one team-member wore this shirt? SH | NO | PR
e. Which shirt did you say that there is only one team-member who wore? LO | IS | EX
f. Who said that there is only one team-member who wore this shirt? SH | IS | EX
g. Which shirt did you say that there is only one team-member wearing? LO | NO | EX
h. Who said that there is only one team-member wearing this shirt? SH | NO | EX
i. Which shirt did you say that Miriam saw only one team-member who wore? LO | IS | OB
j. Who said that Miriam saw only one team-member who wore this shirt? SH | IS | OB
k. Which shirt did you say that Miriam saw that only one team-member wore? LO | NO | OB
l. Who said that Miriam saw that only one team-member wore this shirt? SH | NO | OB

(202) ITEM 26

a. Which box of cookies did you claim that Stan said that he is the only kid who ate?
LO | IS | PR
b. Who claimed that Stan said that he is the only kid who ate this box of cookies?
SH | IS | PR
c. Which box of cookies did you claim that Stan said that only one kid ate? LO | NO | PR
d. Who claimed that Stan said that only one kid ate this box of cookies? SH | NO | PR
e. Which box of cookies did you claim that there is only one kid who ate? LO | IS | EX
f. Who claimed that there is only one kid who ate this box of cookies? SH | IS | EX
g. Which box of cookies did you claim that there is only one kid eating? LO | NO | EX
h. Who claimed that there is only one kid eating this box of cookies? SH | NO | EX
i. Which box of cookies did you claim that Stan found the only kid who ate? LO | IS | OB
j. Who claimed that Stan found the only kid who ate this box of cookies? SH | IS | OB
k. Which box of cookies did you claim that Stan found that only one kid ate? LO | NO | OB
l. Who claimed that Stan found that only one kid ate this box of cookies? SH | NO | OB

(203) ITEM 27

a. Which app do you believe that Maddy claimed that she is the only developer who built?
LO | IS | PR
b. Who believes that Maddy claimed that she is the only developer who built this app?
SH | IS | PR
c. Which app do you believe that Maddy claimed that only one developer built?
LO | NO | PR
d. Who believes that Maddy claimed that only one developer built this app? SH | NO | PR
e. Which app do you believe that there is only one developer who built? LO | IS | EX
f. Who believes that there is only one developer who built this app? SH | IS | EX
g. Which app do you believe that there is only one developer building? LO | NO | EX
h. Who believes that there is only one developer building this app? SH | NO | EX
i. Which app do you believe that Maddy found the only developer who built? LO | IS | OB
j. Who believes that Maddy found the only developer who built this app? SH | IS | OB

k. Which app do you believe that Maddy found that only one developer built? LO | NO | OB
l. Who believes that Maddy found that only one developer built this app? SH | NO | OB

(204) ITEM 28

a. Which machine do you hope that Paul believes that he is the only employee who operates? LO | IS | PR
b. Who hopes that Paul believes that he is the only employee who operates this machine? SH | IS | PR
c. Which machine do you hope that Paul believes that only one employee operates? LO | NO | PR
d. Who hopes that Paul believes that only one employee operates this machine? SH | NO | PR
e. Which machine do you hope that there is only one employee who operates? LO | IS | EX
f. Who hopes that there is only one employee who operates this machine? SH | IS | EX
g. Which machine do you hope that there is only one employee operating? LO | NO | EX
h. Who hopes that there is only one employee operating this machine? SH | NO | EX
i. Which machine do you hope that Paul found the only employee who operates? LO | IS | OB
j. Who hopes that Paul found the only employee who operates this machine? SH | IS | OB
k. Which machine do you hope that Paul found that only one employee operates? LO | NO | OB
l. Who hopes that Paul found that only one employee operates this machine? SH | NO | OB

(205) ITEM 29

a. Which insect did you say that Janet hopes that she is the only scientist who studies? LO | IS | PR
b. Who said that Janet hopes that she is the only scientist who studies this insect? SH | IS | PR
c. Which insect did you say that Janet hopes that only one scientist studies? LO | NO | PR
d. Who said that Janet hopes that only one scientist studies this insect? SH | NO | PR
e. Which insect did you say that there is only one scientist who studies? LO | IS | EX
f. Who said that there is only one scientist who studies this insect? SH | IS | EX
g. Which insect did you say that there is only one scientist studying? LO | NO | EX
h. Who said that there is only one scientist studying this insect? SH | NO | EX
i. Which insect did you say that Janet noticed the only scientist who studies? LO | IS | OB
j. Who said that Janet noticed the only scientist who studies this insect? SH | IS | OB
k. Which insect did you say that Janet noticed that only one scientist studies? LO | NO | OB
l. Who said that Janet noticed that only one scientist studies this insect? SH | NO | OB

(206) ITEM 30

a. Which taxi do you think that Mel hopes that he is the only guy who leased? LO | IS | PR
b. Who thinks that Mel hopes that he is the only guy who leased this taxi? SH | IS | PR
c. Which taxi do you think that Mel hopes that only one guy leased? LO | NO | PR
d. Who thinks that Mel hopes that only one guy leased this taxi? SH | NO | PR
e. Which taxi do you think that there is only one guy who leased? LO | IS | EX
f. Who thinks that there is only one guy who leased this taxi? SH | IS | EX
g. Which taxi do you think that there is only one guy leasing? LO | NO | EX
h. Who thinks that there is only one guy leasing this taxi? SH | NO | EX
i. Which taxi do you think that Mel saw the only guy who leased? LO | IS | OB
j. Who thinks that Mel saw the only guy who leased this taxi? SH | IS | OB

k. Which taxi do you think that Mel saw that only one guy leased? LO | NO | OB
l. Who thinks that Mel saw that only one guy leased this taxi? SH | NO | OB

(207) ITEM 31

a. Which comic book did you say that Nadine thinks that she is the only nerd who bought? LO | IS | PR
b. Who said that Nadine thinks that she is the only nerd who bought this comic book? SH | IS | PR
c. Which comic book did you say that Nadine thinks that only one nerd bought? LO | NO | PR
d. Who said that Nadine thinks that only one nerd bought this comic book? SH | NO | PR
e. Which comic book did you say that there is only one nerd who bought? LO | IS | EX
f. Who said that there is only one nerd who bought this comic book? SH | IS | EX
g. Which comic book did you say that there is only one nerd buying? LO | NO | EX
h. Who said that there is only one nerd buying this comic book? SH | NO | EX
i. Which comic book did you say that Nadine found the only nerd who bought? LO | IS | OB
j. Who said that Nadine found the only nerd who bought this comic book? SH | IS | OB
k. Which comic book did you say that Nadine found that only one nerd bought? LO | NO | OB
l. Who said that Nadine found that only one nerd bought this comic book? SH | NO | OB

(208) ITEM 32

a. Which instrument did you claim that Grover said that he is the only musician who plays? LO | IS | PR
b. Who claimed that Grover said that he is the only musician who plays this instrument? SH | IS | PR
c. Which instrument did you claim that Grover said that only one musician plays? LO | NO | PR
d. Who claimed that Grover said that only one musician plays this instrument? SH | NO | PR
e. Which instrument did you claim that there is only one musician who plays? LO | IS | EX
f. Who claimed that there is only one musician who plays this instrument? SH | IS | EX
g. Which instrument did you claim that there is only one musician playing? LO | NO | EX
h. Who claimed that there is only one musician playing this instrument? SH | NO | EX
i. Which instrument did you claim that Grover heard only one musician who plays? LO | IS | OB
j. Who claimed that Grover heard only one musician who plays this instrument? SH | IS | OB
k. Which instrument did you claim that Grover heard that only one musician plays? LO | NO | OB
l. Who claimed that Grover heard that only one musician plays this instrument? SH | NO | OB

(209) ITEM 33

a. Which iPhone do you believe that Jacky claims that she is the only student who uses? LO | IS | PR
b. Who believes that Jacky claims that she is the only student who uses this iPhone? SH | IS | PR
c. Which iPhone do you believe that Jacky claims that only one student uses? LO | NO | PR
d. Who believes that Jacky claims that only one student uses this iPhone? SH | NO | PR

e. Which iPhone do you believe that there is only one student who uses? LO | IS | EX
f. Who believes that there is only one student who uses this iPhone? SH | IS | EX
g. Which iPhone do you believe that there is only one student using? LO | NO | EX
h. Who believes that there is only one student using this iPhone? SH | NO | EX
i. Which iPhone do you believe that Jacky noticed the only student who uses? LO | IS | OB
j. Who believes that Jacky noticed the only student who uses this iPhone? SH | IS | OB
k. Which iPhone do you believe that Jacky noticed that only one student uses? LO | NO | OB
l. Who believes that Jacky noticed that only one student uses this iPhone? SH | NO | OB

(210) ITEM 34

a. Which kind of cookie do you hope that Zeke believes that he is the only co-worker who relishes? LO | IS | PR
b. Who hopes that Zeke believes that he is the only co-worker who relishes this kind of cookie? SH | IS | PR
c. Which kind of cookie do you hope that Zeke believes that only one co-worker relishes? LO | NO | PR
d. Who hopes that Zeke believes that only one co-worker enjoys this kind of cookie? SH | NO | PR
e. Which kind of cookie do you hope that there is only one co-worker who enjoys? LO | IS | EX
f. Who hopes that there is only one co-worker who enjoys this kind of cookie? SH | IS | EX
g. Which kind of cookie do you hope that there is only one co-worker enjoying? LO | NO | EX
h. Who hopes that there is only one co-worker who enjoys this kind of cookie? SH | NO | EX
i. Which kind of cookie do you hope that Zeke remembered the only co-worker who enjoys? LO | IS | OB
j. Who hopes that Zeke remembered the only co-worker who enjoys this kind of cookie? SH | IS | OB
k. Which kind of cookie do you hope that Zeke remembered that only one co-worker enjoys? LO | NO | OB
l. Who hopes that Zeke remembered that only one co-worker enjoys this kind of cookie? SH | NO | OB

(211) ITEM 35

a. Which grandparent do you know that Abby hopes that she is the only cousin who visited? LO | IS | PR
b. Who knows that Abby hopes that she is the only cousin who visited this grandparent? SH | IS | PR
c. Which grandparent do you know that Abby hopes that only one cousin visited? LO | NO | PR
d. Who knows that Abby hopes that only one cousin visited this grandparent? SH | NO | PR
e. Which grandma do you know that there is only one cousin who visited? LO | IS | EX
f. Who knows that there is only one cousin who visited your grandma? SH | IS | EX
g. Which grandma do you know that there is only one cousin visiting? LO | NO | EX
h. Who knows that there is only one cousin visiting your grandma? SH | NO | EX
i. Which grandma do you know that Abby remembered the only cousin who visited? LO | IS | OB
j. Who knows that Abby remembered the only cousin who visited your grandma? SH | IS | OB

k. Which grandma do you know that Abby remembered that only one cousin visited? LO | NO | OB

l. Who knows that Abby remembered only one cousin visited your grandma? SH | NO | OB

(212) ITEM 36

a. Which rumor do you think that Mark believes that he is the only candidate who denied? LO | IS | PR

b. Who thinks that Mark believes that he is the only candidate who denied this rumor? SH | IS | PR

c. Which rumor do you think that Mark believes that only one candidate denied? LO | NO | PR

d. Who thinks that Mark believes that only one candidate denied this rumor? SH | NO | PR

e. Which rumor do you think that there is only one candidate who denied? LO | IS | EX

f. Who thinks that there is only one candidate who denied this rumor? SH | IS | EX

g. Which rumor do you think that there is only one candidate denying? LO | NO | EX

h. Who thinks that there is only one candidate denying this rumor? SH | NO | EX

i. Which rumor do you think that Mark mentioned the only candidate who denied? LO | IS | OB

j. Who thinks that Mark mentioned the only candidate who denied this rumor? SH | IS | OB

k. Which rumor do you think that Mark mentioned that only one candidate denied? LO | NO | OB

l. Who thinks that Mark mentioned that only one candidate denied this rumor? SH | NO | OB

A.4 Experiment 4: Infinitival relatives I

A.4.1 Model

A mixed effects ordinal regression model with a maximal random effects structure was fitted to the data using the `clmm()` function provided by the `Ordinal` package (Christensen 2019) in R (R Core Team 2021). The ratings were set as the dependent measure, and the other factors and their interactions were set as fixed effects. The random effects structure included random intercepts for subjects and items, as well as random slopes by both subjects and items for all factors and their interactions.

```
Formula:
rating ~ environment * length * structure +
(1 + environment * length * structure | subject) +
(1 + environment * length * structure | item)
```

A separate mixed effects ordinal regression model with a maximal random effects structure was fitted to the data for the EXISTENTIAL condition. Ratings were set as the dependent measure, and LENGTH and STRUCTURE and their interactions were set as fixed effects. The random effects structure included random intercepts for subjects and items, as well as random slopes by both subjects and items for the LENGTH and STRUCTURE factors and their interactions.

Table A.8: Coefficients for Experiment 4 Mixed Effects Model (both environments)

	β	SE	z	p	<0.05?
Environment	-0.1023	0.1379	-0.74	0.458	
Length	-0.8389	0.1579	-5.31	$1.1*10^{-07}$	✓
Structure	-0.0632	0.1298	-0.49	0.626	
Environment × Length	-0.2758	0.2139	-1.29	0.197	
Environment × Structure	-0.3812	0.2386	-1.60	0.110	
Length × Structure	-0.4814	0.2423	-1.99	0.047	✓
Environment × Length × Structure	0.7365	0.4785	1.54	0.124	

```
Formula:
rating ~ length * structure +
(1 + length * structure | subject) +
(1 + length * structure | item)
```

Table A.9: Coefficients for Experiment 4 Mixed Effects Model (EXISTENTIAL environment only)

	β	SE	z	p	<0.05?
Length	-0.8515	0.2257	-3.77	0.0002	✓
Structure	-0.1540	0.2213	-0.70	0.4864	
Length × Structure	-0.1901	0.3285	-0.58	0.5628	

A.4.2 Items

Table A.10: Condition legend

LENGTH (OF DEPENDENCY)	STRUCTURE	ENVIRONMENT
SH = SHORT	NO = NON-ISLAND	PR = PREDICATE
LO = LONG	IS = ISLAND	EX = EXISTENTIAL

(213) ITEM 1

a. Who thinks that Mary believes only one senator to have watched this show? SH | NO | PR
b. Which show do you think that Mary believes only one senator to have watched? LO | NO | PR
c. Who thinks that Mary believes that she is the only senator to have watched this show? SH | IS | PR

d. Which show do you think that Mary believes that she is the only senator to have watched? LO | IS | PR

e. Who thinks that Mary believes that there is only one senator watching this show? SH | NO | EX

f. Which show do you think that Mary believes that there is only one senator watching? LO | NO | EX

g. Who thinks that Mary believes that there is only one senator to have watched this show? SH | IS | EX

h. Which show do you think that Mary believes that there is only one senator to have watched? LO | IS | EX

(214) ITEM 2

a. Who said that Michael proved only one journalist to have read this article? SH | NO | PR

b. Which article did you say that Michael proved only one journalist to have read? LO | NO | PR

c. Who said that Michael proved that he is the only journalist to have read this article? SH | IS | PR

d. Which article did you say that Michael proved that he is the only journalist to have read? LO | IS | PR

e. Who said that Michael proved that there was only one journalist reading this article? SH | NO | EX

f. Which article did you say that Michael proved that there was only one journalist reading? LO | NO | EX

g. Who said that Michael proved that there was only one journalist to have read this article? SH | IS | EX

h. Which article did you say that Michael proved that there was only one journalist to have read? LO | IS | EX

(215) ITEM 3

a. Who knows that Janine declared only one architect to have designed the new library? SH | NO | PR

b. Which new library do you know that Janine declared only one architect to have designed? LO | NO | PR

c. Who knows that Janine declared that she is the only architect to have designed the new library? SH | IS | PR

d. Which new library do you know that Janine declared that she is the only architect to have designed? LO | IS | PR

e. Who knows that Janine declared that there was only one architect designing the new library? SH | NO | EX

f. Which new library do you know that Janine declared that there was only one architect designing? LO | NO | EX

g. Who knows that Janine declared that there was only one architect to have designed the new library? SH | IS | EX

h. Which new library do you know that Janine declared that there was only one architect to have designed? LO | IS | EX

(216) ITEM 4

a. Who hopes that Ben finds only one person to have stolen his car? SH | NO | PR
b. Which car do you hope that Ben finds only one person to have stolen? LO | NO | PR
c. Who hopes that Ben finds that he is the only person to have stolen his car? SH | IS | PR
d. Which car do you hope that Ben finds that he is the only person to have stolen? LO | IS | PR
e. Who hopes that Ben finds that there is only one person stealing his car? SH | NO | EX
f. Which car do you hope that Ben finds that there is only one person stealing? LO | NO | EX
g. Who hopes that Ben finds that there is only one person to have stolen his car? SH | IS | EX
h. Which car do you hope that Ben finds that there is only one person to have stolen? LO | IS | EX

(217) ITEM 5

a. Who knows that Heather assumed only one accountant to have filed this form? SH | NO | PR
b. Which form do you know that Heather assumed only one accountant to have filed? LO | NO | PR
c. Who knows that Heather assumed that she is the only accountant to have filed? SH | IS | PR
d. Which form do you know that Heather assumed that she is the only accountant to have filed? LO | IS | PR
e. Who knows that Heather assumed that there is only one accountant filing this form? SH | NO | EX
f. Which form do you know that Heather assumed that there is only one accountant filing? LO | NO | EX
g. Who knows that Heather assumed that there is only one accountant to have filed this form? SH | IS | EX
h. Which form do you know that Heather assumed that there is only one accountant to have filed? LO | IS | EX

(218) ITEM 6

a. Who said that Adam expects only one tenant to have occupied this apartment? SH | NO | PR
b. Which apartment did you say that Adam expects only one tenant to have occupied? LO | NO | PR
c. Who said that Adam expects that he is the only tenant to have occupied this apartment? SH | IS | PR
d. Which apartment did you say that Adam expects that he is the only tenant to have occupied? LO | IS | PR
e. Who said that Adam expects that there is only one tenant occupying this apartment? SH | NO | EX
f. Which apartment did you say that Adam expects that there is only one tenant occupying? LO | NO | EX
g. Who said that Adam expects that there is only one tenant to have occupied this apartment? SH | IS | EX
h. Which apartment did you say that Adam expects that there is only one tenant to have occupied? LO | IS | EX

(219) ITEM 7

a. Who thinks that Courtney imagines only one art collector to have bid on this painting? SH | NO | PR
b. Which painting do you think that Courtney imagines only one art collector to have bid on? LO | NO | PR
c. Who thinks that Courtney imagines that she is the only art collector to have bid on this painting? SH | IS | PR
d. Which painting do you think that Courtney imagines that she is the only art collector to have bid on? LO | IS | PR
e. Who thinks that Courtney imagines that there is only one art collector bidding on this painting? SH | NO | EX
f. Which painting do you think that Courtney imagines that there is only one art collector bidding on? LO | NO | EX
g. Who thinks that Courtney imagines that there is only one art collector to have bid on this painting? SH | IS | EX
h. Which painting do you think that Courtney imagines that there is only one art collector to have bid on? LO | IS | EX

(220) ITEM 8

a. Who claimed that Javier alleged only one mailman to have lost your mail? SH | NO | PR
b. Which mail did you claim that Javier alleged only one mailman to have lost? LO | NO | PR
c. Who claimed that Javier alleged that he is the only mailman to have lost your mail? SH | IS | PR
d. Which mail did you claim that Javier alleged that he is the only mailman to have lost? LO | IS | PR
e. Who claimed that Javier alleged that there is only one mailman losing your mail? SH | NO | EX
f. Which mail did you claim that Javier alleged that there is only one mailman losing? LO | NO | EX
g. Who claimed that Javier alleged that there is only one neighbor to have opened your mailbox? SH | IS | EX
h. Which mail did you claim that Javier alleged that there is only one neighbor to have opened? LO | IS | EX

(221) ITEM 9

a. Who believes that Serena proved only one kid to have done this chore? SH | NO | PR
b. Which chore do you believe that Serena proved only one kid to have done? LO | NO | PR
c. Who believes that Serena proved that she was the only kid to have done this chore? SH | IS | PR
d. Which chore do you believe that Serena proved that she was the only kid to have done? LO | IS | PR
e. Who believes that Serena proved that there was only one kid doing this chore? SH | NO | EX
f. Which chore do you believe that Serena proved that there was only one kid doing? LO | NO | EX
g. Who believes that Serena proved that there was only one kid to have done this chore? SH | IS | EX
h. Which chore do you believe that Serena proved that there was only one kid to have done? LO | IS | EX

(222) ITEM 10

a. Who hopes that Paul believes only one customer to have ordered this drink?
SH | NO | PR

b. Which drink do you hope that Paul believes only one customer to have ordered?
LO | NO | PR

c. Who hopes that Paul believes that he is the only customer to have ordered this drink?
SH | IS | PR

d. Which drink do you hope that Paul believes that he is the only customer to have ordered?
LO | IS | PR

e. Who hopes that Paul believes that there is only one customer ordering this drink?
SH | NO | EX

f. Which drink do you hope that Paul believes that there is only one customer ordering?
LO | NO | EX

g. Who hopes that Paul believes that there is only one customer to have ordered this drink?
SH | IS | EX

h. Which drink do you hope that Paul believes that there is only one customer to have ordered?
LO | IS | EX

(223) ITEM 11

a. Who knows that Leanne expects only one friend to have enjoyed this restaurant?
SH | NO | PR

b. Which restaurant do you know that Leanne expects only one friend to have enjoyed?
LO | NO | PR

c. Who knows that Leanne expects that she is the only friend to have enjoyed this restaurant?
SH | IS | PR

d. Which restaurant do you know that Leanne expects that she is the only friend to have enjoyed?
LO | IS | PR

e. Who knows that Leanne expects that there is only one friend enjoying this restaurant?
SH | NO | EX

f. Which restaurant do you know that Leanne expects that there is only one friend enjoying?
LO | NO | EX

g. Who knows that Leanne expects that there is only one friend to have enjoyed this restaurant?
SH | IS | EX

h. Which restaurant do you know that Leanne expects that there is only one friend to have enjoyed?
LO | IS | EX

(224) ITEM 12

a. Who thinks that Henry found only one passenger to have boarded this bus?
SH | NO | PR

b. Which bus do you think that Henry found only one passenger to have boarded?
LO | NO | PR

c. Who thinks that Henry found that he was the only passenger to have boarded this bus?
SH | IS | PR

d. Which bus do you think that Henry found that he was the only passenger to have boarded?
LO | IS | PR

e. Who thinks that Henry found that there was only one passenger boarding this bus?
SH | NO | EX

f. Which bus do you think that Henry found that there was only one passenger boarding?
LO | NO | EX

g. Who thinks that Henry found that there was only one passenger to have boarded?
SH | IS | EX

h. Which bus do you think that Henry found that there was only one passenger to have boarded? LO | IS | EX

(225) ITEM 13

a. Who said that Wanda imagines only one player to have worn these shoes? SH | NO | PR
b. Which shoes did you say that Wanda imagines only one player to have worn? LO | NO | PR
c. Who said that Wanda imagines that she is the only player to have worn these shoes? SH | IS | PR
d. Which shoes did you say that Wanda imagines that she is the only player to have worn? LO | IS | PR
e. Who said that Wanda imagines that there was only one player wearing these shoes? SH | NO | EX
f. Which shoes did you say that Wanda imagines that there was only one player wearing? LO | NO | EX
g. Who said that Wanda imagines that there was only one player to have worn these shoes? SH | IS | EX
h. Which shoes did you say that Wanda imagines that there was only one player to have worn? LO | IS | EX

(226) ITEM 14

a. Who claimed that Karl assumes only one artist to have discussed this sculpture? SH | NO | PR
b. Which sculpture did you claim that Karl assumes only one artist to have discussed? LO | NO | PR
c. Who claimed that Karl assumes that he was the only artist to have discussed this sculpture? SH | IS | PR
d. Which sculpture did you claim that Karl assumes that he was the only artist to have discussed? LO | IS | PR
e. Who claimed that Karl assumes that there was only one artist discussing this sculpture? SH | NO | EX
f. Which sculpture did you claim that Karl assumes that there was only one artist discussing? LO | NO | EX
g. Who claimed that Karl assumes that there was only one artist to have discussed this sculpture? SH | IS | EX
h. Which sculpture did you claim that Karl assumes that there was only one artist to have discussed? LO | IS | EX

(227) ITEM 15

a. Who believes that Octavia declared only one doctor to have boarded this flight? SH | NO | PR
b. Which flight do you believe that Octavia declared only one doctor to have boarded? LO | NO | PR
c. Who believes that Octavia declared that she is the only doctor to have boarded? SH | IS | PR
d. Which flight do you believe that Octavia declared that she is the only doctor to have boarded? LO | IS | PR
e. Who believes that Octavia declared that there is only one doctor boarding this flight? SH | NO | EX

f. Which flight do you believe that Octavia declared that there is only one doctor boarding? LO | NO | EX
g. Who believes that Octavia declared that there is only one doctor to have boarded this flight? SH | IS | EX
h. Which flight do you believe that Octavia declared that there is only one doctor to have boarded? LO | IS | EX
i. Who hopes that Philip believes only one custodian to have cleaned this classroom? SH | NO | PR
j. Which classroom do you hope that Philip believes only one custodian to have cleaned? LO | NO | PR
k. Who hopes that Philip believes that he is the only custodian to clean this classroom? SH | IS | PR
l. Which classroom do you hope that Philip believes that he is the only custodian to clean? LO | IS | PR
m. Who hopes that Philip believes that there is only one custodian cleaning this classroom? SH | NO | EX
n. Which classroom do you hope that Philip believes that there is only one custodian cleaning? LO | NO | EX
o. Who hopes that Philip believes that there is only one custodian to have cleaned this classroom? SH | IS | EX
p. Which classroom do you hope that Philip believes that there is only one custodian to have cleaned? LO | IS | EX

(228) ITEM 17

a. Who knows that Jasmine found only one customer to have reviewed this repair shop? SH | NO | PR
b. Which repair shop do you know that Jasmine found only one customer to have reviewed? LO | NO | PR
c. Who knows that Jasmine found that she was the only customer to have reviewed this repair shop? SH | IS | PR
d. Which repair shop do you know that Jasmine found that she was the only customer to have reviewed? LO | IS | PR
e. Who knows that Jasmine found that there was only one customer reviewing this repair shop? SH | NO | EX
f. Which repair shop do you know that Jasmine found that there was only one customer reviewing? LO | NO | EX
g. Who knows that Jasmine found that there was only one customer to have reviewed this repair shop? SH | IS | EX
h. Which repair shop do you know that Jasmine found that there was only one customer to have reviewed? LO | IS | EX

(229) ITEM 18

a. Who thinks that Earl declared only one visitor to have fed this turtle? SH | NO | PR
b. Which turtle do you think that Earl declared only one visitor to have fed? LO | NO | PR
c. Who thinks that Earl declared that he was the only visitor to have fed this turtle? SH | IS | PR
d. Which turtle do you think that Earl declared that he was the only visitor to have fed? LO | IS | PR
e. Who thinks that Earl declared that there was only one visitor feeding this turtle? SH | NO | EX

f. Which turtle do you think that Earl declared that there was only one visitor feeding? LO | NO | EX
g. Who thinks that Earl declared that there was only one visitor to have fed? SH | IS | EX
h. Which turtle do you think that Earl declared that there was only one visitor to have fed? LO | IS | EX

(230) ITEM 19

a. Who said that Farrah alleged only one student to have read this book? SH | NO | PR
b. Which book did you say that Farrah alleged only one student to have read? LO | NO | PR
c. Who said that Farrah alleged that she was the only student to have read this book? SH | IS | PR
d. Which book did you say that Farrah alleged that she was the only student to have read? LO | IS | PR
e. Who said that Farrah alleged that there was only one student reading this book? SH | NO | EX
f. Which book did you say that Farrah alleged that there was only one student reading? LO | NO | EX
g. Who said that Farrah alleged that there was only one student to have read this book? SH | IS | EX
h. Which book did you say that Farrah alleged that there was only one student to have read? LO | IS | EX

(231) ITEM 20

a. Who claimed that Otto assumes only one nurse to have helped this patient? SH | NO | PR
b. Which patient did you claim that Otto assumes only one nurse to have helped? LO | NO | PR
c. Who claimed that Otto assumes that he was the only nurse to have helped this patient? SH | IS | PR
d. Which patient did you claim that Otto assumes that he was the only nurse to have helped? LO | IS | PR
e. Who claimed that Otto assumes that there was only one nurse helping this patient? SH | NO | EX
f. Which patient did you claim that Otto assumes that there was only one nurse helping? LO | NO | EX
g. Who claimed that Otto assumes that there was only one nurse to have helped this patient? SH | IS | EX
h. Which patient did you claim that Otto assumes that there was only one nurse to have helped? LO | IS | EX

(232) ITEM 21

a. Who believes that Ursula proved only one tourist to have visited this town? SH | NO | PR
b. Which town do you believe that Ursula proved only one tourist to have visited? LO | NO | PR
c. Who believes that Ursula proved that she was the only tourist to have visited this town? SH | IS | PR
d. Which town do you believe that Ursula proved that she was the only tourist to have visited? LO | IS | PR
e. Who believes that Ursula proved that there was only one tourist visiting this town? SH | NO | EX

f. Which town do you believe that Ursula proved that there was only one tourist visiting? LO | NO | EX

g. Who believes that Ursula proved that there was only one tourist to have visited this town? SH | IS | EX

h. Which down do you believe that Ursula proved that there was only one tourist to have visited? LO | IS | EX

(233) ITEM 22

a. Who hopes that Alicia expects only one critic to have listened to this album? SH | NO | PR

b. Which album do you hope that Alicia expects only one critic to have listened to? LO | NO | PR

c. Who hopes that Alicia expects that she was the only critic to have listened to this album? SH | IS | PR

d. Which album do you hope that Alicia expects that she was the only critic to have listened to? LO | IS | PR

e. Who hopes that Alicia expects that there was only one critic listening to this album? SH | NO | EX

f. Which album do you hope that Alicia expects that there was only one critic listening to? LO | NO | EX

g. Who hopes that Alicia expects that there was only one critic to have listened to this album? SH | IS | EX

h. Which album do you hope that Alicia expects that there was only one critic to have listened to? LO | IS | EX

(234) ITEM 23

a. Who knows that Yanny imagined only one person to have ordered this ice cream flavor? SH | NO | PR

b. Which ice cream flavor do you know that Yanny imagined only one person to have ordered? LO | NO | PR

c. Who knows that Yanny imagined that he was the only person to have ordered this ice cream flavor? SH | IS | PR

d. Which ice cream flavor do you know that Yanny imagined that he was the only person to have ordered? LO | IS | PR

e. Who knows that Yanny imagined that there was only one person ordering this ice cream flavor? SH | NO | EX

f. Which ice cream flavor do you know that Yanny imagined that there was only one person ordering? LO | NO | EX

g. Who knows that Yanny imagined that there was only one person to have ordered this ice cream flavor? SH | IS | EX

h. Which ice cream flavor do you know that Yanny imagined that there was only one person to have ordered? LO | IS | EX

(235) ITEM 24

a. Who thinks that Joshua assumes only one chef to have prepared this recipe? SH | NO | PR

b. Which recipe do you think that Joshua assumes only one chef to have prepared? LO | NO | PR

c. Who thinks that Joshua assumes that he was the only chef to have prepared this recipe? SH | IS | PR

d. Which recipe do you think that Joshua assumes that he was the only chef to have prepared? LO | IS | PR
e. Who thinks that Joshua assumes that there was only one chef preparing this recipe? SH | NO | EX
f. Which recipe do you think that Joshua assumes that there was only one chef preparing? LO | NO | EX
g. Who thinks that Joshua assumes that there was only one chef to have prepared this recipe? SH | IS | EX
h. Which recipe do you think that Joshua assumes that there was only one chef to have prepared? LO | IS | EX

(236) ITEM 25

a. Who said that Miriam alleged only one team-member to have completed this task? SH | NO | PR
b. Which task did you say that Miriam alleged only one team-member to have completed? LO | NO | PR
c. Who said that Miriam alleged that she was the only team-member to have completed this task? SH | IS | PR
d. Which task did you say that Miriam alleged that she was the only team-member to have completed? LO | IS | PR
e. Who said that Miriam alleged that there was only one team-member completing this task? SH | NO | EX
f. Which task did you say that Miriam alleged that there was only one team-member completing? LO | NO | EX
g. Who said that Miriam alleged that there was only one team-member to have completed this task? SH | IS | EX
h. Which task did you say that Miriam alleged that there was only one team-member to have completed? LO | IS | EX

(237) ITEM 26

a. Who claimed that Stan believes only one kid to have eaten this box of cookies? SH | NO | PR
b. Which box of cookies did you say that Stan believes only one kid to have eaten? LO | NO | PR
c. Who claimed that Stan believes that he was the only kid to have eaten this box of cookies? SH | IS | PR
d. Which box of cookies did you claim that Stan believes that he was the only kid to have eaten? LO | IS | PR
e. Who claimed that Stan believes that there was only one kid eating this box of cookies? SH | NO | EX
f. Which box of cookies did you claim that Stan believes that there was only one kid eating? LO | NO | EX
g. Who claimed that Stan believes that there was only one kid to have eaten this box of cookies? SH | IS | EX
h. Which box of cookies did you claim that Stan believes that there was only one kid to have eaten? LO | IS | EX

(238) ITEM 27

a. Who believes that Maddy declared only one programmer to have built this app? SH | NO | PR
b. Which app do you believe that Maddy declared only one programmer to have built? LO | NO | PR
c. Who believes that Maddy declared that she was the only programmer to have built this app? SH | IS | PR
d. Which app do you believe that Maddy declared that she was the only programmer to have built? LO | IS | PR
e. Who believes that Maddy declared that there was only one programmer building this app? SH | NO | EX
f. Which app do you believe that Maddy declared that there was only one programmer building? LO | NO | EX
g. Who belives that Maddy declared that there was only one programmer to have built this app? SH | IS | EX
h. Which app do you believe that Maddy declared that there was only one programmer to have built? LO | IS | EX

(239) ITEM 28

a. Who hopes that Paul expects only one employee to have operated this machine? SH | NO | PR
b. Which machine do you hope that Paul expects only one employee to have operated? LO | NO | PR
c. Who hopes that Paul expects that he is the only employee to have operated this machine? SH | IS | PR
d. Which machine do you hope that Paul expects that he is the only employee to have operated? LO | IS | PR
e. Who hopes that Paul expects that there was only one employee operating this machine? SH | NO | EX
f. Which machine do you hope that Paul expects that there was only one employee operating? LO | NO | EX
g. Who hopes that Paul expects that there was only one employee to have operated this machine? SH | IS | EX
h. Which machine do you hope that Paul expects that there was only one employee to have operated? LO | IS | EX

(240) ITEM 29

a. Who said that Janet alleged only one scientist to have studied this insect? SH | NO | PR
b. Which insect did you say that Janet alleged only one scientist to have studied? LO | NO | PR
c. Who said that Janet alleged that she was the only scientist to have studied this insect? SH | IS | PR
d. Which insect did you say that Janet alleged that she was the only scientist to have studied? LO | IS | PR
e. Who said that Janet alleged that there was only one scientist studying this insect? SH | NO | EX
f. Which insect did you say that Janet alleged that there was only one scientist studying? LO | NO | EX
g. Who said that Janet alleged that there was only one scientist to have studied this insect? SH | IS | EX

h. Which insect did you say that Janet alleged that there was only one scientist to have studied? LO | IS | EX

(241) ITEM 30

a. Who claimed that Grover proved only one musician to have played this instrument? SH | NO | PR
b. Which instrument did you claim that Grover proved only one musician to have played? LO | NO | PR
c. Who claimed that Grover proved that he was the only musician to have played this instrument? SH | IS | PR
d. Which instrument did you claim that Grover proved that he was the only musician to have played? LO | IS | PR
e. Who claimed that Grover proved that there was only one musician playing this instrument? SH | NO | EX
f. Which instrument did you claim that Grover proved that there was only one musician playing? LO | NO | EX
g. Who claimed that Grover proved that there was only one musician to have played this instrument? SH | IS | EX
h. Which instrument did you claim that Grover proved that there was only one musician to have played? LO | IS | EX

(242) ITEM 31

a. Who believes that Jacky found only one student to have used this iPhone model? SH | NO | PR
b. Which iPhone model do you believe that Jacky found only one student to have used? LO | NO | PR
c. Who believes that Jacky found that she was the only student to have used this iPhone model? SH | IS | PR
d. Which iPhone model do you believe that Jacky found that she was the only student to have used? LO | IS | PR
e. Who believes that Jacky found that there was only one student using this iPhone model? SH | NO | EX
f. Which iPhone model do you believe that Jacky found that there was only one student using? LO | NO | EX
g. Who believes that Jacky found that there was only one student to have used this iPhone model? SH | IS | EX
h. Which iPhone model do you believe that Jacky found that there was only one student to have used? LO | IS | EX

(243) ITEM 32

a. Who claimed that Nadine imagines only one parent to have bought this comic book? SH | NO | PR
b. Which comic book did you claim that Nadine imagines only one parent to have read? LO | NO | PR
c. Who claimed that Nadine imagines that she is the only parent to have read this comic book? SH | IS | PR
d. Which comic book did you claim that Nadine imagines that she is the only parent to have read? LO | IS | PR
e. Who claimed that Nadine imagines that there was only one parent reading this comic book? SH | NO | EX

f. Which comic book did you claim that Nadine imagines that there was only one parent reading? LO | NO | EX
g. Who claimed that Nadine imagines that there was only one parent to have read this comic book? SH | IS | EX
h. Which comic book did you claim that Nadine imagines that there was only one parent to have read? LO | IS | EX

A.5 Experiment 5: Infinitival relatives II

A.5.1 Model

```
Formula:
rating ~ environment * dependency +
(1 + environment * dependency | subject) +
(1 + environment * dependency | item)
```

Table A.11: Coefficients for Experiment 5 Mixed Effects Model

	β	SE	z	p	<0.05?
Environment	-2.0920	0.6403	-3.27	0.0011	✓
Dependency	4.0535	0.6644	6.10	1.1*10^{9}	✓
Environment × Dependency	-0.4328	1.0254	-0.42	0.6730	

A.5.2 Figures

See Figure A.1.

A.5.3 Items

Table A.12: Condition legend

Environment	Dependency type
PR = predicate	MO = movement dependency
OB = object	AN = anaphoric dependency

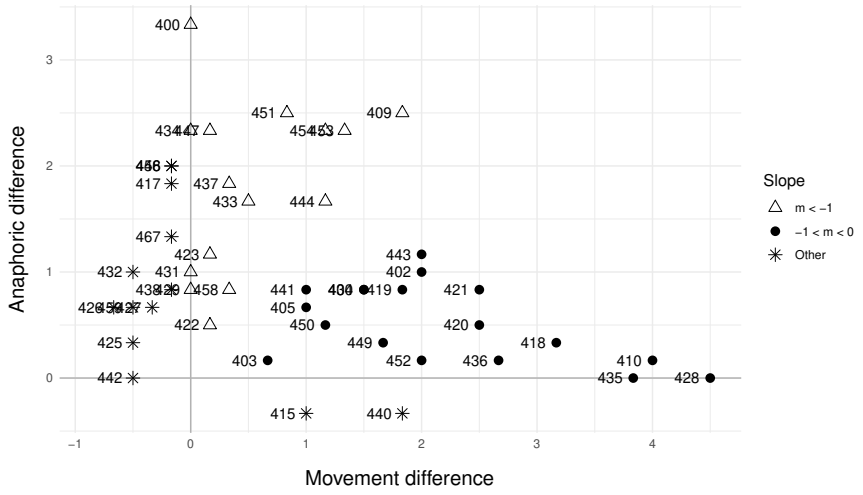


Figure A.1: Experiment 5 participants plotted by the difference between the mean of each of the ANAPHORIC conditions (y-axis) and the difference between the mean of each of the MOVEMENT conditions (x-axis). Slopes are determined by drawing a line through the x- and y-axes of the lines that meet at the point corresponding to each subject.

(244) ITEM 1

a. The president is someone that Mary is the only reporter to have endorsed. PR | MO
b. The president thinks that Mary is the only reporter to have endorsed him. PR | AN
c. The president is someone that Mary interrupted the only reporter to have endorsed. OB | MO
d. The president thinks that Mary interrupted the only reporter to have endorsed him. OB | AN

(245) ITEM 2

a. The Rock is someone that Maria is the only producer to have fired. PR | MO
b. The Rock knows that Maria is the only producer to have fired him. PR | AN
c. The Rock is someone that Maria met the only producer to have fired. OB | MO
d. The Rock knows that Maria met the only producer to have fired him. OB | AN

(246) ITEM 3

a. The vice president is someone that Jasmine is the only relative to have unfriended. PR | MO
b. The vice president says that Jasmine is the only relative to have unfriended him. PR | AN
c. The vice president is someone that Jasmine contacted the only relative to have unfriended. OB | MO
d. The vice president says that Jasmine contacted the only relative to have unfriended him. OB | AN

(247) ITEM 4

a. The Queen is someone that Henry is the only anarchist to have trusted. PR | MO
b. The Queen believes that Henry is the only anarchist to have trusted her. PR | AN
c. The Queen is someone that Henry criticized the only anarchist to have trusted. OB | MO
d. The Queen believes that Henry criticized the only anarchist to have trusted her. OB | AN

(248) ITEM 5

a. The first lady is someone that Paul is the only author to have met. PR | MO
b. The first lady claims that Paul is the only author to have met her. PR | AN
c. The first lady is someone that Paul called the only author to have met. OB | MO
d. The first lady claims that Paul called the only author to have met her. OB | AN

(249) ITEM 6

a. The Pope is someone that Darla is the only CEO to have supported. PR | MO
b. The Pope hopes that Darla is the only CEO to have supported him. PR | AN
c. The Pope is someone that Darla challenged the only CEO to have supported. OB | MO
d. The Pope hopes that Darla challenged the only CEO to have supported him. OB | AN

(250) ITEM 7

a. The governor is someone that Allison is the only staff-member to have reached. PR | MO
b. The governor says that Allison is the only staff-member to have reached him. PR | AN
c. The governor is someone that Allison admires the only staff-member to have reached. OB | MO
d. The governor says that Allison admires the only staff-member to have reached him. OB | AN

(251) ITEM 8

a. Dax Shepard is someone that Patricia is the only talkshow host to have insulted. PR | MO
b. Dax Shepard hopes that Patricia is the only talkshow host to have insulted him. PR | AN
c. Dax Shepard is someone that Patricia despises the only talkshow host to have insulted. OB | MO
d. Dax Shepard hopes that Patricia despises the only talkshow host to have insulted him. OB | AN

(252) ITEM 9

a. The Dalai Lama is someone that Rebecca is the only American to have seen. PR | MO
b. The Dalai Lama thinks that Rebecca is the only American to have seen him. PR | AN
c. The Dalai Lama is someone that Rebecca envies the only American to have seen. OB | MO
d. The Dalai Lama thinks that Rebecca envies the only American to have seen him. OB | AN

(253) ITEM 10

a. Barack Obama is someone that Stacy is the only Republican to have agreed with. PR | MO
b. Barack Obama believes that Stacy is the only Republican to have agreed with him. PR | AN

c. Barack Obama is someone that Stacy respects the only Republican to have agreed with. OB | MO

d. Barack Obama believes that Stacy respects the only Republican to have agreed with him. OB | AN

(254) ITEM 11

a. Beyoncé is someone that Walter is the only fan to have hugged. PR | MO
b. Beyoncé knows that Walter is the only fan to have hugged her. PR | AN
c. Beyoncé is someone that Walter admires the only fan to have hugged. OB | MO
d. Beyoncé knows that Walter admires the only fan to have hugged her. OB | AN

(255) ITEM 12

a. Bernie Sanders is someone that Crystal is the only mayor to have annoyed. PR | MO
b. Bernie Sanders says that Crystal is the only mayor to have annoyed him. PR | AN
c. Bernie Sanders is someone that Crystal teased the only mayor to have annoyed. OB | MO
d. Bernie Sanders says that Crystal teased the only mayor to have annoyed him. OB | AN

(256) ITEM 13

a. Oprah Winfrey is someone that Joel is the only celebrity to have mocked. PR | MO
b. Oprah Winfrey believes that Joel is the only celebrity to have mocked her. PR | AN
c. Oprah Winfrey is someone that Joel dislikes the only celebrity to have mocked. OB | MO
d. Oprah Winfrey believes that Joel dislikes the only celebrity to have mocked her. OB | AN

(257) ITEM 14

a. J.K. Rowling is someone that Larry is the only writer to have sued. PR | MO
b. J.K. Rowling claims that Larry is the only writer to have sued her. PR | AN
c. J.K. Rowling is someone that Larry ridiculed the only writer to have sued. OB | MO
d. J.K. Rowling claims that Larry ridiculed the only writer to have sued her. OB | AN

(258) ITEM 15

a. Ellen DeGeneres is someone that Seinfeld is the only comedian to have disappointed. PR | MO
b. Ellen DeGeneres knows that Seinfeld is the only comedian to have disappointed her. PR | AN
c. Ellen DeGeneres is someone that Comedy Central fired the only comedian to have disappointed. OB | MO
d. Ellen DeGeneres knows that Comedy Central fired the only comedian to have disappointed her. OB | AN

(259) ITEM 16

a. Hillary Clinton is someone that Brandon is the only biographer to have researched. PR | MO
b. Hillary Clinton thinks that Brandon is the only biographer to have researched her. PR | AN
c. Hillary Clinton is someone that Brandon knows the only biographer to have researched. OB | MO
d. Hillary Clinton thinks that Brandon knows the only biographer to have researched her. OB | AN

(260) ITEM 17

a. Leonardo DiCaprio is someone that Paula is the only pool player to have beat. PR | MO
b. Leonardo DiCaprio believes that Paula is the only pool player to have beat him. PR | AN
c. Leonardo DiCaprio is someone that Paula flattered the only pool player to have beat. OB | MO
d. Leonardo DiCaprio believes that Paula flattered the only pool player to have beat him. OB | AN

(261) ITEM 18

a. Bill Nye is someone that Vivian is the only scientist to have condemned. PR | MO
b. Bill Nye claims that Vivian is the only scientist to have condemned him. PR | AN
c. Bill Nye is someone that Vivian interviewed the only scientist to have condemned. OB | MO
d. Bill Nye claims that Vivian interviewed the only scientist to have condemned him. OB | AN

(262) ITEM 19

a. Janet Jackson is someone that Aaron is the only producer to have scrutinized. PR | MO
b. Janet Jackson hopes that Aaron is the only producer to have scrutinized her. PR | AN
c. Janet Jackson is someone that Aaron discussed the only producer to have scrutinized. OB | MO
d. Janet Jackson hopes that Aaron discussed the only producer to have scrutinized her. OB | AN

(263) ITEM 20

a. Hermione Grainger is someone that Snape is the only professor to have doubted. PR | MO
b. Hermione Grainger knows that Snape is the only professor to have doubted her. PR | AN
c. Hermione Grainger is someone that Snape distrusts the only professor to have doubted. OB | MO
d. Hermione Grainger knows that Snape distrusts the only professor to have doubted her. OB | AN

(264) ITEM 21

a. Ruth Bader Ginsburg is someone that Antonin is the only judge to have teased. PR | MO
b. Ruth Bader Ginsburg thinks that Antonin is the only judge to have teased her. PR | AN
c. Ruth Bader Ginsburg is someone that Antonin defended the only judge to have teased. OB | MO
d. Ruth Bader Ginsburg thinks that Antonin defended the only judge to have teased her. OB | AN

(265) ITEM 22

a. Bill Gates is someone that Lauren is the only senator to have educated. PR | MO
b. Bill Gates says that Lauren is the only senator to have educated him. PR | AN
c. Bill Gates is someone that Lauren applauded the only senator to have educated. OB | MO
d. Bill Gates says that Lauren applauded the only senator to have educated him. OB | AN

(266) ITEM 23

a. John Krasinski is someone that Alice is the only admirer to have messaged. PR | MO
b. John Krasinski hopes that Alice is the only admirer to have messaged him. PR | AN
c. John Krasinski is someone that Alice blocked the only admirer to have messaged. OB | MO
d. John Krasinski hopes that Alice blocked the only admirer to have messaged him. OB | AN

(267) ITEM 24

a. Laverne Cox is someone that Manuel is the only TV critic to have disliked. PR | MO
b. Laverne Cox claims that Manuel is the only TV critic to have disliked her. PR | AN
c. Laverne Cox is someone that Manuel denounced the only TV critic to have disliked. OB | MO
d. Laverne Cox claims that Manuel denounced the only TV critic to have disliked her. OB | AN

A.6 Experiment 6: Evidential existential verbs

A.6.1 Model

```
Cumulative Link Mixed Model fitted with the Laplace approximat-
ion

formula: rating ~ response +
                  (1 + response | subject) +
                  (1 + response | item)
data: exp6_data

 link  threshold nobs logLik   AIC     niter       max.grad
 logit flexible  2184 -2847.72 5733.45 2779(23245) 1.39e-03
    cond.H
    4.0e+02

Random effects:
 Groups  Name            Variance Std.Dev. Corr
 subject (Intercept)     4.8762   2.2082
         response_cp-ev  0.6734   0.8206   -0.691
         response_cp-tr  4.2207   2.0544   -0.705  0.929
 item    (Intercept)     1.4518   1.2049
         response_cp-ev  0.4319   0.6572   -0.307
         response_cp-tr  2.4391   1.5618   -0.454  0.199
Number of groups:  subject 91,  item 24

Coefficients:
               Estimate Std. Error z value Pr(>|z|)
```

```
response_cp-ev  -0.4308     0.1993  -2.162   0.0306 *
response_cp-tr  -3.1935     0.4089  -7.811 5.69e-15 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Threshold coefficients:
    Estimate Std. Error z value
1|2  -5.7019     0.3775 -15.103
2|3  -4.0861     0.3652 -11.190
3|4  -2.8262     0.3589  -7.874
4|5  -1.3629     0.3540  -3.850
5|6   0.4434     0.3519   1.260
```

A.6.2 Items

Table A.13: Condition legend for Experiment 6 items

Environment
EX = EXISTENTIAL
EV = EVIDENTIAL EXISTENTIAL
TR = TRANSITIVE VERB

(268) Item 1 Question: Is there anyone who can prepare this dish?

a. Yeah, I’m sure there’s someone who can prepare it. EX
b. Yeah, I heard of someone who can prepare it. EV
c. Yeah, I imitated someone who can prepare it. TR

(269) Item 2 Question: Is there anyone who can solve this problem?

a. Yeah, I’m sure there’s someone who can solve it. EX
b. Yeah, I know someone who can solve it. EV
c. Yeah, I called someone who can solve it. TR

(270) Item 3 Question: Is there anyone who can beat this level?

a. Yeah, I’m sure there’s someone who can beat it. EX
b. Yeah, I heard of someone who can beat it. EV
c. Yeah, I imitated someone who can beat it. TR

(271) Item 4 Question: Is there anyone who can fix this toilet?

a. Yeah, I’m sure there’s someone who can fix it. EX
b. Yeah, I talked to someone who can fix it. EV
c. Yeah, I described someone who can fix it. TR

(272) ITEM 5 Question: Is there anyone who can grow this plant?

a. Yeah, I'm sure there's someone who can grow it. EX
b. Yeah, I met someone who can grow it. EV
c. Yeah, I slapped someone who can grow it. TR

(273) ITEM 6 Question: Is there anyone who can cure this disease?

a. Yeah, I'm sure there's someone who can cure it. EX
b. Yeah, I ran into someone who can cure it. EV
c. Yeah, I praised someone who can cure it. TR

(274) ITEM 7 Question: Is there anyone who can fix this issue?

a. Yeah, I'm sure there's someone who can fix it. EX
b. Yeah, I met someone who can fix it. EV
c. Yeah, I advised someone who can fix it. TR

(275) ITEM 8 Question: Is there anyone who can decode this script?

a. Yeah, I'm sure there's someone who can decode it. EX
b. Yeah, I talked to someone who can decode it. EV
c. Yeah, I criticized someone who can decode it. TR

(276) ITEM 9 Question: Is there anyone who can play this song?

a. Yeah, I'm sure there's someone who can play it. EX
b. Yeah, I heard of someone who can play it. EV
c. Yeah, I advised someone who can play it. TR

(277) ITEM 10 Question: Is there anyone who can win this race?

a. Yeah, I'm sure there's someone who can win it. EX
b. Yeah, I ran into someone who can win it. EV
c. Yeah, I advised someone who can win it. TR

(278) ITEM 11 Question: Is there anyone who can enforce this rule?

a. Yeah, I'm sure there's someone who can enforce it. EX
b. Yeah, I found someone who can enforce it. EV
c. Yeah, I dated someone who can enforce it. TR

(279) ITEM 12 Question: Is there anyone who can afford this gift?

a. Yeah, I'm sure there's someone who can afford it. EX
b. Yeah, I ran into someone who can afford it. EV
c. Yeah, I criticized someone who can afford it. TR

(280) ITEM 13 Question: Is there anyone who can use this strategy?

a. Yeah, I'm sure there's someone who can use it. EX
b. Yeah, I found someone who can use it. EV
c. Yeah, I called someone who can use it. TR

(281) ITEM 14 Question: Is there anyone who can teach this subject?

a. Yeah, I'm sure there's someone who can teach it. EX
b. Yeah, I know someone who can teach it. EV
c. Yeah, I slapped someone who can teach it. TR

(282) ITEM 15 Question: Is there anyone who can tolerate this drug?

a. Yeah, I'm sure there's someone who can tolerate it. EX
b. Yeah, I met someone who can tolerate it. EV
c. Yeah, I dated someone who can tolerate it. TR

(283) ITEM 16 Question: Is there anyone who can represent this defendant?

a. Yeah, I'm sure there's someone who can represent it. EX
b. Yeah, I found someone who can represent it. EV
c. Yeah, I imitated someone who can represent it. TR

(284) ITEM 17 Question: Is there anyone who can prove this claim?

a. Yeah, I'm sure there's someone who can prove it. EX
b. Yeah, I heard of someone who can prove it. EV
c. Yeah, I called someone who can prove it. TR

(285) ITEM 18 Question: Is there anyone who can imprison this mafia member?

a. Yeah, I'm sure there's someone who can imprison it. EX
b. Yeah, I know someone who can imprison it. EV
c. Yeah, I slapped someone who can imprison it. TR

(286) ITEM 19 Question: Is there anyone who can interpret this paragraph?

a. Yeah, I'm sure there's someone who can interpret it. EX
b. Yeah, I talked to someone who can interpret it. EV
c. Yeah, I described someone who can interpret it. TR

(287) ITEM 20 Question: Is there anyone who can repair this injury?

a. Yeah, I'm sure there's someone who can repair it. EX
b. Yeah, I ran into someone who can repair it. EV
c. Yeah, I dated someone who can repair it. TR

(288) ITEM 21 Question: Is there anyone who can corner this market?

a. Yeah, I'm sure there's someone who can corner it. EX
b. Yeah, I found someone who can corner it. EV
c. Yeah, I called someone who can corner it. TR

(289) ITEM 22 Question: Is there anyone who can nail this ballet sequence?

a. Yeah, I'm sure there's someone who can nail it. EX
b. Yeah, I know someone who can nail it. EV
c. Yeah, I criticized someone who can nail it. TR

(290) ITEM 23 Question: Is there anyone who can understand this witness?

a. Yeah, I'm sure there's someone who can understand it. EX
b. Yeah, I met someone who can understand it. EV
c. Yeah, I advised someone who can understand it. TR

(291) ITEM 24 Question: Is there anyone who can finish this mural?

a. Yeah, I'm sure there's someone who can finish it. EX
b. Yeah, I talked to someone who can finish it. EV
c. Yeah, I described someone who can finish it. TR

(292) ITEM 25 (BURN-IN) Question: Is there anyone who can handle this car?

a. Yeah, I'm sure there's someone who can handle it. EX
b. Yeah, I found someone who can handle it. EV
c. Yeah, I advised someone who can handle it. TR

(293) ITEM 26 (BURN-IN) Question: Is there anyone who can fix this book?

a. Yeah, I'm sure there's someone who can fix it. EX
b. Yeah, I heard of someone who can fix it. EV
c. Yeah, I called someone who can fix it. TR

(294) ITEM 27 (BURN-IN) Question: Is there anyone who can stop this leak?

a. Yeah, I'm sure there's someone who can stop it. EX
b. Yeah, I know someone who can stop it. EV
c. Yeah, I criticized someone who can stop it. TR

(295) ITEM 28 (BURN-IN) Question: Is there anyone who can save this tooth?

a. Yeah, I'm sure there's someone who can save it. EX
b. Yeah, I met someone who can save it. EV
c. Yeah, I dated someone who can save it. TR

(296) ITEM 29 (BURN-IN) Question: Is there anyone who can solve this equation?

a. Yeah, I'm sure there's someone who can solve it. EX
b. Yeah, I ran into someone who can solve it. EV
c. Yeah, I described someone who can solve it. TR

(297) ITEM 30 (BURN-IN) Question: Is there anyone who can treat this phobia?

a. Yeah, I'm sure there's someone who can treat it. EX
b. Yeah, I talked to someone who can treat it. EV
c. Yeah, I imitated someone who can treat it. TR

(298) ITEM 31 (BURN-IN) Question: Is there anyone who can develop this skill?

a. Yeah, I'm sure there's someone who can develop it. EX
b. Yeah, I found someone who can develop it. EV
c. Yeah, I praised someone who can develop it. TR

(299) ITEM 32 (BURN-IN) Question: Is there anyone who can get this job?

a. Yeah, I'm sure there's someone who can get it. EX
b. Yeah, I heard of someone who can get it. EV
c. Yeah, I slapped someone who can get it. TR

(300) ITEM 33 (BURN-IN) Question: Is there anyone who can remodel this home?

a. Yeah, I'm sure there's someone who can remodel it. EX
b. Yeah, I know someone who can remodel it. EV
c. Yeah, I advised someone who can remodel it. TR

(301) ITEM 34 (BURN-IN) Question: Is there anyone who can reach this spot?

a. Yeah, I'm sure there's someone who can reach it. EX
b. Yeah, I met someone who can reach it. EV
c. Yeah, I called someone who can reach it. TR

(302) ITEM 35 (BURN-IN) Question: Is there anyone who can balance this tray?

a. Yeah, I'm sure there's someone who can balance it. EX
b. Yeah, I ran into someone who can balance it. EV
c. Yeah, I criticized someone who can balance it. TR

(303) ITEM 36 (BURN-IN) Question: Is there anyone who can remember this conversation?

a. Yeah, I'm sure there's someone who can remember it. EX
b. Yeah, I talked to someone who can remember it. EV
c. Yeah, I dated someone who can remember it. TR

A.7 Experiment 7: Evidential existentials without context

A.7.1 Model

```
Cumulative Link Mixed Model fitted with the Laplace approximat-
ion

formula: rating ~ length * vtype +
                  (1 + length * vtype | subject) +
                  (1 + length * vtype | item)
data:    exp7_results

 link  threshold nobs logLik  AIC     niter         max.grad
 logit flexible  720  -946.38 1996.76 18232(109509) 1.40e-02
    cond.H
    1.1e+04

Random effects:
 Groups  Name                Variance Std.Dev. Corr
 subject (Intercept)         7.2110   2.6853
```

```
          length               1.0253   1.0126   -0.852
          vtype_cp-ev          0.5487   0.7408   -0.888  0.740
          vtype_cp-tr          1.5834   1.2583   -0.523  0.297
                                                         0.841
          length:vtype_cp-ev   2.1143   1.4541   -0.228 -0.086
                                                  0.412  0.641
          length:vtype_cp-tr   1.5489   1.2446   -0.366  0.191
                                             0.222  0.106  0.712
 item     (Intercept)          0.3181   0.5640
          length               3.2795   1.8109    0.233
          vtype_cp-ev          0.7318   0.8555   -0.291 -0.836
          vtype_cp-tr          0.2178   0.4667    0.329  0.567
                                                        -0.681
          length:vtype_cp-ev   0.9686   0.9842   -0.251 -0.961
                                                  0.658 -0.450
          length:vtype_cp-tr   7.2597   2.6944   -0.423 -0.911
                                             0.929 -0.494  0.809
Number of groups:  subject 30,  item 24

Coefficients:
                     Estimate Std. Error z value Pr(>|z|)
length                 0.5477     0.5209   1.052    0.293
vtype_cp-ev           -2.3315     0.4069  -5.730 1.01e-08 ***
vtype_cp-tr           -2.8867     0.4324  -6.677 2.44e-11 ***
length:vtype_cp-ev    -4.7176     0.5648  -8.353  < 2e-16 ***
length:vtype_cp-tr    -4.3074     0.7441  -5.789 7.09e-09 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Threshold coefficients:
    Estimate Std. Error z value
1|2  -6.5216     0.5876 -11.098
2|3  -4.5322     0.5500  -8.240
3|4  -2.8096     0.5288  -5.313
4|5  -1.1466     0.5155  -2.224
5|6   0.9466     0.5112   1.852
```

A.7.2 Items

(304) ITEM 1

a. This is the person who thought that the chef can prepare this dish. SH | NO | CO
b. This is a dish that I thought that the chef can prepare. LO | NO | CO
c. This is the person who heard of the chef who can prepare this dish. SH | IS | EV
d. This is a dish that I heard of the chef who can prepare. LO | IS | EV

Table A.14: Condition legend

Length (of dependency)	Structure	Environment
SH = SHORT	IS = ISLAND	CO = COMPLEMENT
LO = LONG	NO = NON-ISLAND	EV = EVIDENTIAL EXISTENTIAL
		TR = TRANSITIVE VERB

e. This is the person who imitated the chef who can prepare this dish. SH | IS | TR
f. This is a dish that I imitated the chef who can prepare. LO | IS | TR

(305) Item 2

a. This is the woman that believes that the scientist can solve this problem. SH | NO | CO
b. This is a problem that I believe that the scientist can solve. LO | NO | CO
c. This is the woman that knows the scientist who can solve this problem. SH | IS | EV
d. This is a problem that I know the scientist who can solve. LO | IS | EV
e. This is the woman who praised the scientist who can solve this problem. SH | IS | TR
f. This is a problem that I praised the scientist who can solve. LO | IS | TR

(306) Item 3

a. This is the guy that suspects that the gamer can beat this level. SH | NO | CO
b. This is a level that I suspect that the gamer can beat. LO | NO | CO
c. This is the guy that heard of the gamer who can beat this level. SH | IS | EV
d. This is a level that I heard of the gamer who can beat. LO | IS | EV
e. This is the guy that imitated the gamer who can beat this level. SH | IS | TR
f. This is a level that I imitated the gamer who can beat. LO | IS | TR

(307) Item 4

a. This is the person that suggested that the plumber can fix this toilet. SH | NO | CO
b. This is a toilet that I suggested that the plumber can fix. LO | NO | CO
c. This is the person that talked to the plumber who can fix this toilet. SH | IS | EV
d. This is a toilet that I talked to the plumber who can fix. LO | IS | EV
e. This is the person that described the plumber who can fix this toilet. SH | IS | TR
f. This is a toilet that I described the plumber who can fix. LO | IS | TR

(308) Item 5

a. This is the woman that imagines that the farmer can grow this plant. SH | NO | CO
b. This is a plant that I imagine that the farmer can grow. LO | NO | CO
c. This is the woman that met the farmer who can grow this plant. SH | IS | EV
d. This is a plant that I met the farmer who can grow. LO | IS | EV
e. This is the woman that slapped the farmer who can grow this plant. SH | IS | TR
f. This is a plant that I slapped the farmer who can grow. LO | IS | TR

(309) ITEM 6

a.	This is the guy that suspects that the doctor can cure this disease.	SH | NO | CO
b.	This is a disease that I suspect that the doctor can cure.	LO | NO | CO
c.	This is the guy that ran into the doctor who can cure this disease.	SH | IS | EV
d.	This is a disease that I ran into the doctor who can cure.	LO | IS | EV
e.	This is the guy that praised the doctor who can cure this disease.	SH | IS | TR
f.	This is a disease that I praised the doctor who can cure.	LO | IS | TR

(310) ITEM 7

a.	This is the person that claimed that the politician can fix this issue.	SH | NO | CO
b.	This is an issue that I claimed that the politician can fix.	LO | NO | CO
c.	This is the person that met the politician who can fix this issue.	SH | IS | EV
d.	This is an issue that I met the politician who can fix.	LO | IS | EV
e.	This is the person that advised the politician who can fix this issue.	SH | IS | TR
f.	This is an issue that I advised the politician who can fix.	LO | IS | TR

(311) ITEM 8

a.	This is the woman that believes that the scholar can decode this script.	SH | NO | CO
b.	This is a script that I believe that the scholar can decode.	LO | NO | CO
c.	This is the woman that talked to the scholar who can decode this script.	SH | IS | EV
d.	This is a script that I talked to the scholar who can decode.	LO | IS | EV
e.	This is the woman that criticized the scholar who can decode this script.	SH | IS | TR
f.	This is a script that I criticized the scholar who can decode.	LO | IS | TR

(312) ITEM 9

a.	This is the guy that claimed that the musician can play this song.	SH | NO | CO
b.	This is a song that I claimed that the musician who can play.	LO | NO | CO
c.	This is the guy that heard of the musician who can play this song.	SH | IS | EV
d.	This is a song that I heard of the musician who can play.	LO | IS | EV
e.	This is the guy that advised the musician who can play this song.	SH | IS | TR
f.	This is a song that I advised the musician who can play.	LO | IS | TR

(313) ITEM 10

a.	This is the person that imagines that the runner can win this race.	SH | NO | CO
b.	This is a race that I imagine that the runner can win.	LO | NO | CO
c.	This is the person that ran into the runner who can win this race.	SH | IS | EV
d.	This is a race that I ran into the runner who can win.	LO | IS | EV
e.	This is the person that praised the runner who can win this race.	SH | IS | TR
f.	This is a race that I praised the runner who can win.	LO | IS | TR

(314) ITEM 11

a.	This is the woman that thought that the manager can enforce this rule.	SH | NO | CO
b.	This is a rule that I thought that the manager can enforce.	LO | NO | CO
c.	This is the woman that found the manager who can enforce this rule.	SH | IS | EV
d.	This is a rule that I found the manager who can enforce.	LO | IS | EV
e.	This is the woman that dated the manager who can enforce this rule.	SH | IS | TR
f.	This is a rule that I dated the manager who can enforce.	LO | IS | TR

(315) ITEM 12

a. This is the guy that suggested that the parent can afford this gift. SH | NO | CO
b. This is a gift that I suggested that the parent can afford. LO | NO | CO
c. This is the guy that ran into the parent who can afford this gift. SH | IS | EV
d. This is a gift that I ran into the parent who can afford. LO | IS | EV
e. This is the guy that criticized the parent who can afford this gift. SH | IS | TR
f. This is a gift that I criticized the parent who can afford. LO | IS | TR

(316) ITEM 13

a. This is the person that suspected that the player can use this strategy. SH | NO | CO
b. This is a strategy that I suspected that the player can use. LO | NO | CO
c. This is the person that found the player who can use this strategy. SH | IS | EV
d. This is a strategy that I found the player who can use. LO | IS | EV
e. This is the person that called the player who can use this strategy. SH | IS | TR
f. This is a strategy that I called the player who can use. LO | IS | TR

(317) ITEM 14

a. This is the woman that thinks that the professor can teach this subject. SH | NO | CO
b. This is a subject that I think that the professor can teach. LO | NO | CO
c. This is the woman that knows the professor who can teach this subject. SH | IS | EV
d. This is a subject that I know the professor who can teach. LO | IS | EV
e. This is the woman that slapped the professor who can teach this subject. SH | IS | TR
f. This is a subject that I slapped the professor who can teach. LO | IS | TR

(318) ITEM 15

a. This is the guy that suggested that the patient can tolerate this drug. SH | NO | CO
b. This is a drug that I suggested that the patient can tolerate. LO | NO | CO
c. This is the guy that met the patient who can tolerate this drug. SH | IS | EV
d. This is a drug that I met the patient who can tolerate. LO | IS | EV
e. This is the guy that dated the patient who can tolerate this drug. SH | IS | TR
f. This is a drug that I dated the patient who can tolerate. LO | IS | TR

(319) ITEM 16

a. This is the person that claimed that the lawyer can represent this defendant. SH | NO | CO
b. This is a defendant that I claimed that the lawyer can represent. LO | NO | CO
c. This is the person that found the lawyer who can represent this defendant. SH | IS | EV
d. This is a defendant that I found the lawyer who can represent. LO | IS | EV
e. This is the person that imitated the lawyer who can represent this defendant. SH | IS | TR
f. This is a defendant that I imitated the lawyer who can represent. LO | IS | TR

(320) ITEM 17

a. This is the woman that suspects that the expert can prove this claim. SH | NO | CO
b. This is a claim that I suspect that the expert can prove. LO | NO | CO
c. This is the woman that heard of the expert who can prove this claim. SH | IS | EV
d. This is a claim that I heard of the expert who can prove. LO | IS | EV
e. This is the woman that called the expert who can prove this claim. SH | IS | TR
f. This is a claim that I called the expert who can prove. LO | IS | TR

(321) ITEM 18

a. This is the guy that believes that the judge can imprison this mafia member. SH | NO | CO
b. This is a mafia member that I believes that the judge can imprison. LO | NO | CO
c. This is the guy that knows the judge who can imprison this mafia member. SH | IS | EV
d. This is a mafia member that I know the judge who can imprison. LO | IS | EV
e. This is the guy that slapped the judge who can imprison this mafia member. SH | IS | TR
f. This is a mafia member that I slapped the judge who can imprison. LO | IS | TR

(322) ITEM 19

a. This is the person that suggested that the editor can interpret this paragraph. SH | NO | CO
b. This is a paragraph that I suggested that the editor can interpret. LO | NO | CO
c. This is the person that talked to the editor who can interpret this paragraph. SH | IS | EV
d. This is a paragraph that I talked to the editor who can interpret. LO | IS | EV
e. This is the person that described the editor who can interpret this paragraph. SH | IS | TR
f. This is a paragraph that I described the editor who can interpret. LO | IS | TR

(323) ITEM 20

a. This is the woman that imagines that the surgeon can repair this injury. SH | NO | CO
b. This is an injury that I imagines that the surgeon can repair. LO | NO | CO
c. This is the woman that ran into the surgeon who can repair this injury. SH | IS | EV
d. This is an injury that I ran into the surgeon who can repair. LO | IS | EV
e. This is the woman that dated the surgeon who can repair this injury. SH | IS | TR
f. This is an injury that I dated the surgeon who can repair. LO | IS | TR

(324) ITEM 21

a. This is the guy that thinks that the designer can corner this market. SH | NO | CO
b. This is a market that I think that the designer can corner. LO | NO | CO
c. This is the guy that found the designer who can corner this market. SH | IS | EV
d. This is a market that I found the designer who can corner. LO | IS | EV
e. This is the guy that called the designer who can corner this market. SH | IS | TR
f. This is a market that I called the designer who can corner. LO | IS | TR

(325) ITEM 22

a. This is the person that believes that the dancer can nail this ballet sequence. SH | NO | CO
b. This is a ballet sequence that I believe that the dancer can nail. LO | NO | CO
c. This is the person that knows the dancer who can nail this ballet sequence. SH | IS | EV
d. This is a ballet sequence that I know the dancer who can nail. LO | IS | EV
e. This is the person that criticized the dancer who can nail this ballet sequence. SH | IS | TR
f. This is a ballet sequence that I criticized the dancer who can nail. LO | IS | TR

(326) ITEM 23

a.	This is the woman that claimed that the juror can understand this witness.	SH | NO | CO
b.	This is a witness that I claimed that the juror can understand.	LO | NO | CO
c.	This is the woman that met the juror who can understand this witness.	SH | IS | EV
d.	This is a witness that I met the juror who can understand.	LO | IS | EV
e.	This is the woman that advised the juror who can understand this witness.	SH | IS | TR
f.	This is a witness that I advised the juror who can understand.	LO | IS | TR

(327) ITEM 24

a.	This is the guy that imagined that the artist can finish this mural.	SH | NO | CO
b.	This is a mural that I imagined that the artist can finish.	LO | NO | CO
c.	This is the guy that talked to the artist who can finish this mural.	SH | IS | EV
d.	This is a mural that I talked to the artist who can finish.	LO | IS | EV
e.	This is the guy that described the artist who can finish this mural.	SH | IS | TR
f.	This is a mural that I described the artist who can finish.	LO | IS | TR

(328) ITEM 25 (BURN-IN)

a.	This is the person who believes that the driver can handle this car.	SH | NO | CO
b.	This is a car that I believe that the driver can handle.	LO | NO | CO
c.	This is the person who found the driver who can handle this car.	SH | IS | EV
d.	This is a car that I found the driver who can handle.	LO | IS | EV
e.	This is the person who advised the driver who can handle this car.	SH | IS | TR
f.	This is a car that I advised the driver who can handle.	LO | IS | TR

(329) ITEM 26 (BURN-IN)

a.	This is the woman who claimed that the librarian can fix this book.	SH | NO | CO
b.	This is a book that I claimed that the librarian can fix.	LO | NO | CO
c.	This is the woman who heard of the librarian who can fix this book.	SH | IS | EV
d.	This is a book that I heard of the librarian who can fix.	LO | IS | EV
e.	This is the woman who called the librarian who can fix this book.	SH | IS | TR
f.	This is a book that I called the librarian who can fix.	LO | IS | TR

(330) ITEM 27 (BURN-IN)

a.	This is the guy who imagines that the mechanic can stop this leak.	SH | NO | CO
b.	This is a leak that I imagine that the mechanic can stop.	LO | NO | CO
c.	This is the guy who knows the mechanic who can stop this leak.	SH | IS | EV
d.	This is a leak that I know the mechanic who can stop.	LO | IS | EV
e.	This is the guy who criticized the mechanic who can stop this leak.	SH | IS | TR
f.	This is a leak that I criticized the mechanic who can stop.	LO | IS | TR

(331) ITEM 28 (BURN-IN)

a.	This is the person who suggested that the dentist can save this tooth.	SH | NO | CO
b.	This is a tooth that I suggested that the dentist can save.	LO | NO | CO
c.	This is the person who met the dentist who can save this tooth.	SH | IS | EV
d.	This is a tooth that I met the dentist who can save.	LO | IS | EV
e.	This is the person who dated the dentist who can save this tooth.	SH | IS | TR
f.	This is a tooth that I dated the dentist who can save.	LO | IS | TR

(332) ITEM 29 (BURN-IN)

a.	This is the woman who suspected that the intern can solve this equation.	SH | NO | CO
b.	This is an equation that I suspected that the intern can solve.	LO | NO | CO
c.	This is the woman who ran into the intern who can solve this equation.	SH | IS | EV
d.	This is an equation that I ran into the intern who can solve.	LO | IS | EV
e.	This is the woman who described the intern who can solve this equation.	SH | IS | TR
f.	This is an equation that I described the intern who can solve.	LO | IS | TR

(333) ITEM 30 (BURN-IN)

a.	This is the guy who thought that the therapist can treat this phobia.	SH | NO | CO
b.	This is a phobia that I thought that the therapist can treat.	LO | NO | CO
c.	This is the guy who talked to the therapist who can treat this phobia.	SH | IS | EV
d.	This is a phobia that I talked to the therapist who can treat.	LO | IS | EV
e.	This is the guy who imitated the therapist who can treat this phobia.	SH | IS | TR
f.	This is a phobia that I imitated the therapist who can treat.	LO | IS | TR

(334) ITEM 31 (BURN-IN)

a.	This is the person who believes that the athlete can develop this skill.	SH | NO | CO
b.	This is a skill that I believe that the athlete can develop.	LO | NO | CO
c.	This is the person who found the athlete who can develop this skill.	SH | IS | EV
d.	This is a skill that I found the athlete who can develop.	LO | IS | EV
e.	This is the person who praised the athlete who can develop this skill.	SH | IS | TR
f.	This is a skill that I praised the athlete who can develop.	LO | IS | TR

(335) ITEM 32 (BURN-IN)

a.	This is the woman who claimed that the engineer can get this job.	SH | NO | CO
b.	This is a job that I claimed that the engineer can get.	LO | NO | CO
c.	This is the woman who heard of the engineer who can get this job.	SH | IS | EV
d.	This is a job that I heard of the engineer who can get.	LO | IS | EV
e.	This is the woman who slapped the engineer who can get this job.	SH | IS | TR
f.	This is a job that I slapped the engineer who can get.	LO | IS | TR

(336) ITEM 33 (BURN-IN)

a.	This is the guy who imagines that the designer can remodel this home.	SH | NO | CO
b.	This is a home that I imagine that the designer can remodel.	LO | NO | CO
c.	This is the guy who knows the designer who can remodel this home.	SH | IS | EV
d.	This is a home that I know the designer who can remodel.	LO | IS | EV
e.	This is the guy who advises the designer who can remodel this home.	SH | IS | TR
f.	This is a home that I advise the designer who can remodel.	LO | IS | TR

(337) ITEM 34 (BURN-IN)

a.	This is the person who suggested that the welder can reach this spot.	SH | NO | CO
b.	This is a spot that I suggested that the welder can reach.	LO | NO | CO
c.	This is the person who met the welder who can reach this spot.	SH | IS | EV
d.	This is a spot that I met the welder who can reach.	LO | IS | EV
e.	This is the person who called the welder who can reach this spot.	SH | IS | TR
f.	This is a spot that I called the welder who can reach.	LO | IS | TR

(338) ITEM 35 (BURN-IN)

a. This is the woman who suspected that the waiter can balance this tray. SH | NO | CO
b. This is a tray that I suspected that the waiter can balance. LO | NO | CO
c. This is the woman who ran into the waiter who can balance this tray. SH | IS | EV
d. This is a tray that I ran into the waiter who can balance. LO | IS | EV
e. This is the woman who criticized the waiter who can balance this tray. SH | IS | TR
f. This is a tray that I criticized the waiter who can balance. LO | IS | TR

(339) ITEM 36 (BURN-IN)

a. This is the guy who thought that the assistant can remember this conversation. SH | NO | CO
b. This is a conversation that I thought that the assistant can remember. LO | NO | CO
c. This is the guy who talked to the assistant who can remember this conversation. SH | IS | EV
d. This is a conversation that I talked to the assistant who can remember. LO | IS | EV
e. This is the guy who dated the assistant who can remember this conversation. SH | IS | TR
f. This is a conversation that I dated the assistant who can remember. LO | IS | TR

A.8 Experiment 8: Evidential existentials with context

A.8.1 Model

```
Cumulative Link Mixed Model fitted with the Laplace approximat-
ion

formula: rating ~ length * vtype +
                  (1 + length * vtype | subject) +
                  (1 + length * vtype | item)
data:    exp_results

 link  threshold nobs logLik   AIC     niter         max.grad
 logit flexible  3528 -4874.07 9852.15 17491(170948) 1.97e-01
    cond.H
    4.1e+05

Random effects:
 Groups  Name                Variance Std.Dev. Corr
 subject (Intercept)         3.967139 1.99177
         length              1.613865 1.27038  -0.500
         vtype-cp_ev         0.012934 0.11373   0.698 -0.969
         vtype-cp_tr         0.008963 0.09467  -0.092 -0.234
                                                       0.167
         length:vtype-cp_ev  2.307592 1.51908  -0.542  0.315
                                                 -0.415  0.819
         length:vtype-cp_tr  1.724697 1.31328  -0.498  0.194
```

```
                                          -0.302  0.875  0.992
 item    (Intercept)        0.131070 0.36204
         length             1.187670 1.08980   0.050
         vtype-cp_ev        0.291492 0.53990  -0.682  0.172
         vtype-cp_tr        0.302822 0.55029  -0.811  0.321
                                                      0.893
         length:vtype-cp_ev 1.215024 1.10228  -0.055 -0.947
                                                -0.076 -0.329
         length:vtype-cp_tr 1.271888 1.12778  -0.061 -0.831
                                          -0.096 -0.347  0.891
Number of groups:  subject 98,  item 36

Coefficients:
                     Estimate Std. Error z value Pr(>|z|)
length               -1.84808    0.21116  -8.752  < 2e-16 ***
vtype-cp_ev          -0.22843    0.07446  -3.068  0.00216 **
vtype-cp_tr          -0.70272    0.06662 -10.548  < 2e-16 ***
length:vtype-cp_ev   -0.95504    0.13076  -7.304 2.79e-13 ***
length:vtype-cp_tr   -0.90770    0.12518  -7.251 4.14e-13 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Threshold coefficients:
    Estimate Std. Error z value
1|2  -3.2745     0.1915 -17.100
2|3  -1.1947     0.1832  -6.521
3|4   0.4799     0.1822   2.634
4|5   2.2924     0.1861  12.315
5|6   4.2325     0.2001  21.147
```

A.8.2 Items

Table A.15: Condition legend

Length (of dependency)	Structure	Environment
SH = short	IS = island	CO = complement
LO = long	NO = non-island	EV = evidential existential
		TR = transitive verb

(340) Item 1 Question: Is there anyone who can prepare this dish?

a. This is the person who thought that the chef can prepare this dish.
sh(ort) | non(-island) | co(mplement)

b. This is a dish that I thought that the chef can prepare.
LO(NG) | NON(-ISLAND) | CO(MPLEMENT)

c. This is the person who heard of the chef who can prepare this dish.
SH(ORT) | ISL(AND) | EV(IDENTIAL EXISTENTIAL)

d. This is a dish that I heard of the chef who can prepare.
LO(NG) | ISL(AND) | EV(IDENTIAL EXISTENTIAL)

e. This is the person who imitated the chef who can prepare this dish.
SH(ORT) | ISL(AND) | TR(ANSITIVE VERB)

f. This is a dish that I imitated the chef who can prepare.
LO(NG) | ISL(AND) | TR(ANSITIVE VERB)

(341) ITEM 2 Question: Is there anyone who can solve this problem?

a.	This is the woman that believes that the scientist can solve this problem.	SH | NO | CO
b.	This is a problem that I believe that the scientist can solve.	LO | NO | CO
c.	This is the woman that knows the scientist who can solve this problem.	SH | IS | EV
d.	This is a problem that I know the scientist who can solve.	LO | IS | EV
e.	This is the woman who praised the scientist who can solve this problem.	SH | IS | TR
f.	This is a problem that I praised the scientist who can solve.	LO | IS | TR

(342) ITEM 3 Question: Is there anyone who can beat this level?

a.	This is the guy that suspects that the gamer can beat this level.	SH | NO | CO
b.	This is a level that I suspect that the gamer can beat.	LO | NO | CO
c.	This is the guy that heard of the gamer who can beat this level.	SH | IS | EV
d.	This is a level that I heard of the gamer who can beat.	LO | IS | EV
e.	This is the guy that imitated the gamer who can beat this level.	SH | IS | TR
f.	This is a level that I imitated the gamer who can beat.	LO | IS | TR

(343) ITEM 4 Question: Is there anyone who can fix this toilet?

a.	This is the person that suggested that the plumber can fix this toilet.	SH | NO | CO
b.	This is a toilet that I suggested that the plumber can fix.	LO | NO | CO
c.	This is the person that talked to the plumber who can fix this toilet.	SH | IS | EV
d.	This is a toilet that I talked to the plumber who can fix.	LO | IS | EV
e.	This is the person that described the plumber who can fix this toilet.	SH | IS | TR
f.	This is a toilet that I described the plumber who can fix.	LO | IS | TR

(344) ITEM 5 Question: Is there anyone who can grow this plant?

a.	This is the woman that imagines that the farmer can grow this plant.	SH | NO | CO
b.	This is a plant that I imagine that the farmer can grow.	LO | NO | CO
c.	This is the woman that met the farmer who can grow this plant.	SH | IS | EV
d.	This is a plant that I met the farmer who can grow.	LO | IS | EV
e.	This is the woman that slapped the farmer who can grow this plant.	SH | IS | TR
f.	This is a plant that I slapped the farmer who can grow.	LO | IS | TR

(345) ITEM 6 Question: Is there anyone who can cure this disease?

a.	This is the guy that suspects that the doctor can cure this disease.	SH | NO | CO
b.	This is a disease that I suspect that the doctor can cure.	LO | NO | CO
c.	This is the guy that ran into the doctor who can cure this disease.	SH | IS | EV
d.	This is a disease that I ran into the doctor who can cure.	LO | IS | EV
e.	This is the guy that praised the doctor who can cure this disease.	SH | IS | TR

f. This is a disease that I praised the doctor who can cure. LO | IS | TR

(346) ITEM 7 Question: Is there anyone who can fix this issue?

a. This is the person that claimed that the politician can fix this issue. SH | NO | CO
b. This is an issue that I claimed that the politician can fix. LO | NO | CO
c. This is the person that met the politician who can fix this issue. SH | IS | EV
d. This is an issue that I met the politician who can fix. LO | IS | EV
e. This is the person that advised the politician who can fix this issue. SH | IS | TR
f. This is an issue that I advised the politician who can fix. LO | IS | TR

(347) ITEM 8 Question: Is there anyone who can decode this script?

a. This is the woman that believes that the scholar can decode this script. SH | NO | CO
b. This is a script that I believe that the scholar can decode. LO | NO | CO
c. This is the woman that talked to the scholar who can decode this script. SH | IS | EV
d. This is a script that I talked to the scholar who can decode. LO | IS | EV
e. This is the woman that criticized the scholar who can decode this script. SH | IS | TR
f. This is a script that I criticized the scholar who can decode. LO | IS | TR

(348) ITEM 9 Question: Is there anyone who can play this song?

a. This is the guy that claimed that the musician can play this song. SH | NO | CO
b. This is a song that I claimed that the musician who can play. LO | NO | CO
c. This is the guy that heard of the musician who can play this song. SH | IS | EV
d. This is a song that I heard of the musician who can play. LO | IS | EV
e. This is the guy that advised the musician who can play this song. SH | IS | TR
f. This is a song that I advised the musician who can play. LO | IS | TR

(349) ITEM 10 Question: Is there anyone who can win this race?

a. This is the person that imagines that the runner can win this race. SH | NO | CO
b. This is a race that I imagine that the runner can win. LO | NO | CO
c. This is the person that ran into the runner who can win this race. SH | IS | EV
d. This is a race that I ran into the runner who can win. LO | IS | EV
e. This is the person that praised the runner who can win this race. SH | IS | TR
f. This is a race that I praised the runner who can win. LO | IS | TR

(350) ITEM 11 Question: Is there anyone who can enforce this rule?

a. This is the woman that thought that the manager can enforce this rule. SH | NO | CO
b. This is a rule that I thought that the manager can enforce. LO | NO | CO
c. This is the woman that found the manager who can enforce this rule. SH | IS | EV
d. This is a rule that I found the manager who can enforce. LO | IS | EV
e. This is the woman that dated the manager who can enforce this rule. SH | IS | TR
f. This is a rule that I dated the manager who can enforce. LO | IS | TR

(351) ITEM 12 Question: Is there anyone who can afford this gift?

a. This is the guy that suggested that the parent can afford this gift. SH | NO | CO
b. This is a gift that I suggested that the parent can afford. LO | NO | CO
c. This is the guy that ran into the parent who can afford this gift. SH | IS | EV
d. This is a gift that I ran into the parent who can afford. LO | IS | EV
e. This is the guy that criticized the parent who can afford this gift. SH | IS | TR
f. This is a gift that I criticized the parent who can afford. LO | IS | TR

(352) ITEM 13 Question: Is there anyone who can use this strategy?

a. This is the person that suspected that the player can use this strategy. SH | NO | CO
b. This is a strategy that I suspected that the player can use. LO | NO | CO
c. This is the person that found the player who can use this strategy. SH | IS | EV
d. This is a strategy that I found the player who can use. LO | IS | EV
e. This is the person that called the player who can use this strategy. SH | IS | TR
f. This is a strategy that I called the player who can use. LO | IS | TR

(353) ITEM 14 Question: Is there anyone who can teach this subject?

a. This is the woman that thinks that the professor can teach this subject. SH | NO | CO
b. This is a subject that I think that the professor can teach. LO | NO | CO
c. This is the woman that knows the professor who can teach this subject. SH | IS | EV
d. This is a subject that I know the professor who can teach. LO | IS | EV
e. This is the woman that slapped the professor who can teach this subject. SH | IS | TR
f. This is a subject that I slapped the professor who can teach. LO | IS | TR

(354) ITEM 15 Question: Is there anyone who can tolerate this drug?

a. This is the guy that suggested that the patient can tolerate this drug. SH | NO | CO
b. This is a drug that I suggested that the patient can tolerate. LO | NO | CO
c. This is the guy that met the patient who can tolerate this drug. SH | IS | EV
d. This is a drug that I met the patient who can tolerate. LO | IS | EV
e. This is the guy that dated the patient who can tolerate this drug. SH | IS | TR
f. This is a drug that I dated the patient who can tolerate. LO | IS | TR

(355) ITEM 16 Question: Is there anyone who can represent this defendant?

a. This is the person that claimed that the lawyer can represent this defendant. SH | NO | CO
b. This is a defendant that I claimed that the lawyer can represent. LO | NO | CO
c. This is the person that found the lawyer who can represent this defendant. SH | IS | EV
d. This is a defendant that I found the lawyer who can represent. LO | IS | EV
e. This is the person that imitated the lawyer who can represent this defendant. SH | IS | TR
f. This is a defendant that I imitated the lawyer who can represent. LO | IS | TR

(356) ITEM 17 Question: Is there anyone who can prove this claim?

a. This is the woman that suspects that the expert can prove this claim. SH | NO | CO
b. This is a claim that I suspect that the expert can prove. LO | NO | CO
c. This is the woman that heard of the expert who can prove this claim. SH | IS | EV
d. This is a claim that I heard of the expert who can prove. LO | IS | EV
e. This is the woman that called the expert who can prove this claim. SH | IS | TR
f. This is a claim that I called the expert who can prove. LO | IS | TR

(357) ITEM 18 Question: Is there anyone who can imprison this mafia member?

a. This is the guy that believes that the judge can imprison this mafia member. SH | NO | CO
b. This is a mafia member that I believes that the judge can imprison. LO | NO | CO
c. This is the guy that knows the judge who can imprison this mafia member. SH | IS | EV
d. This is a mafia member that I know the judge who can imprison. LO | IS | EV
e. This is the guy that slapped the judge who can imprison this mafia member. SH | IS | TR

f. This is a mafia member that I slapped the judge who can imprison. LO | IS | TR

(358) ITEM 19 Question: Is there anyone who can interpret this paragraph?

a. This is the person that suggested that the editor can interpret this paragraph. SH | NO | CO
b. This is a paragraph that I suggested that the editor can interpret. LO | NO | CO
c. This is the person that talked to the editor who can interpret this paragraph. SH | IS | EV
d. This is a paragraph that I talked to the editor who can interpret. LO | IS | EV
e. This is the person that described the editor who can interpret this paragraph. SH | IS | TR
f. This is a paragraph that I described the editor who can interpret. LO | IS | TR

(359) ITEM 20 Question: Is there anyone who can repair this injury?

a. This is the woman that imagines that the surgeon can repair this injury. SH | NO | CO
b. This is an injury that I imagines that the surgeon can repair. LO | NO | CO
c. This is the woman that ran into the surgeon who can repair this injury. SH | IS | EV
d. This is an injury that I ran into the surgeon who can repair. LO | IS | EV
e. This is the woman that dated the surgeon who can repair this injury. SH | IS | TR
f. This is an injury that I dated the surgeon who can repair. LO | IS | TR

(360) ITEM 21 Question: Is there anyone who can corner this market?

a. This is the guy that thinks that the designer can corner this market. SH | NO | CO
b. This is a market that I think that the designer can corner. LO | NO | CO
c. This is the guy that found the designer who can corner this market. SH | IS | EV
d. This is a market that I found the designer who can corner. LO | IS | EV
e. This is the guy that called the designer who can corner this market. SH | IS | TR
f. This is a market that I called the designer who can corner. LO | IS | TR

(361) ITEM 22 Question: Is there anyone who can nail this ballet sequence?

a. This is the person that believes that the dancer can nail this ballet sequence. SH | NO | CO
b. This is a ballet sequence that I believe that the dancer can nail. LO | NO | CO
c. This is the person that knows the dancer who can nail this ballet sequence. SH | IS | EV
d. This is a ballet sequence that I know the dancer who can nail. LO | IS | EV
e. This is the person that criticized the dancer who can nail this ballet sequence. SH | IS | TR
f. This is a ballet sequence that I criticized the dancer who can nail. LO | IS | TR

(362) ITEM 23 Question: Is there anyone who can understand this witness?

a. This is the woman that claimed that the juror can understand this witness. SH | NO | CO
b. This is a witness that I claimed that the juror can understand. LO | NO | CO
c. This is the woman that met the juror who can understand this witness. SH | IS | EV
d. This is a witness that I met the juror who can understand. LO | IS | EV
e. This is the woman that advised the juror who can understand this witness. SH | IS | TR
f. This is a witness that I advised the juror who can understand. LO | IS | TR

(363) ITEM 24 Question: Is there anyone who can finish this mural?

a. This is the guy that imagined that the artist can finish this mural. SH | NO | CO
b. This is a mural that I imagined that the artist can finish. LO | NO | CO
c. This is the guy that talked to the artist who can finish this mural. SH | IS | EV
d. This is a mural that I talked to the artist who can finish. LO | IS | EV
e. This is the guy that described the artist who can finish this mural. SH | IS | TR
f. This is a mural that I described the artist who can finish. LO | IS | TR

(364) ITEM 25 (BURN-IN) Question: Is there anyone who can handle this car?

a. This is the person who believes that the driver can handle this car. SH | NO | CO
b. This is a car that I believe that the driver can handle. LO | NO | CO
c. This is the person who found the driver who can handle this car. SH | IS | EV
d. This is a car that I found the driver who can handle. LO | IS | EV
e. This is the person who advised the driver who can handle this car. SH | IS | TR
f. This is a car that I advised the driver who can handle. LO | IS | TR

(365) ITEM 26 (BURN-IN) Question: Is there anyone who can fix this book?

a. This is the woman who claimed that the librarian can fix this book. SH | NO | CO
b. This is a book that I claimed that the librarian can fix. LO | NO | CO
c. This is the woman who heard of the librarian who can fix this book. SH | IS | EV
d. This is a book that I heard of the librarian who can fix. LO | IS | EV
e. This is the woman who called the librarian who can fix this book. SH | IS | TR
f. This is a book that I called the librarian who can fix. LO | IS | TR

(366) ITEM 27 (BURN-IN) Question: Is there anyone who can stop this leak?

a. This is the guy who imagines that the mechanic can stop this leak. SH | NO | CO
b. This is a leak that I imagine that the mechanic can stop. LO | NO | CO
c. This is the guy who knows the mechanic who can stop this leak. SH | IS | EV
d. This is a leak that I know the mechanic who can stop. LO | IS | EV
e. This is the guy who criticized the mechanic who can stop this leak. SH | IS | TR
f. This is a leak that I criticized the mechanic who can stop. LO | IS | TR

(367) ITEM 28 (BURN-IN) Question: Is there anyone who can save this tooth?

a. This is the person who suggested that the dentist can save this tooth. SH | NO | CO
b. This is a tooth that I suggested that the dentist can save. LO | NO | CO
c. This is the person who met the dentist who can save this tooth. SH | IS | EV
d. This is a tooth that I met the dentist who can save. LO | IS | EV
e. This is the person who dated the dentist who can save this tooth. SH | IS | TR
f. This is a tooth that I dated the dentist who can save. LO | IS | TR

(368) ITEM 29 (BURN-IN) Question: Is there anyone who can solve this equation?

a. This is the woman who suspected that the intern can solve this equation. SH | NO | CO
b. This is an equation that I suspected that the intern can solve. LO | NO | CO
c. This is the woman who ran into the intern who can solve this equation. SH | IS | EV
d. This is an equation that I ran into the intern who can solve. LO | IS | EV
e. This is the woman who described the intern who can solve this equation. SH | IS | TR
f. This is an equation that I described the intern who can solve. LO | IS | TR

(369) ITEM 30 (BURN-IN) Question: Is there anyone who can treat this phobia?

a.	This is the guy who thought that the therapist can treat this phobia.	SH | NO | CO
b.	This is a phobia that I thought that the therapist can treat.	LO | NO | CO
c.	This is the guy who talked to the therapist who can treat this phobia.	SH | IS | EV
d.	This is a phobia that I talked to the therapist who can treat.	LO | IS | EV
e.	This is the guy who imitated the therapist who can treat this phobia.	SH | IS | TR
f.	This is a phobia that I imitated the therapist who can treat.	LO | IS | TR

(370) ITEM 31 (BURN-IN) Question: Is there anyone who can develop this skill?

a.	This is the person who believes that the athlete can develop this skill.	SH | NO | CO
b.	This is a skill that I believe that the athlete can develop.	LO | NO | CO
c.	This is the person who found the athlete who can develop this skill.	SH | IS | EV
d.	This is a skill that I found the athlete who can develop.	LO | IS | EV
e.	This is the person who praised the athlete who can develop this skill.	SH | IS | TR
f.	This is a skill that I praised the athlete who can develop.	LO | IS | TR

(371) ITEM 32 (BURN-IN) Question: Is there anyone who can get this job?

a.	This is the woman who claimed that the engineer can get this job.	SH | NO | CO
b.	This is a job that I claimed that the engineer can get.	LO | NO | CO
c.	This is the woman who heard of the engineer who can get this job.	SH | IS | EV
d.	This is a job that I heard of the engineer who can get.	LO | IS | EV
e.	This is the woman who slapped the engineer who can get this job.	SH | IS | TR
f.	This is a job that I slapped the engineer who can get.	LO | IS | TR

(372) ITEM 33 (BURN-IN) Question: Is there anyone who can remodel this home?

a.	This is the guy who imagines that the designer can remodel this home.	SH | NO | CO
b.	This is a home that I imagine that the designer can remodel.	LO | NO | CO
c.	This is the guy who knows the designer who can remodel this home.	SH | IS | EV
d.	This is a home that I know the designer who can remodel.	LO | IS | EV
e.	This is the guy who advises the designer who can remodel this home.	SH | IS | TR
f.	This is a home that I advise the designer who can remodel.	LO | IS | TR

(373) ITEM 34 (BURN-IN) Question: Is there anyone who can reach this spot?

a.	This is the person who suggested that the welder can reach this spot.	SH | NO | CO
b.	This is a spot that I suggested that the welder can reach.	LO | NO | CO
c.	This is the person who met the welder who can reach this spot.	SH | IS | EV
d.	This is a spot that I met the welder who can reach.	LO | IS | EV
e.	This is the person who called the welder who can reach this spot.	SH | IS | TR
f.	This is a spot that I called the welder who can reach.	LO | IS | TR

(374) ITEM 35 (BURN-IN) Question: Is there anyone who can balance this tray?

a.	This is the woman who suspected that the waiter can balance this tray.	SH | NO | CO
b.	This is a tray that I suspected that the waiter can balance.	LO | NO | CO
c.	This is the woman who ran into the waiter who can balance this tray.	SH | IS | EV
d.	This is a tray that I ran into the waiter who can balance.	LO | IS | EV
e.	This is the woman who criticized the waiter who can balance this tray.	SH | IS | TR
f.	This is a tray that I criticized the waiter who can balance.	LO | IS | TR

(375) ITEM 36 (BURN-IN) Question: Is there anyone who can remember this conversation?

a. This is the guy who thought that the assistant can remember this conversation. SH | NO | CO

b. This is a conversation that I thought that the assistant can remember. LO | NO | CO

c. This is the guy who talked to the assistant who can remember this conversation. SH | IS | EV

d. This is a conversation that I talked to the assistant who can remember. LO | IS | EV

e. This is the guy who dated the assistant who can remember this conversation. SH | IS | TR

f. This is a conversation that I dated the assistant who can remember. LO | IS | TR

Appendix B

R scripts

B.1 Discrete and gradient model functions

```
create_discrete <- function(gram_ref, ungram_ref, pi,
                            num = length(gram_ref),
                            smooth = TRUE) {

    samples_discrete <- c(sample(gram_ref,
                                 round((1 - pi) * num),
                                 replace = TRUE),
                          sample(ungram_ref,
                                 round(pi * num),
                                 replace = TRUE))
    if (smooth) {
        prob_discrete <- (tabulate(samples_discrete,
                                   nbins = 6) + 1) /
        (length(samples_discrete) + 6)
    } else {
        prob_discrete <- (tabulate(samples_discrete,
                                   nbins = 6)) /
        (length(samples_discrete))
    }
    return(prob_discrete)

}
```

Figure B.1: Function written in R that defines a DISCRETE model

```
create_gradient <- function(gram_ref, ungram_ref, pi,
                            num = length(gram_ref),
                            smooth = TRUE) {
    samples_gradient <- round((1 - pi) *
                              sample(gram_ref,
                                     num,
                                     replace = TRUE) + pi *
                              sample(ungram_ref,
                                     num,
                                     replace = TRUE))
    if (smooth) {
        prob_gradient <- (tabulate(samples_gradient,
                                   nbins = 6) + 1) /
        (length(samples_gradient) + 6)
    } else {
        prob_gradient <- (tabulate(samples_gradient,
                                   nbins = 6)) /
        (length(samples_gradient))
    }
    return(prob_gradient)
}
```

Figure B.2: Function written in R that defines a GRADIENT model

B.2 Optimization functions

B.2.1 `fit_of_pi()`

```
fit_of_pi <- function(pi,
                      model_function,
                      ref_gram,
                      ref_ungram,
                      test,
                      smooth = TRUE,
                      num = length(ref_gram)) {

    model <- model_function(ref_gram = ref_gram,
                            ref_ungram = ref_ungram,
                            pi = pi,
                            num = num,
                            smooth = smooth)$prob
```

```
    mean_model <- sum(model * c(1:6))
    mean_test <- mean(test)
    sq_of_resid <- (mean_model - mean_test)^2

    return(sq_of_resid)

}
```

B.2.2 optimize_pi()

```
optimize_pi <- function(interval,
                        model_function,
                        ref_gram,
                        ref_ungram,
                        test,
                        smooth = TRUE,
                        num = length(ref_gram)) {

    pi_optim <- optimize(f = fit_of_pi,
                         interval = interval,
                         model_function = model_function,
                         ref_gram = ref_gram,
                         ref_ungram = ref_ungram,
                         test = test,
                         smooth = smooth,
                         num = num)
    for (i in 1:5) {
        pi_optim_cur <- optimize(f = fit_of_pi,
                                 interval = interval,
                                 model_function = model_functi
on,
                                 ref_gram = ref_gram,
                                 ref_ungram = ref_ungram,
                                 test = test,
                                 smooth = smooth,
                                 num = num)
        if (pi_optim_cur$objective < pi_optim$objective) {
            pi_optim <- pi_optim_cur
        }
    }

    return(pi_optim$minimum)
```

```
}
```

B.3 Model evaluation functions

B.3.1 Comparison function

```
compare_models <- function(model_discrete,
                           model_gradient,
                           dist_test,
                           chisquare = TRUE) {
    mean_discrete <- sum(model_discrete$prob * 1:6)
    mean_gradient <- sum(model_gradient$prob * 1:6)
    # k is the number of free parameters
    k <- length(model_discrete$prob) - 1
    bic_discrete <- (-2) * sum(dmultinom(
                                    tabulate(dist_test,
                                             nbins = 6),
                                    prob = model_discrete$prob,
                                    log = TRUE
                                )) + k * log(length(dist_test))
    bic_gradient <- (-2) * sum(dmultinom(
                                    tabulate(dist_test,
                                             nbins = 6),
                                    prob = model_gradient$prob,
                                    log = TRUE
                                )) + k * log(length(dist_test))
    bf <- exp(-0.5 * (bic_discrete - bic_gradient))

    # Save this information into a list
    fit <- list("Discrete density" = model_discrete$prob,
                "Gradient density" = model_gradient$prob,
                "Test density" = tabulate(dist_test,
                                          nbins = 6) /
                                  length(dist_test),
                "Test mean" = mean(dist_test),
                "Predicted mean (discrete)" = mean_discrete,
                "Predicted mean (gradient)" = mean_gradient,
                "BIC (discrete)" = bic_discrete,
                "BIC (gradient)" = bic_gradient,
                "BF" = bf,
                "Stats" = c("Discrete mean" = mean_discrete,
                            "Gradient mean" = mean_gradient,
                            "Discrete pi" = model_discrete$pi,
```

```
                              "Gradient pi" = model_gradient$pi,
                              "Discrete BIC" = bic_discrete,
                              "Gradient BIC" = bic_gradient,
                              "BIC difference" = bic_discrete -
                                                  bic_gradient,
                              "BF" = bf))
    if (chisquare) {
        chisq_discrete <- chisq.test(tabulate(dist_test,
                                              nbins = 6),
                                     p = model_discrete$prob,
                                     simulate.p.value = TRUE)
        chisq_gradient <- chisq.test(tabulate(dist_test,
                                              nbins = 6),
                                     p = model_gradient$prob,
                                     simulate.p.value = TRUE)
        fit <- c(fit, list(chisq_discrete = chisq_discrete,
                           chisq_gradient = chisq_gradient))
    }
    fit <- c(fit, list(pi = c(discrete = model_discrete$pi,
                              gradient = model_gradient$pi))
    )
    return(fit)
}
```

B.3.2 Monte Carlo simulation function

```
do_sims <- function(ref_gram,
                    ref_ungram,
                    test,
                    times = 100) {

    # Initialize some variables
    outcomes <- NULL
    density_discrete <- NULL
    density_gradient <- NULL
    discrete_wins <- 0
    gradient_wins <- 0
    decisive_disc_wins <- 0
    decisive_disc_losses <- 0

    for (i in 1:times) {

        # Optimize pi for each model
```

```
    pi_discrete <- optimize_pi(c(0, 1),
                               create_discrete,
                               ref_gram,
                               ref_ungram,
                               test)
    pi_gradient <- optimize_pi(c(0, 1),
                               create_gradient,
                               ref_gram,
                               ref_ungram,
                               test,
                               smooth = FALSE)

    # Generate one of each model
    model_discrete <- create_discrete(ref_gram,
                                      ref_ungram,
                                      pi_discrete)
    model_gradient <- create_gradient(ref_gram,
                                      ref_ungram,
                                      pi_gradient)

    # Now compare the models
    simulation <- compare_models(model_discrete,
                                 model_gradient,
                                 test)

    # Save stats & the probability densities for ea. model
    outcomes <- cbind(outcomes, simulation$Stats)
    density_discrete <- cbind(density_discrete,
                              simulation$`Discrete density`)
    density_gradient <- cbind(density_gradient,
                              simulation$`Gradient density`)
    if (simulation$Stats["BIC difference"] < 0) {
        discrete_wins <- discrete_wins + 1
        if (simulation$Stats["BF"] > 100) {
            decisive_disc_wins <- decisive_disc_wins + 1
        }
    } else {
        gradient_wins <- gradient_wins + 1
        if (simulation$Stats["BF"] > 100) {
          decisive_disc_losses <- decisive_disc_losses + 1
        }
    }

}
```

```
    sim_summary <- data.frame(
                "Mean of discrete means" =
                    round(mean(outcomes["Discrete mean", ]),
                            digits = 2),
                "Mean of discrete pis" =
                    round(mean(outcomes["Discrete pi", ]),
                            digits = 2),
                "Mean of gradient means" =
                    round(mean(outcomes["Gradient mean", ]),
                            digits = 2),
                "Mean of gradient pis" =
                    round(mean(outcomes["Gradient pi", ]),
                            digits = 2),
                "Mean BIC difference" =
                    round(mean(outcomes["BIC difference", ]),
                            digits = 2),
                "Mean BF" = round(mean(outcomes["BF", ]),
                                  digits = 2),
                "Discrete wins" = discrete_wins,
                "Decisive discrete wins" =
                    decisive_disc_wins,
                "Gradient wins" = gradient_wins,
                "Decisive gradient wins" =
                    decisive_disc_losses
                             )

    mean_density_discrete <- apply(density_discrete, 1, mean)
    mean_density_gradient <- apply(density_gradient, 1, mean)
    density_test <- tabulate(test, nbins = 6) / length(test)
    summary_plot <- summary_fig(density_test = density_test,
                                density_discrete =
                                    mean_density_discrete,
                                density_gradient =
                                    mean_density_gradient)

    info <- list("Stats" = outcomes,
                 "Discrete density" = density_discrete,
                 "Gradient density" = density_gradient,
                 "Summary" = sim_summary,
                 "Summary figure" = summary_plot)

    return(info)
}
```

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