NORTHWESTERN UNIVERSITY

Active Assignment of Quantifier Scope Guides Language Processing

A DISSERTATION

SUBMITTED TO THE GRADUATE SCHOOL

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

for the degree

DOCTOR OF PHILOSOPHY

Field of Linguistics

By

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EVANSTON, ILLINOIS

September 2023

ABSTRACT

Active Assignment of Quantifier Scope Guides Language Processing

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This dissertation investigates how scope relations are constructed and evaluated during real-time human sentence processing. Theoretical approaches to processing scope relations exist in a multidimensional space where trade-offs are made around how quickly scope relations can be computed, how many mistakes are made in computing scope relations, and how many different scope relations can be produced. Existing approaches are organized around the idea of minimizing mistakes in computing scope relations, and achieve this by sacrificing incrementality or by avoiding the calculation of scope relations. In this dissertation, I propose a new approach called the active scope model. In the active scope model, the processing of scope is organized around ensuring the parser can always produce a possible scope relation and can do so quickly in a real-time language processing context. The active scope model is also directly rooted in the grammatical concepts of Quantifier Raising and Scope Economy, and for this reason makes different predictions about processing behavior than other approaches.

By investigating the processing of sentences with multiple quantifiers and competing constraints on scope, this dissertation determines that the active scope model appears to most accurately predict the observed processing profile. A major series of investigations

also reveals that the distributional properties of the negative polarity item illusion are also predicted by the active scope model. The active scope model also predicts a novel illusion effect for positive polarity items, which is observed for the first time in this dissertation. The data presented in this dissertation constitutes a major expansion of the empirical landscape of polarity illusions, and supports an analysis of a single generalized polarity illusion which is the result of scope calculation during online sentence processing. With this supporting evidence, this dissertation argues that the real-time processing of scope relations is best captured by the active scope model proposed in this dissertation. As the active scope model is rooted in the grammatical concepts of Quantifier Raising and Scope Economy, this dissertation also proposes that these are necessarily components of the syntactic portion of grammar and that scope relations are calculated in the syntactic module of grammar rather than a later interpretive module.

Acknowledgements

The writing of a dissertation is a highly solitary act but also impossible without a vast community of support. Of course the cornerstone of this community is my dissertation committee composed of my advisor Masaya Yoshida and my dissertation committee members: Jennifer Cole, Jeffrey Runner, Shayne Sloggett, and Ming Xiang. I must thank Jennifer Cole for agreeing to serve on a committee which certainly falls outside her traditional area of focus. With a remarkable talent for asking insightful questions, I'm deeply indebted to her unique perspective. Jeffrey Runner has been a part of my academic community from my earliest days, serving as the department chair of linguistics during my undergraduate studies at the University of Rochester, and inspiring my passion for syntax and sentence processing with his guest lectures on psycholinguistics and his class on HPSG. As a longtime supporter of my research and my career aspirations, I imagine I would be in a very different place without his support. Shayne Sloggett has been my teacher, collaborator, and friend from the very beginning. Many of the ideas in this dissertation grew out of a project proposal for his course on experimental syntax. In a period where my advisor was away, Shayne kept my work on track and challenged my abilities as a researcher in psycholinguistics. Though he has long since left Northwestern, Shayne continues to offer his support and guidance without hesitation, for which he will always have my gratitude. Ming Xiang from our neighbor institution, The University of Chicago, has also been a vital fixture of my local research network. This dissertation owes a deep debt to her expertise in matters of polarity, sentence processing, and pragmatics, as well as her discerning skepticism. She has also given me many chances to share my work with broader communities, through invitations to speak to her lab and other groups at The University of Chicago, for which I am also grateful. And for last my advisor Masaya Yoshida, for whom there can be no sufficient recognition. In the earliest days of my graduate career when circumstances left me intellectually adrift, Masaya immediately took me in and cultivated my interest in syntax, formal approaches to computation, and sentence processing. With his Socratic style, encyclopedic knowledge of syntax, intellectual rigor, and generous nature, his contribution to this dissertation and my development as a researcher cannot be overstated. Our intellectual partnership with remain a singular relationship for the rest of my days, as will our friendship.

Of course, a community is more than a committee and there are countless others who must be thanked. The Syntax, Semantics, and Sentence Processing Lab including members Eszter Ronai, Peter Baumann, Nayoun Kim, Kathleen Hall, Ethan Myers, Hyosik Kim, Anatha Latshaw, Jennifer Dibbern, Michael Dover, Cassie Davenport, Devin Johnson and Austin Keen, has been my intellectual home for these six years. I thank each and every one of you for making the lab such a great place to think and work. Additionally, without the efforts of my research assistants Caroline Berg-Love and Sam Nguyen, superstars among superstars, this dissertation would have a very different shape. I must also thank Michael Glansberg, who took the time to mentor a student from another department and ensured I would achieve the necessary education in matters of semantics and polarity for this dissertation and my future life as a linguist.

I must also thank the broader Northwestern Linguistics Department for their support. Whether during classes, teaching duties, or the occasional casual chat, the members of this department have been a wonderfully supportive community which has allowed me to develop into a true Northwestern linguist. To the members of Syntax Club, I thank you for providing hours of enjoyable conversation and for allowing me to trial run various ideas for syntax education. To my fellow Data Science Fellows, I thank you for providing me a window into the wider world of data driven science and for providing another excellent community of researchers. The work in this dissertation also received valuable commentary and feedback from the research communities at the Linguistic Society of America, Architectures and Mechanisms for Language Processing, and The Society for Human Sentence Processing.

To the more personal, I must thank my cohort-mates Maria Gavino, Jaime Benheim, and Amelia Stecker. The three of you, my dearest colleagues, have made me a sharper researcher, a more empathetic friend, and a better person. For this I will always be grateful. While there have been many other friends and colleagues over the years, I reserve this space to thank Lisa Cox, Thomas Sostarics, Kate Sandberg, Chantal De Leon, and Cassie Davenport for their friendship and camaraderie as fellow travelers on the linguistic highway. I also thank my friends from Rochester: Joe Allen, Daniel Rubery, Aaron Santiago, Nathaniel Woodard, Sarah Pristash, Anthony Vaccaro, Paul Robaszewski, and Katrina Ponti for many years of companionship. Finally, I must thank my wonderful parents, Charles Orth and Beth Rosemergey, and my always supportive brother, Christopher Orth, for their endless encouragement in these years, the years before, and the years to come.

I also must thank the National Science Foundation for funding my research. This material is based upon work supported by the National Science Foundation under Grant No. 2216989 - Doctoral Dissertation Research: Active assignment of quantifier scope guides language processing.

Dedication

To Christopher Logan Orth, my brother and teacher.

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CHAPTER 1

Introduction

In translating theories of scope taking to the realm of online processing, there is perhaps no more important question than when the parser builds structures reflecting scope taking operations, such as quantifier raising (QR) (May 1977). However, existing research does not provide a clear answer to this question. Some authors contend that the parser avoids QR as it is costly to perform (Anderson 2004, Tanaka 2015, Wurmbrand 2018). This conclusion is based on observed acceptability costs for sentences with potentially complex scope structures and a preference for surface scope interpretations. This approach focuses on a parsing constraint which contends that the parser avoids raising whenever possible (Anderson 2004). Others suggest that the parser waits until near the end of the sentence to compute possible scope structures, as this is the point of maximal relevant information (Bott and Schlotterbeck 2015). This position primarily serves to advocate for a third position. I argue that the availability of complex scope structures and a grammatical restriction called Scope Economy require the parser to incrementally and frequently test alternative scope structures during online processing through QR (Brendel 2019, Fox 1995, 2000, Syrett 2015a,b). Throughout the course of this dissertation I develop an active scope model for sentence processing which explains how the sentence processor maximizes the scope structures it can build incrementally while minimizing the situations in which QR is performed ungrammaticality. In service of this argument this dissertation expands the psycholinguistic landscape with new evidence from the processing of sentences with complex scope configurations, a thorough reexamination of the distribution of the negative polarity item (NPI) illusion effect and the discovery of a novel illusion effect for positive polarity items (PPI). I argue that these results can be best captured by a parser that actively tests alternative scope structures by performing QR during incremental processing in line with the proposed active scope model.

1.1. Outline of the Dissertation

The outline of the dissertation is as follows. In the remainder of Chapter 1 I will introduce quantifier raising (QR) as one of the approaches to scope resolution in grammar and the assumed mechanism for scope resolution in this dissertation. This discussion will identify three classes of restrictions that have been proposed to limit the application of QR, including restrictions on what QR can target for raising, restrictions on where the QR movement can originate from and move elements to, and restrictions on when QR is licensed. Of these three classes of restriction, this dissertation focuses on the question of when QR is licensed and the mechanism by which licensing occurs. Scope Economy, as original proposed in Fox (1995), allows scope shifting operations like QR to occur only if they result in a new interpretation relative to the current part of the derivation. This comparison of interpretations presents challenges for theoretical syntax as well as I argue sentence processing, which will be the focus of the remainder of the dissertation.

Chapter 2 begins by laying out the Scope Economy restriction on QR. In this chapter I argue that Scope Economy, by requiring a comparison of interpretations, makes unique demands on the sentence processor. This chapter discusses non-incremental models and QR-avoidant models, two approaches to resolving scope and accounting for Scope Economy in sentence processing (Anderson 2004, Bott and Schlotterbeck 2015, Tanaka 2015, Wurmbrand 2018). I then propose what I call the active scope model, a new approach to scope in sentence processing which posits that, rather than avoiding QR, the parser incrementally and frequently constructs non-surface scope configurations during online sentence processing. The exact specification of when and how the parser decides to raise produces a range of active scope models, which vary in their incrementally and the rate of ungrammatical QR. However, all versions of the active scope model predict more scope related processing activity than non-incremental or QR avoidant models. I then present data from an experiment which is designed to observe processing behavior in sentences with multiple quantifiers and verb phrase ellipsis, providing many opportunities to observe potential effects of scope processing procedures. These results suggest that the parser does frequently construct and evaluate non-surface scope configurations, most closely aligning with the expected profile of an active scope model.

With the evidence from verb phrase ellipsis, Chapter 3 turns to explore one of the hallmark illusion effects in the sentence processing literature, the negative polarity item (NPI) illusion (Drenhaus, Saddy, and Frisch 2005, Muller and Phillips 2020, Orth, Yoshida, and Sloggett 2021, Parker and Phillips 2016, Vasishth, Brüssow, Lewis, and Drenhaus 2008, Xiang, Dillon, and Phillips 2009, Yun, Lee, and Drury 2018). In the canonical NPI illusion, a negative embedded in a relative clause appears to facilitate the processing of a later NPI, *ever*, despite the lack of a possible grammatical link between the two elements. In a series of experiments, this dissertation strengthens existing evidence that the NPI illusion is not a general property of NPI and their licensors, but is restricted to contexts with negative quantifiers (Muller and Phillips 2020, Orth et al. 2021). With this expanded empirical data, this dissertation discusses the goodness of fit of various approaches to capturing the NPI illusion effect in online sentence processing including cue-based retrieval, feature percolation, pragmatic models and active scope models (Eberhard, Cutting, and Bock 2005, Franck, Vigliocco, and Nicol 2002, Giannakidou 2006, Giannakidou and Etxeberria 2018, Lewis and Vasishth 2005, Mendia, Poole, and Dillon 2018, Muller and Phillips 2020, Parker, Shvartsman, and Van Dyke 2017, Patson and Husband 2016, Schwab 2023, Vasishth et al. 2008, Wagers, Lau, and Phillips 2009, Xiang et al. 2009, Xiang, Grove, and Giannakidou 2013). The active scope models are found to possess unique advantages in capturing the newly refined distribution of the NPI illusion effect, due in large part to the focus on quantification instead of NPI related features.

Chapter 4 introduces a series of investigations which uncover a new illusion effect I call the positive polarity item (PPI) illusion. The PPI illusion occurs in exactly the same environment as the NPI illusion, but features a PPI instead of an NPI. While NPI require a grammatical relation with a negative element, PPI require that no such relation exists (Baker 1970, Giannakidou 2011, Homer 2015, 2021, Krifka 1992, Ladusaw 1980, Postal 2000, Progovac 1994, Szabolcsi 2004). Thus, unlike the NPI illusion which is marked by the facilitation of processing of the NPI, the PPI illusion results in a penalty. This PPI illusion is directly predicted by the active scope model, while approaches like cue-based retrieval predict illusions of this kind should not occur (Wagers et al. 2009). Combining the evidence from both NPI and PPI illusion, I conclude that the active scope model most readily explains the distribution of these polarity illusion effects and advocate for a perspective shift towards conceptualizing these as a single generalized polarity illusion effect.

Chapter 5 takes the assumption that polarity illusions are the result of the active scope processing mechanism, and explores further properties and predictions of these models. Specifically, this chapter investigates the ability of polarity illusions to arise when the negative quantifier appears in a sentence initial CP, appears in a sentence initial if conditional clause, and when the negative quantifier binds an element in the relative clause. It appears that the illusion doesn't occur in either the sentence initial CP environment or the if conditional environment, which I argue is a predictable consequence of these constructions' interaction with the QR operation and active scope processing. I also report evidence that binding does not block the appearance of illusion, and instead extends the temporal distance at which the illusion can occur (Parker and Phillips 2016). I argue that the time bound nature of this illusion and the ability of binding to extend this window suggests additional late processes which require fixing scope relations, though this remains a matter for further investigation.

In the final chapter, Chapter 6, I conclude the dissertation. This discussion address the methodological contributions of this dissertation, the empirical contributions related to polarity illusions, the proposed active scope model, and a broader reflection on Scope Economy and QR. With the expectations put forth, let us turn to the discussion of QR and the broader issue of scope resolution.

1.2. Quantifier Raising

Scope shifting and quantification are important phenomena in both theoretical and experimental linguistics research, owing in large part to the apparent contradiction of surfaces forms where there are multiple clear but distinct interpretations (Anderson 2004, Barker, Jacobson, Jacobson et al. 2007, Barker et al. 2007, Bott and Schlotterbeck 2015, Kratzer 1998, Kratzer and Heim 1998, May 1977, Montague 1973, Syrett 2015a, Tanaka 2015). Unsurprisingly the precise properties and mechanisms of both scope taking and quantification have been the subject of considerable debate in the study of language (Barker et al. 2007, Beghelli and Stowell 1997, Bianchi and Chesi 2010, Charlow 2014, 2020, Hornstein 1994, Jacobson 2002, Keshet and Schwarz 2019, Montague 1973, Partee and Rooth 1983, Steedman 1993, Steedman and Baldridge 2011, Szabolcsi 1997, 2010, 2012). For the purposes of this dissertation, we are concerned with the view that scope shifting is achieved through covert operations on quantifiers and operators, with the most notable of these operations being quantifier raising (QR).

QR, minimally conceived, is a structural operation that takes a quantifier containing structure and produces an output structure which leaves the phonological content of the quantifier in place, while covertly raising the meaningful portion of the quantifier to a higher position (May 1977). In the initial formulation this was stated as a transformation rule applied at the syntax semantics interface which adjoined a quantifier to S [1]

This is a critical function to have in some level of the grammar, whether in the syntax or post-syntactic interpretative module. This is because there exist sentences like those in (1.1a) for which there exist multiple interpretations. In this case, these are the interpretations (1.1b) and (1.1c). Rather than a single surface form which can arbitrarily map onto one of two interpretations, QR provides a mechanism by which a single surface form can map onto one of two structures, with each of those structures mapping onto a distinct interpretation. Thus, while in language use scenarios there are a great many factors that influence which structure is adopted, there exists a unique representation for each interpretation with a consistent relation between the pairs.

(1.1) a. A teacher saw every student.

b. *For a teacher, that teacher saw every student*.

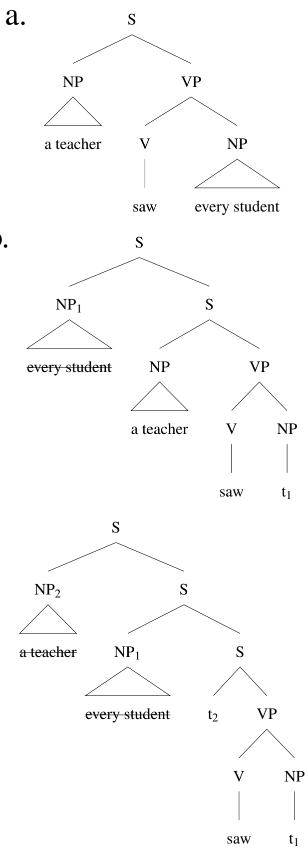
c. *For each student there is some teacher who saw that student.*

Without QR applied, the surface scope interpretation in (1.1b) corresponds to a tree like the one in (1.2a). In this tree, the quantifiers remain in their surface position. By applying QR, the grammar is able to generate a tree like the one in (1.2b). This application of QR

[1] In actuality the entire NP is moved on the basis of its specifier containing an element with the quantifier feature, and different implementations do differently target quantifiers and their constituent phrases. For our purposes, the NP containing the quantifier is moved. At later points of the dissertation I adopt a style of tree with more traditional X-bar features, and the quantifier is adjoined to CP rather than S.

changes the structural relations between the quantifiers, such that now *every* is in a higher structural position than *a*. This allows for the quantifiers to compose with the verb in a different order and yield the non-surface scope interpretation of (1.1c), often called an inverse scope interpretation due to the reversal of the quantifiers from their surface positions. It is also possible for to be applied QR to both quantifiers, and indeed in some theories this is required for reasons related to the composition of semantic types. In this multiple QR case, we would expect a tree like the one in (1.2c). Notably, this configuration results in an ordering of quantifiers that is the same as in (1.2a)[2].

(1.2) a. b. c.



[2]These trees also make the assumption that the QR operation moves the NP and leaves behind a trace in its original position. In different implementations this can instead be a formal variable which is bound by the quantifier or a copy of the same quantified NP. For our purposes these technical details can be set aside, as the critical matter is a syntax which generates two structurally distinct representations to feed into the interpretive interface.

In this way, each representation is associated with a single interpretation, despite the identical surface form. Beyond this basic sketch, there are a number of proposals which attempt to restrict when QR can be applied, as this initial definition yields a transformation with very few limitations. We can categorize these restrictions into three groups, which address different questions about when and how QR can be applied to a structure.

The first group of restrictions asks what elements or features can be targeted by QR. At the broadest level we may simply offer the trivial answer of quantifiers, but there are a number of possible fine-grained restrictions, including those based on the semantic properties of quantifier types, the syntactic type of the quantifier, and even the phonological weight of the elements in question (Charlow 2020, Farkas 1981, Fodor and Sag 1982, Heim 1992, Partee 1991). These restrictions have been proposed to address the fact that certain quantifiers display different degrees of ability to undergo a scope movement. This ranges from the severely limited cases like negative quantifiers, which generally do not produce inverse scope interpretations, to elements like indefinites which can take scope over many environments that other quantifiers cannot (Charlow 2020, Collins 2017, Farkas 1981, Fodor and Sag 1982). As I will demonstrate in this dissertation, evidence from sentence processing suggests that even negative quantifiers, which are highly restricted in their scope interpretations, appear to be targeted by scope shifting operations in incremental sentence processing. In this way it appears that what some have conceptualized as restrictions on what QR can target may be better restated as restrictions on the movement of other related features that would necessarily be moved as a result of QR (Barker 2021, Collins 2017, Collins and Postal 2014, Van Craenenbroeck and Temmerman 2017).

The second group of restrictions asks where QR proceeds from and where QR moves elements to. While originally formulated as a movement of a quantifier to S there are a number of proposals that offer specific landing sites for specific quantifiers, stipulate modified islands for QR, and address wider restrictions on movement operations (Beghelli and Stowell 1997, Cecchetto 2004, Chomsky 1977, 2010, Chomsky et al. 1986, Evans 1977, Farkas 1981, Hornstein 1994, 1995, Huang 1995, May 1977, 1985, Syrett 2015a,b). These restrictions have been proposed on the basis of judgement data related to the interpretation of quantifiers in various syntactic environments, such as finite clauses and relative clauses (Chomsky 2010, Rodman 1976). Additionally, many proposals aim to align the movement of quantifiers with other classes of movement, by making QR subject to other constraints on movement, including cyclicity and the Empty Category Principle (Barker 2021, Cecchetto 2004, Chomsky 1977, 2010, Huang 1995, Syrett 2015b). As recent investigations of QR have demonstrated and the data presented in this demonstration will demonstrate, it appears that cyclicity does play a critical role in determining the distribution of QR (Barker 2021, Cecchetto 2004, Syrett 2015b). However, other properties of QR, such as its ability to escape certain islands, are unique. These properties suggest that QR might be best conceptualized as a unique form of movement limited to a specific set of lexical items.

The final set of restrictions and those investigated most directly in this dissertation are those that ask when is QR licensed. These broadly consist of economy conditions, stated as either necessary conditions on the comparison of the pre-QR and post-QR structure or as complexity considerations at the level of parsing (Anderson 2004, Fox 1995, 2000, Tanaka 2015, Wurmbrand 2018). These economy conditions serve different purposes depending on if they are grammatical or processing restrictions. The grammatical notion of Scope Economy seeks to prune the grammar of structures where QR has been applied in a way that does not result in meaningful interpretative changes for the sentence (Fox 1995, 2000). Processing approaches to Scope Economy broadly seek to operationalize the observation that readers generally prefer surface scope as a parsing principle to avoid QR whenever possible (Anderson 2004, Wurmbrand 2018). In the next chapter, I expand on both kinds of economy condition on QR and their consequences in online sentence processing. Through the course of this dissertation, I argue that the grammatical notion of Scope Economy has clear predictions for how quantifiers should be treated in online sentence processing, which are distinct from other approaches. I also argue that the predictions of the grammatical version of Scope Economy can be experimentally investigated. In the experiments presented in the following chapter, I show that the sentence processor actively performs QR during sentence processing in order to feed the comparison of interpretations that is necessary to satisfy Scope Economy.

CHAPTER 2

Scope In Processing: Evidence from Ellipsis

As it stands today, there is an active question of to what extent does the parser attempt to resolve scope online. To the extent that scope resolution takes place during incremental processing, there is also debate about when during processing scope relations are evaluated and updated. There are three primary proposals that attempt to answer this question, all of which generally engage with the label of quantifier raising (QR), though it should be noted that different approaches stipulate slightly different properties for this operation. These approaches are broadly non-incremental models (Bott and Schlotterbeck 2015), QR-avoidant models (Anderson 2004, Tanaka 2015, Wurmbrand 2018), and active scope models (Orth and Yoshida 2022, Orth et al. 2021, Syrett 2015a,b) which will be the approach developed throughout this dissertation. Important to each of these approaches are the questions of what scope information does the parser have access to at which time points, and to what extent does the parser need to take action to appropriately produce possible scope configurations. In many cases these issues tie back to the computation of Scope Economy, and as such this constraint on QR is an important object of discussion in these approaches. The next section briefly recapitulates QR and introduces Scope Economy before moving into a discussion of each of the three approaches to scope resolution in online processing.

2.1. QR and Scope Economy

Proposed in May (1977) and refined in May (1985) QR is intended to provide a structural proposal to the interpretative puzzle offered in (2.1). As discussed in the previous chapter, examples such as (2.1a) are able to express the meaning of both (2.1b) and (2.1c).

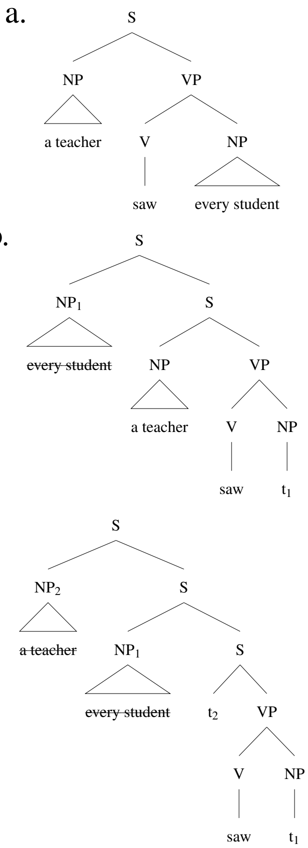
(2.1) a. A teacher saw every student.

b. *For a teacher, that teacher saw every student*.

c. *For each student there is some teacher who saw that student.*

In order to achieve two interpretations of the same string, it must be the case that there are two different representations achievable from this surface string, at some point prior to interpretation. QR is a grammatical rule that produces a distinct structure from the input surface structure as a transitional operation between the surface structure and the logical form. Abstracting away from a particular implementation, QR takes a structure containing a quantified NP and produces the same structure with the quantified NP adjoined to a higher position, around the level of S or CP. As this operation occurs as a transition from surface form to logical form, the new raised structure does not impact the surface realization of the sentence. Thus, the two interpretations appear to have an identical surface form, but maintain unique structural representations. In this way the interpretation of (2.1b) corresponds to the tree, (2.2a), where the quantifiers remain in their surface position while (2.1c) corresponds to a structure where QR has been applied to the lower quantifier, (2.2b). The tree in (2.2c) shows both elements undergoing QR, however we observe that the resulting order of quantifiers is the same as in (2.2a).

(2.2) a. b. c.



As discussed in the previous chapter, this version of QR is relatively unrestricted both in terms of when it is able to apply and in terms of which quantified NPs can move to which positions. In this model QR could be repeatedly applied to the same quantified NP, producing an unlimited number of representations where the quantified NP is raised over its previous position, as in the relation between (2.2a) and (2.2c). This cuts against one of the goals of QR, which is to map distinct interpretations to distinct structures. This, alongside other observations about the distribution of inverse scope, prompted the development of a constraint on QR called Scope Economy (Fox 1995, 2000). Scope Economy is an output condition on the application of QR which rules ungrammatical any application of QR which does not produce a novel interpretation relative to the previous steps in the derivation.[1] A

[1] Under QR systems with variables, QR for the purposes of variable binding is exempted from this condition.

movement which results in a new interpretation is considered to be scope informative. In this way, Scope Economy serves to prevent repeated applications of QR, other vacuous applications of QR, and to capture various scope effects by requiring that QR produce a scope informative structure. As an example, Scope Economy blocks the raising of quantifiers which are commutative, (2.3a), and blocks QR in cases where there aren't other elements with an interpretation that varies based on scope, (2.3b).

(2.3) a. Every climber visited every mountain.

b. Jane saw a mountain.

Scope Economy has also been used to capture an effect observed in the context of Verb Phrase Ellipsis. Sentences like those in (2.4a) are known to be subject to a Scope Parallelism constraint which requires both conjuncts to share the same scope structure (Fox 2002, Johnson 2001, May 1977, Merchant et al. 2001, Sag 1976). Thus, for the example (2.4a) both the dual surface scope interpretation, (2.4b), and the dual inverse scope interpretation, (2.4c), are available, but no hybrid interpretation, (2.4d), is possible.

(2.4) a. A doctor will visit each patient and a nurse will too.

b. *A particular doctor will visit all the patients and particular nurse will also visit all the patients.*

c. *All the patients will be visited by some doctor and all the patients will also be visited by some nurse.*

d. *#A particular doctor will visit all the patients and all the patients will also be visited by some nurse.*

When the subject of either conjunct is replaced by an element which does not interact with scope, as in (2.5a), it is observed that the unmodified conjunct is also required to maintain surface scope, consistent with the interpretation in (2.5b). Without Scope Economy, it would be possible to raise in both conjuncts, informatively in the first and vacuously in the second, to maintain parallelism. As an interpretation like (2.5c) is not available, it appears that some condition must block raising in the conjunct with *Jane*. Thus, the limited availability of interpretations in Verb Phrase Ellipsis appears to require a condition like Scope Economy to exist in the grammar.

(2.5) a. A doctor will visit each patient and Jane will too.

b. *A particular doctor will visit all the patients and Jane will also visit all the patients.*

d. *#Some doctor will visit all the patients and all the patients will also be visited by Jane.*

Scope Economy has a clear function in the grammar, where it serves to prune structures which disrupt the neat mapping between interpretations and structures. The mechanism by which this occurs is a comparison of the interpretations which are read off of structures given in a particular derivation which contains at least one application of QR. This comparative nature generates something of a headache for views of grammar which adopt a forward feeding modular structure, as this condition rules out structures based on interpretation. In a sense, it is the later interpretative module dictating what is acceptable in the structural module which feeds it. As a rule which acts at the edges of multiple modules, Scope Economy and QR appear to have impacts on both the set of structures which are considered grammatical and on the possible interpretations of grammatical structures. A similar set of issues appears when we turn towards the processing of quantifiers and scope, where interpretation is critical for determining if an application of QR is grammatical.

The goal of the human sentence processor is to take some linguistic input and produce a structural representation that can be produced within the comprehender's grammar (Fodor, Bever, and Garrett 1974, Levelt 1974). The most ubiquitous challenge for parsing is resolving ambiguity, existing at both the at lexical and structural levels. This is because, given some later disambiguating information, the parsing decision made at an earlier point of ambiguity could result in a situation where there is no next step in the parse which is compatible with the grammar (Altmann 1998, Crocker 1999, Frazier 1979, Frazier and Rayner 1990, Pickering, Traxler, and Crocker 2000, Rayner, Carlson, and Frazier 1983, Spivey-Knowlton and Sedivy 1995). In such a situation the parse crashes or reanalysis must occur, in either case a costly step (Fodor and Ferreira 2013, Frazier 1979, Frazier and Clifton 1998, Schneider and Phillips 2001, Sturt 1996). As surface and inverse scope structures share an identical surface form, they may already introduce difficulty for the parser. I argue that this difficulty takes on a new level of challenge as the comparison between interpretations underlying Scope Economy adds additional constraints.

Scope Economy requires interpretations, pre-QR and post-QR, to be evaluated for scope informativity relative to one another. In the context of processing, this means that the parser must have access to both structures, as a structure is required to produce an interpretation. Critically, this includes any structure, like a post-QR structure, that Scope Economy may go on to potentially rule out. In this way, QR and Scope Economy produce a different kind of ambiguity for the parser, as the issue is not about building a locally acceptable structure that is rendered ungrammatical by later information. Instead, Scope Economy requires the parser to construct the representation with QR applied in order to compare its interpretation to that of the pre-QR structure. Thus, it is possible that the structure is immediately recognized as ungrammatical if it fails to yield a new interpretation and satisfy Scope Economy. However, the parser cannot simply avoid performing QR and calculating Scope Economy entirely, as inverse scope interpretations are possible, and the parser must be able to produce them. In combination, Scope Economy and QR create a unique challenge for the parser. In order to determine if QR is grammatical, the parser must first perform it. This could be immediately costly if it does not generate a scope informative structure and satisfy Scope Economy. Further aggravating this issue is the fact that there is no unique signal that identifies the full set of environments in which Scope Economy would not be satisfied.

The parser must have some strategy for dealing with this puzzle presented by the comparative nature of Scope Economy. The specific question the parser faces is how to minimize the production of ungrammatical structures, QR that does not satisfy Scope Economy, when grammaticality cannot be determined prior to building the structure. The previously mentioned non-incremental, QR-avoidant and active scope models each attempt to resolve this question in different ways. They also each draw support from different sources of evidence from processing and interpretation studies, which I address in the following sections. In brief, non-incremental models propose the parser waits until the end of the input, or the end of a clause structure, to calculate scope relations. QR-avoidant models redefine Scope Economy as a parsing consideration rather than a grammatical one, resulting in a general prohibition on performing QR. Finally, active scope models propose that the parser strategically tests potential scope configurations by performing QR as the input unfolds. These models present a range of alternatives from those which are minimally incremental and produce non-surface scope structures as a last resort to those which are highly incremental and produce non-surface scope structures more greedily. Let us examine these proposals in turn.

2.2. Non-Incremental Models

As the label may suggest, non-incremental models take the perspective that scope is not calculated incrementally but is instead only calculated when the input is sufficiently complete.

In Bott and Schlotterbeck (2015) the authors explore hypotheses for processing the relative scope of a pair of quantifiers. These are incremental scope interpretation, wherein the relative scope of quantifying expressions is calculated as soon as the units are encountered, and global interpretation, wherein the processor waits until a completed minimal sentence is encountered. The first hypothesis of incremental scope interpretation flows from the general observation that online sentence processing is largely incremental in nature, as evidenced through reading, neural, and behavioral measures of linguistic phenomena ranging from the lexical to the structural and interpretive (Altmann 1999, Clifton Jr, Staub, and Rayner 2007, Crocker 1999, Forster, Guerrera, and Elliot 2009, Kamide, Altmann, and Haywood 2003, Knoeferle, Crocker, Scheepers, and Pickering 2005, Knoeferle, Urbach, and Kutas 2011, Kush 2013, Levy, Reali, and Griffiths 2008, Staub 2015, among many others). Thus, as much of what occurs in sentence processing occurs incrementally, the resolution of scope has no a priori reason to differ in this regard. The second hypothesis of global interpretation takes the position that there is something unique about the computation of scope that requires a form of non-incrementality. The authors argue that this is due to semantics being largely computed only over complete sentences, with partial functions generally being ill-formed.[2] They take as an example the idea that a quantifiers' interpretation denotes a relation between the set of the determiner's restriction, the content of the quantified NP, and the set of the nuclear scope, the remaining material in the proposition. Thus while the set denoted by the determiner's restriction might be able to be identified quickly, the ultimate interpretation of the quantifier requires the full nuclear scope, generally a saturated verbal predicate.

In a series of experiments in German, Bott and Schlotterbeck (2015) tests the predictions of these two hypotheses. More specifically, this consisted of three pre-tests which aimed to

[2]The authors are quick to point out this is a naive extension of theories which are not intended to model processing, and models can be created in such a way that incremental interpretation is possible, as inBott and Sternefeld (2017).

establish some guidelines for the processing and interpretation of scope in German and two main experiments which sought to address the issue of the interpretation of inverted scope constructions. The guideline experiments were intended to show that there are preferences for particular scope interpretations in German, that particular binding configurations require scope inversion, and that interpreting bound variables is not particularly costly. The main experiment leveraged the relatively free word order available in German to manipulate the position of the second quantifier and the verbal predicate. The authors report reading time slowdowns are observed at the point of the second quantifier only when that quantifier appears after the main verb. Thus, they conclude that scope interpretation is only possible once the verb has been processed and a minimal sentence is available for interpretation.

However, there are a number of questions left open in this study. As the authors point out, German was intentionally used as the language of analysis for two of its unique properties. The first is that it has a relatively free word order, allowing for the quantifier to be placed before or after the verb of interest. The second is that German generally is restricted to surface scope, with only a limited possibility of inverse scope (Frey 1993, Krifka 1998, Lechner 1998). Thus, the result has a limited ability to straightforwardly make predictions to languages with more permissive scope movement. Additionally, the authors point out that inverse scope in German is highly dependent on particular word orders, and that particular prosodic contour influences the interpretation of inverse scope in German (Krifka 1998). Taken together, these issues limit the ability to generalize beyond the unique circumstances of processing scope in a non-standard word order in German.

In addition, this study takes difficulty to be the behavioral mark of a scope computation. That is to say, the authors assume that processing activity related to scope interpretation is marked by a reading time slowdown at a quantifier region. In other words, this position contends that non-surface scope is a priori costly even when, as the authors point out, changing scope configurations is necessary to ensure a grammatical instance of variable binding and is the preferred interpretation in the tested context. The general position that scope shifting is inherently costly is not without controversy and the source of costs associated with inverse scope is a topic of some debate, as we discuss in the following sections (Syrett 2015a,b).

With these issues in mind, we can accept the observation that costs appear in the processing of inverse scope in German, but generally after the point of the matrix verb. However, the ability of this hypothesize to generalize is somewhat debatable. Thankfully, the strong claim of the requirement of a minimal sentence provides an easy testing ground for future studies. That is to say, any result which shows scope related processing before the point of a saturated proposition will provide strong evidence against a non-incremental model of scope processing.

2.3. QR-Avoidant Models

Non-incremental models establish a baseline on the dimension of incrementality. Moving one step up the ladder leads us to the class of QR-avoidant models. These approaches stemming from Anderson (2004) take the position that QR is not a cost free operation and as such the parser should aim to minimize its application as much as possible, in line with the ideas from the derivational theory of complexity (Berwick and Weinberg (1983), Fodor et al. (1974), Levelt (1974), Phillips (1996), Pritchett and Whitman (1995)). The most commonly cited supporting evidence for this QR-minimization approach comes from interpretation studies where preferences for surface scope are often robust, though recent advocates have provided further experimental work attempting to illustrate these preferences in online measures (Anderson 2004, Tanaka 2015, Wurmbrand 2018).

On its face, it seems like a model that operates under a QR-avoiding principle should face considerable issue with resolving Scope Economy as a grammatical principle. Indeed, this is so and the initial and subsequent formulations recast Scope Economy as parsing principle rather than a grammatical economy condition (Anderson 2004, Tanaka 2015, Wurmbrand 2018). This principle is envisioned as a parsing preference, thus a defeasible constraint, for the scope configuration with the simplest syntactic structure. Scope configurations of greater complexity would be possible in such a system but would require pragmatic licensing and would incur some operational cost, experimentally indexed by dispreference and increased reading time.

This approach faces several issues in both the grammatical level and the parsing level. First and foremost are the issues caused by removing Scope Economy from the grammar. Shifting the hard grammatical condition of Scope Economy to a defeasible parsing consideration to merely avoid complex scope structures removes the ability of the grammar to prune certain scope configurations. Thus, examples such as those in (2.3) would be many ways ambiguous and ambiguous examples such as (2.1a) would return to an unbounded number of potential structural representations, including those with superfluous raising like (2.2c). From the perspective of performance this issue is resolved as QR is costly and a pragmatic licensor is required for any QR in the first place. Thus, this kind of structure would not be produced in sentence processing. However, this leaves these structures untouched in the grammar, meaning that a grammar without Scope Economy would contain these structures. This would disrupt the mapping between structure and interpretation by introducing many ambiguous structures, and yields a theory of performance that requires that the grammar include a series of representations that will never be constructed in by the performance mechanism. There also remains an issue of how specifically pragmatic support is implemented. A critical question here is how the parser can determine a context supports QR prior to performing QR. There are also additional, more detailed questions regarding what constitutes pragmatic support, which structures are possible to achieve through pragmatic support, and the potential relations between specific kinds of support and specific scope structures. Each of these questions becomes more difficult to answer on the assumption that the parser only has access to the surface representation.

Turning to the issues for such a theory in parsing, there are two primary concerns. The first is with the nature of the scope preference, and the second concerns the application of pragmatic factors overriding this preference. In the interpretation where the parser prefers the less complex scope configuration, we are faced again with the challenge of the comparative. That is to say, the parser is unable to compare the complexity of two structures, or any other property, without access to both structures. We can define some measure of complexity, with respect to parsing operations or structural factors, but this measure provides no value without another value to compare it to. Thus, we are left with only one actionable definition, which is that the parser simply avoids performing QR, as a matter of default construction. However, determining when and how this default can be overridden is a challenging puzzle. The strongest version of this would be to say that the parser completely avoids QR, again as a matter of default. This would be acceptable from a computational standpoint, yielding a parsing procedure which minimizes mistakes, though unacceptable from the perspective of observed behavior and grammatical coverage as the parser needs to be able to produce structures that yield non-surface interpretations. If we add in some sort of escape hatch to allow for QR, say in the presence of a particular pragmatic context, we would regain the ability to generate non-surface scope. However, this opens up the tricky questions of how such a pragmatic engine would work, particularly when the parser has no representation of the structure that the pragmatic factors would license. Note that a strategy like allowing all possible scope relations and only licensing those with pragmatic support would require the presence of inverse scope, meaning that a parser which employs ambiguity necessarily incurs the QR-costs related to producing this structures.

This concern is the core of the second issue for QR-avoidant models. When does context suffice to overturn the parser's QR avoidance and result in the construction of non-surface scope structures? If we simply say that avoidance fails in the cases where inverse scope is pragmatically supported, we endorse a circular chain of reasoning where QR is only applied in places where it is pragmatically supported and the places where it is pragmatically supported are the only places where we observe QR. In this way, QR-avoidant models place the significant burden of reconciling the issue of scope ambiguity entirely on the pragmatics, neglecting the exact specification of that system and its interfaces with the syntax and parsing procedures. However, it is important to note that issues of context and pragmatic conditions are relevant to any model, and thus it is important for accounts of scope processing to provide the relevant input, like potential alternative scope structures, to any pragmatic processes.

2.4. Active Scope Models

The active scope model I propose in this dissertation is specifically focused on resolving the puzzle created by Scope Economy. The active scope model is structural in nature and focuses more specifically on the requirement that the parser must be able to produce non-surface scope structures, rather than a desire to optimize for cost avoidance. As we have seen in the exploration of the non-incremental and QR-avoidant models, parsing strategies trade-off on certain variables. These are the incrementality of processing, or how soon the scope relations are calculated, the costs incurred during processing, penalties for reanalyzing a defunct parse and other operation costs and how reliably the parser can generate scope structures. The proposals thus far have largely sacrificed incrementally in order to minimize costs, either by waiting to the end of the sentence or only pursing scopally complex structures when given unspecified pragmatic license. The active scope model makes a different trade-off by admitting some concessions on cost in order to calculate scope relations earlier during processing. This class of proposal also foregrounds the comparative nature of the Scope Economy condition. At the most unrefined level, active scope models could immediately perform QR when a quantifier is encountered, insuring maximal incrementality. However, I propose that the parser need not be so reckless, and that small sacrifices to incrementality can greatly increase performance with respect to costs while retaining the ability to quickly produce inverse scope structures.

To begin, it is perhaps easiest to walk through the most incremental, most cost-careless version of the active scope processing model. This reckless model would immediately perform QR when a quantifier is encountered. This procedure would ensure that the parser generates all the potentially valid scope structures. In the processing of an example like (2.1a), *a teacher* would be immediately raised before any additional words are encountered. Right away an issue occurs, as in the partial sentence representation consisting of just *a teacher* this QR is not licensed under Scope Economy, as it no new interpretation is formed. Thus, this QR must be reverted at some reanalysis cost (Fodor and Ferreira 2013, Frazier 1979, Frazier and Clifton 1998, Schneider and Phillips 2001, Sturt 1996). When the second quantifier *every student* is encountered, a more complex sequence of actions unfolds. As there are now multiple quantifiers in the structure, a principle must determine the order in which QR is applied to these quantifiers. If we assume QR applications occur from right to left in the structural representation, the new element *every student* is the first to undergo

QR. This is a non-trivial decision about how to resolve the ordering of quantifier raising. A right to left pattern achieves a few benefits. First, it results in starting the operation sequence with the newest quantifier, which will be the most likely to yield a new scope interpretation. Second, raising the new quantifier first doesn't require any shift in attention, as the new quantifier is the element the parser just integrated into the structural representation. The good news is that performing QR on *every student* does in fact produce a syntactic structure with a novel interpretation, (2.2b), allowing the structure to stand with respect to Scope Economy. However, the parser should also consider the first quantifier *a teacher* and once again test its interpretation after undergoing QR. This would result in the generation of a structure like that in (2.2c). This structure is not licensed by Scope Economy, as it has the same interpretation as the initially constructed tree (2.2a). Thus, this raising must be reverted. Having reached the end of the sentence, it is clear that this approach is certainly reckless, as it attempts QR three times and reverts two of those attempts. However, the situation for a more incremental processor is not totally hopeless and a few reasonable restrictions of QR application can maintain the benefits of an incremental approach while avoiding some of the costs.

To begin, it is important to note that the initial raising of *a teacher* could never be scope informative, as the absence of other material means there's no possible way for the interpretation to change and satisfy Scope Economy. The example (2.3b) presents a similar problem, as there is only a single quantifier and no elements which could license an alternative scope configuration under Scope Economy.

As these examples demonstrate, Scope Economy is a condition dependent on the relations between multiple elements. As such, restricting the application of QR in structures with only a single quantifier can reduce ungrammatical QR applications while minimally impacting incrementality. Let us change the parsing rule for QR application to state that QR only occurs when a quantifier is in memory and a scope sensitive element is the most recent input. As this model assumes that memory is structural in nature, a quantifier in memory means that there is a quantifier in the structural representation of the parse thus far. Quantification behaves like other features that have structural consequences, and it is assumed that the parser has access to the full memory structure, its constituent elements, and the features of those elements. A scope sensitive element is a category that includes any element that acts as an operator or variable, thus including items like pronouns, polarity items and quantifiers themselves. This change in the QR application rule results in a substantial reduction in the amount of vacuous QR performed by the parser. Now, the initial raising of *a teacher* in the example above is avoided, and QR only takes place upon arriving at the position of *every student*. Similarly, this procedure avoids vacuous QR in (2.3b), as only a single quantifier appears with no subsequent scope sensitive trigger. A notable consequence of this change is that the active scope model can operate similarly to the non-incremental model in certain configurations. In a sentence like (2.1a), the parser won't attempt to perform QR until the point of the second quantifier, which appears at the end of the sentence. In other words, there are cases where the triggering scope sensitive element appears late in the sentence and thus scope is computed late. However, the active scope model with the scope sensitive trigger mechanism allows for earlier computation of scope, so long as the trigger appears before the end of the clause.

This basic sketch of the active scope model with triggers does not preclude every costly QR application. For example, a sentence like (2.3a) would still result in QR applications which do not change the interpretation. In this case, despite a quantifier and scope sensitive element both being present, the elements are commutative, and their relative order does not change the interpretation. Thus, we would expect to see QR occur at both the point of the second *every* for both the *every* in object position and the *every* in subject position. Both of these QR applications are not licensed under Scope Economy because of the commutative nature of the quantifiers. One could imagine a parser which avoids this by using more fine-grained information about the features of the quantifiers in memory to avoid performing QR in a situation where the features of the trigger and the quantifiers in memory match. This would further reduce the number of times the parser performs ungrammatical QR, but does so at the expense of adding additional computational steps to check the more fine-grained features of every quantifier encountered.

Some data supporting the general idea behind the active scope model exists in the form of studies which show that comprehenders can be quite eager to adopt inverse scope interpretations and that QR does not appear to be highly restricted beyond the availability of such an interpretation (Syrett 2015a,b). Additionally, intervention effects for negative quantifiers observed in the negative polarity item (NPI) and related polarity illusions also suggest a parser which actively considers scope relations online (Muller and Phillips 2020, Orth et al. 2021). This data will be the focus of later chapters of the dissertation, which aim to refine the active scope hypothesis.

Both the most reckless version of the active scope model and the triggered version produce a different set of predictions from the non-incremental and QR-avoidant models. Specifically, the active scope models predict that we should observe costs during sentence processing at points where inverse scope is blocked under Scope Economy, as these are instances where QR must be performed and subsequent reanalysis will incur some cost. Experiment 1 investigates a sentence configuration with multiple quantifiers and competing constraints on scope, in order to provide several points during processing where potential scope related processes can be observed.

2.5. Experiment 1

Experiment 1 looks to observe how the parser processes scope information as the sentence unfolds. To do this, I employ a design which places competing demands on the scope structure of the sentence, which become evaluable at different points in time. In sentences like (2.6a), discussed earlier in this chapter, scope is influenced by the presence of verb phrase ellipsis (VPE). Sentences with VPE are known to be subject to a Scope Parallelism constraint (Fox 2002, Johnson 2001, May 1977, Merchant et al. 2001, Sag 1976). Scope Parallelism requires both the antecedent clause and the ellipsis containing clause to share the same scope structure. Thus, for (2.6a) we can obtain either the dual surface interpretation paraphrased in (2.6b) or the dual inverse interpretation of (2.6c), but there are no hybrid interpretations such as (2.6d).

(2.6) a. A doctor will visit each patient and a nurse will too.

b. *A particular doctor will visit all the patients and particular nurse will also visit all the patients.*

c. *All the patients will be visited by some doctor and all the patients will also be visited by some nurse.*

d. *#A particular doctor will visit all the patients and all the patients will also be visited by some nurse.*

In this way, Scope Parallelism in the context of VPE restricts the space of possible scope interpretations of each of the clauses together. This constraint can also interact with Scope Economy. If Scope Economy blocks the inverse scope interpretation in one of the clauses, the other clause can only be interpreted with surface scope even if Scope Economy is locally satisfied. This is because Scope Parallelism requires both clauses to match in scope structure, and only surface scope is available to the first conjunct. Consider the example in (2.7a). Here the only available interpretation is something like the paraphrase (2.7b) where a particular doctor visits all the patients. This is despite the fact that when standing alone as in (2.8a) both the surface interpretation (2.8b) and the inverse interpretation (2.8c) are available. The restriction comes from the second conjunct, where Scope Economy limits the available structures to only surface scope because QR over the phrase *the nurse* in the second conjunct would not produce a new interpretation and thus be vacuous.

(2.7) a. At least one doctor will visit each patient and the nurse will too.

b. *At least one particular doctor will visit all the patients and the nurse will also visit all the patients.*

c. *#All the patients will be visited by some doctor and the nurse will also visit all the patients.*

(2.8) a. At least one doctor will visit each patient.

b. *At least one particular doctor will visit all the patients.*

c. *All the patients will be visited by some doctor.*

In this study, participants read sentences like those in (2.9) during a Maze-Task reading experiment. In a 2×2 design, the conjuncts were manipulated such that Scope Economy either permits or does not permit raising in either conjunct. This design allows us to observe how the parser handles quantifier scope at several points of interest throughout the sentence. This includes at the end of the first clause, the ellipsis site, the point of each quantifier, and the sentence final wrap up region. A careful examination of the temporal profile across the conditions where raising is variably restricted by Scope Economy will illustrate how the parser computes scope relations as the sentence unfolds. We will also be able to observe which constraints are higher priority in the construction of scope structures during online sentence processing.

Each of the proposals presented thus far makes different predictions about how this sort of sentence might be processed. Non-incremental models would predict that processing differences related to scope should only appear at the ellipsis site in the second conjunct or later, due to the requirement for a minimal sentence. Under the assumption that non-surface scope configurations are more costly, this non-incremental models predict slower reading times for the condition where both surface and inverse scope are possible, the *at least*×*some* condition, than for any condition where Scope Parallelism enforces global surface scope.

QR-avoidant models would predict that costs in processing should be tied to the application of QR. Thus, the condition where both conjuncts allow for surface and inverse scope should be the most costly, and should be costly at the points where QR occurs. Thus reading time slowdown should occur at the point of *each* in the first conjunct when the sentence begins with *at least*. If QR is strictly avoided, we expect no difference in reading times across the conditions at the ellipsis site, as all the conditions are compatible with surface scope. If context can influence the processing of quantifiers as soon as they are encountered, we'd predict that the *at leasttimessome* condition will be read more slowly at ellipsis site, as constructing inverse scope would require a cost of performing QR. No other effects are predicted in earlier regions, as Scope Parallelism in combination with avoiding QR means QR won't be considered until it is recognized that a global inverse scope interpretation is pragmatically supported.

Finally, active scope models would predict that costs should be observed instead in places where QR is blocked under scope economy or by scope parallelism, as the approach contends that the processor regularly attempts to produce non-surface scope interpretations.

The costs we are predicted to observe are reanalysis costs for QR applications which violate Scope Economy or other conditions on movement or scope like Scope Parallelism. Thus at the point of *each* at the first conjunct, we anticipate slower reading times for sentences with *that* than *at least*. We would also anticipate slowdowns in the subject position of the second conjunct if it allows inverse scope and the first conjunct blocks inverse scope. A penalty is also predicted at the ellipsis site if the first allows inverse scope but the second conjunct blocks it, as in the *at least*×*the* condition, as the parser attempts to raise the covert *each* in the ellipsis site to test inverse scope and the possibility of a global inverse scope interpretation. This raising would violate Scope Economy locally, leading to a reading slowdown, and would also require the parser to commit to a surface scope interpretation of the first conjunct. This means reanalysis would be necessary if the parser had constructed an inverse scope interpretation of the first conjunct, and a larger or additional reading time slowdowns may occur in this *at least*×*the* condition.

2.5.1. Materials and Methods

This study included 81 participants who were native English speakers who were recruited on Prolific, a platform for web-based research in the social sciences (Palan and Schitter 2018). A single participant was dropped from the analysis for failure to comply with task directions. The target sample size was selected to ensure sufficient statistical power for the primary experiments and filler materials. Participants were awarded $6 for their participation in the study. The task was estimated to take around 30 minutes, though participants were granted a larger window in which the task could be completed, with the ability to pause and take breaks in a self-guided fashion during that time. The average completion time just over 30 minutes, inclusive of time spend reading forms, performing the experiment, and taking breaks.

The primary task materials consisted of 24 items with 4 conditions each, structured in a 2×2 design. A sample item appears in (2.9). In these items, the first quantifier phrase in each clause was manipulated such that it either allowed for QR with a new interpretation or blocked QR under Scope Economy. In the first conjunct, the subject was either *At least one NP* as in (2.9a-b) or a length matching *That NP* as in (2.9c-d). As a quantifier, *at least one* allows for the possibility of inverse scope of the later *each* and is thought to encourage an inverse scope interpretation (Beghelli and Stowell 1997). On the other hand, *that NP* as a demonstrative is not a quantifier and does not license inverse scope under Scope Economy as no new interpretation is generated based on the QR of *each*. In the second conjunct a similar manipulation takes place with the second conjunct subject being either *some NP* as in (2.9a) and (2.9c) or *the* as in (2.9b) and(2.9d). Much like in the first conjunct, *some* is a quantifier and new interpretation can be generated when *each* is raised over it. On the other hand, *the* does not allow inverse scope as if *each* undergoes QR, no new interpretation is created. As such, Scope Economy blocks QR in this condition. Thus, we observe that inverse scope is possible in both conjuncts in (2.9a), possible in a single conjunct in (2.9b) and (2.9c) and not possible in either conjunct in (2.9d). With this design, we can observe how the parser processes quantifiers when inverse scope is always possible (2.9a), when inverse scope is possible in the first conjunct but later ruled out by Scope Parallelism (2.9b), when inverse scope is possible in the second conjunct, but the first is already committed to surface scope (2.9c), and when any scope shifting at any point would violate Scope Economy (2.9d). Outside these critical manipulations, items were constructed to maintain plausibility as much as possible.

(2.9) a. At least one doctor will visit each patient, and some nurses will too because the hospital is barely busy.

b. At least one doctor will visit each patient, and the nurses will too because the hospital is barely busy.

c. That angry young doctor will visit each patient, and some nurses will too because the hospital is barely busy.

d. That angry young doctor will visit each patient, and the nurses will too because the hospital is barely busy.

Each participant read 96 sentences total, consisting of the 24 critical VPE sentences and 72 filler sentences. The fillers consisted of 3 subsets with similar length and complexity to the VPE sentences.

The reading task itself was presented using Ibex Farm Drummond (2013), a platform for web-based reading experiments. Participants read the items in the style of the grammatical maze task, where participants see two words at a time and must select the word which continues the sentence (Boyce, Futrell, and Levy 2020, Forster et al. 2009, Witzel, Witzel, and Forster 2012). Participants indicated their responses by pressing the "e" or "i" key on their keyboard, indicating the word on the left or right side of the screen. If the participant failed to select the correct continuation of the sentence the trial ended immediately. Otherwise, the next pair in the sentence was presented. These pairs were developed with Automaze, a utility that automates the selection of extremely low probability continuations which match the length and frequency of the target word (Boyce et al. 2020, Gulordava, Bojanowski, Grave, Linzen, and Baroni 2018). The maze task provides more robustly localized effects in replications of results from eye-tracking and self-paced reading and the high level of participant engagement requires makes the method highly suitable to use in a web-based experimental context (Boyce et al. 2020, Forster et al. 2009, Witzel et al. 2012, Zehr and Schwarz 2022). The time participants took to make their selection was recorded, as was the selection choice. Participants were able to pause between sentences and start the next sentence when they were ready. After reviewing a consent form, receiving instructions and a short practice to explain the task, participants began the experiment. Presentation order was randomized across participants using Ibex Farm's inbuilt method.

2.5.2. Results

Data was analyzed using a linear mixed-effects model estimated with the lme4 package for each region of interest (R Core Team 2021). Each model was fit over log transformed reading times with random intercepts for subject and item, unless the estimated variance for the random effect was sufficiently small. Both fixed effects were coded with 1/2 for the inverse scope permitting structure and -1/2 for the inverse scope prohibiting structure, and an interaction term was included. Reading times greater than 10,000 milliseconds were automatically removed from analysis as extreme outliers, as were reading times smaller than 100 milliseconds. A single trial was removed as it appeared to be an outlier in both a Q-Q plot and in a plot of Cook's distance at the ellipsis site. A visualization of the reading times for each region, in this experiment each word, of the sentence is presented in Figure 2.1. Areas marked with points in Figure 2.1 indicate significant results appeared in the model for that region of the sentence.[3] Figure 2.2 focuses on the quantifier related regions of interest. Table 2.1 through Table 2.5 correspond to regions presented in Figure 2.2.

In the first conjunct, no significant effects appear at the point of D head *each*, however significant effects are observed at the point of the N head *patient*. At the point of the N head *patient*, a main effect is observed for the first conjunct scope manipulation such that reading

[3] Note that models were not estimated for the initial four regions corresponding to the subject of the first conjunct. These regions exhibit large differences due to the differences in the lexical materials, with particularly high reading times observed for the adjectives following *that*, as these are relatively unpredictable, compared to the string *at least one NP*. Future work could take up the issue of sentence initial quantification with an alternative set of materials designed to control this region for length effects more tightly.

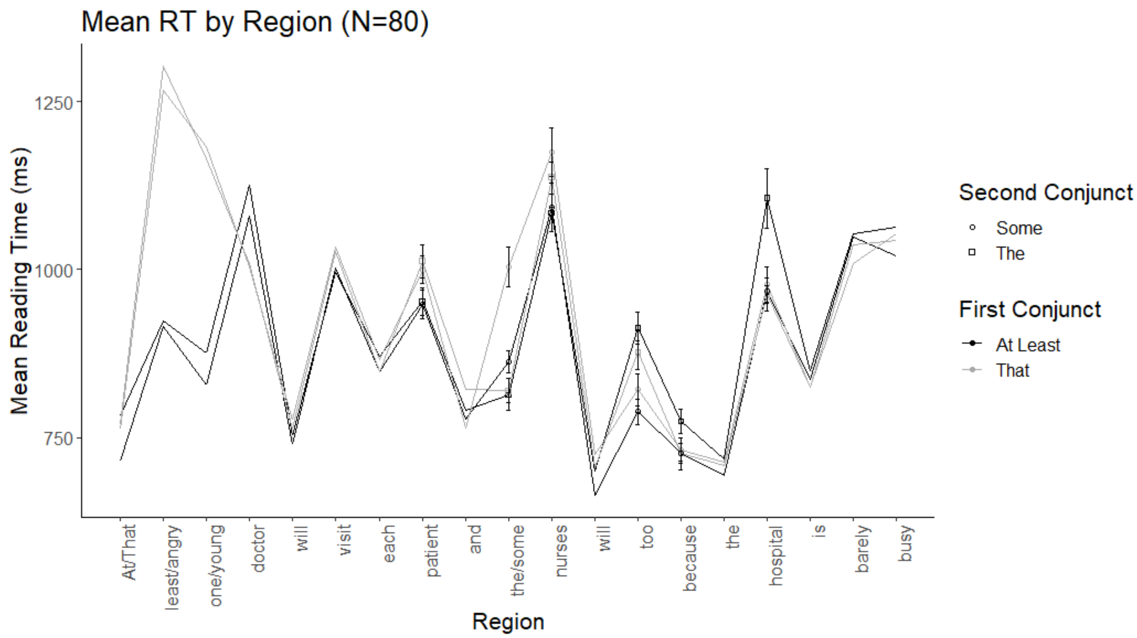


Figure 2.1. Experiment 1: Graph of all regions reading time.

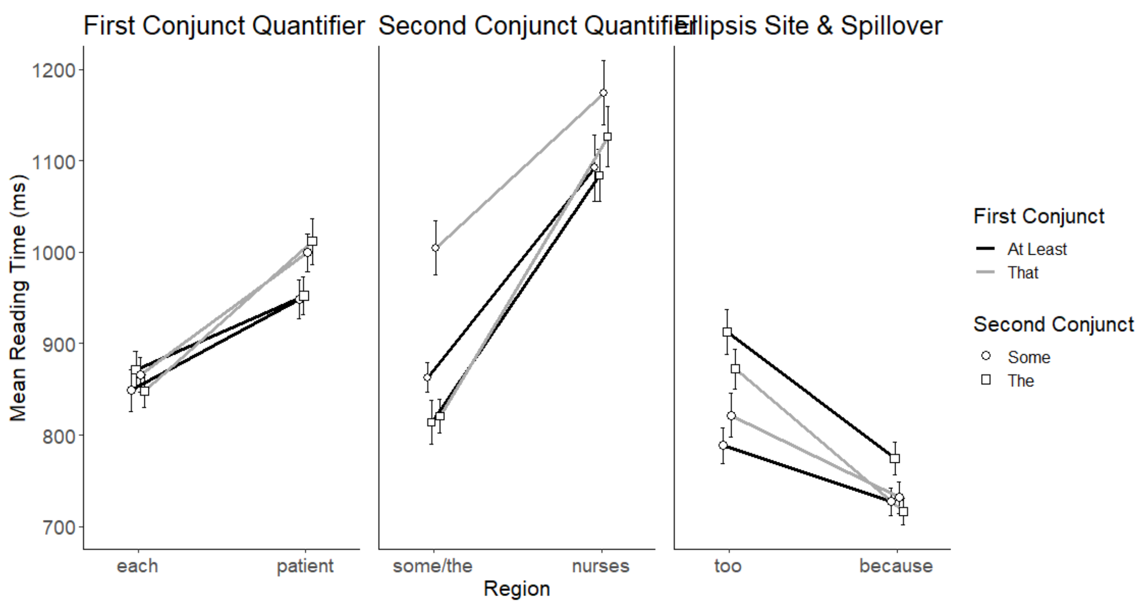


Figure 2.2. Experiment 1: Graph of quantifier regions reading time.

times were slower ($\hat{\beta}$=0.037, se=0.015, t=2.455) when the first conjunct began with *that*. Full model output for the region marked by the N head *patient* is available in Table 2.1.

N Head *Patient*	Estimate	Standard Error	T Value	P Value
Intercept	6.826	0.040	200.793	**<0.001**
First Conjunct That	0.037	0.015	2.455	**0.014**
Second Conjunct The	-0.030	0.015	-0.204	0.838
First Conjunct * Second Conjunct	0.026	0.030	0.089	0.929

Table 2.1. Experiment 1: Mixed effects model of log transformed reading times at region *patient*.

In the second conjunct, significant effects are observed at both the point of the D head *some/the* and the N head *nurses*. At the point of the D head *some/the* a main effect is observed for the first conjunct scope manipulation such that reading times were slower ($\hat{\beta}$=0.069, se=0.016, t=4.403) when the first conjunct began with *that*. A main effect is also observed for the second conjunct scope manipulation such that reading times were faster ($\hat{\beta}$=-0.141, se=0.015, t=-9.125) when the second conjunct began with *the*. This is likely driven by the slow reading times observed in the some$\times$that condition, as the interaction effect of the two terms is also significant ($\hat{\beta}$=-0.066, se=0.031, t=-2.119). Full model output for the region marked by the D head *some/the* is available in Table 2.2. At the point of the N head *nurses* a main effect is observed for the first conjunct scope manipulation such that reading times were slower ($\hat{\beta}$=0.066, se=0.018, t=3.739) when the first conjunct began with *that*. Full model output for the region marked by the N head *nurses* is available in Table 2.3.

Head D *some/the*	Estimate	Standard Error	T Value	P Value
Intercept	6.706	0.024	279.339	**<0.001**
First Conjunct That	0.069	0.016	4.403	**<0.001**
Second Conjunct The	-0.141	0.015	-9.125	**<0.001**
First Conjunct * Second Conjunct	0.066	0.031	2.119	**0.034**

Table 2.2. Experiment 1: Mixed effects model of log transformed reading times at region *some/the*.

Head N *nurses*	Estimate	Standard Error	T Value	P Value
Intercept	6.934	0.036	192.180	**>0.000**
First Conjunct That	0.066	0.018	3.739	**>0.000**
Second Conjunct The	-0.016	0.017	-0.924	0.355
First Conjunct * Second Conjunct	-0.018	0.035	-0.504	0.614

Table 2.3. Experiment 1: Mixed effects model of log transformed reading times at region *nurses*.

We also observe significant effects at the point of the ellipsis site marked by *too* and the spillover region marked by *because*. At the point of the ellipsis site marked by *too* we observe a main effect for the second conjunct scope manipulation such that reading times are slower ($\hat{\beta}$=0.087, se=0.018, t=-4.703) when the second conjunct began with *the*. Full model output for the ellipsis site region marked by *too* appears in Table 2.4. Moving to the spillover region marked by *because* we observe a main effect of the first conjunct scope manipulation such that reading times are faster ($\hat{\beta}$=-0.032, se=0.015, t=–2.185) when the first conjunct began with *that*. This is likely driven by the slow reading times observed in the *At least*×*the* condition, as the interaction of the first conjunct scope manipulation and the second conjunct scope manipulation is also significant ($\hat{\beta}$=-0.058, se=0.030, t=-1.968). Full model output for the ellipsis site spillover marked by *because* appears in Table 2.5.

Ellipsis Site *too*	Estimate	Standard Error	T Value	P Value
Intercept	6.663	0.024	272.024	**<0.001**
First Conjunct That	-0.002	0.018	-0.119	0.905
Second Conjunct The	0.087	0.018	4.703	**<0.001**
First Conjunct * Second Conjunct	-0.051	0.037	-1.392	0.164

Table 2.4. Experiment 1: Mixed effects model of log transformed reading times at region *too*.

Outside these effects in the quantifier related regions, we also observe some significant effects in the wrap up region of the sentence shown in Figure 2.3. Specifically at the point of

Ellipsis Site Spillover *because*	Estimate	Standard Error	T Value	P Value
Intercept	6.549	0.023	285.219	**<0.001**
First Conjunct That	-0.032	0.015	-2.185	**0.029**
Second Conjunct The	0.009	0.014	0.616	0.5379
First Conjunct * Second Conjunct	-0.058	0.030	-1.968	**0.049**

Table 2.5. Experiment 1: Mixed effects model of log transformed reading times at region *because*.

the N head *hospital* we observe a main effect of the first conjunct scope manipulation such that reading times are faster ($\hat{\beta}$=-0.038, se=0.016, t=–2.278) when the first conjunct began with *that*. This is likely driven by the slow reading times in the *At least*$\times$*that* condition, as there is also a significant interaction between the scope manipulations ($\hat{\beta}$=-0.066, se=0.032, t=-2.035). Full model output appears in Table 2.6.

Wrap Up Region *because*	Estimate	Standard Error	T Value	P Value
Intercept	6.834	0.032	216.945	**<0.001**
First Conjunct That	-0.037	0.016	-2.278	**0.023**
Second Conjunct The	0.022	0.016	1.371	0.1707
First Conjunct * Second Conjunct	-0.066	0.032	-2.035	**0.042**

Table 2.6. Experiment 1: Mixed effects model of log transformed reading times at wrap up region *hospital*.

2.5.3. Discussion

At a high level, the results of Experiment 1 indicate that there is considerable scope related activity throughout the processing of the sentence, as marked by the observed differences in reading time at the various scope sensitive regions. Impressionistically, this gives the sense that the parser does not appear to be non-incremental or QR-avoidant with respect to scope processing. Indeed, an examination of the specific pattern of effects appears to endorse this position.

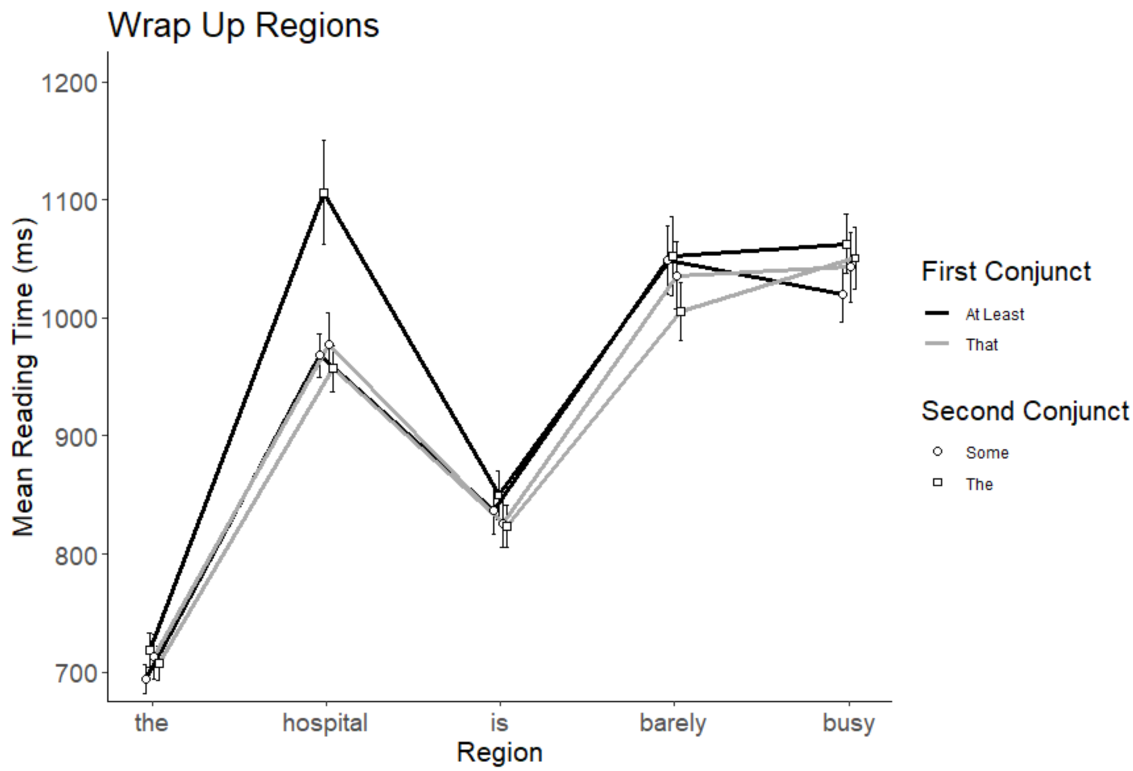


Figure 2.3. Experiment 1: Graph of wrap up regions reading time.

In the first conjunct, we see an effect of the first conjunct manipulation at the point of the object NP, which marks the end of the clause. At the noun position we observe a significant effect such that conditions which have *that* in the first conjunct subject are slower than those with *at least*. In other words, participants read the quantified NP *each N* slower when the subject, *that*, blocks inverse scope than when the subject, *at least*, allows for inverse scope. Thus, there is an apparent processing cost for blocking scope investing. This pattern is incompatible with the predictions of QR-avoidant models, which predict that a condition with a single plausible scope structure, the *that* condition, should be faster than a case where inverse scope is available and promoted, the *at least* condition. This is because the parser would incur some cost of QR for raising *each* in the *at least* condition.

However, the distribution of reading times observed at this region appears more consistent with the predictions of both the non-incremental and active scope models. This region is the end of the clause, which is critical for non-incremental models, and is also the site of the first element which could trigger the parser to perform QR, which is critical for active scope models. However, the effect observed is a slowdown for the condition where inverse scope is blocked, which is not necessarily the prediction of non-incremental models. These models simply predict that scope processing occurs later, and thus they do not predict that costs should be higher when there are less scope structures available. Thus it appears that the effect at this position is most compatible with the active scope model, which predicts reading time slowdowns should occur at quantifier regions when inverse scope is blocked by Scope Economy.

In the second conjunct, we have three regions of interest. These are the subject NP, the ellipsis site marked by *too* and *because* and the trailing wrap up region. In each area, we find significant effects on reading time attributable to the manipulation of the availability of inverse scope in one or both of the conjuncts. Moving lineally through the sentence, at the point of the second conjunct subject, we see effects for both scope manipulations and an interaction effect at the point of the D head. Specifically, the reading of the second clause subject D head is exceptionally slow when the first conjunct subject begins with *that* and the second conjunct subject begins with *some*. In this way, the parser incurs a uniquely large penalty when the first conjunct does not allow for inverse scope but the second conjunct does. In a non-incremental model, there should be no reason for any penalty to occur at the point of the second conjunct subject, as the parser should wait for the conclusion of the second conjunct before performing any calculations. Likewise, a QR-avoidant parser would predict no activity at this region, as the first conjunct *that* would force the second conjunct to hold surface scope under the Scope Parallelism constraint. This enforcement of surface scope would be in line with the general preference of the QR-avoidant model, and we would not predict a slowdown in this case. However, active scope models could predict such a slowdown. In all conditions there exists at least one quantifier in memory, *each*, at the point of the second conjunct determiner. When this determiner is *some* QR is triggered for both *some* and *each*. When the first conjunct subject begins with *that* both instances of QR are ungrammatical. The QR of *some* is uninformative at this juncture with respect to the local clause and thus violates Scope Economy. Meanwhile, QR of *each* is also uninformative, as raising over the first clause subject *that* does not result in a new interpretation. In this way, the effects in this region suggest the parser performs scope related calculations earlier than predicted by non-incremental models. Similarly, the observation of a unique penalty for the case where QR is ungrammatical under Scope Economy aligns with the active scope prediction that the parser attempts QR and faces reanalysis costs, rather than the QR-avoidant prediction that the parser would avoid costs by avoiding raising.

Turning to the processing profile at the point of the ellipsis site marked by *too*, we observe a slower processing when the second conjunct begins with *the*. Carrying over to the ellipsis site, we observe a unique slowdown for the condition with second conjunct *the* and first conjunct *at least*. This unique cost also carries over into the wrap up region at the point marked by *hospital*. Such a pattern is difficult to explain for QR-avoidant models. This is because it is unclear why the conditions which most strongly enforce surface scope are processed slower than those which allow for inverse scope, which QR-avoidant models argue is dispreferred due to an assumed cost of QR. Both non-incremental and active scope models are compatible with the presence of scope related processing activity in the ellipsis site region. However, the evidence of scope related processing at the second conjunct subject quantifier region leans in favor of the active scope models, as this activity occurs before the sentence is appropriately saturated according to non-incremental models. Additionally, the effect direction is not predicted by non-incremental models as the condition with the most potential scope structures, *at least*×*some*, is not slower relative to the other conditions which all only have a single possible structure. The high cost in the *At least*×*the* condition is, however, the direct exact effect predicted by the active scope model. The effects in the wrap up regions suggest the possibility of a late occurring processing related to scope, and is not directly predicted by the active scope model. The presence of this late processing is more directly predicted by non-incremental models. However, these effects are not incompatible with active scope models, as it is possible that the later stages of processing make use of the scope information previously established. It is also possible that reverting both the QR of the covert *each* in the second conjunct and the inverse scope structure of then fist conjunct with *at least* occurs over a period of time larger than the reading of a single word.

2.6. General Discussion

In this chapter, I introduced a range of models for processing scope online. These parsing strategies trade-off in incrementality, the rate of ungrammatical scope structure production, and the ability to generate the scope structures permitted in the grammar. In non-incremental models, scope is not computed until a proposition is satisfied, which generally occurs at the end of a clause. In QR-avoidant models, the parser avoids manipulating the scope structure as much as possible, setting aside the difficulties of formalizing the principle of avoidance and the pragmatic mechanism that overrides this principle. Finally, in active scope models the parser tests out scope configurations incrementally by performing QR as operators and variables sensitive to scope are encountered, in order to ensure non-incremental scope structures are produced and that they do not violate Scope Economy.

In Experiment 1, which was designed to test how scope is or is not incrementally processed during sentence processing, we observe consistent effects of scope manipulations throughout the processing of a multi-clausal structure. These effects often take the form of processing penalties for configurations where inverse scope is blocked, primarily by Scope Economy, but with later costs observed for configurations where inverse scope is blocked globally by Scope Parallelism. This temporal profile suggests that scope processing is incremental and that the parser does not avoid performing QR, an endorsement of the active scope model. In the following chapters, I present investigations of the processing of polarity items. These elements are scope sensitive, but are not able to covertly move via QR. Thus, they provide an excellent testing ground for the generalization of the active scope hypothesis to contexts with triggers for QR which are not themselves quantifiers.

CHAPTER 3

NPI Illusion and the Quantifier Restriction

The previous chapter investigated the real-time processing profile for sentences which contain multiple clauses and multiple quantifiers. The goal of the experiment was to probe the compatibility of the observed word-by-word processing of quantification with three proposals for how scope is processed online. These proposals included non-incremental models which only compute scope at the end of clauses when the semantics are fully saturated, QR-avoidant models which view scope calculation as costly and thus generally avoid it, and active scope models which posit that the parser tests scope configurations incrementally. Effects indicating scope related processing were observed at several regions of interest, and many of these effects were penalties in conditions where inverse scope interpretations were blocked under Scope Economy. This result was most in line with an active scope model with a trigger mechanism. Rather than immediately testing a raised structure when a quantifier is encountered, the parser appears to wait until another element that varies in interpretation based on the scope structure is encountered. In this way, scope relations are computed incrementally, but the parser waits until there is potential for a new interpretation before computing scope relations by performing quantifier raising.

The element that triggered the parser to perform QR was a quantifier in Experiment 1. In this chapter and subsequent chapters, the triggering element is sensitive to quantifier scope but not a quantifier itself. Specifically, this chapter looks at negative polarity items (NPI), and later chapters investigate positive polarity items (PPI). Polarity items (PI) are elements which are sensitive to properties roughly mapping onto the affirmative or negative quality of a sentence (Baker 1970, Fauconnier 1975, Horn 1989, Huddleston 1970, Huddleston and Pullum 2005, Klima 1964, Ladusaw 1980). Sentences containing NPI have been shown to produce a processing illusion effect, wherein certain ungrammatical NPI containing sentences are read more quickly or rated more acceptable than others. Consider the examples in (3.1).

(3.1) a. [$_{\text{NP}}$ **No** hunter [$_{\text{CP}}$ who the farmer likes]] *ever* shot a deer with a rifle.

b. *[$_{\text{NP}}$ The hunter [$_{\text{CP}}$ who the farmer likes]]*ever* shot a deer with a rifle.

c. *[$_{\text{NP}}$ The hunter [$_{\text{CP}}$ who **no** farmer likes]] *ever* shot a deer with a rifle.

In (3.1a) there is an NPI, *ever*, which is properly licensed by a c-commanding negative element *no*. In both (3.1b) and (3.1c) the NPI, *ever*, is ungrammatical as there is no negative element which is in a c-commanding position. Despite the fact that both (3.1b) and (3.1c) are ungrammatical in the same way, it has been shown that the NPI, *ever*, is read faster in (3.1c) and the full sentence (3.1c) is rated more acceptable than (3.1b). This effect has been argued to be a result of a parsing behavior which results in an ungrammatical connection between the relative clause *no* and the NPI (Drenhaus et al. 2005, Muller and Phillips 2020, Orth et al. 2021, Parker and Phillips 2016, Vasishth et al. 2008, Xiang et al. 2009, Yun et al. 2018). While originally a landmark illusion in sentence processing, a growing body of work has shown that the NPI illusion has many unique properties and restrictions which have presented challenges for theories looking to capture this illusion effect (Mendia et al. 2018, Orth et al. 2021, Parker and Phillips 2016, Vasishth et al. 2008, Xiang et al. 2009, 2013).

In this chapter, I will present a series of experiments which are designed to refine our understanding of the distribution of the NPI illusion, testing various elements which normally license NPI in this relative clause illusion position. Each element tested offers unique syntactic, semantic and pragmatic properties, all of which could be relevant for the illusion phenomenon. By exploring a range of NPI licensors systematically, the experiments presented here will support the notion that the NPI illusion is more restricted than previously thought. The results of the studies contained within this chapter show that, among negative licensors, only negative quantifiers give rise to the NPI illusion effect, and can do so regardless of the depth of embedding within a relative clause. Both *didn't* and *no* are negative and NPI licensors, yet the NPI illusion effect only arises with *no*. Similarly, no illusion effect is observed for stand-alone negation, *not*, adverbial negation, *never*, and verbs with relevant properties for NPI licensing, *doubt*.

However, when we turn to other quantifiers we see an illusion effect for *none*, another negative quantifier, and *not a single* a quantifier which is negative by way of composition. These negative quantifiers also produce the illusion from both high and low positions in the relative clause. In this way, the refined distribution of the illusion effect suggests it is uniquely driven by quantifiers that are also negative.

After presenting the experimental data, I will present a few of the approaches to modeling the NPI illusion including cue-based models, feature percolation models, pragmatic models and the active scope models introduced in the previous chapter. I argue that these results are in line with the general prediction of active scope models. Sentences which contain an NPI and a relative clause negative quantifier trigger an attempt to raise the quantifier to a matrix position. This move results in the apparent licensing of the NPI, but negative quantifiers are known to be highly restricted in their movement (Barker 2021, Collins 2017, Van Craenenbroeck and Temmerman 2017). Thus, while these sentences are ungrammatical and the QR of the negative quantifier must be reverted, there is a state during processing where there appears to be a c-command relationship between the negative quantifier and the NPI. This results in a temporary processing boost at the point of the NPI as a new scope structure is constructed, evaluated, and rejected. From this perspective, the NPI illusion is merely an unintended consequence of the active scope parser's testing of QR structures, a procedure which is necessary to incrementally and exhaustively compute scope relations online.

In order to provide background sufficient for understanding the unique properties various NPI licensors bring to the illusion context, the following section briefly lays out the critical theoretical notions related to polarity item licensing, with a focus on identifying the critical features for NPI licensing.

3.1. Polarity and Polarity Items

Polarity is a property of a sentence, or part of a sentence, reflecting the sentences being affirmative or negative (Baker 1970, Fauconnier 1975, Horn 1989, Huddleston 1970, Huddleston and Pullum 2005, Klima 1964, Ladusaw 1980). In (3.2), we see an example of an affirmative sentence, (3.2a), and this syntactic environment is referred to as a positive polarity environment. In (3.2b) we see a negative sentence and thus a negative polarity environment. However, it is possible to have a sentence with multiple distinct polarity environments, whether by virtue of being a multi-clausal structures or by way of the co-occurrence and interaction of multiple polarity setting elements. An example of a sentence with multiple polarity environments is in (3.2c), which features a conjunction of a positive environment and a negative environment. Thus, the concept of a polarity environment is a more flexible notion which can be applied at the level of the sentence, but also at levels below the sentence. The distinction between polarity marking elements, environments, and sentences is often obscure in the discussion of polarity phenomena, though in this dissertation I make my best effort towards a clear use of terms.

(3.2) a. The hunter has shot a bear.

b. The hunter has **not** shot a bear.

c. The hunter has shot a bear and the fisherman hasn't caught a fish.

Previous work on polarity has suggested that positive polarity serves as a default and negative polarity is the marked case. In this view, negative polarity environments must be marked by an overt signal such as the negative element *not* in (3.2b) (Horn 1989, Huddleston and Pullum 2005). It is generally agreed that a negative polarity is marked through explicate morphological means with a so-called 'n-word' like *not* or *never* though the property of negative polarity is often extended to capture predicates which lexically encodes a negative meaning which is weaker than semantic negation like *doubt* (Chierchia et al. 2004, Gajewski 2007, Giannakidou 2011, Homer 2021, Kadmon and Landman 1993, Ladusaw 1980, 1992, Linebarger 1987, Von Fintel 1999). Beyond elements which themselves mark polarity, polarity items (PI) are words or phrases which are only grammatical when within a particular subset of polarity environments (Adger and Quer 1997, Fauconnier 1975, Klima 1964, Krifka 1994, Ladusaw 1980, 1992, Lasnik 1972, Linebarger 1987, Von Fintel 1999). This requirement can be analyzed as a structural relation that holds between an element that impacts the polarity of a clause, such as *not*, and the PI itself. In (3.3) we observe two different examples of PI, the negative polarity item (NPI) *ever* and the positive polarity item (PPI) *still*.

(3.3) a. The hunter **didn't** *ever* shoot a deer.

b. *The hunter **didn't** *still* shoot a deer.

Starting with the NPI *ever* in (3.3a), the nature of the NPI licensing relation can be formalized with two critical components. The first component is downward entailment, which is a semantic property of propositions which can result from negation, among other elements with weaker semantic properties (Fauconnier 1975, Giannakidou 2011, Homer 2021, Klima 1964, Krifka 1994, Ladusaw 1980, 1992, Lasnik 1972, Szabolcsi 2004, Von Fintel 1999).

A sentence is downward entailing if it entails the truth of sentences which are more specific. Consider the examples in (3.4). If a man didn't wear shoes as in (3.4a), it also must be the case that he didn't wear red shoes. In this way, the sentence in (3.4a) entails a more specific proposition and meets the diagnostic for being considered a downward entailing environment. If a man wore red shoes as in (3.4b), then it must also be the case that he wore shoes. Thus, the sentence in (3.4b) entails a more general proposition. This is what we refer to as an upward entailing environment, which is the default entailment pattern.

Considering the NPI *ever* in the context of (3.4), we can see that it is grammatical in the downward entailing (3.4a) but not in the upward entailing (3.4b). Thus, the first critical factor in the licensing of NPI is the presence of a downward entailing environment.

(3.4) a. The man **didn't** (*ever*) wear shoes.

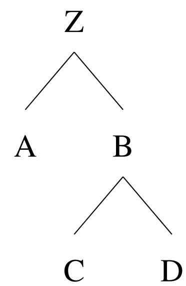
b. The man did (**ever*) wear red shoes.

Having established the semantic property relevant to NPI licensing, the second critical component is a structural factor. The NPI and the element which marks the downward entailing environment are required to be in a c-command relation such that the negative element c-commands the NPI (Ladusaw 1980). C-command is a syntactic configuration in which an element, A, c-commands another element, B, if neither A nor B dominates the other element, and if the first branching node in the structure which dominates A also dominates B (Reinhart 1976).

As this notion is somewhat opaque without a schematic, let us investigate an example. In (3.5), following our definition of c-command, we see that node A c-commands node B. However node A also c-commands nodes C and D, as the first branching element dominating

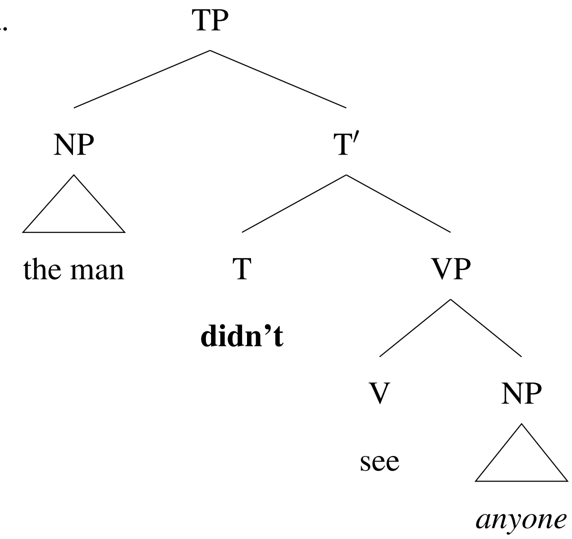
A is Z, which also dominates C and D, though not immediately. Beyond the nodes which A c-commands node B c-commands node A, and nodes C and D c-command one another.

(3.5)

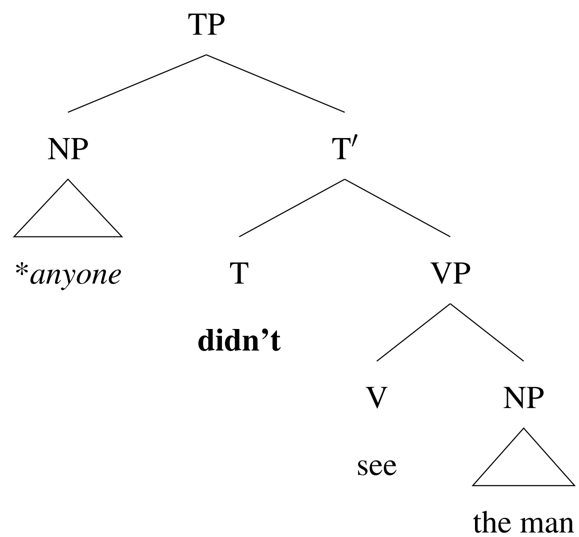


With these conditions together, we have both pieces required for NPI licensing. An NPI is only licensed if it is c-commanded by an element that marks a downward entailing environment. In example (3.6a) *didn't* is grammatical as it satisfies both licensing conditions. *Didn't* itself is a downward entailing element, as we explored in (3.4). *Didn't* is also in a c-command relationship with the NPI *anyone*. This is because neither *didn't* nor *anyone* dominates the other, but the first branching element T' that dominates *didn't* also dominates *anyone*. Thus, this sentence is grammatical and contains a properly licensed NPI, *anyone*. This contrasts with the case of (3.6b). In this case we once again have a downward entailing element, *didn't*, and an NPI, *anyone*. However, *didn't* does not c-command the NPI. While neither *anyone* and *didn't* dominates the other, the first branching element which dominates *didn't* does not also dominate the NPI *anyone*. Thus, *didn't* does not c-command the NPI and the NPI is ungrammatical, failing to satisfy the two components of the licensing relation.

(3.6) a.



b.

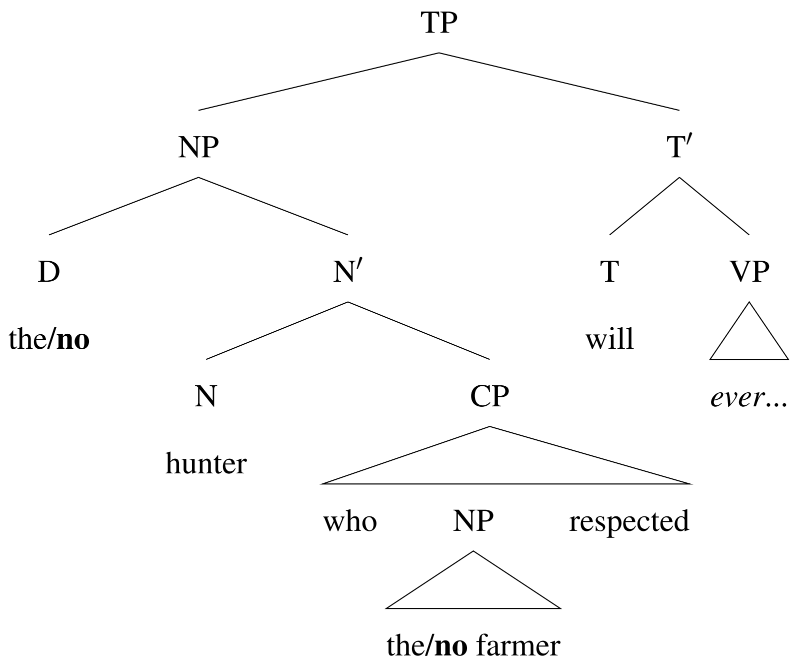


Many proposals exist that state different requirements for licensing NPI. In general, these approaches do not share the same notions of c-command and downward entailment, but instead substitute alternative structural and meaning requirements. In this way, two prominent areas of research in NPI are explorations of the properties and environments that allow for NPI. Other properties proposed to resolve the licensing of NPI include Strawson entailment, non-veridicality, pragmatic strengthening, negative presupposition or some combination of these features which are then deployed in different cases to capture the distribution of NPI (Chierchia 2006, 2013, Chierchia et al. 2004, Giannakidou 2011, Israel 2004, Kadmon and Landman 1993, Krifka 1994, Lahiri 1998, Von Fintel 1999). The structural relationship between licensors and polarity items and the identifying consequences of differing licensing structures for NPI and the broader set of polarity items is another critical research agenda (Barker 2018, Collins and Postal 2014, Gajewski 2007, Homer 2021, Szabolcsi 2004). Investigations in this area often look at complex structures with multiple licensing elements, various levels of embedding and other structural factors. In this way, polarity items have a difficult status where there are clear aspects of structure which control their licensing, but there are also finer grained interpretative factors which refine the broader distributions for particular polarity items. While one could be concerned about the mismatches between a particular theoretical account and the presentation of polarity in processing oriented research, the shared role of structure across accounts allows us to adopt the somewhat simplified licensing condition based in downward entailment, a condition that subsumes many of the finer-grained pragmatic relations, and c-command as presented above, as the licensing pattern in these more basic cases is relatively uncontroversial. With this sketch of PI and the licensing conditions on NPI, let us turn and briefly review the NPI illusion phenomenon and the application of active scope models to the NPI illusion context before presenting the experiments.

3.2. NPI Illusion and the Active Scope Model

Research on polarity in sentence processing has largely focused on NPI and the so-called NPI illusion. The NPI illusion is an effect where a specific subset of sentences containing an ungrammatical NPI display increased sentence level acceptability and faster reading times at the point of the NPI (Drenhaus et al. 2005, Muller and Phillips 2020, Parker and Phillips 2016, Vasishth et al. 2008, Xiang et al. 2009, Yun et al. 2018). The examples (3.1b) and (3.1c) both contain an ungrammatical NPI, as there is no downward entailing element that c-commands the NPI, unlike in (3.1a). Despite (3.1b) and (3.1c) both being ungrammatical, studies have observed increased acceptability and faster reading times at the NPI for sentences like (3.1c) compared to those like (3.1b). As both (3.1b) and (3.1c) are ungrammatical in the same way, the NPI *ever* is not properly licensed, it is somewhat surprising from the perspective of grammar that there is a difference in the processing of these sentences. The syntactic structures of the examples in (3.1) looks like the schematic in (3.7).

(3.7)



From the perspective of online sentence processing, the presence of such an illusion is not a cause for alarm. Various factors ranging from the non-linguistic to the necessarily linguistic can influence the time-course of processing. This is a consequence of integrating our knowledge of language structure within a larger cognitive mechanism which is subject to the incrementality of the linguistic signal. In the case of the so-called NPI illusion, we have a situation with complex linguistic and non-linguistic considerations. In licensing NPI in real time, the parser is required to interface with some representation of the left-context of the sentence, which has already been processed and stored in memory. To resolve this NPI licensing relation when the NPI is encountered, the parser needs to engage with this representation of the previously processed left-context. Thus, the way that this left-context was processed and represented can have a significant impact on how the parser handles the NPI and its licensing relations. Representations which do not explicitly represent structure will need to utilize some sort of heuristic to capture the c-command portion of the licensing relation. Representations which do represent structure will need to integrate the NPI and perform some calculation to calculate its grammaticality at that position.

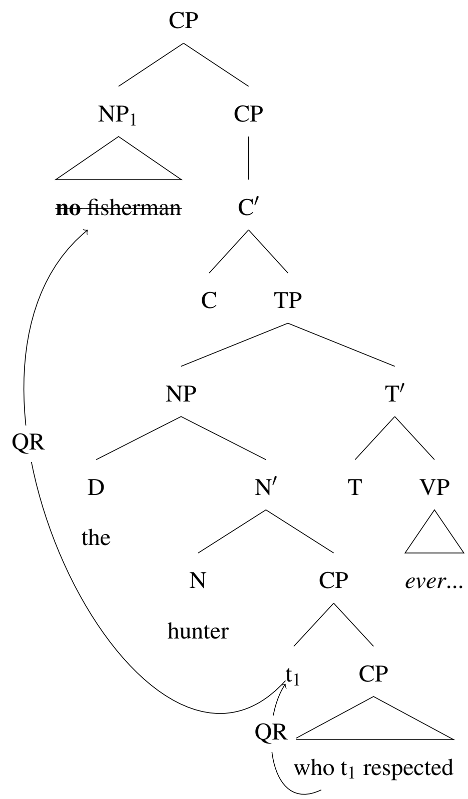
Both types of procedure can explain the presence of errors in online sentence processing. For systems which do not make use of structural representations, errors in structure building can occur systematically as the result of a probabilistic mechanism for integrating new elements into memory. For structural models, errors can occur systematically when parsing procedures require the parser to construct a representation that is either incompatible with later input or is ungrammatical itself. In this way, it is possible that processing behaviors are not easily captured from naive expectations based on the underlying rules of grammar (Lewis and Vasishth 2005, Phillips, Wagers, and Lau 2011, Van Dyke and Lewis 2003, Vasishth et al. 2008, Wagers et al. 2009). Beyond the NPI illusion there are a number of illusion phenomena where expectations from the grammar are subverted, agreement attraction (Patson and Husband 2016, Staub 2010b, Tanner, Nicol, and Brehm 2014, Wagers et al. 2009), missing VP effects (Christiansen and MacDonald 2009, Edward and James 1999) and comparative illusions (Grant 2013, O'Connor 2015, Wellwood, Pancheva, Hacquard, and Phillips 2018) as well as many others. Producing models of sentence processing that explain these effects is one of the most important goals in sentence processing, as they are the most directly observable result of how humans reconcile the demands of their underlying formal grammar, the incrementality of linguistic signal, and the demands of broader cognitive resources. However, it is also critical that these theories are able to model more mundane sentences where the observed processing profiles align with the simple predictions of grammatical theory.

As discussed in Chapter 2, active scope models of the processing of quantification also could be applied in the context of the NPI illusion. In the active scope model with triggers, quantifiers which have been encountered during sentence processing are not immediately evaluated for possible scope configurations. Rather, the parser waits until a scope sensitive element, an operator or variable, is encountered. Only then does the parser construct a representation where QR has been applied to the quantifier in memory representation of the sentence. This QR is evaluated first with respect to Scope Economy and then with respect to other grammatical factors which could apply based on the movement of the quantifier.

The exploration of the NPI illusion has largely consisted of studies where the relative clause negative element is the negative quantifier *no*(Drenhaus et al. 2005, Parker and Phillips 2016, Vasishth et al. 2008). As *no* is a quantifier, the active scope model could be applied to this situation. I argue that the NPI illusion occurs as the parser tests a potential raised scope interpretation, in which the NPI is licensed.

According to the active scope model, the parser performs QR on the quantifiers in the memory representation of the sentence whenever a scope sensitive element is encountered. NPI, being sensitive to the scope of negation, should trigger this active scope mechanism. As recent reevaluations of quantifier raising suggest that relative clauses do not trap quantification, the quantifier from the relative clause can potentially be raised first to the top of the relative clause and then to a matrix position without producing any violations (Barker 2021, Keshet 2007, Syrett 2015a,b). This type of QR out of the relative clause has also been suggested to account for cases where quantified NPs in the relative clause appear to bind pronouns in the matrix clause (Barker and Shan 2008, Elbourne 2001, 2010, 2005, 2009, Evans 1977, 1980, Geach 1962, Heim 1990, Krifka 1996, Kroll 2008) Applied to the context of the NPI illusion sentence, the result of this QR would be a representation of the form of (3.8). In this representation, the negative quantifier that has undergone QR would appear to have scope over the NPI, satisfying its licensing conditions. However, it is known that this is merely an illusion and that these sentences only obtain a temporary processing benefit at the point of the NPI and a mild acceptability boost compared to the ungrammatical baseline (Parker and Phillips 2016). The active scope model may have an answer for this in the grammaticality of the movement of the negative quantifier. When we consider Scope Economy, it appears that the movement is valid, as the QR of the negative quantifier changes the interpretation of the NPI from an ungrammatical case to one that is properly licensed. However, the movement of negation in English is tightly controlled and subject to many restrictions (Barker 2021, Collins 2017, Collins and Postal 2014, Van Craenenbroeck and Temmerman 2017).

(3.8)



The proposals for why negative quantifiers are restricted in this way are varied, but if the movement of negative quantifiers is required to capture the illusion effect, it cannot simply be that these negative quantifiers are invalid targets for QR. Rather, it appears that some independent constraint is necessary. One proposal by Collins (2017) suggests that negation originates in quantifier positions and is raised to matrix positions such that, in sentences such as (3.9a), the overt negation is base generated alongside the quantifier as indicated in (3.9b).

(3.9)

- I didn’t see many people.
- I did NEG [<NEG> <[many people]>] see [<NEG> [many people]].

Under this proposal, the scope of the quantifier and the scope of negation are to a degree separable, but one of the two features must take on the role of setting the scope for the whole compositional quantifier. He argues that negation takes on this role normally through its overt movement to a clausal position. As the overt movement of negation is responsible for setting the scope of negative quantifiers, raising through a covert movement like QR is blocked. As these features, quantification and negation, are separable, the parser must evaluate them in some order. If the goal of the active scope model is to produce and test novel scope structures with quantifiers, it makes sense for the procedure to first deal with any and all quantifier specific movement and evaluation before evaluating other, secondary features such as a negation.

In this view, the QR of the negative quantifier is ungrammatical not due to issues related to quantification but due to the prohibition on the covert movement of negation, which is not checked until all the quantifier specific parsing moves are completed. Because of this ungrammaticality, the parser is forced to revert the QR and return the negative quantifier to its surface position in the relative clause. However, under this approach the parser momentarily produces a representation where the negative quantifier takes scope over the NPI, resulting in a temporary precept of licensing.

Thus, the mechanics of the active scope model produce a series of parsing behaviors which are a good fit to the existing empirical data on the NPI illusion phenomenon. However, because active scope models are limited to quantification, any effect of non-quantified negation would suggest that active scope models cannot account for the full range of NPI illusion effects. In the sections that follow, I systematically test the processing of sentences containing various NPI licensing elements in a non-c-commanding relative clause position. These studies will broaden our empirical understanding of the NPI illusion's distribution and test the most basic prediction of the active scope model in this context, which is that the NPI illusion effect should be limited to quantifiers.

3.3. Experiment 2

To begin to test if the active scope model can be appropriately applied to the NPI illusion, we must investigate what negative elements trigger the effect. If the NPI illusion is indeed a consequence of the processing procedures for resolving quantifier scope, we would expect that the illusion appears uniquely for negative quantifiers. This experiment and the following experiments systematically compare the acceptability of various negative and NPI licensing elements and the canonical relative clause negative quantifier *no* in the NPI illusion context. Also included are two baseline conditions; one with a negative quantifier in the matrix subject and one with no negative element present in the sentence. Thus, the negative element in question can be compared both to the ungrammatical baseline and relative clause *no* which is known to produce an illusion effect.

In Experiment 2 the negative element under investigation is the sentiential negation *didn't*. As this element is not eligible for QR, as it is not part of a quantified noun phrase, the active scope model does not predict the presence of the NPI illusion with *didn't*. Thus, we would anticipate the illusion effect appears only for the relative clause negative quantifier *no*. If some other process drives the NPI illusion effect, sentential negation is a good candidate for producing the illusion effect for two reasons. The first is that sentential negation clearly licenses NPI in the standard c-commanding configuration. The second is that sentiental negation in the relative clause appears close in position to the relative clause subject position, where *no* is located. Thus, any process in which the illusion manifests simply on the basis of a relative clause element's ability to license NPI predicts an illusion effect for *didn't*.

3.3.1. Materials and Methods

Participants were 64 English speakers living in the United States contracted through Amazon's Mechanical Turk, a crowd-working platform (https://www.mturk.com/). An initial 72 participants were recruited, but 2 were removed from the analysis for self-reporting as non-native speakers of English and an additional 5 participants were excluded from the analysis for failure to comply with task directions. A single participant's data was not available due to technical issues in completing the experiment. All participants were compensated $2 for their participation. The task itself was estimated to take around 20 minutes, though participants were allowed 1 hour to complete the task with the ability to pause during that time. Participants were directed to a page with information about the study before giving their informed consent to participate.

The task materials consisted of 32 items with 4 conditions. A sample item is shown in (3.10). The negation in bold and italicization of polarity items is merely for the ease of tracking dependencies in this dissertation, and was not visible to participants in any of the presented studies. The items were structured with a subject modified by a relative clause, followed by the polarity item *ever* located after a modal, *will* or *would*, and before the matrix verb. In the grammatical baseline condition (3.10a) the matrix subject included the negative quantifier *no* which licenses the later NPI *ever*. In the ungrammatical baseline condition (3.10b) no negative element is present, leaving the NPI *ever* unlicensed. In the negative quantifier condition (3.10c), the relative clause subject contains the negative quantifier *no*. Finally, in the test condition (3.10d) the sentential negation *didn't* is present. The structure of the relative clause is modified such that the linear order of the negative elements is as similar as possible. Thus, in both conditions upon entering the relative clause domain signaled by *who* the first element encountered is a negative NPI licensing element. In this way, linear order is also matched between the conditions as a potential contributing factor.

(3.10) a. **No** hunter who the fisherman believed to be respectable will *ever* shoot a brown bear.

b. The hunter who the fisherman believed to be respectable will *ever* shoot a brown bear.

c. The hunter who **no** fisherman believed to be respectable will*ever* shoot a brown bear.

d. The hunter who **didn't** believe the fisherman to be respectable will *ever* shoot a brown bear.

In all cases, care was taken to construct the items such that all sentences were similarly plausible and as close to identical as possible outside of the critical manipulations. Each participant rated a total of 116 sentence pairs, consisting of 32 NPI containing sentences and 84 filler sentences. The filler sentences consisted of two subsets that featured sentences which manipulated the matching or mismatching of features unrelated to quantification and polarity. Overall, the items were balanced such that participants saw an equal mix of grammatical and ungrammatical sentences, discounting sentences which could potentially produce an illusion effect.

The seeded acceptability judgement sentences were presented in Ibex Farm, a platform for web-based linguistics experiments (Drummond 2013).[1] Each sentence was presented in a word-by-word fashion at a fixed rate of 275 milliseconds per word, with a 100 millisecond buffer between words. Participants were instructed to read each sentence carefully as it was presented and to determine if it was a good sentence of English or not. After the last word

[1]Note that this platform has been retired and replaced with PCIbex, a platform extending the framework of Ibex Farm with additional functions (Zehr and Florian 2022).

of the sentence was presented, a response screen was displayed for participants. This screen remained for a three-second period in which participants could indicate the acceptability of the sentence by pressing the *f* key when they believed the sentence was a good English sentence and by pressing the *j* key when they believed the sentence was not a good sentence of English. If neither key was pressed within this three-second window, a message was displayed indicating the response was too slow. After each sentence, participants were allowed to pause and begin the next sentence by pressing the space key. Participants completed a short practice session and received a restatement of the task instructions prior to beginning the main experiment. Within the main experiment, presentation order was pseudo-randomized across participants using Ibex Farm's Latin Square and randomization methods.

3.3.2. Results

Data were analyzed using a logistic mixed-effects model, which was estimated using the lme4 package (R Core Team 2021). The employed a Helmert coded fixed effects structure with 3 fixed effects. The first fixed effect was between grammatical and ungrammatical NPI, weighted 1 and -1/3. Within the ungrammatical NPI cases, the next nested fixed effect was between the ungrammatical baseline lacking negation and the two potential illusion conditions, weighted 1 and -1/2. The final fixed effect was between the two potential illusion conditions, with relative clause *no* weighted 1 and relative clause *didn't* weighted -1. A random intercept by item was included, as well as a random intercept by participant. Trials which with exceptionally slow (>5,000 milliseconds) or exceptionally fast (<100 milliseconds) were excluded from the analysis. Under the active scope model, all three contrasts are predicted to be significant, as the grammatical baseline should be more acceptable than all the ungrammatical conditions, the potential illusion condition should be more acceptable than the ungrammatical baseline, and the relative clause *no* condition should be more acceptable than the relative clause *didn't* condition which does not receive the acceptability boost that marks the illusion effect. Accounts that argue that negation is the only critical feature predict a contrast for the first two effects, but do not predict a significant difference between *no* and *not*.

The results of Experiment 2 are presented graphically in Figure 3.1, and the full model output is displayed in Table 3.1. We observe a significant effect at the intercept and each of the fixed effects. At the intercept we observe a significant negative beta value ($\hat{\beta}$ = -0.493, z = -3.044, p<0.01). The grammaticality contrast is highly significant with higher acceptability ratings for the grammatical sentences ($\hat{\beta}$ = 1.609, z = 16.187, p<0.001). The ungrammatical baseline is also significant with lower acceptability ratings than the potential illusion sentences ($\hat{\beta}$ = -0.224, z = -2.412, p<0.05). Finally, the contrast between the illusion conditions is significant with higher acceptability ratings for the *no* condition that the *didn't* condition ($\hat{\beta}$ = 0.265, z = 3.411, p<0.001).

Fixed Effect	Estimate	Standard Error	z Value	p Value
Intercept	-0.493	0.162	-3.044	**<0.01**
Grammaticality	1.609	0.099	16.187	**<0.001**
Ungrammatical Baseline	-0.224	0.093	-2.412	**<0.05**
Relative Clause *No*	0.265	0.078	3.411	**<0.001**

Table 3.1. Experiment 2: Logistic mixed effects model output.

3.3.3. Discussion

The results of Experiment 2 show a clear difference in the acceptability of the canonical NPI illusion case with relative clause *no* and the test case *didn't*. Thus, it appears to be the case that sentences with a negative quantifier in the relative clause give rise to the so-called NPI illusion effect, while those with a non-quantifier negative element do not. This result is in

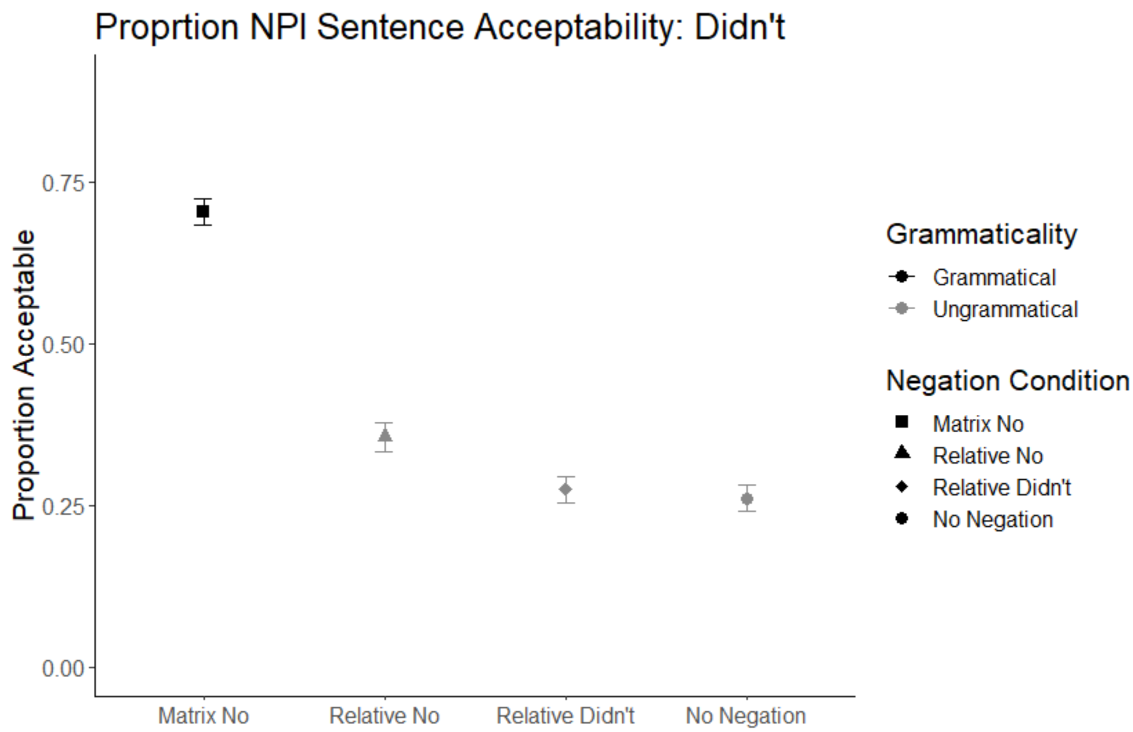


Figure 3.1. Experiment 2: Graph of speeded acceptability judgement.

line with the predictions of the active scope model for processing quantification. However, there are several potential alternative explanations for the lack of an observed effect for sentences containing *didn't*. A simple explanation could be that, due to the speeded nature of the reading task, participants do no integrate negative contractions due to their small visual footprint (Gibson, Bergen, and Piantadosi 2013). In Experiment 3 this issue is directly investigated using stand-alone sentential negation. Additionally, the structural or linear position of negation could impact the NPI illusion and will be examined in subsequent experiments. The semantic qualities of the negative element may also be at issue and are also tested in further experiments.

3.4. Experiment 3

Experiment 3 investigates the NPI illusion potential of sentential negation in the form of *not* when it stands in its independent, uncontracted form. This serves several functions. Once again, the active scope model predicts that this element would not produce an illusion effect, as it is not a quantifier. However, by testing *not* we can test alternative hypothesis for why there appears to be no illusion for *didn't*. First, by using the stand-alone form, we can determine if the effects observed in Experiment 2 were a result of the relatively low visual prominence of contracted negation. Second, testing *not* in its original uncontracted position allows for the investigation of another syntactic position within the relative clause, if syntactic position is instead the critical driver of the illusion. Finally, it is possible that when *not* stands independently, it is generally perceived as more prominent.[2] The factor of the prominence of negation could be important in the ability to remember or recall the negative element for NPI licensing, and thus might predict an illusion effect for this more prominent negation.

3.4.1. Materials and Methods

Participants were 40 English speakers living in the United States contracted through Amazon's Mechanical Turk, a crowd-working platform (https://www.mturk.com/). 42 total participants participated in the experiment, but 2 participants failed to comply with task directions and were removed from the analysis. All participants were compensated $2 for their participation. The task itself was estimated to take around 20 minutes, though participants were allowed 1 hour to complete the task with the ability to pause during that

[2]There is an extensive literature on the prosodic prominence of negation across conversational contexts, some of which suggests that while isolated negation may appear more focused both contracted and uncontracted negation receive prosodic prominence (Hirschberg 1990, 1993, O'Shaughnessy and Allen 1983, Yaeger-Dror 1997).

time. Participants were directed to a page with information about the study before giving their informed consent to participate.

The task materials consisted of 32 items with 4 conditions. A sample item is shown in (3.11). The item design followed the parameters of Experiment 2 but featured *not* in the test condition (3.11d).

(3.11) a. **No** hunter who the fisherman believed to be respectable will *ever* shoot a brown bear.

b. The hunter who the fisherman believed to be respectable will *ever* shoot a brown bear.

c. The hunter who **no** fisherman believed to be respectable will*ever* shoot a brown bear.

d. The hunter who did **not** believe the fisherman to be respectable will *ever* shoot a brown bear.

As in Experiment 2, each participant rated a total of 116 sentence pairs, consisting of 32 NPI containing sentences and 84 filler sentences. The filler sentences were the same as those used in Experiment 2, as were the experimental procedures.

3.4.2. Results

Data analysis for Experiment 3 followed the same procedures as for Experiment 2, with the final fixed effect contrasting the relative clause *no* condition with the relative clause *not* condition. As such the active scope model predicts all three fixed effects should be significant, as the grammatical baseline should be more acceptable than the ungrammatical sentences, the potential illusion sentences should be more acceptable than the ungrammatical baseline, and the relative clause *no* condition should be more acceptable than the *not* condition.

Accounts which contend only the presence of a negation feature is critical only predict the significance of the first two effects, as both negative elements are predicted to receive the acceptability boost relative to the ungrammatical baseline that marks the illusion effect.

The results of Experiment 3 are presented graphically in Figure3.2, and the full model output is displayed in Table 3.2. Each of the fixed effects in the model was significant. The grammaticality contrast is highly significant with higher acceptability ratings being observed for the grammatical sentences ($\hat{\beta}$ = 0.990, z = 8.042, p<0.001). The ungrammatical baseline contrast is also significant with lower acceptability ratings for the ungrammatical baseline than the potential illusion sentences ($\hat{\beta}$ = -0.365, z = -3.126, p<0.01). Finally, the contrast between the illusion conditions is significant with higher acceptability ratings for the *no* condition than the *not* condition ($\hat{\beta}$ = 0.337, z = 3.478, p<0.001). This suggests the difference between the ungrammatical condition and the potential illusion condition is largely driven by the *no* condition.

Fixed Effect	Estimate	Standard Error	z Value	p Value
Intercept	-0.257	0.226	-1.138	>0.05
Grammaticality	0.990	0.123	8.042	**<0.001**
Ungrammatical Baseline	-0.365	0.117	-3.126	**<0.01**
Relative Clause *No*	0.337	0.096	3.478	**<0.001**

Table 3.2. Experiment 3: Logistic mixed effects model output.

3.4.3. Discussion

The results of Experiment 3 show a clear difference in the acceptability of the canonical NPI illusion case with relative clause *no* and the test case *not*. Thus, it appears the contracted form and uncontracted form both fail to give rise to the NPI illusion effect. This is in line with the predictions of an active scope model of quantifier processing, which predicts an illusion effect should only occur in the presence of a negative quantifier. Experiment 4

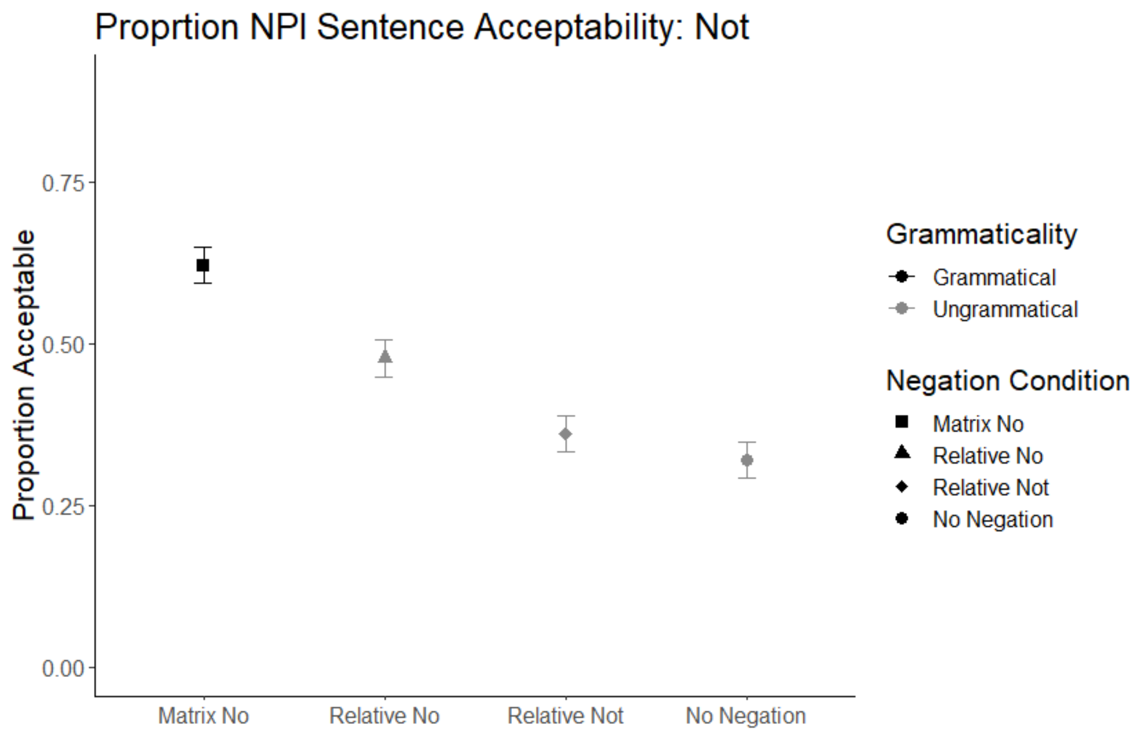


Figure 3.2. Experiment 3: Graph of speeded acceptability judgement.

focuses on the element *never*, which introduces new semantic and syntactic properties to the tested negative element.

3.5. Experiment 4

Experiment 4 investigates the NPI illusion potential of the negative adverbial *never*. Unlike sentential negation, negative adverbials have more options for their syntactic location, and thus produce more observable scope effects. Consider the examples in (3.12), adapted from Bellert (1977) and Jackendoff (1972). In (3.12a) we observe a sentence containing both a negative adverbial, *never* and a sentential modal adverb *probably*. When in their base position the combination of the two elements is acceptable, however when *never* is fronted a crash occurs. This is due to the relative scope of *never* and *probably*. When *probably* takes the higher scope position in (3.12a) the semantics of the sentence become a probability statement over the negated proposition *Mary ran so fast*. As *probably* is a predicate ranging over truth values, there is no issue when it appears above a negation. However, there is an issue when *never* takes high scope as in (3.12b). The issue is that the proposition is in the scope of *never* and should be rendered false. At the same time, *probably* takes scope over the proposition, and should return some probability over the truth value of that proposition. Thus, a contradiction is created as *never* simultaneously works to negate the proposition while *probably* works to qualify the truth value of the proposition. In this way, *never* can have significant interactions with various scope sensitive elements, depending on its overt position. If the system which gives rise to the NPI illusion is sensitive to a broader range of possible movements or scope relations than those produced by QR, it may be reasonable to expect an NPI illusion effect for environments with relative clause *never*. Additionally, testing *never* allows us to fill in more of the syntactic paradigm of the illusion effect, as it occupies a distinct syntactic position from *didn't* and *not*.

(3.12) a. Mary probably **never** ran so fast.

b. ***Never** did Mary probably run so fast.

As in the previous experiments in this chapter, the active scope model does not predict the presence of an illusion for *never*. This is because, despite appearing to have significant interactions with other scope sensitive elements, *never* itself is not a quantifier and is not eligible to undergo QR.

3.5.1. Materials and Methods

Participants were 42 English speakers living in the United States contracted through Amazon's Mechanical Turk, a crowd-working platform (https://www.mturk.com/). A single participant was removed from the analysis after self-identifying as a non-native speaker of English. All participants were compensated $2 for their participation. The task itself was estimated to take around 20 minutes, though participants were allowed 1 hour to complete the task with the ability to pause during that time. Participants were directed to a page with information about the study before giving their informed consent to participate.

The task materials consisted of 32 items with 4 conditions. A sample item is shown in (3.13). The item design followed the parameters of Experiment 2 but featured *never* in the test condition (3.13d). Note this item structure preserves the linear position of the negative element as immediately following *who*.

(3.13)
a. **No** hunter who the fisherman believed to be respectable will *ever* shoot a brown bear.
b. The hunter who the fisherman believed to be respectable will *ever* shoot a brown bear.
c. The hunter who **no** fisherman believed to be respectable will*ever* shoot a brown bear.
d. The hunter who **never** believed the fisherman to be respectable will *ever* shoot a brown bear.

As in Experiments 2 and 3, each participant rated a total of 116 sentence pairs, consisting of 32 NPI containing sentences and 84 filler sentences. The filler sentences were the same as those used in Experiments 2 and 3, as were the experimental procedures.

3.5.2. Results

Data analysis for Experiment 4 followed the same procedures as for Experiments 2 and 3, with the final fixed effect contrasting the relative clause *no* condition with the relative clause *never* condition. The predictions of the active scope model remain the same as in Experiments 2 and 3, as *never* is not eligible to undergo QR.

The results of Experiment 4 are presented graphically in Figure 3.3, and the full model output is displayed in Table 3.3. We observe a significant effect at the intercept and for the grammaticality contrast, and marginal effects for the ungrammatical baseline and the illusion contrast. At the intercept we observe a significant negative beta value ($\hat{\beta}$ = -0.817, z = -4.895, p<0.001). The grammaticality contrast is highly significant with higher acceptability ratings for the grammatical sentences ($\hat{\beta}$ = 1.433, z = 12.193, p<0.001). The ungrammatical baseline is marginally significant with lower acceptability ratings than the potential illusion sentences ($\hat{\beta}$ = -0.217, z = -1.864, p<0.07). Finally the contrast between the illusion conditions is also marginally significant with higher acceptability ratings for the *no* condition than the *never* condition ($\hat{\beta}$ = 0.185, z = 1.905, p<0.06).

Fixed Effect	Estimate	Standard Error	z Value	p Value
Intercept	-0.817	0.167	-4.895	**<0.001**
Grammaticality	1.433	0.118	12.193	**<0.001**
Ungrammatical Baseline	-0.217	0.117	-1.864	<0.07
Relative Clause *No*	0.185	0.097	1.905	<0.06

Table 3.3. Experiment 4: Logistic mixed effects model output.

A post-hoc analysis investigated the differences of each condition in comparison to the no negation, ungrammatical baseline as the reference level. Thus, in this model each of the potential illusion cases, *never* and *no*, is compared to the ungrammatical baseline on its own. The full model output available in Table (3.4), finds a significant effect in the intercept ($\hat{\beta}$ = -1.512, z = -7.102, p<0.001), the comparison between the grammatical and ungrammatical

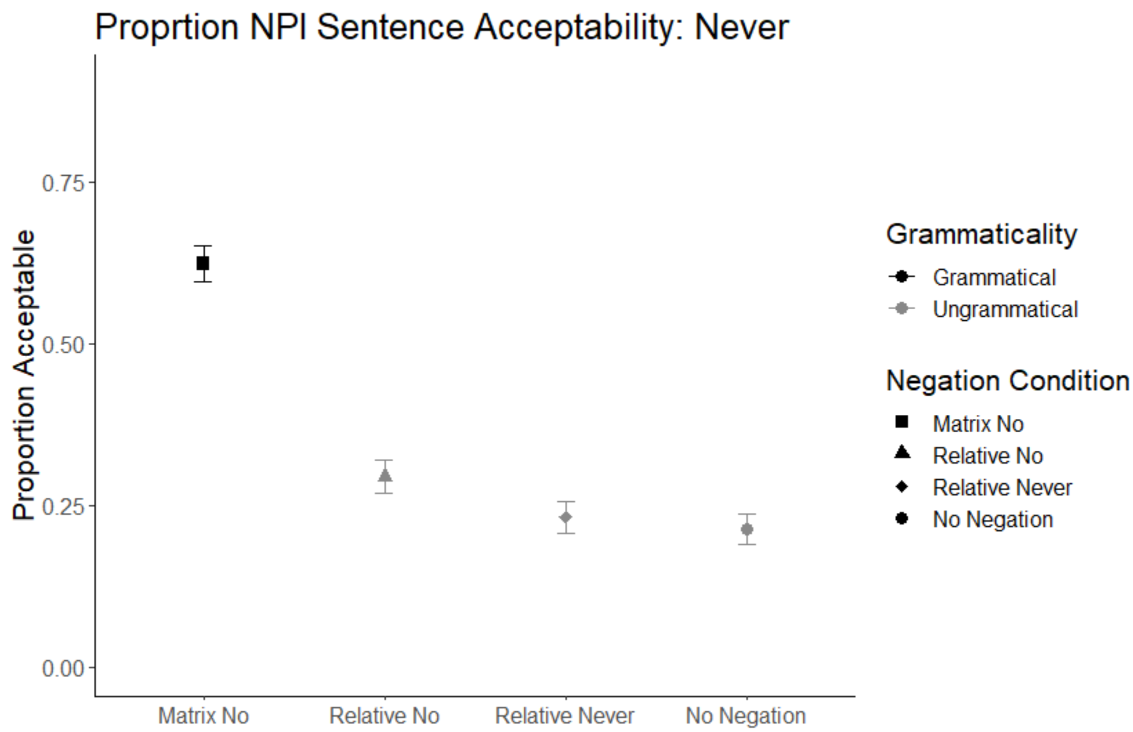


Figure 3.3. Experiment 4: Graph of speeded acceptability judgement.

baselines ($\hat{\beta}$ = 2.128, z = 10.663, p<0.001), and the comparison between the relative clause *no* condition and the ungrammatical baseline ($\hat{\beta}$ = 0.511, z = 2.597, p<0.01).

Fixed Effect	Estimate	Standard Error	z Value	p Value
Intercept	-1.512	0.213	-7.102	**<0.001**
Matrix *No*	2.128	0.200	10.663	**<0.001**
Relative Clause *No*	0.511	0.197	2.597	**<0.01**
Relative Clause *Never*	0.131	0.2034	0.694	>0.05

Table 3.4. Experiment 4: Post-hoc logistic mixed effects model output.

3.5.3. Discussion

The results of Experiment 4 are slightly less clear than those obtained in the previous studies. While the same general pattern we observed in Experiments 2 and 3 is obtained here, the effects for the ungrammatical baseline and the illusion contrast are only marginally significant. However, the shape of the data suggests that marginal significance is likely an artifact of a weaker illusion effect for the relative clause *no* in this experiment. Compared to Experiment 3 which has a similar sample size, we observe a notable skew towards ungrammaticality on the whole. The significant intercept indicates that the average of responses was significantly biased towards an unacceptable response. This bias was also detected in Experiment 2 which also features a significant intercept, though notably less significant. However, the Experiment 2 also has a larger sample size (64 vs. 41) which may have aided in effect detection in the face of the overall skew. In the post-hoc model which directly compares each condition to the ungrammatical baseline, we observe a significant effect in the case of relative clause *no* but not in the case of relative clause *never*, suggesting that the illusion occurs but only in the case of *no*.

Given these factors, it seems reasonable to conclude that the results of Experiment 4 pattern like those of Experiments 2 and 3, with an overall skew producing some compression of the observed effects. It appears that despite the relative complexity of *never* as a scope sensitive element and its different syntactic position than *didn't* and *not*, no illusion was detected. Meanwhile, *no* continues to show meaningful differences from these tested cases and the ungrammatical baseline, as predicted by the active scope model. In the final investigation of non-quantifier NPI licensors, Experiment 5 tests a subset of NPI licensing verbs, such as *doubt*.

3.6. Experiment 5

Turning from the elements which contain semantic negation, Experiment 5 investigates verbs like *doubt* which license NPI through the property of downward entailment. Normally NPI are licensed by a c-command relation with a negative element, but downward entailing elements are also able to license NPI, though through a slightly different mechanism.

Rescuing is a proposed alternative mechanism by which an NPI can be licensed where there is no obvious negative element (Giannakidou 2006, 2011). An NPI is considered rescued when the environment containing the NPI entails a proposition which itself would license and NPI (Giannakidou 2006). This is an approach has been extended to capture the viability of NPI like *ever* located under downward entailing verbs like *doubt* or non-negative elements like *only*. In (3.14) we see this licensing by entailment applied in a sentence containing the NPI *ever* and the downward entailing verb *doubt*.

(3.14) The professor **doubts** the student ever finished the reading →

The professor does **not** believe the student *ever* finished the reading.

Thus, unlike *no not*, *didn't*, and *never*, it is possible that *doubt* licenses NPI through a different mechanism in the grammar and by extension in processing. However, it is somewhat unlikely that this unique mechanism applicable in a small subset of NPI containing environments produces the same behavioral pattern observed exclusively in the case of *no*. Nevertheless, this experiment tests *doubt* and similar verbs in the same manner as Experiments 2-4. The prediction of the active scope model remains the same, with an illusion expected for the quantified negation *no* but not for downward entailing verbs.

3.6.1. Materials and Methods

Participants were 70 English speakers living in the United States contracted through Amazon's Mechanical Turk, a crowd-working platform (https://www.mturk.com/). A total of 6 participants had their data set aside from analysis for failing to comply with task directions. All participants, regardless of data quality, were compensated $2 for their participation. The task itself was estimated to take around 20 minutes, though participants were allowed 1 hour to complete the task with the ability to pause during that time. Participants were directed to a page with information about the study before giving their informed consent to participate.

The task materials consisted of 32 items with 4 conditions. A sample item is shown in (3.15). The item design followed the parameters of Experiment 1 but featured a negative verb in the test condition (3.15d). These verbs were *doubt*, *refute*, *forget*, *deny*, *amaze*, and *surprise*. The content of the relative clause is slightly adjusted from Experiments 2-4 to account for the properties of the tested verbs and their control condition counterparts. Note as well that the NPI licensing element in this study appears in a different linear position in this study, following the subject of the relative clause in (3.15) instead of the word *who*. Previous work has suggested that linear distance can impact the illusion, particularly when there are greater temporal distances between the negative element and the NPI (Parker and Phillips 2016). In this case, the downward entailing verb is linearly closer to the NPI than *no*. Thus, any confounding effect would be predicted to make the illusion finding more likely to be observed for downward entailing verbs than negative quantifiers. By using downward entailing verbs, we can investigate a different syntactic position and licensing mechanism without much concern about confounding effects from linear order.

(3.15) a. **No** hunter who the fisherman remembered would go camping will *ever* shoot a brown bear.

b. The hunter who the fisherman remembered would go camping will *ever* shoot a brown bear.

c. The hunter who **no** fisherman remembered would go camping will*ever* shoot a brown bear.

d. The hunter who the fisherman **forgot** would go camping will *ever* shoot a brown bear.

Participants rated 104 sentences, consisting of 24 critical trials and 80 filler trials. This experiment used a different sent of filler sentences from the previous experiments but the filler sentences were similar in length and complexity to the NPI sentences and investigated sentence properties unrelated to those investigated here. Overall, participants rated an equal number of grammatical and ungrammatical sentences outside the potential illusion cases. In all other respects the procedure remained the same as in Experiments 2-4.

3.6.2. Results

Data analysis for Experiment 5 followed the same procedures as for Experiments 2-4, with the final fixed effect contrasting the relative clause *no* condition with the relative clause verb condition. The predictions of the active scope model remain the same as in Experiments 2-4, as *doubt* is not eligible to undergo QR.

The results of Experiment 5 are presented graphically in Figure 3.4, and the full model output is displayed in Table 3.5. We observe a significant effect at the intercept and for each of the fixed effects. At the intercept we observe a highly significant negative beta value ($\hat{\beta}$ = -1.295, z = -4.988, p<0.001). The grammaticality contrast is also highly significant with higher acceptability ratings for the grammatical sentences ($\hat{\beta}$ = 0.573, z = 4.894, p<0.001). The ungrammatical baseline contrast is significant with lower acceptability ratings for

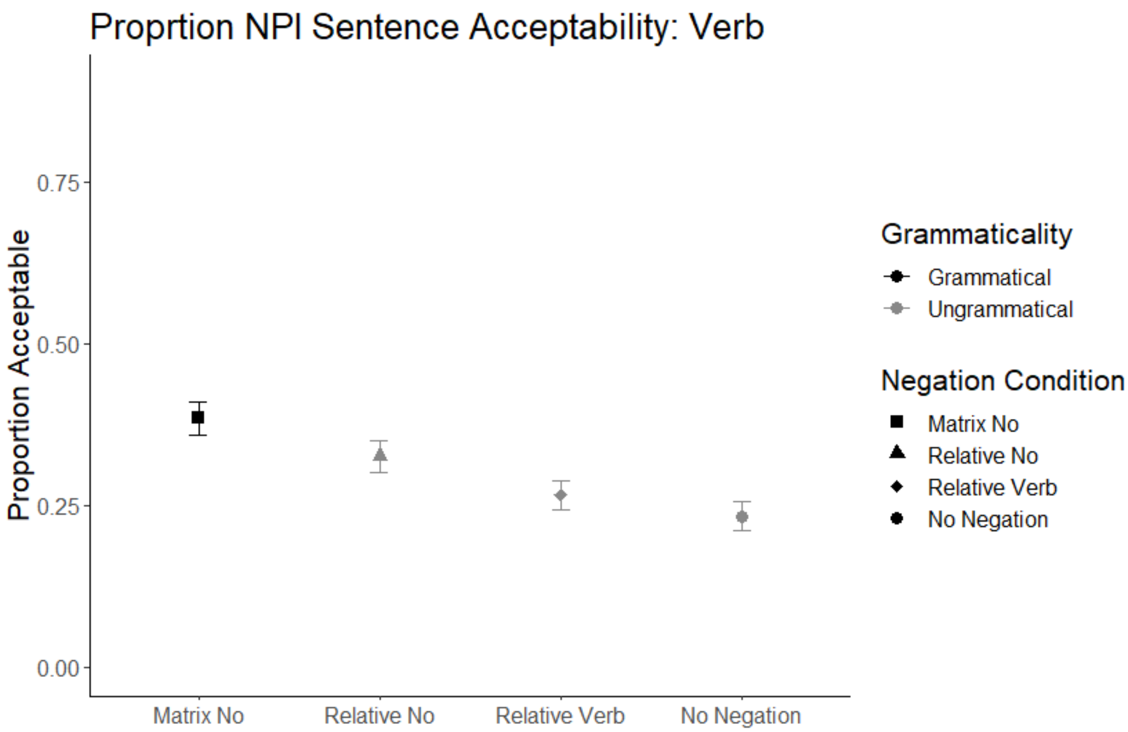


Figure 3.4. Experiment 5: Graph of speeded acceptability judgement.

the ungrammatical baseline than the potential illusion sentences ($\hat{\beta}$ = -0.246, z = -2.068, p<0.05). Finally, the contrast between the illusion conditions is also significant with higher acceptability ratings for the *no* condition than the verb condition ($\hat{\beta}$ = 0.219, z = 2.230, p<0.05).

Fixed Effect	Estimate	Standard Error	z Value	p Value
Intercept	-1.295	0.260	-4.988	**<0.001**
Grammaticality	0.573	0.117	4.894	**<0.001**
Ungrammatical Baseline	-0.246	0.119	-2.068	**<0.05**
Relative Clause *No*	0.219	0.098	2.230	**<0.05**

Table 3.5. Experiment 5: Logistic mixed effects model output.

On visual inspection, the mean for the verb condition appears to be somewhat higher than the mean for the ungrammatical baseline. A post-hoc analysis investigated the differences of each condition in comparison to the no negation, ungrammatical baseline as the reference level. In this way, both the relative clause *no* and relative clause verb conditions are compared directly with the ungrammatical baseline. Full model output appears in Table (3.6). The model finds a significant effect at the intercept ($\hat{\beta}$ = -1.731, z = -5.927, p<0.001), a significant effect for the grammatical baseline ($\hat{\beta}$ = 1.010, z = 5.058, p<0.001), and for the relative clause *no* condition ($\hat{\beta}$ = 0.588, z = 2.923, p<0.01). No significant effect was found for the relative clause verb condition.

Fixed Effect	Estimate	Standard Error	z Value	p Value
Intercept	-1.731	0.292	-5.927	**<0.001**
Grammatical	1.010	0.200	5.058	**<0.001**
Relative Clause *No*	0.588	0.201	2.923	**<0.01**
Relative Clause Verb	0.149	0.206	0.725	>0.05

Table 3.6. Experiment 5: Post-hoc logistic mixed effects model output.

3.6.3. Discussion

The results of Experiment 5 suggest that there is no illusion effect for downward entailing verbs. The same general pattern we observed in Experiments 2-4 is once again obtained here. There is a notable difference in the overall distribution of the data, such that responses appear compressed. Notably, the grammatical baseline case with matrix *no* is rated as acceptable less than half the time. While it is difficult to determine the source of this compression, this experiment used different filler materials than the previous studies, which may have led participants to adopt a more conservative framing of acceptability of the sentences overall. However, the relatively clear significance of the fixed effects support the idea that downward entailing verbs do not produce an illusion effect like negative quantifiers. This is further supported by the post-hoc model, which finds a difference between the ungrammatical condition and the relative clause *no* condition, but does not find a difference between the ungrammatical condition and the relative clause verb condition. Thus, the results suggests that licensing by rescuing pathway proposed for downward entailing verbs does not directly interface with the illusion phenomenon.

Taken as a whole, Experiments 2-5 provide compelling evidence that the negative quantifier *no* is unique amongst NPI licensors in its ability to give rise to the so-called NPI illusion effect. By testing several forms, syntactic positions and semantic properties, we have narrowed down the space of possible drivers for the illusion effect. Sourcing the effect in the mere able to license NPI seems non-tenable. Instead, this evidence seems to point in a direction predicted by the active scope model - the quantifier status of the negative quantifier *no* is a unique driver of the effect. However, having only investigated the form *no* in one particular position in the relative clause, this claim is a bit premature. The following experiments serve to test negative quantifiers by specifically looking at different forms, sources of negation and syntactic positions.

3.7. Experiment 6

In Experiment 6 we shift the focus away from non-quantifier sources of negation and begin to investigate how the illusion is sensitive to other properties of negative quantifiers. To begin, Experiment 6 investigates the simplest question: do we see the so-called NPI illusion effect with other simple negative quantifiers? Under the active scope model, this would be the anticipated behavior. However, as the literature to date has largely focused on *no*, it is possible that there is some unique effect for *no* specifically (Phillips et al. 2011). Thus, in Experiment 6 we investigate if *none* gives rise to the illusion effect similar to *no*. While the interpretative properties of negative quantifiers can be complex, particularly in the realm of presupposition, the two quantifiers pattern similarly in terms of interpretation(Sudo 2014, Sudo, Romoli, Hackl, and Fox 2012).

3.7.1. Materials and Methods

Participants were 70 English speakers living in the United States contracted through Amazon's Mechanical Turk, a crowd-working platform (https://www.mturk.com/). A single participant was removed from the analysis after self-identifying as a non-native speaker of English. All participants were compensated $2 for their participation. The task itself was estimated to take around 20 minutes, though participants were allowed 1 hour to complete the task with the ability to pause during that time. Participants were directed to a page with information about the study before giving their informed consent to participate.

The task materials consisted of 32 items with 4 conditions. A sample item is shown in (3.16). The item design followed the parameters of Experiment 1 but featured *none* in the test condition (3.16d).[3] Once again the item structure preserves the linear position of negation, though it should be noted that *none* employs the partitive construction in these examples, rendering the noun phrase longer in the *none* condition than the *no* condition.

(3.16) a. **No** producer who the superstar believed to be respectable will *ever* make a blockbuster hit.

b. The producer who the superstar believed to be respectable will *ever* make a blockbuster hit.

c. The producer who **no** superstar believed to be respectable will*ever* make a blockbuster hit.

[3] Unfortunately, the hunter and the fisherman were busy with other items during this experiment. Thus, we are left with the producer and the superstar instead.

d. The producer who **none** of the superstars believed to be respectable will *ever* make a blockbuster hit.

The composition and procedures of the study followed those of the previous experiments in this chapter, with two filler groups of similar length and complexity.

3.7.2. Results

Data analysis for Experiment 6 followed the same procedures as for Experiments 2-5, with the final fixed effect contrasting the relative clause *no* condition with the relative clause *none*.The active scope model predicts a difference between the grammatical baseline and the ungrammatical sentences, a difference between the illusion candidates and the ungrammatical baseline, but does not predict a difference between *no* and *none*. This is because both elements are eligible for QR, and thus they should trigger the same steps in the active scope model.

The results of Experiment 6 are presented graphically in Figure 3.5, and the full model output is displayed in Table 3.7. We observe a significant effect at the intercept and for each of the fixed effects except the final illusion contrast. At the intercept we observe a significant positive beta value ($\hat{\beta}$ = 0.574, z = 3.635, p<0.001). The grammaticality contrast is highly significant with higher acceptability ratings for the grammatical sentences ($\hat{\beta}$ = 0.496, z = 5.326, p<0.001). The ungrammatical baseline contrast is significant with lower acceptability ratings for the ungrammatical baseline than the potential illusion sentences ($\hat{\beta}$ = -0.224, z = -2.721, p<0.01). However, the contrast between the *no* condition that the *none* condition was not significant ($\hat{\beta}$ = -0.042, z = -0.578, p>0.05).

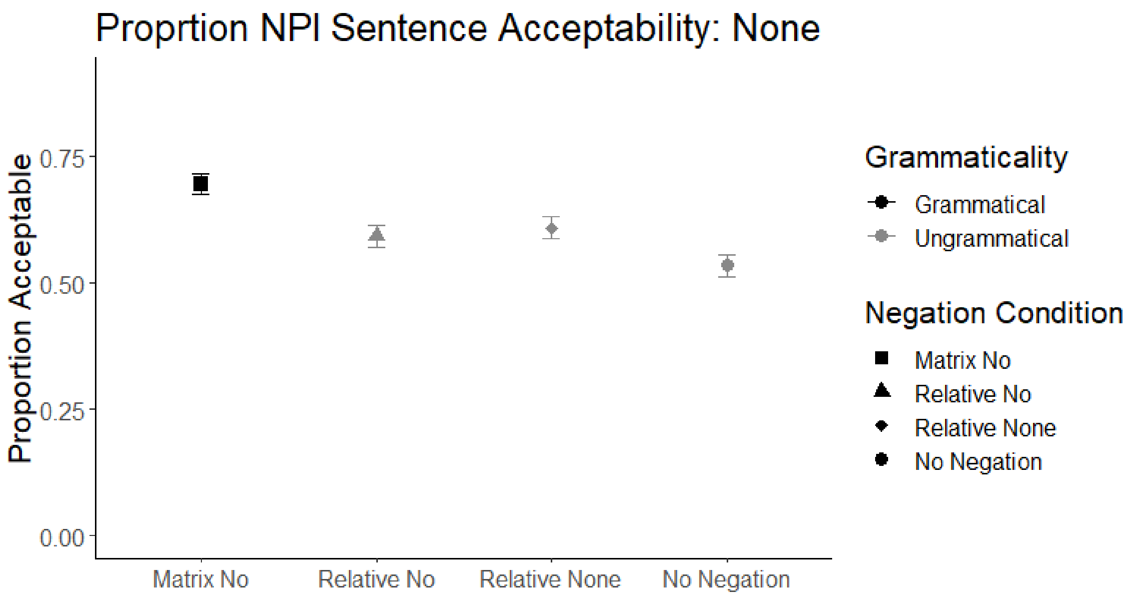


Figure 3.5. Experiment 6: Graph of speeded acceptability judgement.

Fixed Effect	Estimate	Standard Error	z Value	p Value
Intercept	0.574	0.158	3.635	**<0.001**
Grammaticality	0.496	0.093	5.326	**<0.001**
Ungrammatical Baseline	-0.224	0.082	-2.721	**<0.01**
Relative Clause *No*	-0.042	0.072	-0.578	>0.05

Table 3.7. Experiment 6: Logistic mixed effects model output.

3.7.3. Discussion

The results of Experiment 6 display a different pattern than what we have seen thus far. While both the grammaticality contrast and the ungrammatical baseline contrast are significant, there is no significant effect observed in the illusion contrast comparing *no* and *none*. As there is a significant negative effect of the ungrammatical baseline, it appears that both *no* and *none* display the acceptability boost marking the NPI illusion effect. This result reassures us that the NPI illusion phenomenon is not uniquely triggered by the negative form *no*. This result also buoys the active scope prediction, as both negative quantifiers appear to display the illusion profile. Thus, having observed the NPI illusion with multiple negative quantifiers and no other forms of negation, the idea that the process must be about quantification appears to be on the right track. In Experiment 7 we test a remaining confound of structural position, as the negative quantifier has always appeared in the subject position of the relative clause.

3.8. Experiment 7

Experiment 7 investigates the role of the structural position of the negative quantifier in the NPI illusion. Up to this point, each experiment has placed the negative quantifier *no* as the first element encountered in the relative clause. The active scope model does not have stipulations on the position of quantifiers impacting the parser's deployment of QR, so this approach predicts no meaningful difference based on position of the relative clause. However, it is possible that some aspect of this structural position or linear ordering contributes to the illusion effect in a meaningful way. Thus, this experiment investigates the role of position within the relative clause.

3.8.1. Materials and Methods

Participants were 70 English speakers living in the United States contracted through Amazon's Mechanical Turk, a crowd-working platform (https://www.mturk.com/). All participants were compensated $2 for their participation. The task itself was estimated to take around 20 minutes, though participants were allowed 1 hour to complete the task with the ability to pause during that time. Participants were directed to a page with information about the study before giving their informed consent to participate.

The task materials consisted of 32 items with 4 conditions. A sample item is shown in (3.17). The item design followed the parameters of Experiment 1 but featured *no* in a different position in the test condition (3.17d). To attempt to control for linear position, the illusion conditions (3.17c) and (3.17d) attempt to place *no* in as similar of a position as possible in regard to the surface order. The baseline conditions (3.17a) and (3.17b) maintain their structure from previous experiments, and thus (3.17d) does uniquely vary from the other conditions in the form of the relative clause.

(3.17)
a. **No** hunter who the fisherman believed to be respectable will *ever* shoot a brown bear.
b. The hunter who the fisherman believed to be respectable will *ever* shoot a brown bear.
c. The hunter who **no** fisherman believed to be respectable will*ever* shoot a brown bear.
d. The hunter who believed **no** fisherman to be respectable will*ever* shoot a brown bear.

The composition and procedures of the study followed those of the previous experiments in this chapter, with two filler groups of similar length and complexity.

3.8.2. Results

Data analysis for Experiment 7 followed the same procedures as for Experiments 2-6, with the final fixed effect contrasting the two relative clause *no* conditions. The active scope model predicts that relative clause *no* should be more acceptable than the ungrammatical baseline regardless of which position it is in, as QR can occur from both subject and object

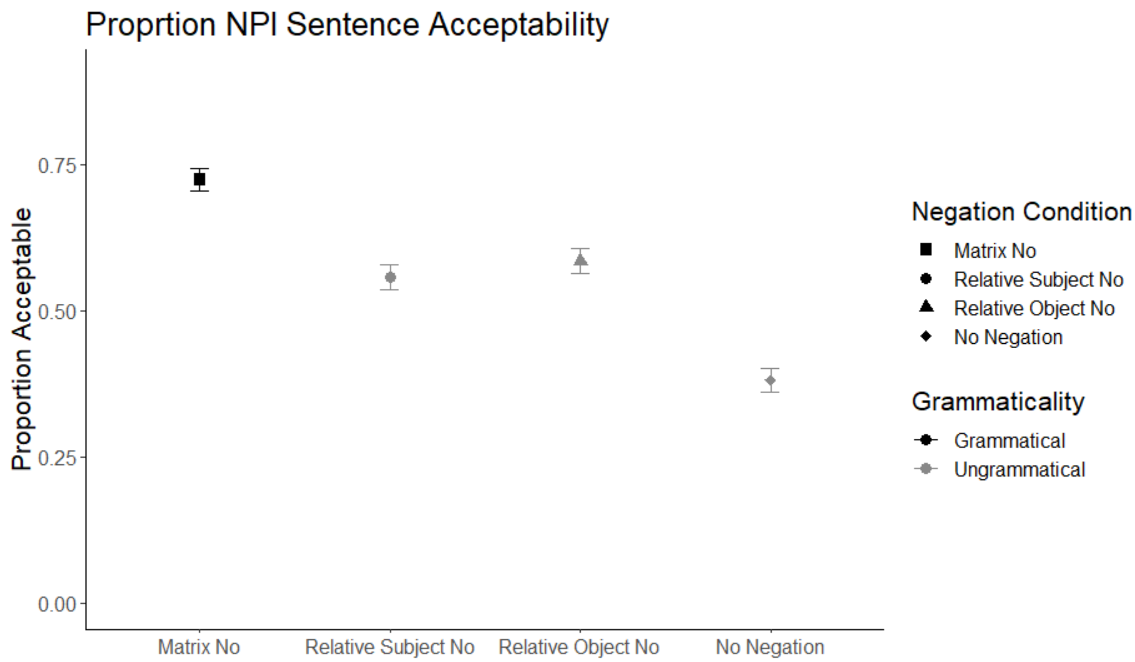


Figure 3.6. Experiment 7: Graph of speeded acceptability judgement.

positions. Thus only effects for the grammaticality contrast and the ungrammatical baseline are expected to be significant.

The results of Experiment 7 are presented graphically in Figure 3.6, and the full model output is displayed in Table 3.8. We observe a significant effect at the intercept and for each of the fixed effects except the final illusion contrast. At the intercept we observe a significant positive beta value ($\hat{\beta}$ = 0.341, z = 2.176, p<0.05). The grammaticality contrast is highly significant with higher acceptability ratings for the grammatical sentences ($\hat{\beta}$ = 0.882, z = 9.547, p<0.001). The ungrammatical baseline contrast is also highly significant with lower acceptability ratings for the ungrammatical baseline than the potential illusion sentences ($\hat{\beta}$ = -0.670, z = -8.103, p<0.001). However, the contrast between the *no* conditions was not significant ($\hat{\beta}$ = -0.077, z = -1.107, p>0.05).

Fixed Effect	Estimate	Standard Error	z Value	p Value
Intercept	0.341	0.157	2.176	**<0.05**
Grammaticality	0.882	0.0902	9.547	**<0.001**
Ungrammatical Baseline	-0.670	0.083	-8.103	**<0.001**
Relative Clause *No*	-0.077	0.069	-1.107	>0.05

Table 3.8. Experiment 7: Logistic mixed effects model output.

3.8.3. Discussion

The results of Experiment 7 appear to align with the structurally agnostic predictions of the active scope model. While both the grammaticality contrast and the ungrammatical baseline contrast are significant, there is no significant effect observed in the illusion contrast comparing the two *no* conditions. As there is a significant negative effect of the ungrammatical baseline, it appears that *no* displays the acceptability boost marking the NPI illusion effect regardless of its position within the relative clause. With this assurance, it appears that the predictions of active scope model are born out in the empirical landscape of the NPI illusion phenomenon. As a final test, Experiment 8 looks to investigate a compositionally negative quantifier in both relative clause positions.

3.9. Experiment 8

Experiment 8 blends the goals of Experiments 6 and 7 in a single study. The aims are twofold. First, the study looks to probe the illusion generation of a compositionally negative quantifier phrase, in this case *not a single*. There are several important pieces to this test. First, the negative element which contributes the negative force to the quantifier is *not*, which was determined not to result in illusions in its typical location as sentential negation in Experiments 2 and 3. Thus, testing this quantifier provides evidence that the contribution of the negative force is independent of the form of negation and that the critical factor is that the negation functions as part of a quantifier. Second, *not a single* is a compositionally negative quantifier rather than the morphologically or lexically negative *no* and *none*. Thus, this test provides insight into the status of compositional quantifiers in the NPI illusion and active scope model. It is possible that the parser faces additional costs for moving a compositionally negative quantifier, due to its increased syntactic and phonological weight. The idea here is that as a general property of sentence processing, the effort required to manipulate larger elements can manifest as increased costs relative to performing the same operation on smaller elements. Finally, this test employs the structural manipulation of Experiment 7. In principle, QR can be performed from either position with no difference on the grammaticality of the movement. Thus, both *no* and *not a single* should be able to generate illusions from either position. In this way, Experiment 8 serves as a validation of Experiment 7, in addition to testing the important questions related to compositionally negative quantifiers.

3.9.1. Materials and Methods

Participants were 71 English speakers living in the United States contracted through Amazon's Mechanical Turk, a crowd-working platform. Ultimately, 2 participants were removed from the analysis after self-identifying as non-native speakers of English and a single participant was removed from analysis for failure to comply with task directions. All participants were compensated $2 for their participation. The task itself was estimated to take around 20 minutes, though participants were allowed 1 hour to complete the task with the ability to pause as needed during that time. Prior to the experiment, participants were directed to a page with information about the study with information about the experiment to give their informed consent to participate in the experiment.

The task materials consisted of 36 items with 6 conditions. A sample item is shown in (3.18). The item design followed the parameters of Experiment 2 but featured an expanded paradigm with both positions of *no* replicated from Experiment 6 and comparable test conditions for *not a single* in each position (3.18e-f). Once again the item structure preserves the linear position of negation, though it should be noted that *not a single* contains several unique words, rendering the noun phrase longer in the *not a single* conditions than the *no* conditions.

(3.18)
a. **No** hunter who the fisherman believed to be trustworthy will *ever* shoot a bear.
b. The hunter who the fisherman believed to be trustworthy will *ever* shoot a bear.
c. The hunter who **no** fisherman believed to be trustworthy will*ever* shoot a bear.
d. The hunter who believed **no** fisherman to be trustworthy will*ever* shoot a bear.
e. The hunter who **not a single** fisherman believed to be trustworthy will*ever* shoot a bear.
f. The hunter who believed **not a single** fisherman to be trustworthy will*ever* shoot a bear.

The composition and procedures of the study followed those of the previous experiments in this chapter, with two filler groups of similar length and complexity.

3.9.2. Results

Data analysis for Experiment 8 followed the same procedures as for Experiments 2-7, with an expanded paradigm to capture the structural manipulation. As in the previous experiments, the first contrast is between the grammatical and ungrammatical items weighted 1 and -1/5 respectively. For the ungrammatical contrast, the ungrammatical baseline was weighted -1 while the potential illusion conditions were weighted 1/4. For the illusion contrast, the *no* conditions were weighted 1/2 and the *not a single* conditions were weighted -1/2. Finally, a contrast for height weighted the *not* and *not a single* conditions, with 1/2 for those in the high position and -1/2 for those in the low position. The first model also includes an interaction term for height and the illusion contrast. Under the active scope model, we predict both the grammaticality contrast and the ungrammatical baseline contrast should be significant. The active scope model makes no prediction about height, or the structure of the quantifier, and as such no significant effect is predicted for the contrast between the height in the relative clause or the constant between *no* and *not a single*.

The results of Experiment 8 are presented graphically in Figure 3.7, and the full model output is displayed in Table 3.9. We observe a significant effect at the intercept and for the grammatical and ungrammatical contrasts. We also find an effect for the illusion contrast, but not for the height contrast or the interaction of the two effects. At the intercept we observe a marginally significant negative beta value ($\hat{\beta}$ = -0.377, z = -1.895, p<0.06). The grammaticality contrast is significant with higher acceptability ratings for the grammatical sentences ($\hat{\beta}$ = 1.092 z = 9.405, p<0.001). The ungrammatical baseline contrast is also highly significant with lower acceptability ratings for the ungrammatical baseline than the potential illusion sentences ($\hat{\beta}$ = -0.431, z = -3.796, p<0.001). The contrast between the *no* conditions and the *not a single* conditions was also significant ($\hat{\beta}$ = 0.410, z = 3.337, p>0.001). While this pattern of result would suggest that *not a single* does not produce the illusion effect, visual inspection of Figure 3.7 suggests that we may be seeing a smaller yet still significant difference between the *not a single* conditions and the ungrammatical baseline.

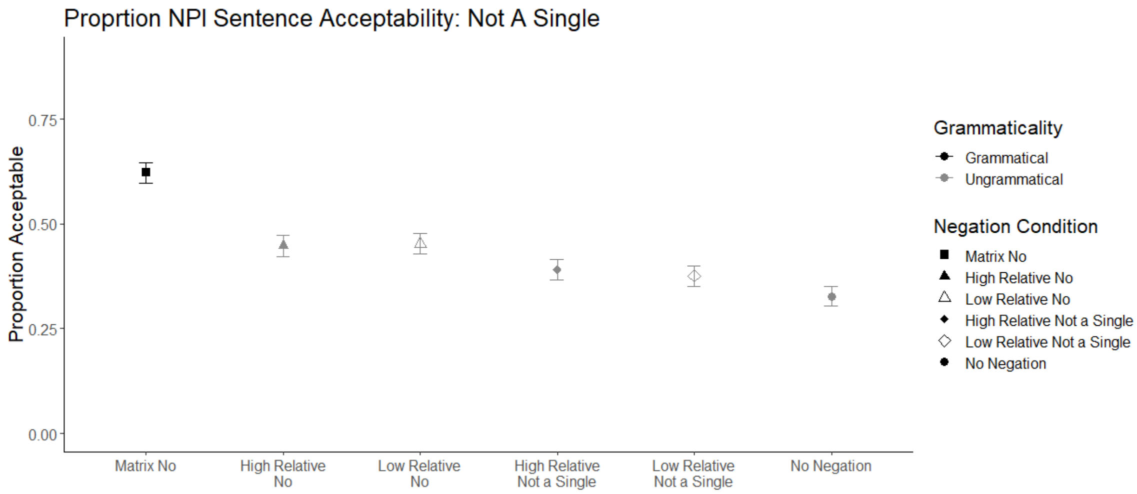


Figure 3.7. Experiment 8: Graph of speeded acceptability judgement.

Thus, a post-hoc model was fit which adjusts the fixed effects to compare *not a single* directly to the ungrammatical baseline, following the design of the post-hoc model in Experiment 4. Following the first model, the first contrast is between the grammatical and ungrammatical items weighted 1 and -1/5 respectively. The second fixed effect compares the *no* conditions weighted 1/2 to the ungrammatical baseline and the *not a single* conditions each weighted -1/3. The final contrast independently compares the performance of the two *not a single* conditions weighted 1/2 to the ungrammatical baseline weighted -1. Full output of this model appears in Table (3.10).

As this model utilizes a similar architecture, both the intercept and grammaticality effects remain unchanged. We observe a significant effect for the comparison between *no* and the *not a single* conditions and ungrammatical baseline ($\hat{\beta}$ = 0.625 z = 4.619, p<0.001). For the primary contrast of interest, we also observe a significant positive effect in the contrast between the *not a single* conditions and the ungrammatical baseline ($\hat{\beta}$ = 0.222 z = 2.158, p<0.05).

Fixed Effect	Estimate	Standard Error	z Value	p Value
Intercept	-0.377	0.199	-1.895	<0.06
Grammaticality	1.092	0.116	9.405	**<0.001**
Ungrammatical Baseline	-0.431	0.113	-3.796	**<0.001**
Relative Clause *No*	0.410	0.123	3.337	**<0.001**
Height	0.023	0.122	0.190	>0.05
Relative Clause *No* * Height	-0.119	0.245	-0.486	>0.05

Table 3.9. Experiment 8: Logistic mixed effects model output.

Fixed Effect	Estimate	Standard Error	z Value	p Value
Intercept	-0.377	0.199	-1.895	**<0.10**
Grammaticality	1.092	0.116	9.405	**<0.001**
No vs. NAS + Ungrammatical Baseline	0.625	0.135	4.619	**<0.001**
NAS vs. Ungrammatical Baseline	0.222	0.103	2.158	**<0.05**

Table 3.10. Experiment 8: Post-hoc logistic mixed effects model output.

3.9.3. Discussion

The results of Experiment 8 require some interpretation but inform each of the three questions. Critically, we observe an illusion effect for *not a single* as indicated by the final contrast of the post-hoc model. Notably a smaller benefit than obtained by *no*, it appears both negative quantifiers produce the illusion effect. Thus, we can address our critical questions. First, *not* can give rise to the illusion effect, so long as it is part of a quantifier. In this way, we can verify that the negative force of *not* contributes to the illusion, so long as it is in a position which can do so. Second, *not a single* as a compositional negative quantifier shows a smaller illusion effect as indicated by the second model. This suggests a potential wider role for syntactic and phonological weight, such that elements with larger structures or phonological content are more costly to manipulate in processing in general. However, the height term of the first model and its interaction are non-significant, indicating that the distance of QR is irrelevant to this cost, and it is the content of the phrase undergoing QR that modulates the ultimately observed effect size.

This result is not directly predicted from the active scope model, though there are reasonable potential sources for this effect. On one hand, the increased size, phonologically and structurally, of the quantifier could indicate that the cost of performing QR, independent of the costs related to checking Scope Economy, is dependent on the size of the moved element. Such a size to cost of movement function could be specific to the active scope model, or more likely is a more general property in the parser related to manipulating larger chunks of the structural memory representation. On the other hand, this result could owe in part to the unique properties of this particular quantifier. Nothing in the active scope model prevents there from being additional consequences for processing which are rooted in particular quantifier features or their semantics. In other words, the active scope model predicts a baseline behavior for all quantifiers, but it is possible for additional, unrelated, processes to occur for a subset of quantifiers based on their featural or semantic properties. Future studies should aim to address these potential sources directly but comparing quantifiers with different properties to one another in matching structures and by comparing quantified NPs of various sizes undergoing QR to those undergoing other kinds of movement.

Taking stock of the studies presented in this chapter thus far, we have observed a relatively consistent pattern, as illustrated in Figure (3.8). Impressionistically, we observe acceptability at its highest across the experiments in the grammatical baseline condition featuring *no* in the matrix subject position. The lowest acceptability also consistently appears in the ungrammatical baseline condition without negation. The relative clause *no* conditions are distinctly more acceptable than the ungrammatical baseline, while the tested conditions vary in their acceptability, which I have argued is due to the quantifier status of the negative

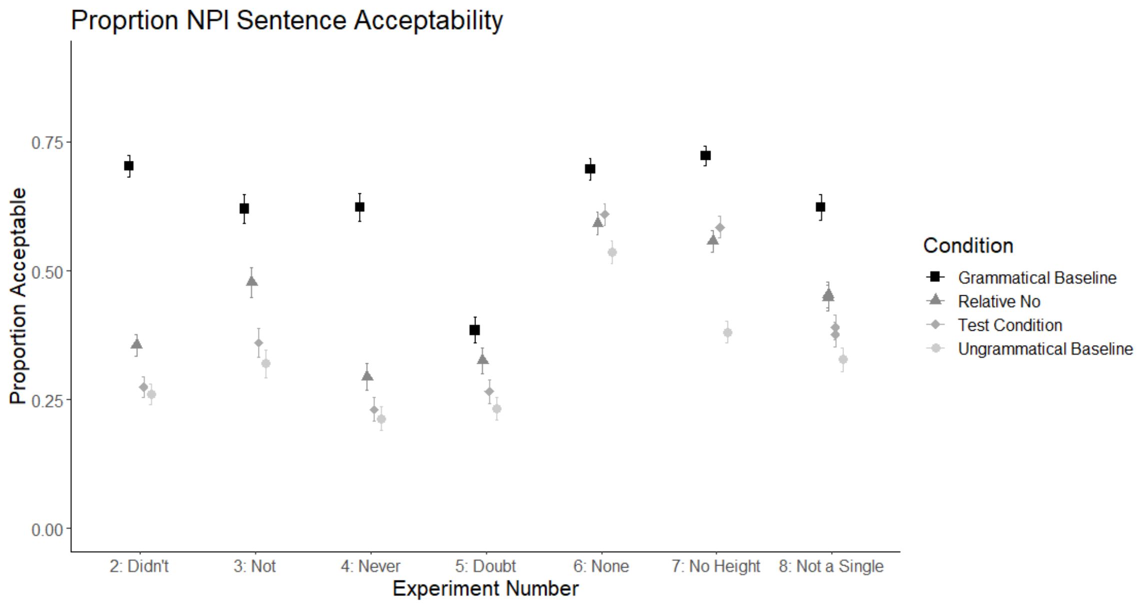


Figure 3.8. Experiments 2-8: Graph of speeded acceptability judgement.

element in the tested conditions. The figure also makes salient the compression observed in Experiment 5, where the condition means are skewed lower, but the acceptability floor remained in place. Some compression also appears in Experiment 6, where condition means appear to be skewed higher, but the acceptability ceiling does not raise.

A final meta-analysis was conducted for the purposes of enhancing the ability to interpret the role of quantification across the experiments. In this model, the data from each of Experiments 2-8 was pooled. The data were then analyzed with logistic mixed-effects model, which was estimated using the lme4 package (R Core Team 2021). The model contained a fixed effect for condition with the ungrammatical baseline as the reference level as well as random intercepts by subject, item, and experiment. In this way, all conditions are compared to the ungrammatical baseline, which is the relevant baseline for determining the presence of an illusion effect. As this meta-analysis is designed to explore the role of quantifier status and no effect of position was detected in Experiments 7 or 8, the height manipulations are collapsed in this analysis. Full model output appears in Table (3.11). With the ungrammatical baseline serving as the reference level, we find a significant effect of the grammatical baseline ($\hat{\beta}$ = 1.687 z = 25.690, p<0.001). The relative clause *no* condition, the canonical illusion example, is also significantly more acceptable than the ungrammatical baseline ($\hat{\beta}$ = 0.682 z = 11.402, p<0.001). We also observe significant effects for *none*, ($\hat{\beta}$ = 0.755 z = 5.984, p<0.001), and *not a single*, ($\hat{\beta}$ = 0.295 z = 2.587, p<0.01). A final significant effect is observed in the case of downward entailing verbs like *doubt*, ($\hat{\beta}$ = 0.453 z = 2.741, p<0.01). No significant effects were detected for *didn't*, *not*, or *never*.

Fixed Effect	Estimate	Standard Error	z Value	p Value
Intercept	-0.968	0.211	-4.579	**<0.001**
Grammatical Baseline	1.687	0.066	25.690	**<0.001**
Relative No	0.682	0.060	11.402	**<0.001**
Didn't	-0.137	0.135	-1.015	>0.05
Not	0.143	0.165	.866	>0.05
Never	0.010	0.167	0.060	>0.05
Verb/Doubt	0.453	0.165	2.741	**<0.01**
None	0.755	0.126	5.984	**<0.001**
Not a Single	0.295	0.114	2.587	**<0.01**

Table 3.11. Experiment 2-8: Meta-analysis logistic mixed effects model output.

According to this meta-analysis, it appears that acceptability boosts relative to the ungrammatical baseline, the signature of the NPI illusion phenomenon, manifest in the situations with quantified negation as well as the verb condition. However, this effect for verb in the meta-analysis should be considered with some skepticism. First, as is visible in Figure (3.8), the data in Experiment 5 is overall skewed low relative to the other experiments while maintaining a similar acceptability floor. This marked distinction suggests it might be more appropriate to analyze this experiment separately from the others. In the individual experiment analysis of Experiment 5, we observed a significant effect for the illusion contrast in the first model. This suggests that the relative clause verb condition is not processed in the same way as the relative clause *no* condition, which is the canonical illusion example. Further, the post-hoc analysis of the data from Experiment 5 found no significant difference between the relative clause verb condition and the ungrammatical baseline, which is the traditional diagnostic for the NPI illusion.

Given the unique experiment level behavior of Experiment 5 and the experiment specific models' effects, it seems more likely that relative clause verbs do not produce the NPI illusion effect, or at least do not do so in a manner similar to relative clause *no*. On the basis of these speeded acceptability judgement results, it appears that the illusion effect is strongly linked to the quantifier status of the element located in the relative clause, as predicted by the active scope model. There is, however, a need for further investigations of NPI licensing verbs and development of approaches which could capture a unique effect for this category of NPI licensors.

For the final two experiments of this chapter, we evaluate evidence from eye-tracking while reading experiments, which are intended to capture the critical quantifier restriction of the NPI illusion in real-time processing.

3.10. Experiment 9

The experiments presented in this chapter thus far have indicated that there is a notable acceptability bump for sentences which contain an NPI and a relative clause negative quantifier. However, these studies have all relied on speeded acceptability judgements. While this method is an accepted tool for investigating the NPI illusion effect (Parker and Phillips 2016), it does not offer any insight into how the illusion unfolds during the processing of the sentence. Thus, Experiments 9 and 10 are intended to provide insight into the real-time processing of these NPI contained sentences. Additionally, the active scope model makes specific predictions about when and where effects should be observed in processing. As such, it is not sufficient to merely observe how the acceptability of sentences is impacted by the presence of scope taking and scope sensitive elements. Thus, while Experiments 2-8 each support the high level prediction of the distribution of the NPI illusion made by the active scope model, it is also important to understand the moment to moment processing of sentences containing an NPI.

In Experiment 9 we use eye-tracking while reading, a temporally sensitive method which has been previously used to investigate NPI processing, to observe the moment to moment processing behavior of NPI containing sentences (Vasishth et al. 2008). Specifically, Experiment 9 combines the test cases of Experiment 2, which explored the illusion potential of sentential negation in the form of *didn't*, and Experiment 7 which tested the negative quantifier *no* in high and low positions in the relative clause. Thus, the active scope model predicts a reading time benefit in both cases of relative clause *no*, with no meaningful benefit for relative clause *didn't*. As the active scope model predicts these effects occur quickly upon encountering a scope sensitive trigger, the effects are expected to appear at the point of the polarity item *ever*, and appear in early reading measures.

3.10.1. Materials and Methods

Participants were 50 English speakers recruited through Northwestern University's linguistics subject pool. A total of 2 participants were removed from the analysis for failing to achieve an accuracy in the comprehension questions of at least 75%. All participants received course credit for their participation. The task itself was estimated to take around 40 minutes, though participants were allowed 1 hour to complete the task with the ability to take breaks as needed during that time. Prior to the experiment, participants were directed to a page with information about the study before giving their informed consent to participate.

The task materials consisted of 40 items with 5 conditions. A sample item is shown in (3.19). The item design followed the conventions of the previous experiments, except that there were two test cases, one containing *didn't* and one containing *no* in a lower relative clause position.

(3.19)
a. **No** hunter who the fisherman believed to be respectable will *ever* shoot a brown bear.
b. The hunter who the fisherman believed to be respectable will *ever* shoot a brown bear.
c. The hunter who **no** fisherman believed to be respectable will*ever* shoot a brown bear.
d. The hunter who believed **no** fisherman to be respectable will*ever* shoot a brown bear.
e. The hunter who **didn't** believe the fisherman to be respectable will*ever* shoot a brown bear.

A challenge in the design of items in this experiment is the tension between linear ordering and clause structure. As it has been previously observed that sufficient linear distance can toggle the illusion effect, an important consideration is matching as closely as possible the surface ordering of the elements (Parker and Phillips 2016). At the same time, relative clauses of different structures are known to incur different processing costs cross-linguistically (Gibson 1998, Gibson et al. 2000, King and Just 1991, Levy, Fedorenko, and Gibson 2013, Lin and Bever 2006, MacWhinney and Pléh 1988, Nakamura and Miyamoto 2013, Price and Witzel 2017, Ronai and Xiang 2023, Staub 2010a, Staub, Dillon, and Clifton Jr 2017, Traxler, Morris, and Seely 2002).[4] In this study, items are designed to place

[4] It has been argued that such differences may be due to properties of the self-paced reading task, which would not apply in this eye-tracking experiment (Roland, Mauner, and Hirose 2021).

the negative element in the relative clause as close to the onset of the relative clause as possible. Thus, the *didn't* condition and low *no* conditions differ in clause structure from the baselines and the high *no* condition. This is unfortunately an unavoidable compromise that must be made when investigating various syntactic positions in the relative clause. For this reason, Experiment 10 serves as a follow-up where clause structure is explicitly controlled. Outside the trade-off of clause structure and linear distance, care was taken to construct the items such that all sentences were similarly plausible and as close to identical as possible.

Each participant read a total of 148 sentences, consisting of the 40 critical NPI containing sentences and 108 filler sentences. The filler sentences were similar in length and complexity to the NPI sentences, and all items were presented in a pseudo-randomized manner such that items from the sub-experiment were not presented in sequence.

Participants read each sentence while their eye movements were tracked using a tower-mounted SR Research EyeLink 1000 Plus eye-tracker, sampling eye-movements at the rate of 2000Hz. Before the experiment began, participants were calibrated with a three point calibration, and recalibration was conducted whenever necessary. The participants were given short breaks, which were always followed by recalibration. At the start of each trial, the black box appeared to the left of where the target sentence would appear. This box would disappear once a participant fixated on it, and the sentence would be revealed all at once. Participants were asked to answer comprehension questions after each sentence and responded by pressing the right or left bumper on a game controller.

3.10.2. Results

Data analysis for Experiment 9 focused on 3 regions of interest. These include the pre-critical region composed of the post-verbal relative clause material, the critical region composed of the auxiliary *will* and the NPI *ever*, and the spillover region consting of the next two words

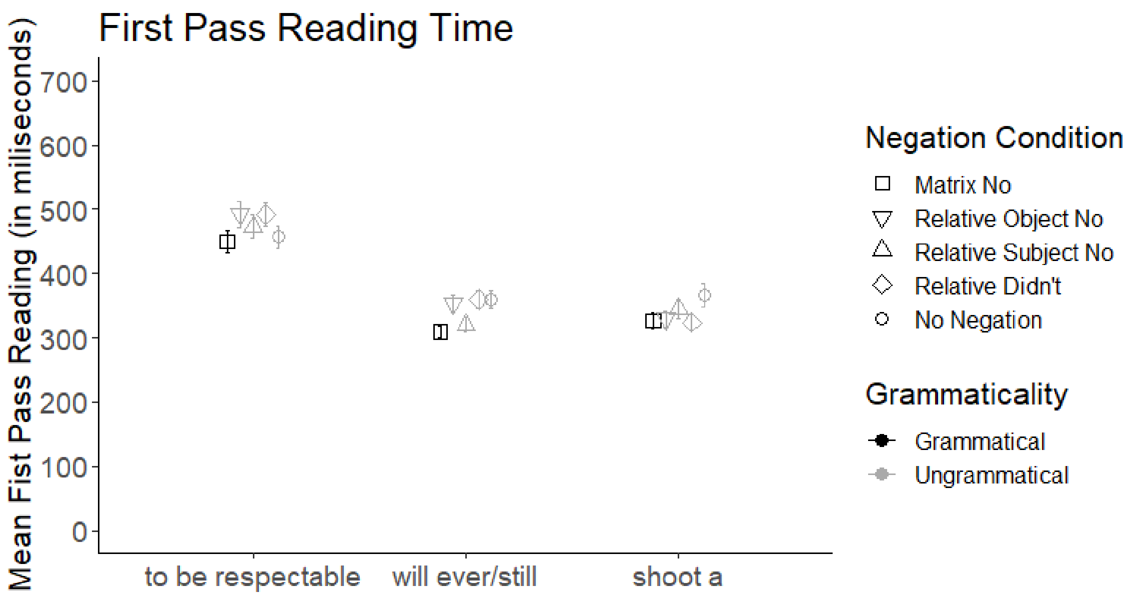


Figure 3.9. Experiment 9: Graph of first past reading time.

in the sentence, generally the matrix verb and a determiner. The critical region includes both *will* and *ever* as the function word status of these elements yielded a high skip rate of (23.8%) even when regioned together. The measures of interest reported include first pass reading time, go-past reading time, total reading time and re-reading time. Each measure is presented graphically for each of the regions in Figures 3.9-3.12.

Fixed Effect	Estimate	Standard Error	t Value	p Value
Intercept	-0.025	0.033	-0.747	>0.05
Grammaticality	-0.056	0.027	-2.060	**<0.05**
Ungrammatical Baseline	0.036	0.025	1.430	>0.05
Didn’t	0.027	0.024	1.114	>0.05
No Height	-0.054	0.021	-2.592	**<0.01**

Table 3.12. Experiment 9: Linear mixed effects model output for critical region first pass reading.

Fixed Effect	Estimate	Standard Error	t Value	p Value
Intercept	-0.019	0.040	-0.489	>0.05
Grammaticality	-0.014	0.030	-0.452	>0.05
Ungrammatical Baseline	0.029	0.029	1.018	>0.05
Didn't	-0.005	0.026	-0.193	>0.05
No Height	0.022	0.023	0.949	>0.05

Table 3.13. Experiment 9: Linear mixed effects model output for spillover region first pass reading.

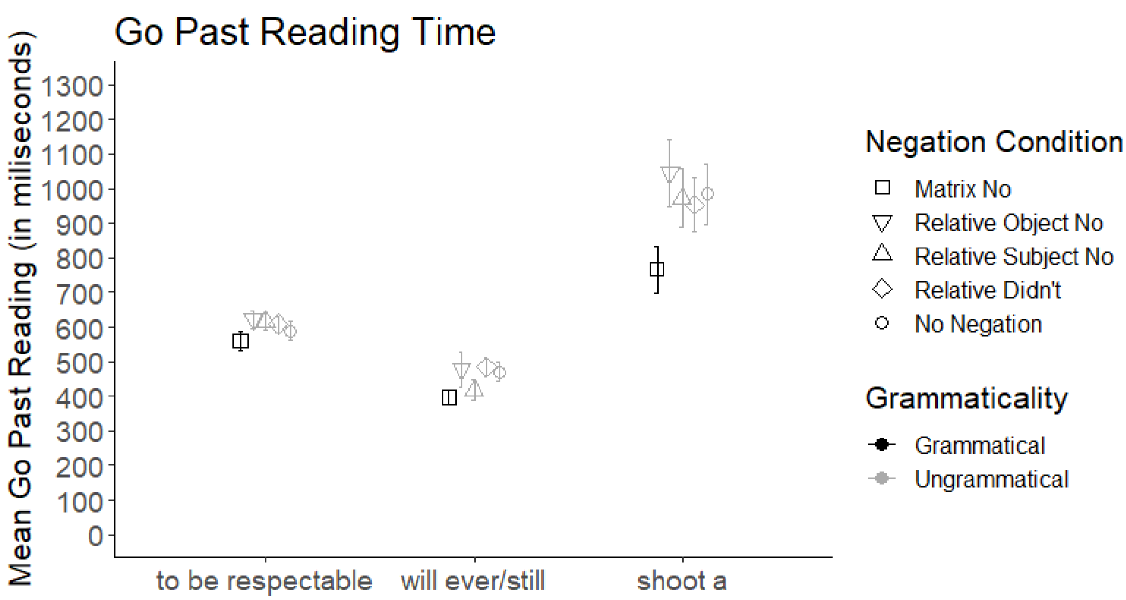


Figure 3.10. Experiment 9: Graph of go past reading time.

Fixed Effect	Estimate	Standard Error	t Value	p Value
Intercept	-0.026	0.039	-0.663	>0.05
Grammaticality	-0.060	0.036	-1.680	<0.10
Ungrammatical Baseline	0.039	0.033	1.168	>0.05
Didn't	0.056	0.032	1.753	**<0.10**
No Height	-0.058	0.028	-2.101	**<0.05**

Table 3.14. Experiment 9: Linear mixed effects model output for critical region go past reading.

Fixed Effect	Estimate	Standard Error	t Value	p Value
Intercept	0.001	0.086	0.013	>0.05
Grammaticality	-0.147	0.050	-2.932	**<0.01**
Ungrammatical Baseline	0.036	0.048	0.750	>0.05
Didn't	0.017	0.044	0.376	>0.05
No Height	-0.014	0.038	-0.375	>0.05

Table 3.15. Experiment 9: Linear mixed effects model output for spillover region go past reading.

For each measure of interest, a linear mixed-effects model was fit to the log transform of the reading measure as observed in the critical region *will ever* and the spillover region. Observations with no value, indicating that the participant did not engage in the reading behavior of interest, were coded as NA values to preserve the shape of the data and allow for consistent log transformation of reading times. Each model consisted of four fixed effects and a random intercept by subject and by item. The first fixed effect contrasted the grammatical conditions weighted 1 and -1/4. The second fixed effect contrasted the ungrammatical baseline with potential illusion cases weighted 1 and -1/3. The third fixed effect contrasted the *didn't* condition with the relative clause *no* conditions weighted 1 and -1/2. Finally, the fourth fixed effect contrasted the two relative clause *no* conditions weighted 1 and -1. The structure of these final contrasts follows the observation from the previous experiments that quantifier status is likely to produce a significant effect, while the position of the negative quantifier is unlikely to produce a significant effect. We present the full model output for each of the measures at the critical and spillover regions in Tables 3.12-3.19.

As a high level summary, a consistent effect of grammaticality is observed, such that the critical and spillover regions are read faster across measures in sentences with properly licensed NPI. An effect of the position of relative clause *no* was observed, such that *no* in the

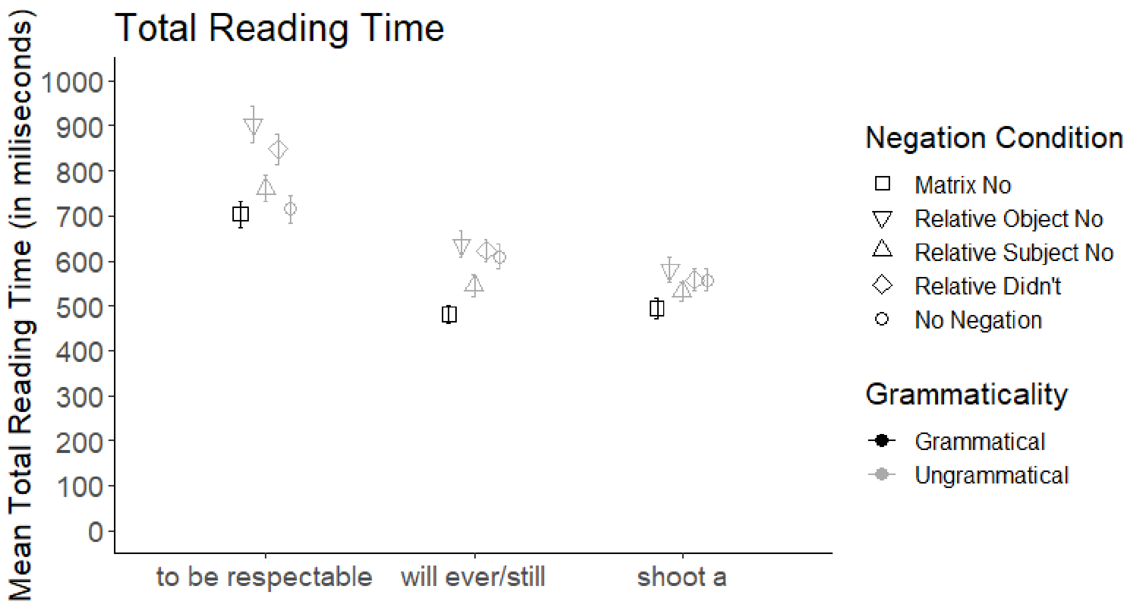


Figure 3.11. Experiment 9: Graph of total time reading.

Fixed Effect	Estimate	Standard Error	t Value	p Value
Intercept	-0.027	0.046	-0.595	>0.05
Grammaticality	-0.145	0.034	-4.313	**<0.001**
Ungrammatical Baseline	0.024	0.031	0.784	>0.05
Didn't	0.050	0.030	1.695	<0.10
No Height	-0.077	0.026	-3.024	**<0.01**

Table 3.16. Experiment 9: Linear mixed effects model output for critical region total time reading.

Fixed Effect	Estimate	Standard Error	t Value	p Value
Intercept	-0.035	0.054	-0.651	>0.05
Grammaticality	-0.091	0.034	-2.658	**<0.01**
Ungrammatical Baseline	-0.024	0.033	-0.707	>0.05
Didn't	0.029	0.031	0.962	>0.05
No Height	-0.021	0.026	-0.789	>0.05

Table 3.17. Experiment 9: Linear mixed effects model output for spillover region total time reading.

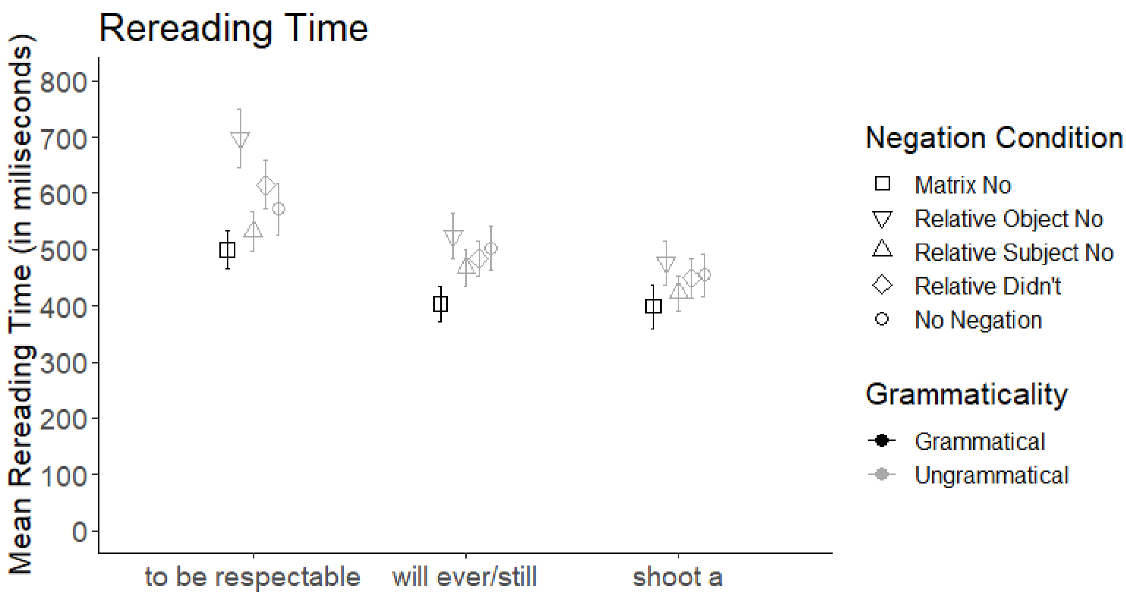


Figure 3.12. Experiment 9: Graph of rereading time.

Fixed Effect	Estimate	Standard Error	t Value	p Value
Intercept	-0.058	0.046	-1.270	>0.05
Grammaticality	-0.132	0.057	-2.316	**<0.05**
Ungrammatical Baseline	0.011	0.048	0.237	>0.05
Didn't	0.017	0.045	0.391	>0.05
No Height	-0.048	0.040	-1.211	>0.05

Table 3.18. Experiment 9: Linear mixed effects model output for critical region rereading time.

Fixed Effect	Estimate	Standard Error	t Value	p Value
Intercept	-0.047	0.048	-0.989	>0.05
Grammaticality	-0.130	0.065	-1.988	**<0.05**
Ungrammatical Baseline	0.043	0.067	0.638	>0.05
Didn't	0.004	0.057	0.078	>0.05
No Height	-0.041	0.052	-0.789	>0.05

Table 3.19. Experiment 9: Linear mixed effects model output for spillover region rereading time.

relative clause subject position resulted in a critical region that was read faster than when *no* appeared in the relative clause object position. Additionally, in both go past and total time we observe a marginally significant effect of the *didn't* contrast such that sentences containing *didn't* were read slower in the critical region than those containing *no*. However, the lack of a distinction for the ungrammatical baseline contrast indicates that these observations should be taken with caution, as while we may observe differences amongst the illusion potential cases they are not on the whole significantly different from the ungrammatical baseline in this experiment.

3.10.3. Discussion

The results of Experiment 9 clearly reflect that reading times are sensitive to the grammatical status of an NPI at the point it is encountered. However, the differences observed among the ungrammatical and potential illusion cases offer less clarity. Statistical trends suggest that *didn't* may result in less of a processing boost at the point of the NPI than *no*. They also suggest that relative clause subject *no* produces an illusion effect, while relative clause object *no* does not. However, these comparisons are held back by two primary factors. The first is the lack of a significant difference between the potential illusion cases on the whole and the ungrammatical baseline. The second is the confounding factor of clause structure. As the most consistent effect to appear in these measures outside the grammaticality contrast is the difference in the height of *no*, Experiment 10 isolates this comparison with appropriately matched ungrammatical baselines, setting aside the issue of relative clause *didn't*.

3.11. Experiment 10

The results of Experiment 9 suggest that, in word by word reading times, the NPI illusion is restricted to relative clause subject negative quantifiers. This distribution of illusion is at odds with the global acceptability findings reported in Experiments 7 and 8 which indicate that relative clause negative quantifiers produce the NPI illusion effect regardless of position. The active scope model also makes no prediction that the location of the quantifier within the relative clause should be critical to the illusion effect. As discussed in the design and results of Experiment 9, testing these two positions against one another introduces an unavoidable confound in clause structure. As relative clause structure has important consequence for word by word reading times, Experiment 10 looks to baseline the two structures independently to determine if both positions give rise to an illusion effect in reading times. In this design, the active scope model predicts faster reading times for both relative clause *no* conditions than for their structurally matched baselines without negation.

3.11.1. Materials and Methods

53 English speakers were recruited through Northwestern University's linguistics subject pool. A single participant was removed from analysis after their accuracy in comprehension questions was determined to be less than 75%. All participants received course credit for their participation. The task itself was estimated to take around 40 minutes, though participants were allowed 1 hour to complete the task with the ability to take breaks as needed during that time. Participants were directed to a page with information about the study before giving their informed consent to participate.

The task materials consisted of 32 items with 4 conditions. A sample item is shown in (3.20). Diverging from the design of previous experiments, Experiment 10 includes no grammatical baseline. Instead, the design focuses on the minimal set of conditions necessary to capture the effect of relative clause *no* while controlling for clause structure. Thus, we have two ungrammatical baseline conditions, a relative subject baseline, (3.20a), and a relative object baseline, (3.20c). Compared against their own baselines, the test conditions investigate the role of relative clause subject *no*, (3.20b), and relative clause object *no* (3.20d).

(3.20)
a. The hunter who the fisherman had stalked through the woods will *ever* shoot a bear in a preserve.
b. The hunter who **no** fisherman had stalked through the woods will *ever* shoot a bear in a preserve.
c. The hunter who had stalked the fisherman through the woods will *ever* shoot a bear in a preserve.
d. The hunter who had stalked **no** fisherman through the woods will *ever* shoot a bear in a preserve.

As in the previous experiments, care was taken to construct the items such that all sentences were similarly plausible and as close to identical as possible.

Each participant read a total of 116 sentences, consisting of the 32 critical NPI containing sentences and 108 filler sentences. The filler sentences were similar in length and complexity to the NPI sentences, and all items were presented in a pseudo-randomized manner such that items from the sub-experiment were not presented in sequence. The experimental procedures remain the same as in Experiment 9.

3.11.2. Results

Data analysis for Experiment 10 focused on 3 regions of interest. These include the pre-critical region composed of the remaining relative clause material after the verb and object if present, the critical region composed of the auxiliary *will* and the NPI *ever*, and the spillover region consting of the next three words, including the matrix verb and object NP. The critical region includes both *will* and *ever* as a high skip rate of (27.4%) was observed

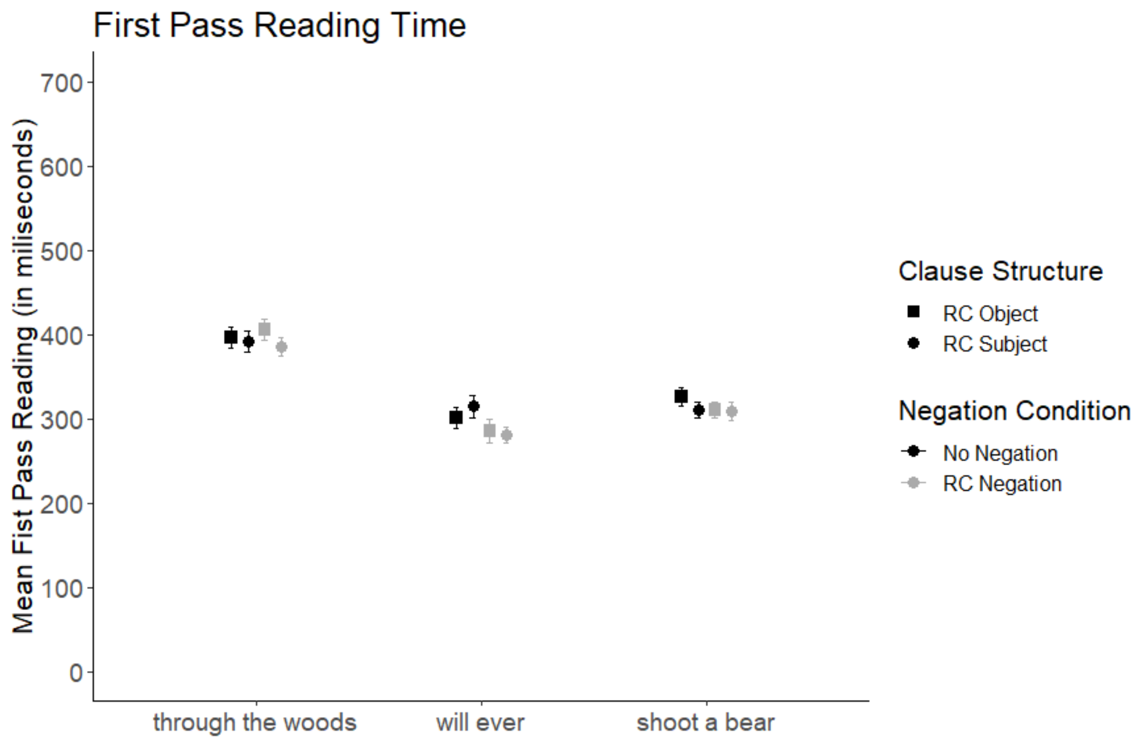


Figure 3.13. Experiment 10: Graph of first past reading time.

for these words even when regioned together. As measures of interest, we report first pass reading time, go-past reading time, total reading time and re-reading time. Each measure is presented graphically for each of the regions in Figures 3.13-3.16.

Fixed Effect	Estimate	Standard Error	t Value	p Value
Intercept	-0.030	0.038	-0.769	>0.05
Relative Subject	0.0270	0.028	0.955	>0.05
No Negation	0.058	0.028	2.073	**<0.05**
Relative Subject * No Negation	0.072	0.056	1.291	>0.05

Table 3.20. Experiment 10: Linear mixed effects model output for the critical region first pass reading.

For each measure of interest, a linear mixed-effects model was fit to the log transform of the reading measure as observed in the critical region *will ever* and the spillover region.

Fixed Effect	Estimate	Standard Error	t Value	p Value
Intercept	-0.027	0.033	-0.818	>0.05
Relative Subject	-0.048	0.030	-1.604	>0.05
No Negation	0.031	0.030	1.029	>0.05
Relative Subject * No Negation	0.008	0.060	0.129	>0.05

Table 3.21. Experiment 10: Linear mixed effects model output for spillover region first pass reading.

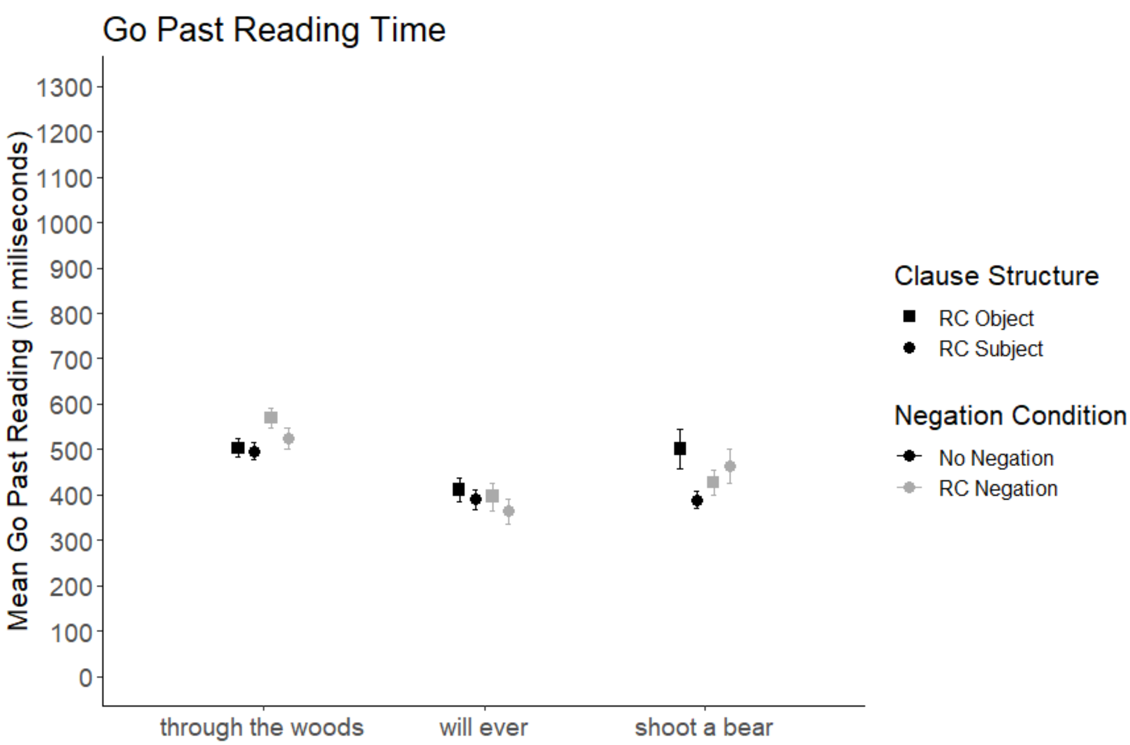


Figure 3.14. Experiment 10: Graph of go past reading time.

Fixed Effect	Estimate	Standard Error	t Value	p Value
Intercept	-0.027	0.043	-0.629	>0.05
Relative Subject	-0.036	0.040	-0.847	>0.05
No Negation	0.057	0.039	1.442	>0.05
Relative Subject * No Negation	0.069	0.079	0.876	>0.05

Table 3.22. Experiment 10: Linear mixed effects model output for the critical region go past reading.

Fixed Effect	Estimate	Standard Error	t Value	p Value
Intercept	-0.021	0.044	0.480	>0.05
Relative Subject	-0.075	0.038	-1.925	**<0.10**
No Negation	0.027	0.039	0.701	>0.05
Relative Subject * No Negation	-0.096	0.078	-1.235	>0.05

Table 3.23. Experiment 10: Linear mixed effects model output for spillover region go past reading.

Observations with no value, indicating that the participant did not engage in the reading behavior of interest, were coded as NA values to preserve the shape of the data and allow for consistent log transformation of reading times. Each model consisted of two fixed effects, an interaction, and a random intercept by subject and by item. The first fixed effect contrasted the ungrammatical baselines to the negation present conditions, weighted 1/2 and -1/2. The second fixed effect contrasted the sentences with relative clause subjects and those with relative clause objects, weighted 1/2 and -1/2. The third fixed effect is the interaction of these two terms. Full model output for each of the measures at the critical and spillover regions is presented in Tables 3.20-3.27.

Fixed Effect	Estimate	Standard Error	t Value	p Value
Intercept	-0.031	0.052	-0.587	>0.05
Relative Subject	-0.045	0.036	-1.252	>0.05
No Negation	0.045	0.036	1.242	>0.05
Relative Subject * No Negation	-0.069	0.072	-0.953	>0.05

Table 3.24. Experiment 10: Linear mixed effects model output for critical region total time reading.

We observe very few significant effects of the manipulations in this experiment, however there is a significant effect which is worth some consideration. At the critical region *will ever* we see a significant effect in first past reading times such that the ungrammatical baselines are read slower than their negation containing counterparts ($\hat{\beta}$ = 0.058, t = 2.073, $p<0.05$).

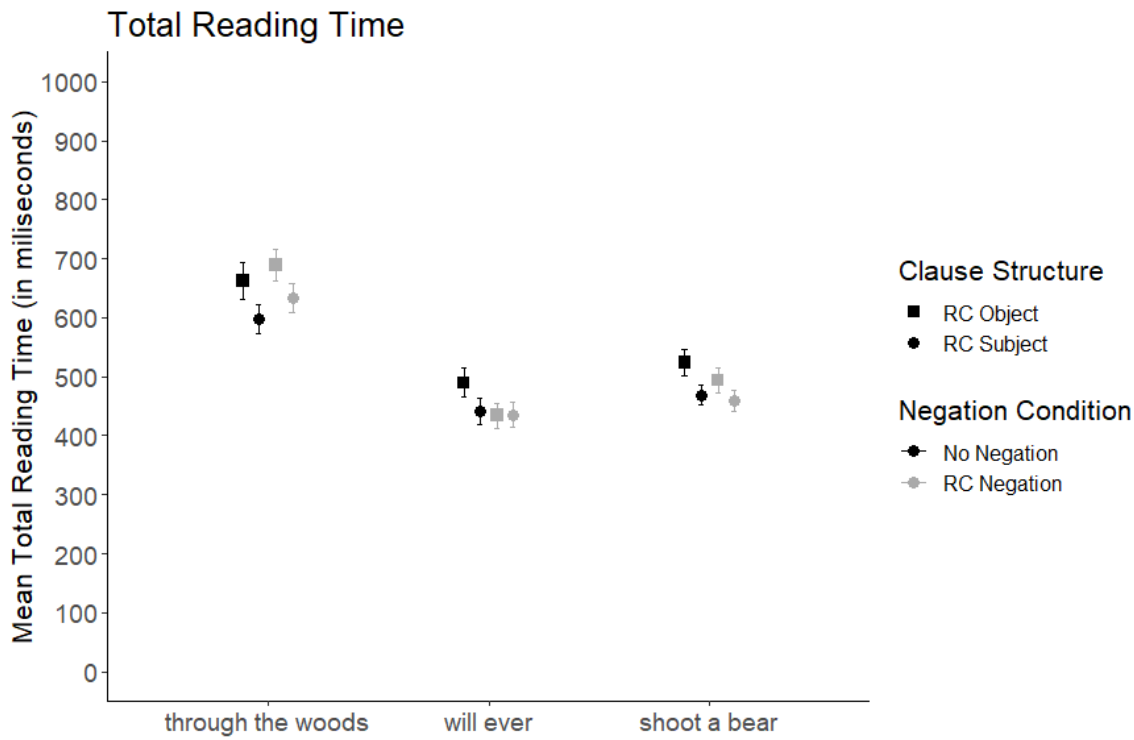


Figure 3.15. Experiment 10: Graph of total time reading.

Fixed Effect	Estimate	Standard Error	t Value	p Value
Intercept	-0.023	0.041	-0.562	>0.05
Relative Subject	-0.053	0.036	-1.447	>0.05
No Negation	0.051	0.036	1.406	>0.05
Relative Subject * No Negation	-0.042	0.073	-0.575	>0.05

Table 3.25. Experiment 10: Linear mixed effects model output for spillover region total time reading.

This effect is consistent with the general pattern we would expect of the NPI illusion in reading times. Outside this effect, we also observe a significant interaction in rereading time at the critical region ($\hat{\beta}$ = -0.329, t = -2.511, p>0.05), appearing to be driven substantially by the relative slowness of the ungrammatical baseline containing a relative clause object.

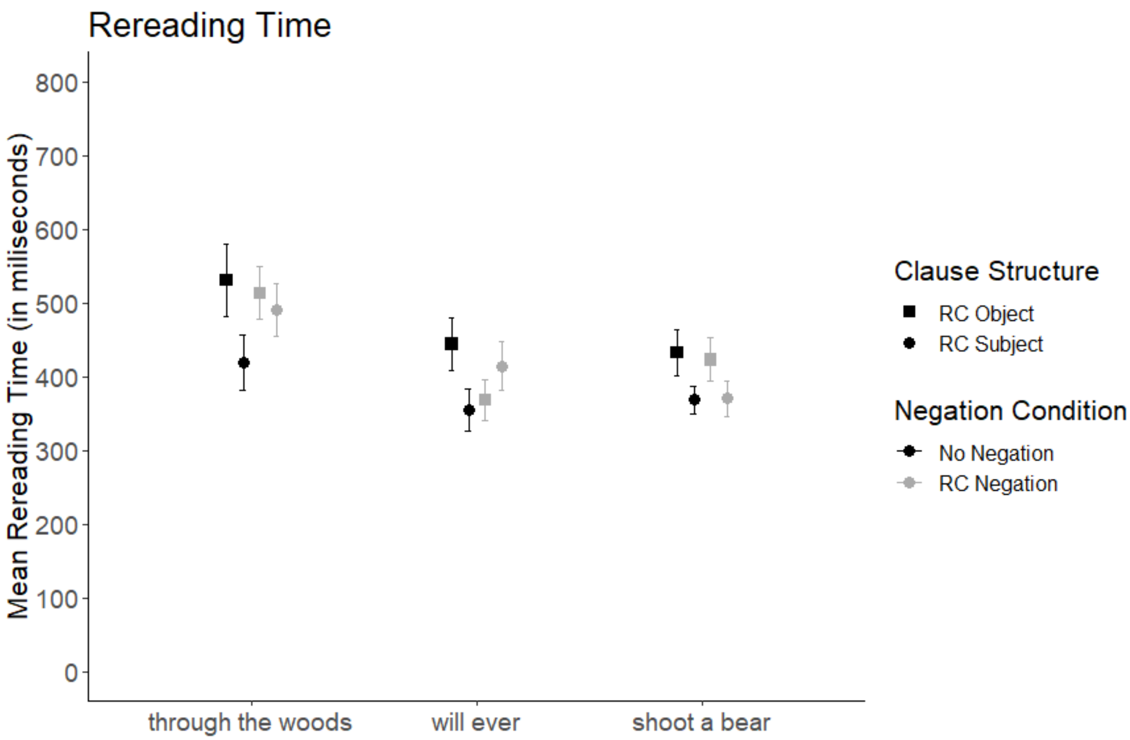


Figure 3.16. Experiment 10: Graph of rereading time.

Fixed Effect	Estimate	Standard Error	t Value	p Value
Intercept	-0.018	0.043	-0.415	>0.05
Relative Subject	-0.065	0.065	-0.999	>0.05
No Negation	-0.002	0.065	-0.002	>0.05
Relative Subject * No Negation	-0.329	0.131	-2.511	**<0.05**

Table 3.26. Experiment 10: Linear mixed effects model output for critical region rereading time.

Fixed Effect	Estimate	Standard Error	t Value	p Value
Intercept	-0.002	0.042	-0.051	>0.05
Relative Subject	-0.047	0.062	-0.750	>0.05
No Negation	0.013	0.062	0.208	>0.05
Relative Subject * No Negation	0.028	0.125	0.221	>0.05

Table 3.27. Experiment 10: Linear mixed effects model output for spillover region rereading time.

3.11.3. Discussion

Experiment 10 attempted to provide an accounting for the potential difference between relative clause subject and relative clause object *no* observed in Experiment 9. In this respect, we observe a significant effect in first pass reading time at the critical region, such that the ungrammatical baselines are read slower than their *no* containing counterparts. Taking this effect alone, it does appear that the illusion, should it occur, occurs with negative quantifiers positioned both high and low in the relative clause at the point the NPI is encountered. Such a result is compatible with the predictions of active scope models of quantifier processing.

Taken together with Experiment 9, the results from eye-tracking offer more muddled evidence than compared to the results of the speeded acceptability judgement studies. In Experiments 2-8 we see robust and consistent effects of relative clause negative quantifiers on the acceptability of NPI containing sentences. In the eye-tracking studies, however, the effects are somewhat diffuse. In Experiment 9 we observe the effects of illusion weakly in the critical region in several reading time measures. However, in Experiment 10, we only observe the boost relative to the ungrammatical baseline in first pass time at the critical region. In this way it appears that the effects observed in eye-tracking may not be so reliably linked to a particular measure. This makes for some difficulty in determining the more narrow time-course of the illusion phenomenon, and makes generating predictions about illusion behavior tied to specific measures challenging as well. This issue is addressed more directly in the next chapter which includes a series of studies which aim to explore the appropriateness of various methodologies for detecting polarity illusion phenomena.

3.12. General Discussion

With the experiments presented in this chapter, the empirical landscape of the NPI illusion phenomenon is greatly enhanced. The core observation provided by these experiments is that the so-called NPI illusion is not a generalized phenomenon amongst NPI licensors. Instead, the NPI illusion is limited to negative elements which are also quantifiers. Within this general category, however, the parameters are quite broad. We observe in Experiments 6 and 8 that the illusion is not restricted to the specific word-form *no*. In Experiment 8 we further observe that a compositionally negative quantifier *not a single* can also give rise to the illusion effect, albeit a somewhat weaker one. Finally, Experiments 7-10 suggest that the position within the relative clause is not directly relevant for the NPI illusion. So long as a negative quantifier appears in the relative clause, the illusion can occur.

With this enhanced understanding of the distribution of the NPI illusion, we are now in a position to evaluate the performance of active scope models against other proposals which aim to account for this phenomenon. In the following sections, we discuss how this new data and the existing work on the distribution of the NPI illusion are accounted for by several approaches including cue-based retrieval models, feature percolation models, pragmatic models, and the active scope model.

3.12.1. Cue-based Retrieval Models

Cue-based retrieval models of sentence processing were one of the first to be applied to the NPI illusion (Lewis and Vasishth 2005, Parker et al. 2017, Van Dyke and Lewis 2003, Vasishth et al. 2008, Wagers et al. 2009). In the framework of cue-based retrieval, sentences are processed using a feature-driven parallel access memory mechanism. Linguistic elements are stored in a relatively unstructured memory space after they are encountered, with the critical component of these representations being features like [singular], or [subject]. As processing continues, linguistic elements that are encountered deploy retrieval cues, which target objects in memory which have some sort of feature. Depending on the implementation of the retrieval system multiple retrieval cues contribute independently or while in others the contribution of a retrieval cue is not independent of other cues (Lewis and Vasishth 2005, Parker 2019, Van Dyke 2007, Wagers 2008, Yadav, Smith, Reich, and Vasishth 2023). As these cues activate the matching features of linguistic elements stored in memory, the linguistic element with the highest activation is retrieved and is linked to the element which initiated the retrieval. In cases where no linguistic elements in memory are a perfect match, the closest match is the most likely to be retrieved. This allows for a link to be established between a linguistic element and one in memory that only partially matches the retrieval cues. Subject to the amount of noise in the activation process, cases of partial match retrieval can become more or less common. Reprinted here as (3.21), we can walk through how processing of the NPI would proceed in each of these cases.

(3.21) a. [$_{NP}$ **No** hunter [$_{CP}$ who the farmer likes]] *ever* shot a deer with a rifle.
b. *[$_{NP}$ The hunter [$_{CP}$ who the farmer likes]]*ever* shot a deer with a rifle.
c. *[$_{NP}$ The hunter [$_{CP}$ who **no** farmer likes]] *ever* shot a deer with a rifle.

In Vasishth et al. (2008), the earliest application of a cue-based model to the NPI illusion, it was proposed that the features of interest were a [negative] feature and a [c-command] feature, echoing the licensing conditions on NPI previously discussed. In the grammatical case (3.21a), the processing of the sentence is relatively straightforward. As the element *no* is negative and in the correct structural position, both retrieval cues contribute to the activation of this element and a link can be reliably formed between the NPI and its licensing negation. In the case of (3.21b), there is no element which matches the [negation] cue. In this case, it is likely an element which satisfies the [c-command] cue would be retrieved. However, as this element lacks the appropriate [negation] cue there is a probability that this discrepancy is noticed and reanalysis occurs (Martin and McElree 2008, Nicenboim and Vasishth 2018). While there is a lack of formalization as to the next computational step in ungrammatical sentences, it is broadly assumed that because there is no possible target that could satisfy the NPI, this reanalysis should also fail, and the comprehender should face severe costs for this ungrammatical sentence (Yadav et al. 2023). Finally, the illusion condition in (3.21c) faces a similar issue. Unlike in the grammatical case where no element matches on the [negation] cue, in the illusion case there is a single element matching on the [negation] cue. This element however does not match on the [c-command] cue. Thus, the processing of this sentence should be similar to the ungrammatical (3.21b), with the exception that the NPI is linked to the negative element rather than a c-commanding one. Depending on the relative importance of the cues and the independence of the contribution of cues, this single match may result in immediate reanalysis if detected, or could pass remarked upon. In this way, it is possible that readers could link the NPI to a non-commanding negation without detecting the violation immediately, yielding a detectable processing benefit relative to the ungrammatical baseline at the point of the NPI.

While the cue-based architecture has had notable success in its application to a number of processing phenomena, particularly in the case of agreement attraction, there are a number of issues which arise in its application to the NPI illusion. First, careful readers should note the difference between cues like [singular] and [negative] which are clearly the product of the lexical properties of the encoded linguistic element and those like [subject] or [c-command] which cannot be specific to a lexical item. The reliance on cues which cannot be singled by the lexical item alone is a general issue in the cue-based framework, though attempts have been made to devise systems which allow for the emergence of so-called relational cues (Kush, Lidz, and Phillips 2015, Kush 2013, McElree 2000). It is the opinion of this author that the inclusion of these relational cues in a system which is intended to operate based on the lexical features of linguistic elements is theoretically undesirable. However, in a parallel-access system which operates based on featural access, it appears unlikely that there is another way to inject these structural features without fundamentally changing the architecture of cue-based systems.

The second issue is in the difference can be observed in the ungrammatical case and the illusion case. Both sentences are of course ungrammatical and ultimately violate the licensing conditions on the NPI. Abstracting from specific features, they also experience a very similar processing profile in that there are elements which partially match. In the ungrammatical case, there are elements which match solely on the [c-command] feature, while in the illusion case, there are elements which match solely on the [negation] feature. The observed behavior in response to these partial matches is different, however. In this case, the lack of an articulated understanding of what occurs in ungrammatical instances is problematic (Yadav et al. 2023). One can imagine a simple solution in the relative contribution of the two classes of cues, lexical and structural, but this returns us to the issue of the validity of structural cues. If we systematically up-weight the role of lexical cues over structural cues, it is unclear if these models make the right sorts of predictions in the broader sentence processing context. A more target approach would be to specifically up-weight the [negation] cue, however, this option leads to a third set of issues.

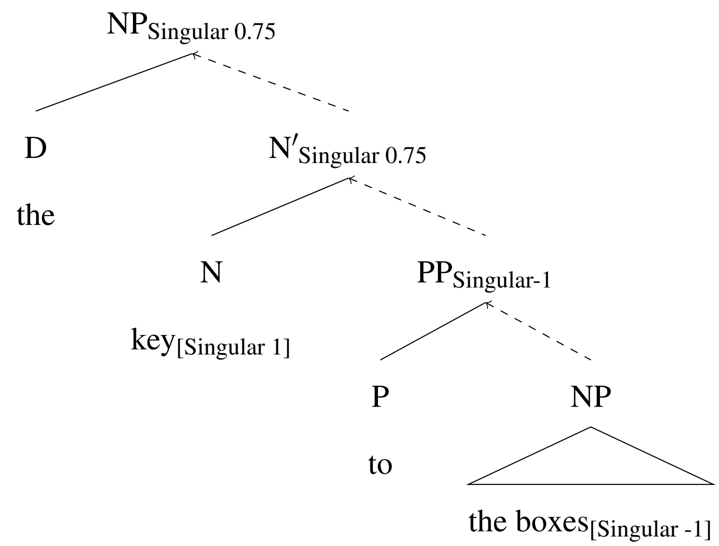
The final issue with the cue-based approach to the NPI illusion is that it predicts a uniform treatment of potential negative licensing elements. That is to say, we would predict that any element with the [negative] cue which resides in a relative clause should be able to trigger this illusion. This includes negative quantifiers like the originally tested *no*, but also sentential negation in the form of *not*, the adverbial negation *never*, negative verbs like *doubt* and other elements. In other words, any element which is predicted to license NPI is also predicted to result in an NPI illusion. In the experiments presented in this chapter we have seen that the NPI illusion appears uniquely in cases with negative quantifiers like *no*, *not a single*, and *none*. Thus, it appears that cue-based models would require significant amendments in order to simultaneously capture the NPI illusion's quantifier restriction while maintain the full class of negative elements' ability to license NPI from a c-commanding position.

3.12.2. Feature Percolation Models

Feature percolation models are similar to cue-based models in that relations between elements are calculated on the basis of the memory representation of features. Unlike in cue-based models, the memory representation employed in feature percolation can be distorted as processing occurs. Much like cue-based retrieval models, feature percolation models have been applied to many illusions in sentence processing, though notably not to the NPI illusion (Eberhard et al. 2005, Franck et al. 2002, Patson and Husband 2016). In this section, I touch upon how this class of model could be most straightforwardly applied to the case of the NPI illusion, though there are credible alternative proposals.

Under feature percolation, the representation of what was previously encountered in the left-context is not as unstructured as in cue-based models. Instead, there is some manner of structural representation in which lexical items and their features are arranged. As elements combine within the structure, their features are composed together, such that a noun-phrase may be more or less singular than its head if it contains plural sub-parts. Consider (3.22), an example from agreement attraction.

(3.22)



Each noun head enters into the representation with its proper featural value. The word *key* has the feature [singular 1] indicating a confident singular feature, while *boxes* is [singular -1] indicating a confident plural feature. As more elements are combined in the structure, the features are also combined such that the composite NP does not straightforwardly match the feature of its head. Instead, the phrase level feature is some combination of the features of the elements below, in this particular instance the function composing the elements favors the higher element and the NP retains a mostly singular value of [singular 0.75]. The values here are merely to demonstrate the general idea, and actual implementations of feature percolation vary in the relative contribution of features as a function of height and category. However, we can see how this might be applied to the case of the NPI illusion. In the grammatical case of (3.21a), the top most element of the subject is the negative element *no*, suggesting that this NP should be considered to be mostly negative and a suitable target for resolving NPI licensing. In the ungrammatical case of (3.21b), there are no negative elements present at all, and thus the subject is entirely positive. As there are no suitable targets for resolving NPI licensing, this should cause some processing difficulty. In so-called

NPI illusion cases like (3.21c), there is a negative element embedded within the subject. Thus, relative to some function, the subject in this condition should appear more negative than that of the ungrammatical condition (3.21) and should in principle be more frequently targeted for resolving NPI licensing.

At this juncture, there are two critical issues for the feature percolation approach and its potential applications to the NPI illusion. The first is shared with cue-based retrieval and is that this approach predicts uniform behavior for all NPI licensors. As with cue based models, in feature percolation any [negative] cue which resides in a relative clause should be able to trigger this illusion. There is perhaps more of an outlet for amending this behavior in feature percolation, as the structural representation required for calculating percolation may also be used to control which features percolate. If for example we stipulate that only features of elements of like category percolate, we could produce a system in which the [negative] feature of an NP is only the result of its constituent N features, and bypasses the influence of an adverbial negation for example. Of course, such a modification would need to be supported by the broader evidence from the processing of other phenomena.

The second issue facing feature percolation in the NPI space is the nature of how negation composes cross-linguistically. In languages with negative concord, the subsequent presence of a negative element after an initial one does not change the interpretation and is often obligatory. However, in languages like many of the varieties of English, two negations in sequence combine to produce a positive interpretation. That is to say, the composite of two negative features is a strong positive valuation, rather than a negative one. Thus, the presence of features which do not compose in an additive is an open challenge must be addressed in this class of model.

3.12.3. Pragmatic Models

Turning away from feature driven models, pragmatic models aim to account for the NPI illusion effect as a consequence of the normal pragmatic licensing of NPI in a real-time context (Giannakidou 2006, Giannakidou and Etxeberria 2018, Mendia et al. 2018, Muller and Phillips 2020, Schwab 2023, Xiang et al. 2009, 2013). As a prerequisite, these models adopt a view of NPI licensing in the grammar that is largely based in pragmatics. Pragmatic models generally take the position that the NPI illusion is the result of the parser incorrectly applying the pragmatic properties of an earlier environment to the environment containing the NPI. Generally, this means that the NPI is evaluated as if it were contained within the relative clause. Here I present 2 approaches, pragmatic rescuing and scalar licensing.

Rescuing, as discussed in Experiment 4, is a proposed alternative mechanism by which an NPI can be licensed where there is no obvious negative licensor (Giannakidou 2006, 2011). An NPI is considered rescued when the environment containing the NPI entail a proposition which itself would license and NPI (Giannakidou 2006). This is an approach which has been extended to capture the viability of NPI like *ever* which are located under downward entailing verbs like *doubt* or non-negative elements like *only*. In (3.23) we see this licensing by entailment applied in a sentence containing the NPI *ever* and the downward entailing verb *doubt*.

(3.23) The professor **doubts** the student ever finished the reading →

The professor does **not** believe the student *ever* finished the reading.

Rescuing as applied in the theory takes place when there is no negative element to license the NPI and as such some have suggested that the NPI illusion could be driven by this or related pragmatic mechanisms (Mendia et al. 2018, Muller and Phillips 2020, Xiang et al. 2009, 2013). The link between the illusion cases and NPI licensor is perhaps not as transparent as has been suggested. The result of rescuing in theory is that the NPI is licensed by this alternative means. If we apply this to the NPI illusion environment, it would then lead us to expect that these cases should be processed like genuine licensing cases, contrary to fact as we consistently observe degraded acceptability of NPI illusion sentences compared to grammatical baselines (Parker and Phillips 2016). As another matter, it seems odd to apply rescuing to the NPI illusion context as a matter of the involved elements and structures. Rescuing in theory applies when there are no negative elements and the environment containing the NPI entails an NPI licensing proposition. However, the matrix clause in these cases does not appear to yield this entailment pattern. The neighboring relative clause also fails to satisfy this requirement, as it generally contains an explicitly negative element, *no*. It is also unclear by what means the parser would arrive at the consultation of the relative clause for the interpretation of a matrix element. Such a pattern would suggest the presence of a broader issue in processing related to detecting the edge of relative clauses. However, if we detected the NPI illusion effect in the presence of rescuing elements like *doubt* or *only*, our theory of the source of the illusion in online processing would likely need to interface with rescuing at some level.

Similar in kind to the rescuing approaches are scalar approaches which suggest that negative quantifiers within a relative uniquely evoke a set of scalar alternatives relevant for the licensing of NPI (Giannakidou and Etxeberria 2018, Muller and Phillips 2020, Schwab 2023, Xiang, Kramer, and Nordmeyer 2020). As these approaches rely on a similar mechanism, many of the same issues present in rescuing are present in the scalar approach to the NPI illusion. In the theory the scalar approaches to NPI licensing are driven by relations between the lexical alternatives of the NPI and the phrase that contains the NPI (Chierchia et al. 2004, Israel 1996, 2011, Kadmon and Landman 1993, Krifka 1994). In the computation of an NPI acceptability, an NPI is licensed through the scalar mechanism if it presents the strongest alternative in the environment. Consider the example in (3.24) where *ever* in this context entails all the propositions with similar lexical substitutions, including *yesterday* or *three times*.

(3.24) No hunter [*ever*] saw the fisherman $\rightarrow$

No hunter saw the fisherman [yesterday/last week/three times]

Similar to rescuing the idea for the application of the scalar licensing mechanism to illusion cases is that the NPI takes the relative clause as the relevant phrase for evaluating the NPI rather than the matrix clause which is the actual position of the NPI. If the licensing of an NPI is a result of a comparison of the scalar alternatives of the NPI within some context, the use of the relative clause does not make sense as it is not the context the NPI appears within. Thus, the question become exactly how the relative clause would come to replace the matrix clause as the evaluated proposition in the first place. It seems that this calculation would require not simply failing to calculate the closure of the relative clause, which in principle should not be difficult, but also require the comprehender to integrate the NPI into a valid structural position within the relative clause to form a proposition over which entailment can be calculated. Finally, much like rescuing, it is unclear how exactly the parser would come to evaluate these sentences as worse than their grammatical baselines, as the result of the scalar licensing process is a licensed NPI.

With respect to the experiments presented in this chapter, the pragmatic theories position is not heavily impacted. While some authors have suggested a unique role of negative quantifiers as providing a "stronger negative force" (Muller and Phillips 2020), both the semantic or pragmatic nature of this negative force and the details of the pragmatic engine remain underdeveloped.

3.12.4. Active Scope Models

Finally, we return to the active scope models. As we have seen in the experiments presented in this chapter, the NPI illusion is restricted to contexts with negative quantifiers. This fits neatly within the natural prediction of active scope models, as active scope models are primarily concerned with identifying the possible scope positions of quantifiers. Further, it is observed that various potential confounds including morphological form, compositionality, and syntactic position do not appear to impact the NPI illusion effect. Regardless of the form or position of the negative quantifier in the relative clause, the NPI illusion can occur. This supports the idea that the active resolution of quantifier scope is a highly inclusive process, targeting any and all quantification and scope sensitive material, and facing whatever unintended processing complications arise.

From this perspective, it appears that the moniker of NPI illusion is somewhat misguided. Rather than a unique phenomenon which occurs for NPI and their licensors, the active scope model suggests that the NPI illusion is an unintended consequence of another system which applies to a broad range of situations. Indeed, the broadness of active scope models allows for another bold prediction. This is that positive polarity items (PPI) should also produce an illusion effect when placed in the NPI illusion context. However, because PPI are ungrammatical in the scope of negation, the effect of such an illusion should be reversed. This prediction, much like the quantifier restriction, is unique to active scope models. The next chapter explores the possibility of a PPI illusion and discuss the predictions made by the alternative approaches to NPI illusion discussed at the end of this chapter.

CHAPTER 4

The PPI Illusion

In the previous chapter, the negative polarity item (NPI) illusion effect was observed to be relatively constrained such that it only occurs in the presence of a negative quantifier. However, it was also observed that the illusion appears regardless of the position of the quantifier in the relative clause and in the presence of various forms of negative quantifier. The discussion evaluated each of cue-based models, feature percolation models, pragmatic models, and active scope models in light of this new evidence regarding the distribution of the NPI illusion effect. The conclusion finds that the active scope model easily predicts the new NPI illusion data, while each of the other approaches would require a significant adjustment to extend to the new data. It was also noted that the active scope model makes further predictions for the processing of polarity items beyond NPI. Namely, the active scope model predicts that positive polarity items (PPI) should also produce an illusion effect, though in the opposite direction of the NPI illusion effect. This is because the core mechanism of active scope models does not evaluate the various licensing conditions, and merely cares that PI are scope sensitive elements. This chapter explores this possible PPI illusion theoretically and experimentally. The chapter begins with a review of positive polarity in theory before moving to a discussion of how each of the sentence processing approaches described in the last chapter would handle PPI in online processing. I then present 4 experiments which are intended to determine if there is a PPI illusion, identify the direction of the illusion effect, and test if the PPI illusion is also restricted to quantified negation. As a summary, the experimental evidence suggests that PPI illusions do occur, the

PPI illusion results in a percept of ungrammaticality rather than grammaticality, and the PPI illusion is sensitive to the quantification status of the negative element in the relative clause.

4.1. Positive Polarity

As discussed in the previous chapter, polarity is a property of a sentence that indicates if the sentence is affirmative or negative (Baker 1970, Fauconnier 1975, Horn 1989, Huddleston 1970, Huddleston and Pullum 2005, Klima 1964, Ladusaw 1980).

Previous studies suggest that sentences which are not marked by an overt polarity controlling element, like *not* or other negative operators discussed in the previous chapter, have positive polarity (Horn 1989, Huddleston and Pullum 2005). As there are elements which are restricted to negative polarity environments, NPI, it is perhaps unsurprising that there are also elements which are restricted to positive polarity environments. These positive polarity items (PPI) are something of a grammatical mirror of NPI. PPI include words like *some*, *still*, *already* and *somewhat*. As we can see in example (4.1), a sentence with a negative operator can host an NPI, but is ungrammatical if it contains a PPI. The reverse also holds, as a sentence lacking a negative operator cannot host an NPI but a PPI is perfectly acceptable in this context. Thus, at the most basic level we can consider NPI to be elements which must be embedded in a sentence with negative content while PPI are elements that must be embedded in a sentence with affirmative content (Baker 1970, Giannakidou 2011, Homer 2015, 2021, Krifka 1992, Szabolcsi 2004).

(4.1) a. The man **didn't** (*ever* / **still*) wear shoes.

b. The man did (**ever* / *still*) wear shoes.

More formally, we can operationalize the conditions on PPI in a similar manner to the conditions on NPI. As discussed in the previous chapter, NPI are licensed when they are in a c-command relation with a negative element. PPI, being the grammatical mirrors of NPI are also sensitive to the c-command relation with a negative element (Baker 1970, Giannakidou 1997, Homer 2015, 2021, Ladusaw 1980, Postal 2000, Progovac 1994). However, rather than being licensed by this configuration, PPI are ungrammatical in this configuration. This relation between the PPI and the environment is often referred to as anti-licensing. The core idea is that PPI are by default licensed, but this licensing can be interrupted when the PPI is c-commanded by a negative or downward entailing element. Thus, anti-licensing requires the same ingredients as licensing, an element and a structural configuration, but results in the opposite outcome, ungrammaticality rather than grammaticality. While other phenomena are not often couched in the terminology of anti-licensing, we can observe that certain binding conditions effectively work in this way. Consider the examples in (4.2). In (4.2a-b) we observe a minimal pair of sentences consisting of a gender marked definite NP subject and a pronoun object. While (4.2b) is grammatical, Binding Condition B requires a pronoun to be free from a local, c-commanding antecedent (Chomsky 1981). In other words, a pronoun is generally licensed and this licensing is disrupted by a specific configuration, local c-command with a potential antecedent. Principle C functions in a similar but less specific way, requiring that an R-expression be free from a c-command relation with a potential antecedent. Thus, (4.2d) is grammatical, while (4.2c) is a case of an ungrammatical configuration of pronoun and R-expression.

(4.2) a. *The woman$_i$ scolded her$_i$.

b. The woman scolded him.

c. She$_i$ asked Mary$_i$ to visit.

d. She asked him to visit.

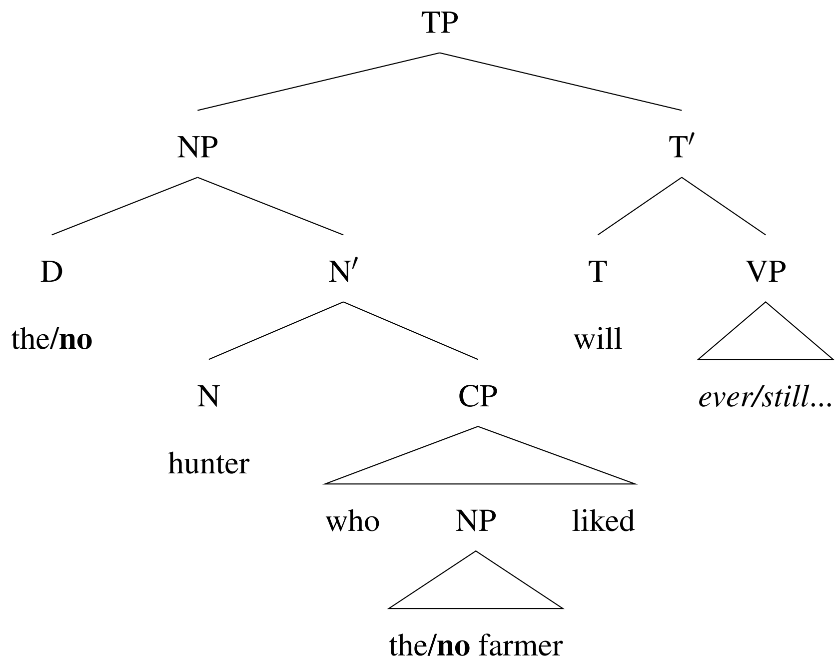
There have been efforts to develop alternative accounts where PPI, instead of being anti-licensed by c-commanding negation, are instead licensed by a c-command relation with an affirmative marking element (Giannakidou 2006, Szabolcsi 2004). When considering English, it is highly unclear if there even is such an affirmative element. To the extent there could be an affirmative operator, it would be covert in English, as there is no clear corresponding affirmative word form. It is also entirely clear that overt negative marking elements like *not* influence the distribution of PPIs. As negation appears in many syntactic positions with an array of different semantic strengths, it is likely that a single affirmative operator would be insufficient to capture the effect of negation (Homer 2021). Rather, it seems we would need a suite of affirmative operators which compete for the various positions that can be occupied by negation, all of which would be covert. Thus, for our purposes we maintain that PPI are anti-licensed when in a c-command relation with a downward entailing element.

Zooming out to the wider polarity system, it appears that NPI and PPI share sensitivity to the same features and grammatical relations. Both classes of PI are sensitive to negative elements and the c-command relation. What is critically different between the two classes is the response to the c-command relation with a negative element. NPI require this relation to be licensed, while PPI cannot survive in this relation. Thus, as we turn to models of processing which aim to capture the distribution of effects related to NPI and PPI, we must consider that the polarity items are best captured by a shared set of features and relations with the outcome depending on the type of polarity item. Specifically, this requires our systems to recognize both licensing and anti-licensing relations.

4.2. Processing Predictions

As discussed in the previous chapter, sentence processing research on the processing of polarity has primarily focused on the so-called NPI illusion phenomenon. This illusion is marked by increased acceptability and faster reading times at the point of an NPI in sentences that contain an ungrammatical NPI in a particular structural context (Drenhaus et al. 2005, Muller and Phillips 2020, Orth et al. 2021, Parker and Phillips 2016, Vasishth et al. 2008, Xiang et al. 2009, Yun et al. 2018). As the results of the previous chapter show, however, this structural context is more specific than originally suggested. For the NPI illusion to occur, the requisite ingredients are an NPI in the matrix clause and a negative quantifier embedded in a relative clause which occurs prior to the point of the NPI (Orth et al. 2021). A schematic of the NPI illusion environment with a PPI is as appears in 4.3.

(4.3)



Understanding the structural constraints which control for the possibility of the NPI illusion effect, we can ask if a PPI illusion is possible and which theories would predict such an illusion. As a schematic of what such an illusion would look like, we can consider the examples from the NPI illusion with a PPI in their place. Thus, we observe our standard NPI illusion paradigm in (4.4a-c) where the ungrammatical (4.4c) containing relative clause quantified negation is read more quickly and rated more acceptable than the ungrammatical (4.4b) which lacks negation altogether. For a potential PPI illusion, everything is reversed.

The baseline with matrix *no* in (4.4d) is now an ungrammatical baseline. Meanwhile, the baseline without any negative element (4.4e) is perfectly grammatical. The potential illusion case in (4.4f) then is the reverse of the NPI case. Here, if a PPI illusion occurs, we would expect to observe a penalty in the processing of (4.4f) relative to the structurally similar baseline in (4.4e).

(4.4) a. [$_{\text{NP}}$ **No** hunter [$_{\text{CP}}$ who the farmer likes]] *ever* shot a deer with a rifle.

b. *[$_{\text{NP}}$ The hunter [$_{\text{CP}}$ who the farmer likes]]*ever* shot a deer with a rifle.

c. *[$_{\text{NP}}$ The hunter [$_{\text{CP}}$ who **no** farmer likes]] *ever* shot a deer with a rifle.

d. *[$_{\text{NP}}$ **No** hunter [$_{\text{CP}}$ who the farmer likes]] *still* shot a deer with a rifle.

e. [$_{\text{NP}}$ The hunter [$_{\text{CP}}$ who the farmer likes]] *still* shot a deer with a rifle.

f. [$_{\text{NP}}$ The hunter [$_{\text{CP}}$ who **no** farmer likes]] *still* shot a deer with a rifle.

4.2.1. Cue-based Retrieval Models

Cue-based retrieval models were one of the first accounts applied to the NPI illusion phenomenon (Lewis and Vasishth 2005, Parker et al. 2017, Van Dyke and Lewis 2003, Vasishth et al. 2008, Wagers et al. 2009). In a cue-based retrieval framework, sentences are processed by storing lexical items and their features in memory and creating relations between these features through a feature-driven parallel access memory mechanism. For example, upon encountering the word *waitress*, the word would be moved into a relative unstructured memory space where its critical features like [+noun] and [+singular] would be available for other operations. The primary operation is retrieval. When a new lexical item is encountered, it comes with a number of retrieval cues which activate particular features in memory. For example, the verb *served* would activate the [+noun] feature as it attempts to integrate with a subject in memory. Note that different features are proposed in different cue-based models, ranging from true lexical features like [+singular] to covertly structural features like [+subject] to highly abstract features in a higher dimensional space. These retrieval cues then provide activation to their corresponding features in memory, either independently or through some non-independent co-activation function (Lewis and Vasishth 2005, Parker 2019, Van Dyke 2007, Wagers 2008, Yadav et al. 2023). Regardless of the specifics, the retrieval cues activate features in memory and after some time the element with the highest activation level is retrieved and thus linked to the element which instigated the retrieval. In cases where the retrieval cues fail to perfectly match the features of an element in memory, the closest match is likely to have the highest activation level and be retrieved. Through this mechanism, a link can be established between two elements in a sentence, even if there is not a corresponding grammatical link.

As discussed in the previous chapter, this is applied to the NPI illusion under the assumption that NPI deploy two retrieval cues [+negative] and [+c-command]. The NPI illusion then occurs when there is a negative element in a non-c-commanding position, resulting in a near match and the retrieval of a negative element which does not in fact license the NPI. I discussed several challenges for the application of cue-based retrieval to the case of the NPI illusion with the quantified negation restriction in the previous chapter. There were three critical challenges, these being the inclusion of relational cues like [+c-command], a lack of specificity in the behavior of the model when confronted with ungrammatical materials, and the apparent inability to restrict the occurrence of the NPI illusion to only cases with quantified negation (Kush et al. 2015, Kush 2013, McElree 2000, Yadav et al. 2023).

As we look to extend cue-based retrieval models of sentence processing to the PPI case, they must contend with these issues as well the unique challenge of dealing with anti-licensing relations. These anti-licensing relations appear to be in direct conflict with the purpose of the retrieval mechanism. Generally, retrieval is thought to be for the purposes of forming licit, grammatical dependencies or producing dependencies which are as close to grammatical as possible when no grammatical dependency can be formed (Lewis and Vasishth 2005, Vasishth et al. 2008). Thus, we are left with something of a puzzle with PPI and other elements with anti-licensing conditions. A PPI is sensitive to the relation of c-command with a negative element, such that it is rendered ungrammatical. Thus, a system which is intended to produce grammatical dependencies should never attempt to link a PPI to a negative element, as the result of such a link would be the ungrammaticality of the sentence. However, if a processing system fails to establish such a link when it is present, the ultimate representation of the sentence will incorrectly permit a PPI to exist when there should be an anti-licensing relation. In this way, it appears that retrieval based models which operate in a goal-oriented way towards forming grammatical dependencies will never be able to capture anti-licensing conditions, including for PPI. As such, these models also do not predict any sort of PPI illusion effect.

If one were to instead adopt the previously discussed view that PPI are instead licensed via c-command relation with a positive operator, cue-based models still fail to predict an illusion effect for PPI. Under this positive operator approach, PPI would not deploy retrieval cues which activate [+negative] features in memory, and instead would probe for a [+positive] feature. Thus, we would predict that a PPI should never be impacted by negation, regardless of position. This of course is incompatible with the observed data and would lead to cue-based models failing to predict an illusion effect for PPI.

Another approach is to posit a model which more conservatively employs cue-based retrieval solely as a mechanism to recover from perceived ungrammaticality (Wagers et al.

2009). Under this kind of approach, retrieval only occurs when the input appears to be ungrammatical. Thus, once again, no illusion effect is predicted when a PPI occurs in the NPI illusion context. This is because the PPI is grammatical in these configurations. Taken together, it appears that the cue-based retrieval models, of various forms, do not predict a PPI illusion effect.

4.2.2. Feature Percolation Models

For feature percolation models, things appear different. Much like cue-based models, these models are sensitive to the relations between various lexical features. Unlike in cue-based models, the memory representations of features are structured, much like in a syntactic tree, and are also mutable. These properties have led to feature percolation models being applied to many illusion cases, though notably not the NPI illusion (Eberhard et al. 2005, Franck et al. 2002, Patson and Husband 2016). Under feature percolation models, features are gradient and a complex phrase which contains multiple instances of competing features is interpreted as having a weighted combination of those properties. For example, a noun phrase like *the man's dogs*, which contains both a singular NP and a plural NP, would have a less strongly weighted [singular] feature than *the man's dog*. In the context of the NPI illusion, the argument is that the subject contains an embedded negative element and is thus less strongly positive than the ungrammatical baseline containing no negative element. That allows for the matrix subject to more often be used to resolve the ungrammatical NPI through a dependency with the slightly negative tinged matrix NP. As discussed in the previous chapter, this account faces an issue in restricting the NPI illusion to only quantification environments, and in the deployment of polarity as a binary scale.

Setting this issue aside, however, it appears that the feature percolation model more straightforwardly predicts the presence of a PPI illusion. If the percolation of a relative clause negative feature allows for the NPI to create a dependency with the matrix element for licensing purposes, this same percolation should also allow for the PPI to detect a c-commanding negative matrix element for anti-licensing. Thus, feature percolation models are compatible with the production of an illusion of ungrammaticality for a PPI in the NPI illusion context, allowing for the idea that negative and positive exist as opposites in a binary feature system.

4.2.3. Pragmatic Models

Pragmatic models of the NPI illusion consider the NPI illusion effect as a consequence of attempting to apply the pragmatic engine responsible for NPI licensing in real-time (Giannakidou 2006, Giannakidou and Etxeberria 2018, Mendia et al. 2018, Muller and Phillips 2020, Schwab 2023, Xiang et al. 2009, 2013). As discussed in the previous chapter, the primary issue for pragmatic models is in detailing how the pragmatic engine for calculating the grammaticality of an NPI comes to be misapplied in an online context. That is to say, how does rescuing function for elements which are not grammatical rescuers, or how does the pragmatic engine come to evaluate an NPI as if it were in the relative clause instead of the matrix clause it visibly appears in.

To extend this kind of approach to the possibility of a PPI illusion, one would need to commit both to the status of PPI as an element that is licensed by a positive operator or anti-licensed by negative operators, as well as a particular pragmatic engine which is responsible for calculating this relation. In the end, it is likely that these approaches would wind up with a similar set of challenges as faced in the NPI case. Specifically, these are issues in restricting the triggers for PPI illusion to a specific subset of elements that anti-license PPI and explaining how the PPI comes to be evaluated with respect to the properties of a proposition it is within.

4.2.4. Active Scope Models

Active scope models, as explored in this dissertation, are largely concerned with capturing the potential configurations of quantifiers and scope sensitive elements. In the previous chapter, we illustrated how an active scope model with a trigger could account for the distribution of the NPI illusion phenomenon, including its restriction to quantified negation. Turning to PPI, active scope models predict an illusion of ungrammaticality. This is because, much like feature percolation models, the active scope model is not concerned directly with the features of the polarity item itself. As PPI are scope sensitive elements, the presence of a PPI should trigger the raising of previously encountered quantifiers. Thus, a negative quantifier in the relative clause should be raised and evaluated for Scope Economy. In this case, the movement of the negative quantifier is independently barred, in the same way as it was in the NPI case (Collins 2017), and must be reverted. What differs is the percept of the temporary structure, where the negative quantifier takes wide scope. In this case, the PPI was happy with the initial sentence configuration, but by placing the negative quantifier in a c-commanding position, the anti-licensing condition on the PPI is met. Thus, rather than a temporary sensation of licensing as observed in the NPI case, what occurs in the PPI case is a temporary sensation of anti-licensing. In this way, the active scope model predicts that we should observe an illusion of ungrammaticality when a PPI appears in the NPI illusion context, subject to all the same restrictions as the NPI illusion.

4.3. Experiment 11

Experiment 11 consists of a free time response judgement study investigating the illusion potential of sentences containing both positive and negative polarity items. As discussed above, PPI are grammatical mirrors to NPI. Instead of being licensed by c-commanding negative operators they are anti-licensed by c-commanding negative operators (Giannakidou 2011, Homer 2021, Szabolcsi 2004). For our purposes, we observe that PPI like *still* or *somewhat* are ungrammatical in environments which allow for NPI, as demonstrated in (4.5a) and (4.5b). The illusion cases in (4.5c), much like it was for NPI, are straightforwardly expected to behave like the cases where no negative element is present (4.5b). This owes to the fact that the negative element in (4.5c) is contained within the relative clause, and thus lacks the proper structural configuration to anti-license the PPI *still*. Using a paradigm like the example below, Experiment 11 investigates the possibility that PPI are influenced by negative elements which do not c-command the polarity item.

(4.5) a. **No** hunter who the fisherman trusted trusted will **ever**/still* shoot a bear.

b. The hunter who the fisherman trusted trusted will **ever***/still shoot a bear.

c. The hunter who **no** fisherman trusted trusted will **ever**$^{?}$/still$^{?}$ shoot a bear.

Each of the processing theories above maps on to a different prediction about the illusion potential of PPI containing sentences. Cue-based retrieval models don't predict the illusion under the assumption that dependency formation, as executed through retrieval, is goal oriented to create grammatical dependencies. On the other hand, a feature based system like feature percolation does predict a PPI illusion with a reversed effect direction from the NPI illusion. As the representation before the point of the polarity item will be the same, a matrix NP with a slightly more negative interpretation than the baseline, NPI and PPI alike should react to this structure in accordance with their own grammaticality constraints. Pragmatic theories at the moment do not make a clear prediction, as a specific commitment about the pragmatic licensing of PPI would be required. Finally, active scope models also predict an illusion for PPI with a reversed effect direction from the NPI illusion. Much like in feature percolation, both NPI and PPI interact with the memory representation of the sentence in the same way. For the active scope model, this would be by the polarity item triggering the raising of quantifiers in the memory representation. Thus, in both the case of the NPI and PPI the negative quantifier would be structurally available for QR under the active scope model, and should give arise to illusions for both.

4.3.1. Materials and Methods

Participants were 85 English speakers living in the United States contracted through Amazon's Mechanical Turk, a crowd-working platform (https://www.mturk.com/). All participants were compensated $2 for their participation. The task itself was estimated to take around 20 minutes, though participants were allowed 1 hour to complete the task with the ability to pause during that time. Participants were directed to a page with information about the study before giving their informed consent to participate.

The task materials consisted of 36 items with 6 conditions. Each item contained two sentences, a context sentence and a critical sentence. The context sentence introduces a reference set for the subject of the critical sentence, as shown in the sample item (4.6). The critical sentences were structured with a subject modified by a relative clause, followed by a polarity item located after the modal *will* but before the matrix verb, as shown in the sample item (4.7). The negation in bold and italicization of polarity items is merely for the ease of tracking dependencies in this dissertation, and was not visible to participants in any of the presented studies. The design of the items contains an NPI group and a PPI group each with a matrix negation condition (4.7a,d), a negation absent condition (4.7b,e), and a relative clause *no* condition(4.7c,f). Thus, for both NPI and PPI conditions we test a grammatical baseline, an ungrammatical baseline and a potential illusion condition with relative clause negation. The NPI and PPI pairs were varied in the experiment, such that half of the items tested the NPI *ever* and the PPI *still* and the other half of the items tested the NPI *at all* and the PPI *already*. This was intended to help ensure that the effects we observe are not somehow unique properties of *ever* and *still* which are the primary items tested in the other experiments in this dissertation and in the literature more broadly.

(4.6) Some local hunters are debating the use of bows in big game hunting.

(4.7)
a. **No** hunter that the fisherman trusted with a secret will *ever* shoot a bear.
b. The hunter that the fisherman trusted with a secret will *ever* shoot a bear.
c. The hunter that **no** fisherman trusted with a secret will *ever* shoot a bear.
d. **No** hunter that the fisherman trusted with a secret will *still* shoot a bear.
e. The hunter that the fisherman trusted with a secret will *still* shoot a bear.
f. The hunter that **no** fisherman trusted with a secret will *still* shoot a bear.

In all cases, care was taken to construct the items such that all sentences were similarly plausible and as close to identical as possible outside the critical manipulations. Each participant rated a total of 116 sentence pairs, consisting of 36 PI containing sentences and 80 filler sentences. The filler sentence pairs consisted of two subsets of sentence types of similar length and complexity to the PI containing sentences.

Sentences were presented in Ibex Farm, a platform for web-based linguistics experiments (Drummond 2013).[1] Participants were instructed to read each sentence pair carefully and rate the acceptability of the second sentence on a scale of 1 to 7. After selecting an acceptability score for the sentence, the next pair could be viewed by pressing the space key, allowing the opportunity to take a break between items. Participants also completed a short practice sentence after reviewing the consent materials and received a restatement of instructions before they began the main experiment. Within the main experiment, presentation order was

[1]Note that this platform has been retired and replaced with PCIbex, a platform extending the framework of Ibex Farm with additional functions (Zehr and Florian 2022).

pseudo-randomized across participants using Ibex Farm's Latin Square and randomization methods.

4.3.2. Results

Data were analyzed using a cumulative link model, which was estimated using the ordinal package (R Core Team 2021). The model uses a nested Helmert architecture with 5 fixed effects. The first contrast is between the PPI conditions weighted 1/3 and the NPI conditions weighted -1/3. Within the PPI conditions, there was a contrast between the anti-licensing condition with matrix *no*, weighted 1, and the licensed conditions, weighted -1/2. The final PPI contrast is between the potential illusion condition with relative clause *no*, weighted 1, and the condition without any negation, weighted -1. These conditions are mirrored for the NPI conditions. Thus, there was a contrast for the licensed NPI condition, weighted 1, and the unlicensed conditions, weighted -1/2. The final NPI contrast was between the illusion condition with relative clause *no*, weighted 1, and the condition without negation present, weighted -1. A random intercept was included by item. A random intercept was included by participant, as well as a random slope for the outermost contrast between the PPI and NPI conditions. Trials where participants responded abnormally fast, <100ms, and abnormally slow, >30,000ms, were removed from the analysis. In total 116 observations of the initial 3024 were removed from the analysis.

The results of Experiment 11 are presented graphically in Figure 4.1, the fixed effects output is displayed in Table 4.1, and the thresholds are presented in Table 4.2. We observe a significant effect for each of the fixed effects. Polarity has a significant effect in the model ($\hat{\beta}$ = 1.911, z = 11.253, $p < 0.001$). Within the NPI contrasts we see an effect for both the contrast between licensed and unlicensed NPI conditions ($\hat{\beta}$ = 1.137, z = 16.345, $p < 0.001$) and between the relative clause *no* condition and the condition without negation ($\hat{\beta}$ = 0.218,

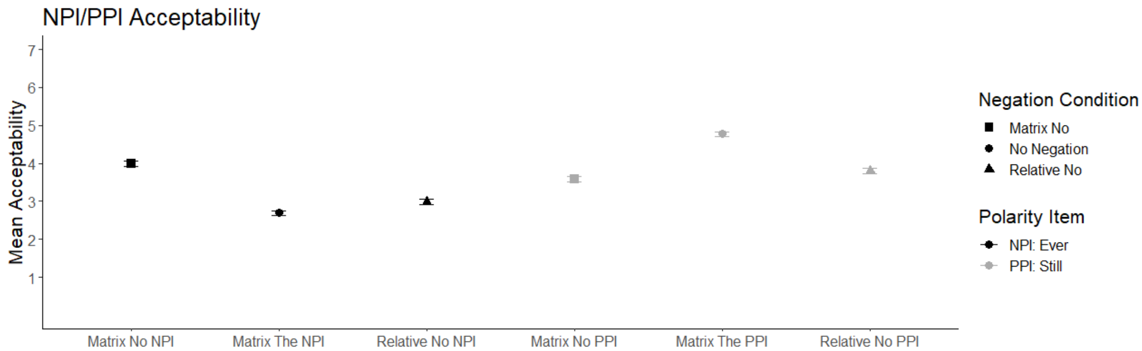


Figure 4.1. Experiment 11: Graph of acceptability judgement.

z = 3.772, p < 0.001). On the PPI side of things, we see similarly a significant effect for the contrast between anti-licensed and licensed PPI ($\hat{\beta}$ = -0.680, z = -10.114, p < 0.001) and for the contrast between the relative clause *no* condition and the condition without negation ($\hat{\beta}$ = -0.729, z = -12.154, p < 0.001). An immediately important comparison is that the estimate of the effect corresponding to the NPI illusion is much smaller than the effect corresponding to the PPI illusion, reflecting the large penalty observed when relative clause *no* occurs with a PPI.

Fixed-Effects	Estimate	Standard Error	z Value	p Value
PPI	1.911	0.170	11.253	**<0.001**
Licensed NPI	1.137	0.070	16.345	**<0.001**
Illusion NPI	0.217	0.058	3.772	**<0.001**
Anti-licensed PPI	-0.680	0.067	-10.114	**<0.001**
Illusion PPI	-0.729	0.060	-12.154	**<0.001**

Table 4.1. Experiment 11: Cumulative link mixed model fixed effects.

4.3.3. Discussion

From Experiment 11 we see a clear illusion effect for both NPI and PPI in the presence of relative clause *no*. NPI containing sentences receive a slight bump in acceptability when

Threshold	Estimate	Standard Error	z Value
1|2	-2.953	0.165	-17.853
2|3	-1.352	0.157	-8.616
3|4	-0.146	0.155	-0.942
4|5	1.044	0.156	6.679
5|6	2.579	0.163	15.840
6|7	4.642	0.193	24.081

Table 4.2. Experiment 11: Cumulative link mixed model threshold output.

the sentence contains a relative clause negative quantifier, while PPI containing sentences experience a larger acceptability penalty when the sentences contain a relative clause negative quantifier. Thus, both PPI and NPI are impacted by the presence of structurally inaccessible negation, but the direction of the impact is opposite, as predicted by their licensing and anti-licensing conditions.

These illusion effects however do not appear to be entirely equal. We observe an asymmetry in effect size such that PPI experience a much larger penalty than NPI experience a boost. This could owe to several potential sources.

One potentially interesting idea is that higher costs owe to the fact these illusions are of different types. The NPI illusion is an illusion of acceptability, as the error which results in linking the NPI to the negation achieves the appearance of a grammatical outcome from the perspective of the NPI. The PPI illusion on the other hand is a processing error which results in another error signal, an anti-licensed NPI. It is possible that a sequence of parsing moves that each result in an ungrammatical structure could produce emergent costs, a penalty for repeatedly failing to converge on a grammatical structure.

Another potential explanation is that we are observing a difference in acceptability due to the combination of multiple factors impacting acceptability. Critical to this paradigm is the presence of negative elements like *no*, which serve as important pieces of the illusion.

Negative elements like these have been shown to result in general acceptability penalties, particularly when presented without a context that indicates an upcoming negative element (Nordmeyer and Frank 2015, Tian and Breheny 2016). In the case of the NPI illusion, we could be observing a combination of effects in opposing directions. The NPI illusion effect results in an acceptability boost, but this effect is diminished by the co-occurring more general penalty for having a negative element. In the PPI case, however, the illusion effect is also a penalty, thus the two effects result in movement in the same direction. This means that the difference in effect size is not about the illusions' relative strength, but rather an artifact of how the direction of the illusion effect interacts with the general negation penalty.

Another, not independent possibility is that this effect size difference is a property of the task, untimed acceptability judgement. If we are seeing separate contributions for the illusion effects and a general negation penalty, we would expect these costs to be localized to their triggers in more temporally sensitive measures. Similarly, if there are differences in the treatment of NPI and PPI in processing as suggested by cue-based retrieval or pragmatic accounts, it is possible that untimed acceptability judgement is obscuring some of these differences. Thus, in Experiment 12 we turn to an eye-tracking while reading investigation of the NPI and PPI illusion, in hopes that the increased temporal resolution can tease apart the apparent asymmetry in effect sizes.

4.4. Experiment 12

Experiment 12 adapts the materials from Experiment 11 for use in an eye-tracking while reading experiment to investigate the time course of the NPI and PPI illusion effects. While previous work on the NPI illusion has had success detecting the illusion in various methods including eye-tracking while reading, self-paced reading, and speeded acceptability judgement, there exist fewer reports of the illusion in untimed acceptability judgements

(Drenhaus et al. 2005, Parker and Phillips 2016, Vasishth et al. 2008). Thus, there are several reasons to investigate the NPI and PPI illusion together in a more temporal sensitive measure. First, this experiment can serve as a replication of the results of Experiment 11 in a methodology which has previously captured the NPI illusion effect robustly. Second, the temporal resolution offered by eye-tracking while reading will allow us to have a better understanding of the mechanism underlying the acceptability effect observed in Experiment 11. If there are differences in the processing procedures for NPI and PPI, a more robust temporal measure could reveal them. Finally, the enhanced temporal resolution may help resolve the question of effect size asymmetry of the two illusion effects, as the polarity items and the negative elements will have their own associated measures. As a baseline, the active scope model predicts that the illusion effects should emerge at the point of the polarity item. As the active scope model predicts that evaluating scope is a high priority goal for the parser, we might further expect effects to be detected in earlier processing measures.

4.4.1. Materials and Methods

Participants included 60 English speakers recruited through the Northwestern University linguistics subject pool, drawn from undergraduate students in introductory linguistics courses. Only participants who successfully achieved and retained satisfactory calibration during the experiment were included in the final sample. All participants in the final sample scored greater than 70% on comprehension question accuracy. All participants regardless of the completion of the experiment were awarded course credit for their participation. The task was estimated to take around 40 minutes, though participants were allowed to take breaks within a total 1-hour window to complete the task. Prior to beginning the experiment, participants were directed to a page with information about the study before giving their informed consent to participate.

The task materials consisted of 36 items, each with a context sentence and 6 conditions. The items were adapted from those used in Experiment 11 with the addition of length matched post-verb material in the matrix clause, ensuring that the critical region and spillover regions are free from end of sentence wrap-up effects. The addition of the context sentence was intended to provide a reference set compatible with both positive and negative critical sentences, and improve the acceptability of the modifying relative clause. The items were also adjusted to all use *ever* and *still* to keep word length as consistent as possible. A sample context sentence and item are presented in (4.8-4.9).

(4.8) Some local hunters are debating the use of bows in big game hunting.

(4.9)
a. **No** hunter that the fisherman trusted with a secret will *ever* shoot a bear with a bow.
b. The hunter that the fisherman trusted with a secret will *ever* shoot a bear with a bow.
c. The hunter that **no** fisherman trusted with a secret will *ever* shoot a bear with a bow.
d. **No** hunter that the fisherman trusted with a secret will *still* shoot a bear with a bow.
e. The hunter that the fisherman trusted with a secret will *still* shoot a bear with a bow.
f. The hunter that **no** fisherman trusted with a secret will *still* shoot a bear with a bow.

As participants read each sentence, their eye movements were tracked by a tower-mounted SR Research EyeLink 1000 Plus eye-tracker. The sampling rate was 2000Hz. The experiment used 3 point horizontal calibration. Calibration occurred at the beginning of the study and reoccurred whenever necessary, after breaks or other instances of track-loss. Participants were offered a minimum of two short breaks. Each trial in the experiment presented two sentences displayed one after the other on the same screen. The context sentence was displayed in full, and participants pushed a bumper on a game controller to indicate that they were ready for the critical sentence. At the start of a critical sentence presentation, a black box appeared aligned to the left edge of the beginning of the sentence to standardize initial fixation. Eye movements were tracked during these trials, and participants indicated they were done reading the sentence by pushing a bumper on a game controller. After each critical sentence, participants were presented with a comprehension question and responded by pushing the left or right bumper on a gaming controller, aligned with a response on the left or right of the screen.

4.4.2. Results

Data were analyzed using linear mixed effects models fit over log transformed reading time measures at various regions of interest. In this study, the critical region was composed of the region *will ever/still* and the spillover region consisted of the matrix verb plus its object, *shoot a bear* in (4.9). Analysis of skipping rates in the critical region indicated a skipping rate of approximately 27%. While not entirely unexpected due to the highly functional content of *will ever/still*, the high rates motivate the two word critical region and the analysis of spillover region reading behavior. Trials in which the entire reading of the sentence was extremely fast, <500ms, or extremely slow, <25,000ms, were automatically removed from analysis. Values of zero indicated no reading in the measure of interest, and were re-coded as NA to preserve the shape of the data and accommodate log transformation.

The measures of interest modeled in this study include first pass reading, go-past reading or regression path duration, total reading time and rereading time. For each measure of

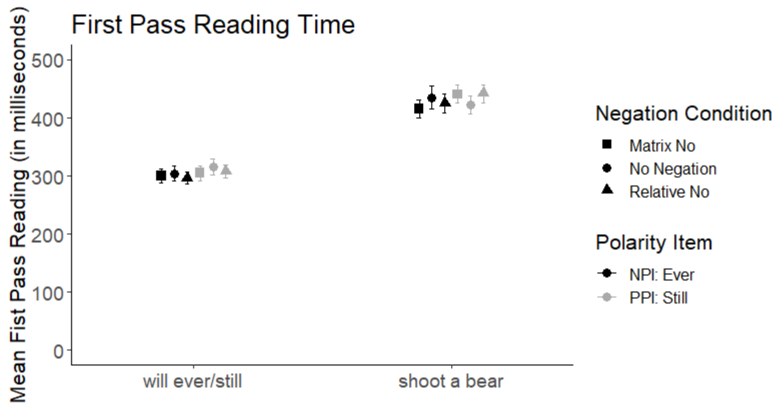


Figure 4.2. Experiment 12: Graph of first pass reading time.

interest, a model was fit for both the critical and spillover regions using the same fixed effects structure as Experiment 11, as well as random intercepts by participant and item.

Fixed-Effects	Estimate	Standard Error	t Value	p Value
Intercept	-0.031	0.030	-1.006	>0.100
PPI	0.031	0.033	0.914	>0.100
Licensed NPI	-0.001	0.022	-0.032	>0.100
Illusion NPI	0.001	0.019	0.068	>0.100
Anti-licensed PPI	-0.016	0.023	-0.707	>0.100
Illusion PPI	0.007	0.020	0.345	>0.100

Table 4.3. Experiment 12: Linear mixed effects model output for critical region first pass reading.

Fixed-Effects	Estimate	Standard Error	t Value	p Value
Intercept	-0.018	0.045	-0.412	>0.100
PPI	0.045	0.037	1.217	>0.100
Licensed NPI	0.005	0.024	0.184	>0.100
Illusion NPI	0.023	0.021	1.074	>0.100
Anti-licensed PPI	0.025	0.024	1.043	>0.100
Illusion PPI	0.038	0.021	1.798	>0.050

Table 4.4. Experiment 12: Linear mixed effects model output for spillover region first pass reading.

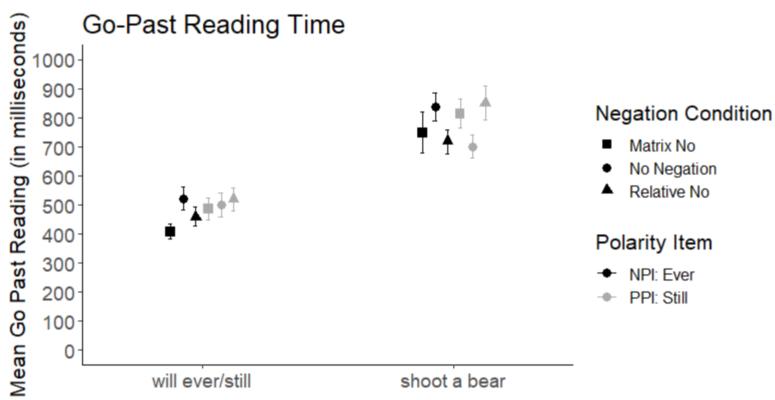


Figure 4.3. Experiment 12: Graph of go past reading time.

First pass reading time is the sum of the initial fixation within a region and any subsequent refixations that occur prior to a fixation outside the region. First pass reading time is presented graphically in Figure 4.2 and the model outputs of log transformed first pass time for the critical region and spillover region are presented in Table 4.3 and Table 4.4. No significant effects are observed in first pass time in either region.

Fixed-Effects	Estimate	Standard Error	t Value	p Value
Intercept	-0.016	0.041	-0.394	>0.100
PPI	0.070	0.052	1.335	>0.100
Licensed NPI	-0.064	0.035	-1.868	<0.070
Illusion NPI	-0.021	0.030	-0.714	>0.100
Anti-licensed PPI	-0.010	0.035	-0.271	>0.100
Illusion PPI	0.028	0.031	0.896	>0.100

Table 4.5. Experiment 12: Linear mixed effects model output for critical region go past reading.

Go-past time consists of first pass reading time plus any fixations to the left that occur before a fixation to the right of the region of interest. In other words, go-past time includes all time spend reading the word when it is initially encountered and any regressions to previously encountered materials before the reader moves on to new material. Go-past

Fixed-Effects	Estimate	Standard Error	t Value	p Value
Intercept	-0.007	0.052	-0.124	>0.100
PPI	0.082	0.051	1.598	>0.100
Licensed NPI	-0.084	0.034	-2.444	**<0.050**
Illusion NPI	-0.059	0.030	-1.977	**<0.050**
Anti-licensed PPI	0.030	0.034	0.880	>0.100
Illusion PPI	0.062	0.030	2.088	**<0.050**

Table 4.6. Experiment 12: Linear mixed effects model output for spillover region go past reading.

reading time is presented graphically in Figure 4.3 and the model outputs for the critical and spillover regions are presented in Table 4.5 and Table4.6. A marginally significant effect of the NPI grammaticality contrast appears in the critical region ($\hat{\beta}$ = -0.064, t = -1.868, p < 0.07). We also observe three significant effects in the spillover region. We observe no main effect of NPI or PPI status. Within the NPI contrasts we see a significant effect for both the grammaticality contrast ($\hat{\beta}$ = -0.084, t = -2.444, p < 0.050) and the contrast between the relative clause *no* condition and the ungrammatical baseline condition ($\hat{\beta}$ = -0.059, t = -1.977, p < 0.050). Within the PPI contrast, only the contrast between relative clause *no* and the grammatical baseline is significant ($\hat{\beta}$ = 0.062, t = 2.088, p < 0.050). Upon investigation of Figure 4.3 we can see that the lack of an effect for the ungrammatical PPI is likely driven by the extreme slowness observed in the relative clause *no* condition, which on average was read slower than even the ungrammatical baseline.

Total reading time is the sum of the initial fixations within a region and all refixations that occur within that region, inclusive of later regressions. Total reading time is presented graphically in Figure 4.4 and the model outputs for the critical and spillover regions are presented in Table 4.7 and Table 4.8. We observe significant effects in both the critical and spillover regions. In total time at the critical region, there is a significant effect within the

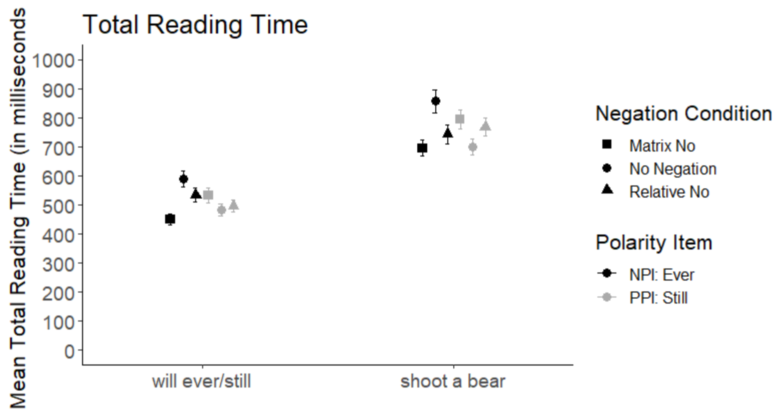


Figure 4.4. Experiment 12: Graph of total time reading.

Fixed-Effects	Estimate	Standard Error	t Value	p Value
Intercept	-0.021	0.035	-0.586	>0.100
PPI	-0.021	0.045	-0.464	>0.100
Licensed NPI	-0.109	0.030	-3.616	**<0.001**
Illusion NPI	-0.040	0.025	-1.574	>0.100
Anti-licensed PPI	-0.039	0.030	1.290	>0.100
Illusion PPI	0.020	0.026	0.747	>0.100

Table 4.7. Experiment 12: Linear mixed effects model output for critical region total time reading.

Fixed-Effects	Estimate	Standard Error	t Value	p Value
Intercept	-0.009	0.045	-0.198	>0.100
PPI	0.001	0.044	0.019	>0.100
Licensed NPI	-0.059	0.029	-2.444	**<0.050**
Illusion NPI	-0.065	0.025	-1.977	**<0.050**
Anti-licensed PPI	0.052	0.029	1.802	>0.050
Illusion PPI	0.053	0.025	2.088	**<0.050**

Table 4.8. Experiment 12: Linear mixed effects model output for spillover region total time reading.

NPI contrast for NPI licensing ($\hat{\beta}$ = -0.109 t = -3.616, p<0.001). In the spillover region we observe an effect for NPI licensing $\hat{\beta}$ = -0.059 t = -2.444, p<0.050), the NPI illusion

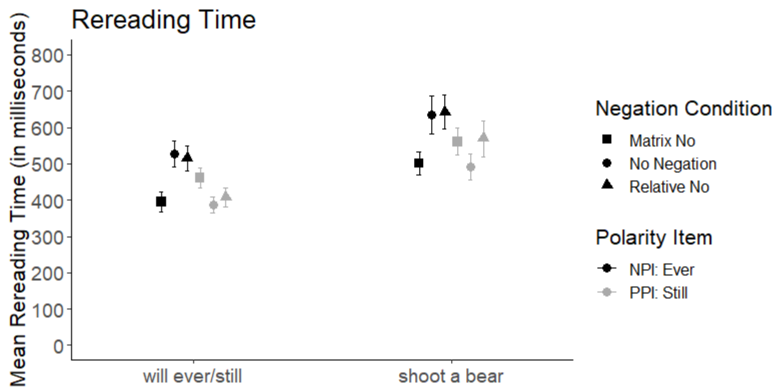


Figure 4.5. Experiment 12: Graph of rereading time.

condition ($\hat{\beta}$ = -0.065 t = -1.977, p<0.050), and the PPI illusion condition ($\hat{\beta}$ = 0.053 t = 2.088, p<0.050).

Fixed-Effects	Estimate	Standard Error	t Value	p Value
Intercept	-0.025	0.031	-0.804	>0.100
PPI	-0.121	0.059	-1.740	**<0.100**
Licensed NPI	-0.134	0.049	-2.758	**<0.010**
Illusion NPI	0.003	0.037	0.070	>0.100
Anti-licensed PPI	0.084	0.045	1.836	**<0.100**
Illusion PPI	0.006	0.041	0.137	>0.100

Table 4.9. Experiment 12: Linear mixed effects model output for critical region rereading time.

Fixed-Effects	Estimate	Standard Error	t Value	p Value
Intercept	-0.031	0.049	-0.632	>0.100
PPI	-0.131	0.080	-1.633	>0.090
Licensed NPI	-0.099	0.053	-1.881	**<0.100**
Illusion NPI	0.009	0.046	0.197	<0.070
Anti-licensed PPI	0.055	0.053	1.046	>0.050
Illusion PPI	0.030	0.047	0.636	>0.100

Table 4.10. Experiment 12: Linear mixed effects model output for spillover region rereading time.

Rereading time includes only the fixations that occur in a region after first pass reading has concluded. Rereading time is presented graphically in Figure 4.5 and the model outputs for the critical and spillover region are reported in Table 4.9 and Table 4.10. In the critical region we observe a marginally significant effect of PPI vs. NPI ($\hat{\beta}$ = -0.121, t = -1.740, p < 0.090), a significant effect of NPI licensing ($\hat{\beta}$ = -0.134, t = -2.758, p < 0.010), and a marginally significant effect of PPI anti licensing ($\hat{\beta}$ = 0.084, t = 1.836, p < 0.070). On visual inspection, rereading time appears to differ from other measures, as only the PPI conditions appear to follow the illusion trend visually.

4.4.3. Discussion

Looking at the results of the eye-tracking study from a holistic perspective, they appear to support the idea that there is an illusion for PPI which shares the temporal profile of the NPI illusion. Thus, at a high level the results of Experiment 12 generally replicate the findings of Experiment 11, and appear consistent with the active scope model.

However, the results of Experiment 12 offer less temporal insight than we may have hoped at the outset. The strongest effects for both illusions manifest in the spillover region in go-past and total reading time, both relatively late measures. While it is clear that the type of polarity item condition controls some aspects of the illusion effect and that both effects share a general temporal profile, the displacement of the effect to the spillover region and late measures may suggest that the process resulting in the illusion effect requires more time or computation than other early processes. We also do not observe much of a difference in effect strength between the two types of illusion, suggesting that the differences observed in Experiment 11 could owe to the properties of untimed acceptability judgement rather than a deeper processing difference.

At the same time, the displacement of both effects and the relative weakness of the effects observed in some measures could owe to noise in both reading times and temporal profile. As such, I seek to validate the results of the eye-tracking experiment in an additional replication in a different task which boasts a high degree of temporal sensitivity and a reduced bleeding of effects into spillover regions.

4.5. Experiment 13

Experiment 13 utilizes materials adapted from those used in Experiments 1 and 2 in a lexical maze task (Boyce et al. 2020, Forster et al. 2009, Witzel et al. 2012). The use of the Maze task is intended both to provide verification for the results observed in eye-tracking and to establish the task as an appropriate tool for web-based experiments seeking to investigate polarity phenomena. Notably, the maze task is thought to excel at localized effect detection, resulting in few instances of effects predicted at a critical region appearing instead in the spillover region (Boyce et al. 2020). As such, the active scope model predicts that both NPI and PPI should result in an illusion effect at the point of the polarity item.

4.5.1. Materials and Methods

Participants were 60 monolingual speakers of English from the United States recruited through Prolific, a platformed designed for crowd-working in a research context (Palan and Schitter 2018). All participants were compensated $8 for their participation. The task was estimated to take about 40 minutes to complete, though participants were allowed a total window of 150 minutes to complete the task with an ability to pause between trials.

Using a lexical maze task implemented in PCIbex Farm, we measured participant's word by word reading times (Boyce et al. 2020, Forster et al. 2009, Witzel et al. 2012, Zehr and Schwarz 2022). Participants in a lexical maze task read a sentence one word at a time.

Each word of the sentence is presented alongside a plausible pseudo-word of English. If an incorrect selection is made, the trial immediately ends and the experiment proceeds to the next sentence. The design of these tasks have a few properties that make them a good fit for web-based research. First, evidence shows that maze tasks provide more robustly localized effects in replications of results from eye-tracking and self-paced reading (Boyce et al. 2020, Forster et al. 2009, Witzel et al. 2012, Zehr and Schwarz 2022). As the results reported in eye-tracking contained significant effects spread across the critical and spillover regions, using the maze task for external validation could shine a light on the time course of the observed illusion effects. Second, maze tasks require a higher level of participant engagement than comparable tasks like self-paced reading. When a participant incorrectly selects a pseudo-word, the trial ends. This failure state ensures that participants who intend to finish the task successfully attend to the task in a way that is difficult to enforce outside of laboratory conditions. In combination with observe low mistake rates and higher effect detection reported for the task, this attention feature allows for more consistent participant behavior in a web-based context without a penalty to statistical power (Boyce et al. 2020).

The grammatical version of this task, which was used in Experiment 1 and is used again later in Experiments 17 and 18, was not selected for task theoretic reasons. In the grammatical version of the maze task, participants are presented with the target word from the sentence and a statistically unlikely alternative. While this approximation of grammaticality works well enough in studies with uniformly grammatical items, the NPI and PPI paradigms include ungrammatical baselines as well as illusion cases. Thus, in this context it becomes difficulty to conceptualize the role of a statistically unlikely or ungrammatical alternative to the target word, when the target word itself may be ungrammatical or perceived as such via an illusion. Thus, this experiment employs the lexical maze task, which does not make assumptions about grammaticality or probability of the target words.

The materials for this task consisted of 36 items with 6 conditions. The pattern of these items matches the pattern of the critical sentences from Experiments 1 and 2. A sample item is presented in (4.10). The pseudo-words utilized in the study were generated using the Wuggy program to mirror the phonological features of the target word while respecting the various phonotactic constraints of English (Keuleers and Brysbaert 2010). All items were constructed such that the critical sentences were similarly plausible and a similar as possible outside the critical manipulations. All participants read a total of 116 sentences, consisting of 36 NPI/PPI sentences and 80 filler sentences.

After receiving instructions and reviewing an informed consent document, participants reviewed the task instructions and completed a short practice section. Readers were instructed to pick the real word of English by pressing the 'e' or 'i' key corresponding to the word on the left or right side of the screen. Incorrect selections ended the trial immediately, and the participant is prompted to begin the next trial. After each trial, regardless of the answers selected, participants could pause to take a break before beginning the next trial by pressing the space key. Presentation order was randomized across participants using PCIbex Farm's Latin squaring and randomization method.

(4.10)
a. **No** congressman that the voter remembered from a commercial will *ever* support an increase in the budget.
b. The congressman that the voter remembered from a commercial will *ever* support an increase in the budget.
c. The congressman that **no** voter remembered from a commercial will *ever* support an increase in the budget.

d. **No** congressman that the voter remembered from a commercial will *still* support an increase in the budget.

e. The congressman that the voter remembered from a commercial will *still* support an increase in the budget.

f. The congressman that **no** voter remembered from a commercial will *still* support an increase in the budget.

4.5.2. Results

Data were analyzed using linear mixed-effects models fit over log-transformed reading time at the critical region, the polarity item, and the spillover region, the following verb. The fixed effects structure remains the same as in the previous experiments. A random intercept was included by participant and by item, as well as a random slope for the polarity contrast by participant. Trials with first word response times longer than 10 seconds were excluded prior to analysis, as the participant was likely not yet ready to start the trial. Observations with unusually fast, <100ms, or unusually slow, >10,000ms, were dropped from the analysis. A total of 8 trials were removed from the analysis after they were determined to be influential outliers in either the critical region, spillover region or both. A potential outlier was excluded if it appeared as an outlier based on visual analysis of at least two of the model Q-Q plot, plotted Cook's distance or plotted leverage by residual. The response times at the critical and spillover region are plotted in Figure 4.6 and model output for the critical and spillover regions appears in Table 4.11 and Table 4.12.

We observe critical effects in both the critical and spillover regions. Within the critical region we see a significant effect for each contrast aside from the global polarity contrast. Thus, we observe a reading time boost for licensed NPI ($\hat{\beta}$ = -0.053, t = -4.855, p<0.001) and a reading time penalty for the relative clause *no* NPI condition compared to the

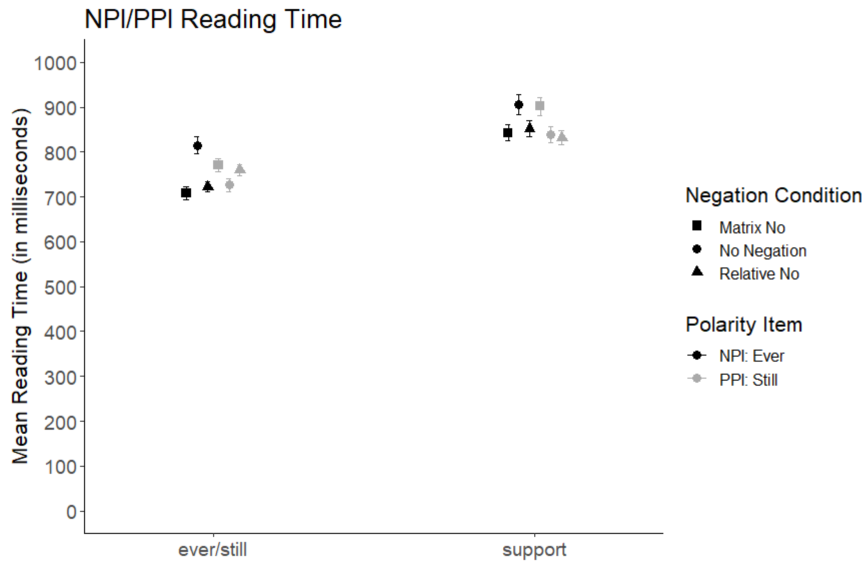


Figure 4.6. Experiment 13: Graph of critical and spillover region reading time.

Fixed-Effects	Estimate	Standard Error	t Value	p Value
Intercept	-0.004	0.021	-0.212	>0.100
PPI	0.016	0.020	0.787	>0.100
Licensed NPI	-0.053	0.011	-4.855	**<0.001**
Illusion NPI	0.044	0.009	-4.741	**<0.001**
Anti-licensed PPI	0.025	0.010	2.363	**<0.050**
Illusion PPI	0.021	0.009	2.214	**<0.050**

Table 4.11. Experiment 13: Linear mixed effects model output for critical region reading time.

Fixed-Effects	Estimate	Standard Error	t Value	p Value
Intercept	-0.007	0.026	-0.264	>0.100
PPI	-0.019	0.022	-0.867	>0.100
Licensed NPI	-0.020	0.013	-1.516	>0.050
Illusion NPI	-0.025	0.011	-2.241	**<0.050**
Anti-licensed PPI	0.037	0.013	2.878	**<0.010**
Illusion PPI	-0.003	0.011	-0.271	>0.100

Table 4.12. Experiment 13: Linear mixed effects model output for spillover region reading time.

ungrammatical NPI baseline ($\hat{\beta}$ = -0.044, t = -4.741, p<0.001). Within the PPI effects we see a penalty for anti-licensed PPI ($\hat{\beta}$ = 0.025, t = 2.363, p<0.050) as well as a penalty for the relative clause *no* PPI condition ($\hat{\beta}$ = -0.021, z = 2.214, p<0.050). Note that in this experiment, we do not appear to observe as large of a discrepancy in the effect size of the two illusions. Both the NPI and PPI illusion conditions appear to be clearly distinct from their baseline containing no negation. They do however also appear close to their respective matrix negation baseline, suggesting a strong impact of relative clause *no* for both polarity item types.

In the spillover region a significant effect is observed for the contrast between the relative clause *no* NPI condition and the ungrammatical baseline ($\hat{\beta}$ = -0.025, t = -2.241, p<0.050). We also observe a contrast between the anti-licensed PPI condition and the licensed PPI conditions ($\hat{\beta}$ = 0.037, t = 2.878, p<0.010). Thus, we appear to see the NPI illusion effect spreading into the spillover region while the PPI illusion effect appears to have abated, as the PPI reading time pattern is consistent with the overall grammaticality judgement of the sentence.

4.5.3. Discussion

In Experiment 13 we once again observe clear illusion effects for both NPI and PPI, as predicted under the active scope model. The effects are well localized to the critical region containing the polarity item, rather than appearing in the spillover region as they often did in the eye-tracking in Experiment 12. With the relatively high skipping rates and multiple regions and measures where the effect was detected in Experiment 12, it becomes somewhat difficult to translate the results between the two studies, other than to say that both eye-tracking and the maze task find evidence that is tied to a similar region of the sentence. As an additional check on the acceptability judgment results, the effect sizes observed for the NPI and PPI illusions in the critical region are similar. Notably in the spillover region, we observe that the NPI illusion effect appears to persist while the pattern of means for the PPI conditions is consistent with the grammatical expectations for the sentence. This could indicate a difference in the resolution of the grammaticality state of each illusion effect. It is possible that the clash between the ungrammaticality of the link between the NPI and the negative element and the link's validation of the NPI's licensing condition produces a tension requiring further processing to resolve. This stands in contrast to the PPI case, where both the link between the negative element and the PPI and the PPI's anti-licensing conditions result in ungrammaticality, motivating a quicker transition to an alternative parse.

Setting aside the various differences in what each experiment observes, the three experiments each present broadly matching illusion effects for NPI and PPI, which are preceded by a relative clause embedded negative element. For NPI we observe the traditional NPI illusion effect where acceptability is higher and reading time at the point of the NPI is faster than in the ungrammatical baseline. For PPI, we observe the opposite, where acceptability is lower, and reading time is slower than the grammatical baseline.

This finding is not predicted by cue-based retrieval or pragmatic accounts of NPI illusion as presently implemented. However, these results are broadly compatible with feature percolation and active scope models. In adjudicating which accounts best capture this new polarity illusion landscape, there is an important factor which these experiments do not speak to. Namely, as shown in the previous chapter and in the work of Orth et al. (2021) and Muller and Phillips (2020) the NPI illusion only appears when the negative element in the relative clause is a quantified negation. The experimental materials used in this chapter all employed *no*. As such, the results are consistent with the quantifier restriction observed for the NPI illusion, but they do not rule out the possibility that PPI illusion could occur in the presence of non-quantified negation. If the PPI illusion is not subject to this restriction, it could be evidence that, despite the surface similarity, the two polarity illusion do owe to different processes. Thus, Experiment 14 looks to address the question of the role of quantification in the PPI illusion directly.

4.6. Experiment 14

The NPI and PPI illusion effects appear to occur in similar environments and with a similar temporal profile, based on the results of Experiments 1-3. As such, the results of these experiments suggest that both illusions are likely produced by the same mechanism, with differences in effect direction owing to the licensing or anti-licensing requirement of the polarity item. However, these experiments have not validated generalization of the quantifier restriction on NPI illusions, which was the critical object of discussion in the previous chapter. In Experiment 14 we investigate this question directly by comparing the ability of relative clause *no* and relative clause *didn't* to trigger the PPI illusion effect. Finding that this restriction holds for the PPI illusion effect as well as the NPI illusion effect would further support the idea that the two illusions are produced by the same sentence processing procedure. Further, this restriction would suggest that active scope models hold the most promise for capturing both illusion effects, as active scope models are uniquely able to predict both the existence of the PPI illusion and the general restriction of polarity illusions to contexts with negative quantifiers. Thus, Experiment 14 consists of a speeded acceptability judgement study using the paradigm of Orth et al. (2021) deployed in the previous chapter.

4.6.1. Materials and Methods

Participants for Experiment 14 consisted of 72 English speakers living in the United States contracted through Amazon's Mechanical Turk. All participants were compensated $2 for their participation. The task itself was estimated to take about 20 minutes to complete, though participants were allotted 1 hour to complete the task with the ability to take breaks during that time. One participant's data was unavailable due to a technical issue in sending the results to the experiment's host server, and an additional 5 participants were dropped from the ultimate analysis as they rated every critical trial as acceptable. Thus, data from only 66 participants was analyzed in the final sample.

The task materials consisted of 24 items with 4 conditions. Following the design of Orth et al. (2021) deployed in the previous chapter, the conditions tested were a grammatical PPI baseline, an ungrammatical baseline with matrix *no*, and potential illusion conditions with *no* and *didn't* in the relative clause. A sample item is presented in (4.11).

(4.11)
- a. **No** overbearing parent who the moody daughter silently resented will *still* control everything.
- b. The overbearing parent who the moody daughter silently resented will *still* control everything.
- c. The overbearing parent who **no** moody daughter silently resented will *still* control everything.
- d. The overbearing parent who the moody daughter **didn't** silently resent will *still* control everything.

In all cases, care was taken to construct items with similar plausibility and high similarly outside the critical manipulations. Each participant rated 96 sentences total, consisting of the 24 critical items and 72 filler sentences, balanced for grammaticality setting aside potential illusion sentences. Sentences were presented in the speeded acceptability format using Ibex Farm (Drummond 2013). Each sentence was presented word-by-word with a fixed presentation rate of 275ms per word with a 100ms pause between words. Participants were instructed to read each sentence carefully to determine if it was a good sentence of English or not. Once the final word of the sentence was displayed, a response screen appeared and prompted participants to press the 'f' key for a good sentence of English or the 'j' key if they thought the sentence was not a good English sentence. This screen persisted for 3 seconds, after which the trial ended if the participant failed to response and displayed feedback indicating the response was too slow. After each sentence was evaluated, participants could begin the next sentence by pressing the space key, allowing the opportunity to take a pause between trials. Participants were instructed to review an informed consent document, complete a short practice section, and review the task instructions again before beginning the main experiment. Presentation order was randomized across participants using Ibex Farm's Latin squaring and randomization method.

4.6.2. Results

Data were analyzed using a logistic mixed-effects model. The model employed a Helmert coded fixed-effects structure with 3 effects. The first effect was between the anti-licensed PPI, weighted 1, and the 3 licensed conditions, weighted -1/3. The second effect was between the grammatical PPI, weighted 1, and the potential illusion conditions, weighted -1/2. The final contrast was between the potential illusion condition with relative clause *no* and the potential illusion condition with relative clause *didn't*. Random intercepts by subject and by item were included, as well as a random slope by participant for the anti-licensing contrast.

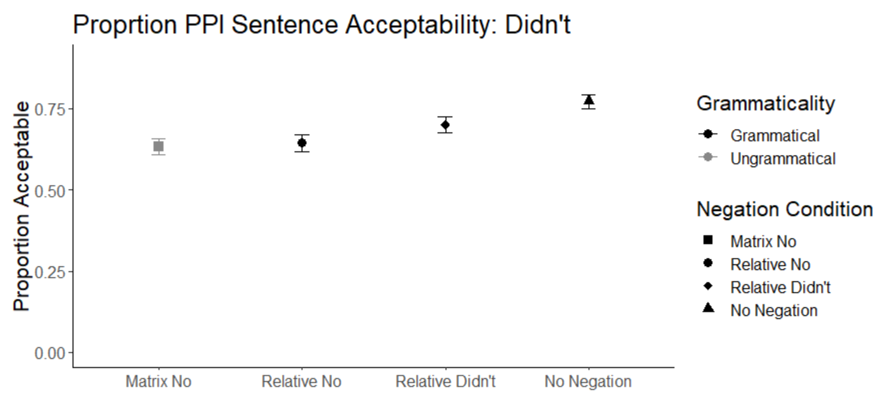


Figure 4.7. Experiment 14: Graph of speeded acceptability judgement.

The results of Experiment 14 are presented graphically in Figure 4.7 and the model output appears in Table 4.13. We observe a significant effect for anti-licensed PPI ($\hat{\beta}$ = -0.281, z = -2.517, p <0.001) as well as a significant effect for the contrast between the grammatical PPI and the potential illusion conditions ($\hat{\beta}$ = 0.039, z = 3.725, p <0.050). We find no significant effect for the contrast comparing the two illusion conditions. However, as their means appear to be relatively far apart, a post-hoc analysis was conducted with the no negation, grammatical PPI condition as the reference level.

Fixed-Effects	Estimate	Standard Error	z Value	p Value
Intercept	0.891	0.124	7.171	**<0.001**
Anti-licensed PPI	-0.281	0.112	-2.517	**<0.050**
No Negation	0.039	0.106	3.725	**<0.001**
Illusion PPI	-0.134	0.085	-1.583	>0.100

Table 4.13. Experiment 14: Logistic mixed effects model output.

In the post-hoc analysis, we observe a significant difference between the grammatical NPI condition and each of the other conditions. Full model output appears in Table 4.14. In this model the contrast between the grammatical baseline and the ungrammatical baseline is highly significant ($\hat{\beta}$ = -0.767, z = -4.087, p <0.001) as we might expect. We see similarly sized effect for the contrast between the grammatical baseline and the relative clause *no* condition ($\hat{\beta}$ = -0.724, z = -4.031, p <0.001). The contrast between the grammatical baseline and the relative clause *didn't* condition is also significant ($\hat{\beta}$ = -0.456, z = -2.538, p <0.05), though with a notably smaller effect size.

Fixed-Effects	Estimate	Standard Error	z Value	p Value
Intercept	1.377	0.173	7.984	**<0.001**
Grammatical vs. Ungrammatical	-0.767	0.188	-4.087	**<0.001**
Grammatical vs. Didn't	-0.456	0.180	-2.538	**<0.05**
Grammatical vs. No	-0.724	0.180	-4.031	**<0.001**

Table 4.14. Experiment 14: Post-hoc logistic mixed effects model output.

4.6.3. Discussion

The results of Experiment 14 appear to provide additional evidence that the processing of PPI and the associated PPI illusion mirrors the processing of NPI and the NPI illusion. First, setting aside the relative clause *didn't* condition, we once again observe an illusion effect such that PPI containing sentences with relative clause *no* are rated worse than the grammatical baseline without any negation. Thus, the general effect of an illusion for PPI replicates in a fourth experiment and methodology.

In addressing the role of quantification, the tested illusion cases with relative clause *no* and *didn't* both appear worse than the grammatical baseline with no negation present. Thus, on the surface it appears that the illusion effect obtains for both cases contrary to the quantifier restriction observed in the previous chapter, Orth et al. (2021), and Muller and Phillips (2020). However, this may not be the full story. Examining the effect sizes of the first model and the distribution of the means, it appears that the relative *no* condition may be driving the contrast between the tested illusions and the baseline, though the model does not consider the two illusions to be significantly different. In a post-hoc model with the grammatical condition without negation as the reference level, we see that all three conditions with negation are significantly different from the grammatical case, suggesting that the presence of negation is influencing the ultimate judgement in each case. Looking at the effect sizes, we can also see that the difference between the grammatical baseline and relative clause *no* ($\hat{\beta}$ = -0.724, z = -4.031) is more similar to the difference between the grammatical baseline and the ungrammatical baseline ($\hat{\beta}$ = -0.767, z = -4.087) than the difference between the grammatical baseline and relative clause *didn't* ($\hat{\beta}$ = -0.456, z = -2.538). Thus, there may be a difference in the underlying mechanism between the two apparent 'illusion' cases.

As suggested in the discussion of Experiment 11, the contribution of negation itself is likely a critical element here. Studies across different task types, including judgement studies, show costs of negation, particularly when the negation appears out of the blue (Nordmeyer and Frank 2015, Tian and Breheny 2016). In this study without context sentences and with limited temporal resolution, it is likely that a portion of the signal detected owes to the mere presence of negation rather than a true instance of an illusory dependency. In the future, studies targeting the role of quantification in the PPI illusion should employ methods with enhanced temporal resolution or designs which directly account for the independent role of negation.

4.7. General Discussion

In this chapter we have observed experimental evidence that there exists an illusion of ungrammaticality for PPI which are embedded in the NPI illusion context. In this respect, the two polarity items appear to be opposite sides of the same coin. The shared temporal profile and apparent quantification restriction provide further evidence that the two illusions are the result of the same process in online sentence comprehension. On this basis, it is the position of this dissertation that the appropriate conceptualization for these phenomena is that of a single generalized polarity illusion rather than two separate illusion phenomena. That is to say, the illusion effect we observe for NPI and PPI is the same effect, but the directional of the effect is a response of the features of the polarity item.

Turing to consider the processing approaches to polarity items, we should prioritize approaches that most strongly predict the occurrence of both NPI and PPI illusion. In this regard, it appears clear that active scope models hold the most promise.

Cue-based retrieval models, holding the distinction of being one of the earliest approaches to capturing the NPI illusion phenomenon, fail to predict many aspects of the illusion profile that have emerged over the course of this dissertation. Due to the reliance on a simple negation cue, cue-based models do not predict the quantifier restriction observed in great detail in the case of NPI processing nor the extension of such a restriction to the case of PPI (Muller and Phillips 2020, Orth et al. 2021). As we have discussed previously, amending the retrieval cues encoded on the polarity items to more narrowly target quantified negation would have negative consequences for the ability of the model to capture the relatively frequent cases of NPI being licensed by non-quantified negative elements. Cue-based retrieval models also do not predict the PPI illusion in any form. As retrieval is stated as an operation that is intended to form grammatical dependencies, there is no expectation that the processor should ever attempt to link a PPI to a negative element, as such a dependency would render a sentence ungrammatical (Wagers et al. 2009). In other words, the core engine of cue-based retrieval models is not equipped to account for the presence of illusions of ungrammaticality, as these models hold grammaticality as a goal state for processing. As such, any attempt to extend cue-based models to capture the empirical distribution of polarity illusion as presented in this dissertation would require substantial revision of the architecture of the cue-based system, as well as to its deployment of features.

Feature percolation models, another feature driven approach to sentence processing, do predict the presence of a PPI illusion effect. As the polarity item integrates with the representation of the preceding material, the slight negativity of the matrix subject owing to the presence of a relative clause negation is equally able to impact the incorporation of an NPI or PPI. These approaches however face the same issue cue-based retrieval models do with respect to the quantifier restriction of these illusion effects. As suggested in the previous chapter, one strategy for resolving this issue would be to limit percolation to elements of like categories. In other words, a matrix subject NP would only percolate the negative features of negative NPs, while elements like sentential negation and downward entailing verbs would not impact the feature of the larger NP. Such an adjustment would likely have wider consequences for the application of feature percolation models to other phenomena, which would need to be evaluated in light of the empirical evidence. Another open question for feature percolation approaches is the extent to which a feature binary between negative and affirmative is appropriate. In languages with negative concord, this binary opposition of negation and affirmation is supported by the interpretation of sentences with multiple negations as negative. However, in double negation languages like English, multiple negations together can result in a positive interpretation. This suggests that the simple additive nature of a binary feature space for negation and affirmation may not be appropriate for capturing the broader behavior of the polarity system in processing.

Pragmatic accounts of polarity illusion have a compelling intuitive basis, but lack the ability to generalize across polarity item types, fail to provide a compelling account for the observed restriction to quantified negation, and do not articulate a clear mechanism for how the polarity item comes to be evaluated in a different syntactic position than it appears. Rather than an indictment of these approaches, the expansion of the empirical landscape of these various illusion effects should serve as guideposts for the development of any pragmatics based account of polarity processing.

Active scope models have a different set of considerations, as the approach is designed around the processing of quantification rather than polarity. Critically, the active scope model does not have an issue in restricting the distribution to solely negative quantifiers, as the model only predicts interference as a result of attempted quantifier raising. The active scope approach also predicts the presence of a PPI illusion effect on the basis that PPI are scope sensitive elements and thus should serve as a trigger for quantifier raising in exactly the same way as NPI. Thus, the active scope models account for the most challenging aspects of the distribution of the generalized polarity illusion.

In the following chapter, I adopt the perspective of the active scope model and investigate extensions of the illusion paradigm. Specifically, I investigate two factors predicted to be important for the distribution of polarity illusions under a quantifier driven approach. The first is the environment in which the non-commanding negation occurs, and the second is how existing binding relationships modulate the availability of the negative quantifier for the purposes of generating an illusion effect.

CHAPTER 5

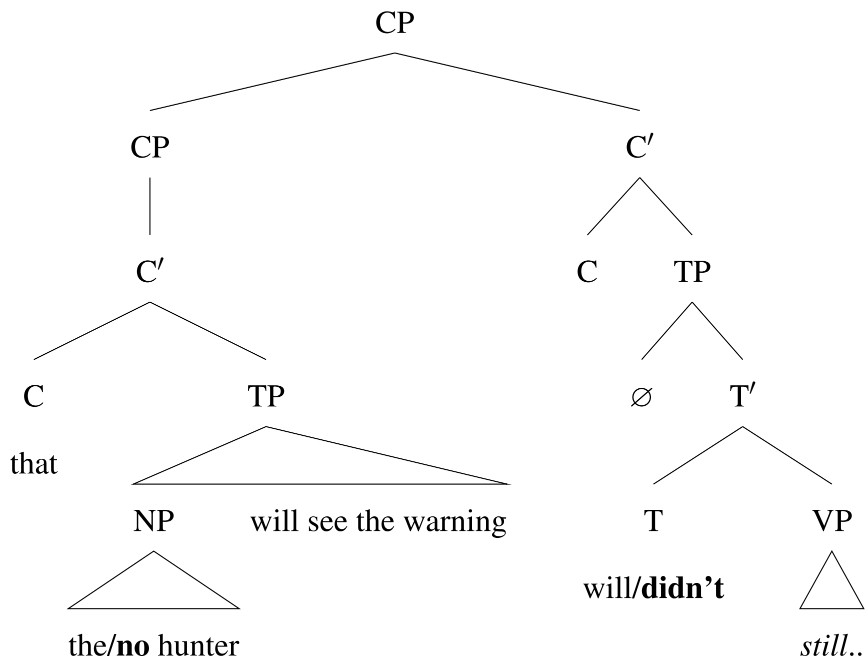
Further Consequences of Scope in the Generalized Polarity Illusion

Having expanded the empirical and theoretical landscape of polarity illusions, this chapter focuses on exploratory work intended to further broaden our understanding of the illusion phenomenon. Specifically, the experiments in this chapter test the ability of the illusion to occur in different clause structures and test if the illusion is impacted by the establishment of scope relations before the point of the polarity item. Both of these factors impact the syntactic and semantic status of the negative quantifier rather than the polarity item. Thus, these manipulations are generally not expected to produce an impact under any approach other than the active scope model, which places a unique importance on the negative quantifier.

5.1. Experiment 15

Experiment 15 investigates the environmental sensitivity of the polarity illusion effect by testing the illusion paradigm with a sentence initial CP rather than a subject modified by a relative clause. An initial CP provides, on the surface, an environment compatible with the polarity illusion effect as a negative element can be embedded in a non-commanding position prior to the point of the polarity item. A structural depiction of the paradigm appears in (5.1), following the analysis from Adger (2003) where the CP itself is the specifier of the matrix CP, semantically associated with a null pronoun in the specifier of TP. While the initial CP contains a negative subject, the CP itself is not negative and thus does not anti-license the PPI *still* in this context.

(5.1)



This environment differs from the relative clause in a critical aspect relevant for active scope models. Relative clauses have been shown to be permeable to quantifier interpretation with a number of examples (Barker 2021, Cecchetto 2004, Syrett 2015a,b). This permeability is perhaps best exemplified by the so-called donkey sentence paradigm, in which the variable within the relative clause appears to bind a pronoun in the matrix clause as in (5.2) (Barker and Shan 2008, Elbourne 2001, 2010, 2005, 2009, Evans 1977, 1980, Geach 1962, Heim 1990, Krifka 1996, Kroll 2008). That is to say, *it* does not refer to a particular donkey, but is free to vary with the farmer so that a farmer treats the donkey that they own kindly.

(5.2) Every farmer [∅who owns a donkey] treats it kindly.

While there remain questions related to how quantifiers are able to escape from various clauses, it has been suggested that the movement of a quantifier within and out of a clause must each independently satisfy scope Economy (Cecchetto 2004, Syrett 2015b). Thus, a relative clause in examples like (5.2) can be escaped as the presence of the relative clause operator allows for the local QR to satisfy Scope Economy while the presence of operators in the matrix CP, the subject quantifier *every* and the pronoun *it*, allows for the secondary QR in the matrix clause to satisfy Scope Economy.

Unlike in the relative clause cases, there is no such pathway in the case of the initial CP example (5.1). In the initial CP, there exists no operator which can result in a local application of QR that satisfies Scope Economy. Unlike in the case of relative clauses, the CP specifier in examples like (5.1) contains no scope sensitive operator. Thus, QR applied to the quantifier in the initial CP has no potential to generate a new interpretation and should be ruled out under Scope Economy. Lacking the first link in the series of QR operations, the second instance of QR, which would move the quantifier to take scope over the entire matrix clause, is not able to even be tested. If the parser never tests this position, the active scope model would then predict no illusory interference effect from the negative quantifier *no*, as it is trapped within the initial CP.

Of course, feature based systems do not make this distinction, as they are not concerned with the structure of the content that appears before the polarity item. For a model like cue-based retrieval, the situation for examples like (5.1) is exactly the same as it is in the case of relative clauses. There is a negative element, *no*, which has a [+negative] feature but lacks the [+c-command] feature. Thus, while not an ideal match, cue-based models and other feature based systems would predict that a negative element in an initial CP should cause an illusion in the same way as a negative element in a relative clause. By testing the ability of sentences containing an initial CP to create an illusion effect, we can gain a clearer understanding of relative roles of features and structures in the polarity illusion phenomenon.

5.1.1. Materials and Methods

Participants were 60 monolingual speakers of English from the United States recruited through Mechanical Turk, a platformed designed for crowd-working in a research context (Palan and Schitter 2018). All participants were compensated $8 for their participation. The task was estimated to take about 40 minutes to complete, though participants were allowed a total window of 150 minutes to complete the task with an ability to pause between trials.

Using a lexical maze task implemented in PCIbex Farm, participants' word by word reading times were measured (Boyce et al. 2020, Forster et al. 2009, Witzel et al. 2012, Zehr and Schwarz 2022). Participants in a lexical maze task read a sentence one word at a time. Each word of the sentence is presented alongside a plausible pseudo-word of English. If an incorrect selection is made, the trial immediately ends and the experiment proceeds to the next sentence.

The materials for this task consisted of 32 items with 4 conditions. The design of the items follows the design utilized in Orth et al. (2021). A sample item is presented in (5.3). The pseudo-words utilized in the study were generated using the Wuggy program to mirror the phonological features of the target word while respecting the various phonotactic constraints of English (Keuleers and Brysbaert 2010). All items were constructed such that the critical sentences were similarly plausible and a similar as possible outside the critical manipulations. All participants read a total of 118 sentences, consisting of 32 polarity illusion sentences and 86 filler sentences.

(5.3)
a. That the hunter will see the warning about bears **didn't** *still* surprise the warden.
b. That the hunter will see the warning about bears will *still* surprise the warden.
c. That **no** hunter will see the warning about bears will *still* surprise the warden.

d. That the hunter **didn't** see the warning about bears will *still* surprise the warden.

After receiving instructions and reviewing an informed consent document, participants reviewed the task instructions and completed a short practice section. Readers were instructed to pick the real word of English by pressing the 'e' or 'i' key corresponding to the word on the left or right side of the screen. Incorrect selections ended the trial immediately, and the participant is prompted to begin the next trial. After each trial, regardless of the answers selected, participants could pause to take a break before beginning the next trial by pressing the space key. Presentation order was randomized across participants using PCIbex Farm's Latin squaring and randomization method.

5.1.2. Results

Data were analyzed using linear mixed-effects models fit over log-transformed reading time at the critical region, the polarity item, and the spillover region, the following verb. The models employed a Helmert coded fixed-effects structure with 3 effects. The first effect was between the anti-licensed PPI, weighted 1, and the 3 licensed conditions, weighted -1/3. The second effect was between the grammatical PPI, weighted 1, and the potential illusion conditions, weighted -1/2. The final contrast was between the potential illusion condition with initial CP contained *no* and the potential illusion condition with initial CP contained *didn't*. Random intercepts by subject and by item were included in the spillover model, and a random intercept by subject was included in the critical region model after analysis suggested a random intercept by item did not improve model fit. Trials with first word response times longer than 10 seconds were excluded prior to analysis, as the participant was likely not yet ready to start the trial. Observations with unusually fast, <100ms, or unusually

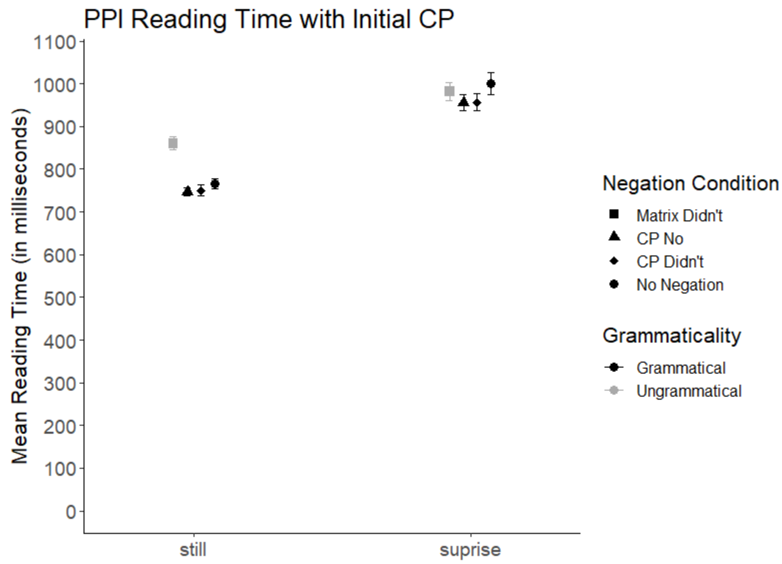


Figure 5.1. Experiment 15: Graph of reading time

slow, >10,000ms, were dropped from the analysis. A total of 3 trials were removed from the analysis after they were determined to be influential outliers in either the critical region, spillover region or both. A potential outlier was excluded if it appeared as an outlier based on visual analysis of at least two of the model Q-Q plot, plotted Cook's distance or plotted leverage by residual.

The response times at the critical and spillover region are plotted in Figure 5.1 and model output for the critical and spillover regions appears in Table 5.1 and Table 5.2.

At the critical region we observe a significant effect for anti-licensed PPI ($\hat{\beta} = 0.088$, $t = 8.591$, $p < 0.001$). We observe no effect of the no negation contrast or of the illusion element contrast. No significant effects are detected in the spillover region.

Fixed-Effects	Estimate	Standard Error	t Value	p Value
Intercept	-0.002	0.016	-0.110	>0.100
Anti-licensed PPI	0.088	0.010	8.591	**<0.001**
No Negation	0.016	0.010	1.623	>0.100
Illusion PPI	0.005	0.009	0.541	>0.100

Table 5.1. Experiment 15: Linear mixed effect model output of critical region reading time.

Fixed-Effects	Estimate	Standard Error	t Value	p Value
Intercept	-0.002	0.029	-0.081	>0.100
Anti-licensed PPI	0.017	0.012	1.411	>0.100
No Negation	0.010	0.012	0.928	>0.100
Illusion PPI	0.002	0.010	0.233	>0.100

Table 5.2. Experiment 15: Linear mixed effect model output of spillover region reading time.

5.1.3. Discussion

The results of Experiment 15 appear in line with the expectation of active scope models. As QR is not possible out of the initial CP position, no illusion effect is expected. On the other hand, this finding presents another challenge for cue-based retrieval other feature based models, as these models do not make a distinction between a negation embedded within a relative clause and a negation embedded within a subject CP. Thus, these results are compelling evidence in favor of the active scope model. In Experiment 16 we investigate a third class of environment which has potentially different expectations under an active scope model.

5.2. Experiment 16

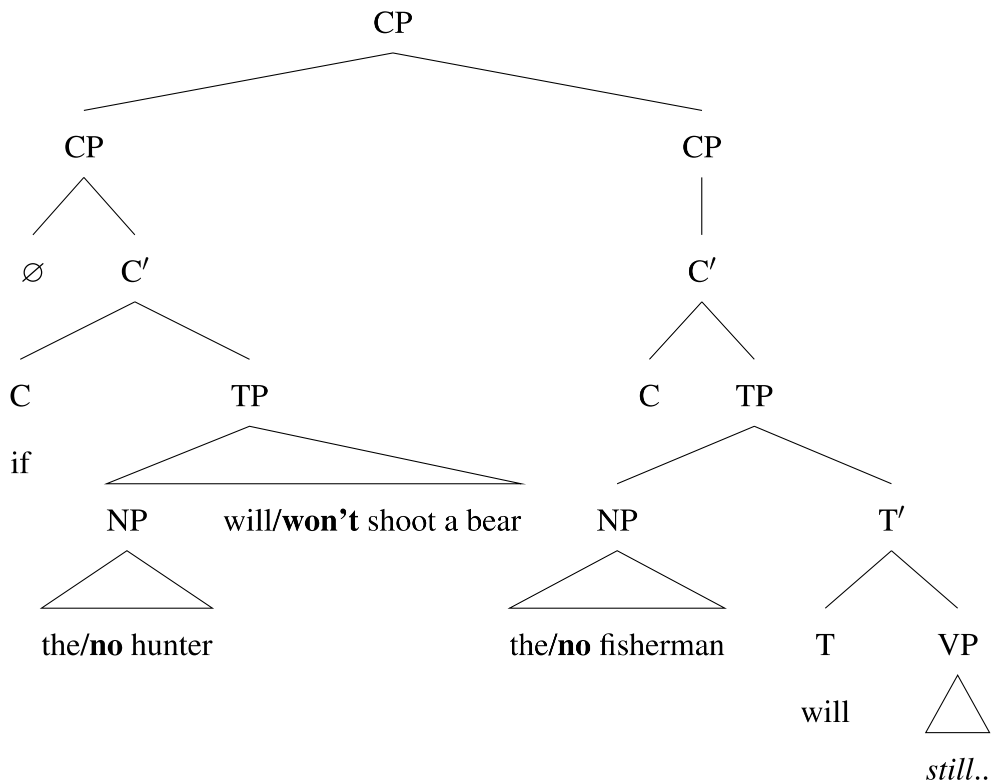
Experiment 16 builds upon the environmental finds of Experiment 15 by investigating a third class of embedding clause, which could predict a different temporal profile under the active scope model. If conditional clauses are similar to relative clauses in that they can be permeable to QR (Barker 2021). In fact, the donkey paradigm attested in the case of relative clauses similarly appears in the presence of if conditionals as in (5.4) (Barker and Shan 2008, Elbourne 2001, 2010, 2005, 2009, Evans 1977, 1980, Geach 1962, Heim 1990, Krifka 1996, Kroll 2008).

(5.4) If a farmer owns a donkey he treats it kindly.

Thus, if conditionals could in principle be expected to share a similar illusion profile to relative clauses. The structure of if conditionals is an expansive topic, is subject to much cross-linguistic variation, and is further complicated by the appearance of *if* and related elements in questions and other constructions (Bhatt and Pancheva 2017). For a comprehensive overview of the syntactic properties of conditionals, refer to Bhatt and Pancheva (2017).

For our purposes we take the position that, in English, the *if* which appears in conditionals is the head of a CP whichis attached to the matrix clause above the level of the subject Bhatt and Pancheva (2017), Iatridou and Embick (1994), Kayne (1991). In these constructions *if* itself abstracts over possible worlds and an additional operator in the specifier of CP controls whether the clause is interpreted as a question or a conditional. Thus, the structure of such a clause would appear as in (5.5)

(5.5)



Thus, if conditionals share properties with both initial CP configurations and relative clause configurations. Like the initial CP configuration, the if conditional configuration involves a CP which attaches high in the syntactic structure and linearly precedes the point of the polarity item. Additionally, like a relative clause, the if conditional contains an operator, both *if* itself and the requisite covert element in the specifier of CP, which can allow for the movement of a quantifier that is licensed under Scope Economy. In this respect, the if conditional has the structural appearance similar to the initial CP configuration, but its properties relevant for QR are more like a relative clause.

However, this is not the entire story, as there is a critical difference between the relative clause case and the if conditional case. Specifically, in the relative clause the operator which allows for QR to be licensed under Scope Economy is covert, while in the case of if conditionals, *if* is present in the surface form.

In the case of relative clauses, the operator which allows for QR to be licensed under Scope Economy is a covert element in the specifier of CP, which links the modified noun to the relative clause pronoun and by extension the gapped position. Thus, for the active scope model with triggers, there is no element in the relative clause itself that triggers QR. Rather, only an outside element like the pronoun in (5.2) or a later polarity item can serve as a trigger for the initial application of QR. In the case of if conditionals, *if* serves as an overt operator, which is relevant for the computation of Scope Economy. Thus, under the active scope model with triggers, the parser will have both the pieces it needs, a scope sensitive element and a quantifier, at the point of the quantifier contained within the conditional. While this QR only applies to the local CP containing the if conditional, this QR would be ruled out by the independent restriction on the movement of negation discussed in earlier portions of this dissertation (Barker 2021, Collins 2017, Collins and Postal 2014, Van Craenenbroeck and Temmerman 2017). If the parser can track this attempted application of QR which is blocked for reasons independent of Scope Economy, the parser should not attempt QR again at the point of the polarity item, blocking the illusion effect.

Thus, it could be the case that despite being a permeable environment, the prior testing of QR in the context of the if conditional could block the emergence of an illusion effect at the point of the polarity item. In Experiment 16 we investigate the processing profile of PPI following an if conditional clause containing negation.

5.2.1. Materials and Methods

Participants were 80 monolingual speakers of English from the United States recruited through Prolific, a platformed designed for crowd-working in a research context (Palan and Schitter 2018). All participants were compensated $8 for their participation. The task was estimated to take about 40 minutes to complete, though participants were allowed a total window of 150 minutes to complete the task with an ability to pause between trials.

The procedure and design of Experiment 16 follow the principles from Experiment 15. The materials for this task consisted of 32 items with 4 conditions. A sample item is presented in (5.6). All participants read a total of 120 sentences, consisting of 32 polarity illusion sentences and 88 filler sentences.

(5.6)
a. If the hunter will shoot a bear, **no** fisherman will *still* visit the river during mating season.
b. If the hunter will shoot a bear, the fisherman will *still* visit the river during mating season.
c. If **no** hunter will shoot a bear, the fisherman will *still* visit the river during mating season.
d. If the hunter **won't** shoot a bear, the fisherman will *still* visit the river during mating season.

5.2.2. Results

Data were analyzed using linear mixed-effects models fit over log-transformed reading time at the critical region, the polarity item, and the spillover region, the following verb. The model architecture, data processing and outlier exclusion followed the structure from Experiment 15. A total of 4 trials were removed from the analysis after they were determined to be influential outliers in either the critical region, spillover region or both.

The response times at the critical and spillover region are plotted in Figure 5.2 and model output for the critical and spillover regions appears in Table 5.3 and Table 5.4.

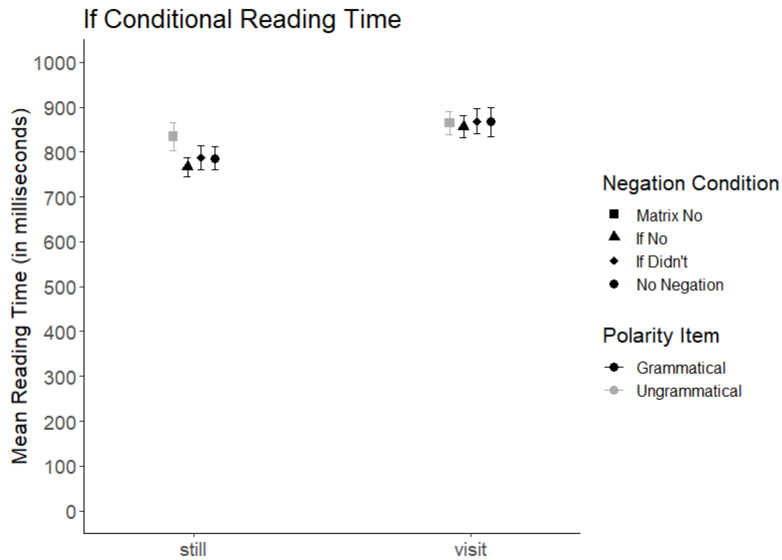


Figure 5.2. Experiment 16: Graph of reading time.

At the critical region we observe a significant effect for anti-licensed PPI ($\hat{\beta}$ = 0.051, t = 3.924, p <0.001). We observe no effect of the no negation contrast or of the illusion element contrast. No significant effects are detected in the spillover region.

Fixed-Effects	Estimate	Standard Error	t Value	p Value
Intercept	-0.001	0.018	-0.025	>0.100
Anti-licensed PPI	0.051	0.013	3.924	**<0.001**
No Negation	0.010	0.014	0.753	>0.100
Illusion PPI	-0.005	0.008	-0.599	>0.100

Table 5.3. Experiment 16: Linear mixed effect model output of critical region reading time.

5.2.3. Discussion

The results of Experiment 16 look similar to those of Experiment 15, with no illusion effect detected at the point of the PPI *still*. Thus, it appears that the environment merely being permeable to QR is not sufficient for triggering the polarity illusion phenomenon. Rather, it

Fixed-Effects	Estimate	Standard Error	t Value	p Value
Intercept	0.000	0.021	0.019	>0.100
Anti-licensed PPI	0.001	0.012	0.103	>0.100
No Negation	-0.004	0.013	-0.341	>0.100
Illusion PPI	-0.001	0.008	-0.182	>0.100

Table 5.4. Experiment 16: Linear mixed effect model output of spillover region reading time.

appears that the presence of scope sensitive triggers for QR earlier in the sentence is crucial to producing the effect at the point of the polarity item. This is in-line with the expectations of an active scope model in which the parser is able to track the success, or failure, of previously conducted QR operations. Because *if* serves as an overt scope sensitive element which licenses QR in the if-conditional, the parser is triggered to test the raising of *no* at an earlier point in processing than in the case of relative clauses where the scope sensitive element is covert.

As an interim summary, this dissertation has examined the potential of polarity illusions in three different configurations of polarity item, quantifier and scope sensitive operator. In the canonical relative clause configuration, the structure contains a covert scope sensitive operator, a negative quantifier, and a polarity item in that order. In the initial CP configuration, the structure contains only a negative quantifier and a polarity item. In the if conditional configuration, the structure contains an overt scope sensitive operator as well as a covert one, a negative quantifier, and a polarity item. What we have observed is a scope sensitive operator in the same clausal domain as the negative quantifier is required for the illusion. However, the lack of an illusion for the if conditional configuration, which meets this requirement, further suggests that it is also critical that the polarity item be the first overt scope sensitive element encountered. This is because the presence of an overt scope sensitive element before the point of the polarity item will result in the parser testing and ultimately rejecting the possibility of QR before the polarity item is ever encountered.

Having examined the role of the environment containing the negative quantifier, the final two experiments of this dissertation turn to investigate another important factor in the representation of quantifiers. Specifically, these experiments look to determine how the parser handles existing scope relations as processing unfolds.

5.3. Experiment 17

Experiment 17 investigates how the presence of multiple scope configurations impacts the availability of polarity illusion. Leveraging the finding from Chapter 3 that *none* allows for polarity illusion effects, we can investigate what happens when the negative quantifier that would trigger a polarity illusion binds a pronoun in the relative clause in a configuration like (5.7). In this example, the relative clause subject *none of the salesmen* can bind and serve as the antecedent for the embedded pronoun *him*. On one hand, if the parser prioritizes maintaining binding relations it is possible that the parser would, after connecting the negative quantifier to a pronoun within the relative clause, remove that negative quantifier from consideration for future QR operations. However, it is also possible that the parser would still perform QR in this configuration, as a quantifier can be involved in many scope relations at once, as in (5.2).

(5.7) The carpenter who **none** of the salesmen said believed *him* about the tool will *still* build a house in the suburbs.

An attentive reader may notice that this configuration shares certain properties with the if conditional structure presented in Experiment 16. Namely, prior to the point of the polarity item both a negative quantifier, *none*, and a scope sensitive element *him* are available. Thus, under the trigger based active scope model, we might anticipate that the parser will have attempted QR prior to the point of the polarity item *still*. However, there is an important distinction between the two cases. In the if conditional configuration, the operator is linearly prior to and structurally higher than the quantifier. This means that in the if conditional case, QR could potentially reverse the structural ordering of the operators and result in a new interpretation. In the pronoun case presented in (5.7), the quantifier lineally precedes and c-commands the embedded pronoun. Therefore, applying QR to the quantifier cannot alter the structural order of the two operators. Further, at this point in the sentence, there is not another overt operator which could vary in interpretation based on the QR of the negative quantifier *none*. A trigger based active scope model which accounts for this and other configurations where QR is guaranteed to vacuous based on the overt elements would predict no QR occurs until the point of the polarity item. Thus, evidence of an illusion effect at the point of the polarity item can tell us not only about binding, but also about the parser's treatment of scope configurations where QR is guaranteed to be vacuous.

5.3.1. Materials and Methods

Participants were 40 monolingual speakers of English from the United States recruited through Prolific, a platformed designed for crowd-working in a research context (Palan and Schitter 2018). All participants were compensated $8 for their participation. The task was estimated to take about 40 minutes to complete, though participants were allowed a total window of 150 minutes to complete the task with an ability to pause between trials.

This task employed a grammatical maze task implemented in PCIbex Farm which allows us to measure participant's word by word reading times (Boyce et al. 2020, Forster et al. 2009, Witzel et al. 2012, Zehr and Schwarz 2022). Like in the lexical maze task, participants in a grammatical maze task read a sentence one word at a time. Each word of the sentence is presented alongside another valid word of English which is matched for length but is highly implausible given the preceding context, selected through the use of A-Maze which automates foil selection (Boyce et al. 2020). If an incorrect selection is made, the trial immediately ends and the experiment proceeds to the next sentence. In this experiment we find the grammatical maze is justified as the polarity item is never ungrammatical, unlike in many previous experiments in this dissertation which opted to use a lexical variant of the maze task.

The materials for this task consisted of 24 items with 4 conditions. The sentences follow a similar schematic to the other experiments in this dissertation, being composed of a matrix subject modified by a relative clause and a matrix verb preceded by the PPI *still*. A sample item is presented in 5.8. In this design, however, we manipulate whether the relative clause subject is a negative quantifier *none* or a non-negative quantifier *one*. Also manipulated is the gender of the pronoun, *him* or *her*, that occurs in the relative clause, such that the pronoun matches or does not match the gender of the relative clause subject. The noun heads of these subjects include words like *waiters*, *fishermen*, and *queens* which were drawn from previous studies exploring gender mismatch effects (Carreiras, Garnham, Oakhill, and Cain 1996, Kazanina, Lau, Lieberman, Yoshida, and Phillips 2007, Kennison and Trofe 2003, Reali, Esaulova, Öttl, and Von Stockhausen 2015, Sturt 2003, Van Gompel and Liversedge 2003). The items were structured such that gender match occurred half the time with the pronoun *him* and half the time with the pronoun *her* to prevent associating mismatches with a particular gender feature.

(5.8)
a. The carpenter who **none** of the salesmen said believed *him* about the tool will *still* build a house in the suburbs.
b. The carpenter who one of the salesmen said believed *him* about the tool will *still* build a house in the suburbs.

c. The carpenter who **none** of the salesmen said believed *her* about the tool will *still* build a house in the suburbs.

d. The carpenter who one of the salesmen said believed *her* about the tool will *still* build a house in the suburbs.

After receiving instructions and reviewing an informed consent document, participants reviewed the task instructions and completed a short practice section. Readers were instructed to pick the real word of English by pressing the 'e' or 'i' key corresponding to the word on the left or right side of the screen. Incorrect selections ended the trial immediately, and the participant is prompted to begin the next trial. After each trial, regardless of the answers selected, participants could pause to take a break before beginning the next trial by pressing the space key. Presentation order was randomized across participants using PCIbex Farm's Latin squaring and randomization method.

5.3.2. Results

Data were analyzed using linear mixed-effects models fit over log-transformed reading time at the critical region, the polarity item, the spillover region, the following verb and the embedded pronoun region. For the critical and spillover region, the model consisted of two fixed effects and their interaction. The first effect was a contrast between *one*, weighted 1/2, and *none*, weighted -1/2, and the second effect was a contrast between mismatched gender, weighted 1/2, and matched gender, weighted -1/2. For the model of the pronoun region, an additional fixed effect was added for the contrast between *him*, weighted 1/2, and *her*, weighted -1/2. Interactions with this fixed effect were also added. All models include random intercepts by participant and by item. A total of 4 trials were removed from the

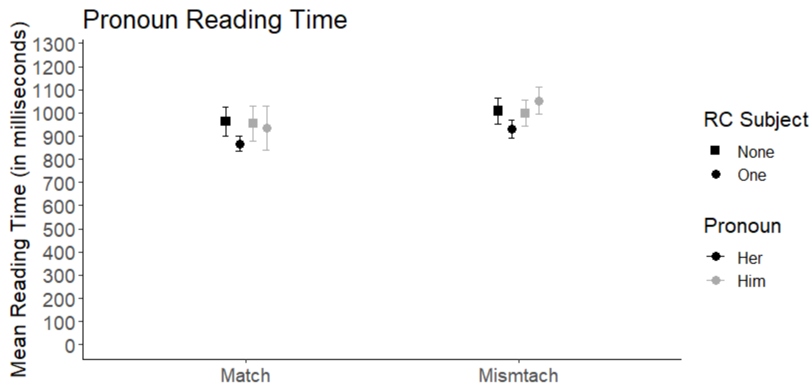


Figure 5.3. Experiment 17: Graph of pronoun reading time.

analysis after they were determined to be influential outliers in either the critical region, spillover region or both.

The response times at the pronoun region are plotted in Figure 5.3 and model output appears in Table 5.5. The response times at the critical and spillover region are plotted in Figure 5.4 and model output for the critical and spillover regions appears in Table 5.6 and Table 5.7.

At the pronoun region we observe a significant effect for mismatching gender ($\hat{\beta} = 0.120$, t = 3.480, p <0.001), such that reading times are slower when the gender mismatches the relative clause subject. We find no effect for which pronoun is used, nor for the determiner of the relative clause subject. No significant interactions are observed.

At the critical region, we observe no significant main effects. However, we do observe a significant effect of the interaction between mismatch and one ($\hat{\beta} = 0.119$, t = 2.007, p <0.05), such that reading time is particularly slow when the pronoun is mismatched and the relative clause subject determiner is *none*. No significant effects are detected in the spillover region.

Fixed-Effects	Estimate	Standard Error	t Value	p Value
Intercept	0.005	0.038	0.120	>0.100
Mismatch vs. Match	0.120	0.035	3.480	**<0.001**
One vs. None	-0.026	0.033	-0.807	>0.100
Him vs. Her	0.002	0.035	0.047	>0.100
Mismatch * Him	0.049	0.071	0.690	>0.100
Mismatch * One	0.042	0.088	0.473	>0.100
One * Him	0.036	0.072	0.504	>0.100
Mismatch * One * Him	0.092	0.130	0.704	>0.100

Table 5.5. Experiment 17: Linear mixed effect model output of pronoun region reading time.

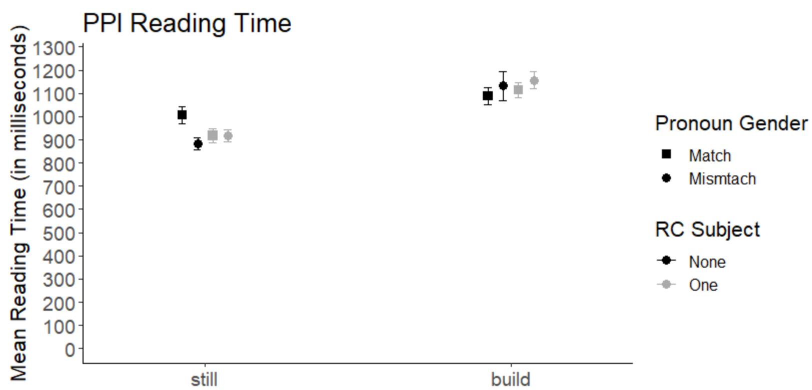


Figure 5.4. Experiment 17: Graph of polarity item reading time.

Fixed-Effects	Estimate	Standard Error	t Value	p Value
Intercept	-0.001	0.032	-0.008	>0.100
Mismatch	-0.036	0.029	-1.226	>0.100
One vs. None	-0.009	0.028	-0.320	>0.100
Mismatch * One	0.119	0.059	2.007	**<0.050**

Table 5.6. Experiment 17: Linear mixed effect model output of critical region reading time.

Fixed-Effects	Estimate	Standard Error	t Value	p Value
Intercept	0.011	0.041	0.265	>0.100
Mismatch	0.006	0.034	0.175	>0.100
One vs. None	-0.011	0.030	-0.363	>0.100
Mismatch * One	-0.090	0.070	-1.280	>0.100

Table 5.7. Experiment 17: Linear mixed effect model output of spillover region reading time.

5.3.3. Discussion

First, we do in fact observe the expected gender mismatch effect at the embedded pronoun, suggesting that participants are attempting to link this pronoun to the relative clause subject. This occurs without any effects of the negativity of the quantifier or the specific gender features in play. Thus, we are in a position to ask if the binding which occurs at the point of the pronoun impacts the availability of the quantifier for the upcoming potential polarity illusion.

We observe an interaction at the critical region that indicates longer reading times for one of the *none* conditions. Surprisingly, this polarity illusion effect was only detected when the embedded pronoun matched the gender of the relative clause subject. Thus, it appears that binding an element in the relative clause does not prevent the polarity illusion, rather in this case it is required for the polarity illusion to go through. This is a somewhat unexpected result, but one that could be explained based on previously known properties of the polarity illusion.

As demonstrated in Parker and Phillips (2016), the polarity illusion is subject to a temporal constraint called the temporal switch. By inserting enough time between the relative clause quantifier and the polarity item the illusion can be toggled off, thus there appears to be a temporal switch that deactivates the illusion effect. This switch was proposed to be the result of the decay of the negative quantifier's activation in memory or the completion of some other scope related processing (Parker and Phillips 2016). Under the memory activation hypothesis, the negative quantifier would be reactivated by the pronoun in the match condition. This boost of activation creates something of a temporal bridge, keeping the activation of the negative quantifier high enough that it is available for the illusion generating process at the point of the later polarity item. When the pronoun mismatches, however, the negative quantifier decays in memory to the point that it cannot be successfully reaccessed by the time the polarity item is reached. At the same time, the illusion profile uncovered in Chapters 2 and 3 suggests that activation based approaches like cue-based retrieval face significant issues in modeling the polarity illusion phenomena. Further, Parker and Phillips (2016) show that this temporal switch effect appears to be unique to NPI illusions, as it does not occur in other grammaticality illusions like agreement attraction. These other grammaticality illusions are also much more successfully modeled by cue-based retrieval (Wagers et al. 2009). Thus, at this point the source of the temporal switch is unclear as its direct relevance to the pattern of results obtained in Experiment 17. To determine if this is a genuine case of the illusion being impacted by this temporal switch, Experiment 18 looks to directly test the role of extra material in the relative clause.

5.4. Experiment 18

Experiment 18 looks to determine the role of temporal distance in the results of Experiment 17. Specifically, Experiment 18 manipulates the amount of time between the relative clause negative quantifier and the matrix clause polarity item. In this way, we can determine how the pattern of illusion effects observed in Experiment 17 is impacted by the relation between the negative quantifier in the relative clause and the pronoun.

5.4.1. Materials and Methods

The materials and Methods of Experiment 18 broadly followed the paradigm of Experiment 17. Participants were 81 monolingual speakers of English from the United States recruited through Prolific, a platformed designed for crowd-working in a research context (Palan and Schitter 2018). All participants were compensated $8 for their participation. The task was estimated to take about 40 minutes to complete, though participants were allowed a total window of 150 minutes to complete the task with an ability to pause between trials.

Like Experiment 17 this task employed a grammatical maze task implemented in PCIbex Farm which allows us to measure participant's word by word reading times (Boyce et al. 2020, Forster et al. 2009, Witzel et al. 2012, Zehr and Schwarz 2022).

The materials for this task consisted of 24 items with 4 conditions adapted from the materials used in Experiment 17. Like in Experiment 17, the gender of the relative pronoun was manipulated such that it either matched or mismatched the gender of the relative clause subject. The noun heads of these subjects include words like *waiters*, *fishermen*, and *queens* which were drawn from previous studies exploring gender mismatch effects (Carreiras et al. 1996, Kazanina et al. 2007, Kennison and Trofe 2003, Reali et al. 2015, Sturt 2003, Van Gompel and Liversedge 2003). The items were structured such that gender match occurred half the time with the pronoun *him* and half the time with the pronoun *her* to prevent associating mismatches with a particular gender feature.

Unlike in Experiment 17, all conditions included the relative clause subject with the negative quantifier *none*. Instead, we manipulate the length of the relative clause by manipulating the presence of relative clause material following the pronoun. A sample item is presented din 5.9. In all cases, the region manipulated consisted of a three word prepositional phrase immediately following the pronoun.

(5.9) a. The carpenter who **none** of the salesmen said believed *him* about the tool will *still* build a house in the suburbs.

b. The carpenter who **none** of the salesmen said believed *her* about the tool will *still* build a house in the suburbs.

c. The carpenter who **none** of the salesmen said believed *him* will *still* build a house in the suburbs.

d. The carpenter who **none** of the salesmen said believed *her* will *still* build a house in the suburbs.

5.4.2. Results

Data were analyzed using linear mixed-effects models fit over log-transformed reading time at the critical region, the polarity item, and the embedded pronoun region. For the critical and spillover region, the model consisted of two fixed effects and their interaction. The first effect was a contrast between the long condition, weighted 1/2, and the short condition, weighted -1/2, and the second effect was a contrast between mismatched gender, weighted 1/2, and matched gender, weighted -1/2. For the model of the pronoun region, an additional fixed effect was added for the contrast between *him*, weighted 1/2, and *her*, weighted -1/2. Interactions with this fixed effect were also added. All models include random intercepts by participant and by item. One trial was removed from the analysis after they were determined to be influential outliers in the critical region.

The response times at the pronoun region are plotted in Figure 5.5 and model output appears in Table 5.8. The response times at the critical region are plotted in Figure 5.6 and model output for the critical region appears in Table 5.9.

At the pronoun region we observe a significant effect for mismatching gender ($\hat{\beta}$ = 0.120, t = 3.480, p <0.001), such that reading times are slower when the gender mismatches the relative clause subject. We also find a significant effect for the gender of the pronoun, such that *her* is generally read faster ($\hat{\beta}$ = 0.120, t = 3.480, p <0.001). This effect appears to be driven by uniquely fast reading times for *her* in the short mismatch condition.

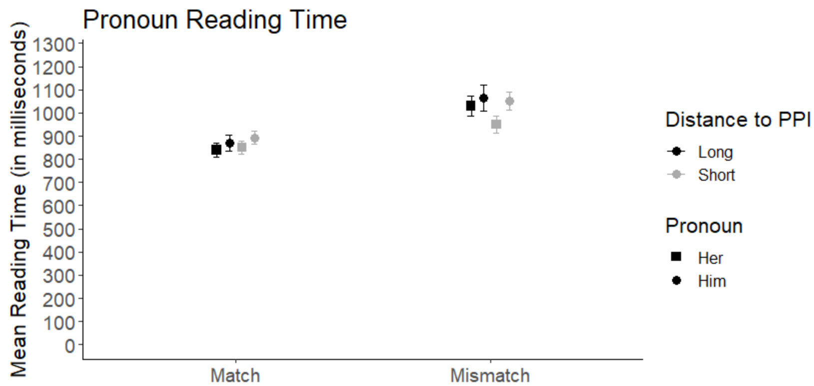


Figure 5.5. Experiment 18: Graph of pronoun reading time.

Fixed-Effects	Estimate	Standard Error	t Value	p Value
Intercept	0.001	0.028	0.042	>0.100
Long vs. Short	-0.001	0.020	-0.097	>0.100
Mismatch vs. Match	0.139	0.019	7.224	**<0.001**
Him vs. Her	0.048	0.019	2.494	**<0.050**
Long * Mismatch	0.062	0.038	1.593	>0.100
Long * Him	-0.046	0.039	-1.169	>0.100
Mismatch * Him	0.006	0.073	0.079	>0.100
Long * Mismatch * Him	-0.105	0.079	-1.331	>0.100

Table 5.8. Experiment 18: Linear mixed effect model output of pronoun region reading time.

At the critical region we observe a single significant main effect, such that the polarity item in the long condition is read faster than in the short condition ($\hat{\beta}$ = -0.061, t = -2.624, p <0.01). While the mean reading time for the long match condition is slower than the mean for the long mismatch condition, there is no significant interaction. Thus, we do not replicate the distinction observed between the two *none* conditions observed in Experiment 17.

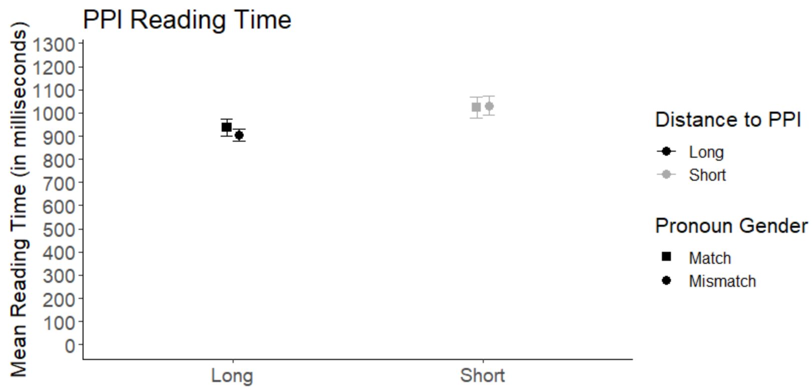


Figure 5.6. Experiment 18: Graph of polarity item reading time.

Fixed-Effects	Estimate	Standard Error	t Value	p Value
Intercept	0.006	0.027	0.230	>0.100
Long	-0.061	0.023	-2.624	**<0.010**
Mismatch	-0.008	0.023	-0.346	>0.100
Long * Mismatch	-0.038	0.047	-0.824	>0.100

Table 5.9. Experiment 18: Linear mixed effect model output of critical region reading time.

5.4.3. Discussion

The results of Experiment 18 are somewhat challenging to interpret. First and foremost, we do observe a gender mismatch effect again at the point of the pronoun, suggesting that participants are attempting to bind the pronoun. However, unlike in Experiment 17 we observe a small effect for the gender of the pronoun, such that in general *her* is read faster than *him*. For our purposes there is little to say about the faster reading times for *her* besides that the nature of gender biases in nouns should be investigated in more detail (Ackerman 2019).

Turning to the critical region containing the PPI *still*, the main effect observed here suggests that the polarity illusion penalty occurs in the short conditions, but not in either of the long conditions. This indicates a failure to replicate the detection of the illusion in the *none* and *match* condition found in Experiment 17. As the illusion penalty does appear to occur in the short conditions, it might be the case that the design of these experiments has situated the items in the long condition at the boundary of the temporal switch. Regardless, the question remains of what exactly is the nature of the temporal switch.

One potential alternative to the cue-based framing is that the temporal switch reflects a hardening of scope representation that is necessary for other forms of processing. As discussed in earlier remarks on pragmatic approaches to the polarity illusion phenomena, many pragmatic processes exist which are critically reliant on the syntactic and semantic structure of an utterance. While likely not the driver of the polarity illusion effect, pragmatic processes are likely to occur in an incremental fashion during online sentence processing, and it may behoove the parser to commit to a scope representation before doing any pragmatic inferencing. By introducing a pronoun for the negative quantifier to bind, it is possible that this hardening of the scope representation is delayed, allowing for the illusion to occur at a greater temporal distance than it otherwise would.

The observation of an illusion at the point of the polarity item also supports the idea that the trigger based active scope model makes rational choices about deploying QR in configurations where QR is guaranteed to be vacuous based on the elements which are overtly present. If the parser were to have triggered QR at the point of the embedded pronoun, we would not expect to see any meaningful differences at the point of the polarity item, as the configuration would result in a similar calculation as the if conditional configuration tested in Experiment 16. However, we do observe an illusion effect in the short conditions. This suggests that rather than performing QR at the first scope sensitive element, the embedded pronoun, the parser recognizes the configuration of overt materials as one unable to produce a novel scope interpretation and does not attempt QR until the point of the polarity item.

5.5. General Discussion

The experiments presented in this chapter aimed to explore how other properties relevant for the processing of quantifiers could impact the distribution of polarity illusion effects. In Experiments 15 and 16 we find that the polarity illusion effect does not appear to occur in sentences with an initial CP containing negation or sentences with an if-conditional containing negation. On the view that the polarity illusion is a result of the processing quantifiers, this may not be so surprising. As an initial CP does not allow for the quantifier to escape and take higher scope like a relative clause does, it stands to reason that the illusion would not occur if the underlying mechanism relies on QR. If-conditionals, on the other hand, should allow the quantifier to escape, and thus we might expect them to pattern like sentences with an initial CP rather than the relative clause sentences. However, unlike in the case of an initial CP or a relative clause, if-conditionals contain a scope sensitive operator which is visible before the point of the polarity item. Under an active scope model with triggering, it is possible that instead of performing QR at the point of the polarity item, QR is performed earlier at the point of the quantifier itself. In this way, the parser has tested the QR of the negative quantifier in the if-conditional before the point of the PPI. If the parser tracks unsuccessful attempts at QR, it is possible that the negative quantifier necessary to trigger the illusion would be unavailable for another QR attempt, resulting in processing which mirrors the baseline without negation.

In Experiments 17 and 18 we found that the polarity illusion effect does not appear to be prevented by existing binding relationships. We also find a pattern of results consistent with the temporal switch previously reported in the polarity illusion literature (Parker and Phillips

2016). The exact nature of this switch, and why it appears to narrowly apply to polarity illusions, is unclear, though it may be possible that this switch reflects the parser's need to fix the scope interpretation to perform pragmatic processing in an incremental fashion. The results of Experiments 17 and 18 also suggest that the active scope model with triggers is sensitive to certain configurations where QR cannot possibly produce a novel interpretation, and does not perform QR in these cases.

CHAPTER 6

Conclusion

This dissertation has sought to address the processing of quantifier scope relations in sentence processing. In the course of this investigation, there are three main areas in which our domain of knowledge has expanded, which I will briefly summarize before beginning a more detailed conclusion on each of these matters.

The first area is our empirical knowledge of human sentence processing behaviors and outcomes. Chapter 2 of this dissertation focused on the processing of scopally complex sentences with verb phrase ellipsis and showed that the parser appears to readily and frequently attempt to evaluate quantifiers as if they were in a non-surface position, suggesting the human sentence parser is committed to ensuring scope structures abide by Scope Economy. In Chapter 3 we observed exhaustively that the NPI illusion is conditioned on the presence of a negative quantifier of any form. Chapter 4 expanded this knowledge by testing the illusion potential of PPI, finding a counterpart illusion of ungrammaticality for PPI in the same contexts where NPI illusion has been observed. Finally, Chapter 5 expanded the set of environments that these polarity illusions have been tested in and showed that the presence of a polarity illusion is conditioned on the quantifier permeability of the negation containing context and the surface ordering of operators. Chapter 5 also investigated how the parser handles existing binding relations in the context of the illusion and provided additional evidence for a so-called temporal switch in the polarity illusion phenomenon.

While accruing this empirical evidence of processing behavior, the dissertation also proposed and refined the notion of an active scope model for the processing of quantifiers online. At a high level, this model suggests that the parser frequently performs QR in order to probe for novel scope interpretations incrementally during sentence processing. However, the temporal profiles and distributional properties observed in this dissertation also advocate for a version of active scope processing which makes certain concessions for the covertness of various quantifiers, variables, operators and other scope sensitive materials, in order to minimize applications of QR which can never yield a novel interpretation.

Finally, this dissertation, in pursing evidence in favor of a parser which aims to satisfy Scope Economy online, argues for a central place of quantifier raising and Scope Economy in our grammatical theories. As theoretical research begins to reexamine evidence about the ability of quantifiers to take wider scope, this dissertation stands as further evidence in favor of a theory of QR which is less environmentally restricted. As Scope Economy is uniquely able to explain the processing behavior observed in these experiments, this dissertation also serves as a call for a deeper investigation into how our grammatical theory can be made more compatible with the interpretation comparison that rests at the heart of Scope Economy.

6.1. Methodological Matters

Much of this dissertation has been devoted to empirical content. Through a series of 18 experiments using methods including untimed sentence judgement, speeded acceptability judgement, eye-tracking while reading, and the Maze Task, this dissertation has aimed to systematically investigate some of the properties of the human sentence processor. In this regard, there are a few more general matters that this dissertation speaks to.

Through the course of this dissertation, the Maze-Task has been deployed, in both its grammatical and lexical forms. The experiments using this methodology, Experiment 1, Experiment 13 and Experiments 15-18, each display a general sensitivity to the linguistic content and more specifically show patterns of result in line with the linguistically motivated hypotheses posited throughout this dissertation. Thus, it is my hope that this dissertation can be used as a practical example of how this method can be adopted more broadly in psycholinguistic research. In particular, the results presented in Chapter 4 where the Maze Task was employed alongside untimed acceptability judgements and eye-tracking while reading suggest the promise of an important niche for the Maze Task. These results, much like the untimed acceptability results, were obtained over the web while at the same time providing a clearer demonstration of the hypothesized effects than was observed in eye-tracking while reading. While it should be noted that a predictive mapping from Maze-Task effects and particular eye-tracking measures is not clear and unlikely to develop, the Maze-Task has proven to be a reliable replicator of effects observed in other methodologies, while boasting a simpler analysis and deployment pipeline than eye-tracking while reading.

As a second matter, this dissertation has largely eschewed methods that measure interpretation like analysis of comprehension questions or truth value judgement tasks (Crain and McKee 1985, Crain and Thornton 1998). While these methods have been used to gain insight into what kinds of interpretations readers can arrive at, it remains true that for a given sentence many interpretations can be possible (Crain and McKee 1985, Crain and Thornton 1998, Ferreira and Yang 2019, Spychalska, Kontinen, and Werning 2016, Syrett 2015b). Perhaps more importantly, it is also the case that there are many potential processing strategies which arrive at the same interpretation, but take different steps in the moment-to-moment processing before the point that these tasks can measure. Considering that it is the case that any sentence which could be interpreted with inverse scope can be interpreted with surface scope, barring an independent constraint such as scope parallelism, these interpretive measures are not enough to understand how meaning is derived from a sentence as it unfolds. At a broad level, the active scope model proposed in this dissertation sets out predictions for which regions we might expect to see incremental processing activity and the relative differences between different quantification conditions. On the basis of this evidence we can clearly observe that even in cases like those presented in Experiment 1, many potential scope configurations can be considered, despite there being a single licit interpretation that must be adopted. In this way, I also hope that this dissertation serves as a model for a different approach to investigating meaning in sentence processing, which is less concerned with final outcome and instead strives to understand the sequence of processes which lead up to a final interpretive decision.

6.2. The Generalized Polarity Illusion

As a matter of general contribution to the body of evidence in sentence processing, this dissertation has greatly expanded our understanding of the NPI illusion, uncovered a novel illusion in the processing of PPI, and explored these illusions in new syntactic environments. In Chapter 3, through a series of systematic investigations targeting different properties of various NPI licensors this dissertation has demonstrated that the NPI illusion is limited to negative quantifiers, echoing recent investigations (Muller and Phillips 2020, Orth et al. 2021). Within that category, however, the illusion is robust as it was regularly detected with various experimental and statistical measures and with varying forms of negative quantifiers. This restriction to quantification should be the first call to reconsider the origin and framing of the illusion, as quantification is not a property directly related to the licensing conditions of NPI. Indeed, this restriction to negative elements which are also quantifiers is one of the most difficult aspects of the illusion profile to account for in feature based systems which are driven by the licensing needs of the NPI.

Underscoring further this independence from licensing conditions is the discovery of a novel illusion of ungrammaticality for PPI in the NPI illusion context detailed in Chapter

4. As PPI should never attempt to form a dependency with a negative element, this result directly challenges the notion that the PPI illusion could be accounted for by a feature-based system which aims to produce grammatical structures (Wagers et al. 2009). However, the fact that this PPI illusion effect also appears to be sensitive to the quantifier status of the intervening negative element suggests that the same mechanism that underlies the NPI illusion should also generate the PPI illusion.

In this way, this dissertation advocates for a shift from the conceptualization of an NPI illusion of grammaticality and a PPI illusion of ungrammaticality, to a framework of a generalized polarity illusion. Under this generalized polarity illusion framework, the mechanism of illusion is independent to the triggering polarity item's response to a negative element. Instead, what is critical is how the negative quantifier comes to be interpreted with scope over the polarity item, which I have argued to be through the incremental and frequent application of QR during online sentence processing.

In the realm of the generalized polarity illusion, we observe more evidence for the importance of quantification in the experiments presented in Chapter 5. When a negative quantifier is embedded in an environment which does not allow for a quantifier to escape, such as the initial CP tested in Experiment 15, no illusion effect occurs. This environmental factor is difficult to account for in feature-based systems, as the linear configuration of elements remains unchanged from the canonical relative clause polarity illusion. However, the lack of an illusion when a negative quantifier is embedded within an initial CP is easily accounted for in the active scope approach to the illusion. As the initial CP contains no scope sensitive element other than the negative quantifier, the initial application of QR will be ungrammatical with respect to Scope Economy, preventing the parser from ever considering a configuration where the negative quantifier takes scope over the polarity item.

This dissertation also has, unintentionally, generated some evidence in favor of the temporal switch for NPI illusions, in which the effect disappears with sufficient temporal distance between the negative quantifier and the polarity item. Experiments 17 and 18 show that the distance at which the illusion effect can be observed can be extended by establishing a binding relation between the negative quantifier and the relative clause. As remarked in Parker and Phillips (2016), this temporal switch appears to be a unique feature of the polarity illusion, as it does not appear with illusion effects like agreement attraction. Because this effect appears unique to an illusion which is not easily captured in feature based systems, this dissertation takes the opinion that this switch could reflect a hardening of scope commitments which feeds incremental pragmatic processing rather than degraded memory activation. However, future work on the nature of this temporal switch and the time course of pragmatic processes will be necessary to adopt a firmer conclusion.

6.3. Active Scope Models

One of the critical goals of this dissertation was to present a novel proposal for how quantification and scope are processed in real time, which I have called the active scope model. As discussed in Chapter 2, the landscape of approaches to scope in sentence processing is organized around the parameters of the degree of incrementality and the frequency at which non-surface scope representations are constructed. Specifically discussed in this dissertation were three models for scope resolution. In so called non-incremental models, scope related calculation does not take place until a minimal sentential unit is processed.(Bott and Schlotterbeck 2015). In QR avoidant models the parser considers non-surface scope only in the presence of pragmatically supporting context, though the exact nature of how and when pragmatic factors allow for inverse scope is somewhat unclear (Anderson 2004, Tanaka 2015, Wurmbrand 2018). Finally, in active scope models, it is proposed that the parser attempts QR regularly in order to ensure that the potential scope configurations for a sentence are produced and that those configurations respect the Scope Economy condition on QR. As discussed in various points of this dissertation, this procedure could be highly greedy by performing QR as soon as a quantifier is encountered, or more strategic by only performing QR when other scope sensitive elements are present in positions that could allow for changes in the scope structure.

Experiment 1 serves as the most comprehensive test of the processing profile of quantification, with the most scopally complex condition boasting 4 quantifiers alongside the scope parallelism constraint on ellipsis (Fox 2002, Johnson 2001, May 1977, Merchant et al. 2001, Sag 1976). In this experiment, the presence of quantifiers in both the first and second conjunct was manipulated in order to observe differences in how the parser treats quantifiers in the presence of other materials relevant for determining the scope configuration of the sentence. The study found evidence of considerable scope related activity throughout the tested sentences. This gives the sense that the parser's treatment of quantification does not appear to require a fully specified sentential unit, as predicted by non-incremental models. It also suggests that the parser does no uniformly avoid performing QR as predicted by QR-avoidant models. In particular, the presence of penalties at quantifier regions in contexts where QR would be ruled out by Scope Economy suggests that the parser will regularly construct a new scope configuration using QR, only to find a Scope Economy violation which requires undoing that operation. These penalties exist even in conditions where scope parallelism would also rule out the application of QR. This suggests that the parser is compelled to test scope relations and does not rely on the constraints external to Scope Economy to control the deployment of QR in online processing.

The findings related to the generalized polarity illusion further support the idea that the parser actively tests quantifier scope by performing QR, and that this active scope processing can have consequences for the processing of other elements online. First, the observed restriction of the polarity illusion to contexts with negative quantifiers aligns with the active scope model, as it provides a mechanism by which a polarity item that is not c-commanded by a negative element comes to be evaluated as if it were in the scope of a negative quantifier. The appearance of illusion effects for both NPI and PPI in directions consistent with their licensing conditions is also predicted, as raising a negative quantifier to a scope position over the matrix clause by QR would be expected to influence the grammaticality of both kinds of polarity item.

The environmental considerations tested in Chapter 5 also speak to act specification of active scope processing. Rather than raising a quantifier as soon as it is encountered, we proposed in Chapter 2 that the deployment of QR could be triggered by the presence of scope sensitive elements. In the case of polarity illusions using a relative clause design, this point is at the polarity item itself. However, in the context of if conditionals explored in Experiment 16, the conditional *if* itself provides an earlier scope sensitive element to trigger raising. This earlier scope sensitive element would allow for QR to occur at the point of the negative quantifier, and thus predict that the issue of the scope of the negative quantifier will have been resolved before reaching the point of the polarity item. Indeed, what we observe is a clear lack of illusion effect at the point of the polarity item, suggesting that whatever mechanism gives rise to the polarity item illusion in relative clause contexts is unavailable in the if conditional context. Likewise, Experiments 17 and 18 suggest that not every scope sensitive element will immediately trigger the computation of QR. In these cases where a pronoun is c-commanded by a negative quantifier, we still are able to observe an illusion effect at the point of a polarity item. This suggests that the pre-computation that occurred when the scope sensitive *if* appeared before the negative quantifier does not occur when a pronoun occurs in a position c-commanded by a negative quantifier. From the perspective of Scope Economy, this lopsided role of scope sensitive triggers make sense. If a pronoun is already c-commanded by a quantifier and no other scope sensitive materials are present, QR will never produce a novel interpretation. In contrast, if a scope sensitive element like *if* appears in a position c-commanding a quantifier, QR could result in a new valid scope configuration where the quantifier now c-commands the conditional. Thus, the procedures for the active processing of quantifier scope appear to be optimized around Scope Economy considerations, while ignoring external constraints like scope parallelism or limitations on the movement of negation (Barker 2021, Collins 2017, Collins and Postal 2014, Fox 2002, Johnson 2001, May 1977, Merchant et al. 2001, Sag 1976, Van Craenenbroeck and Temmerman 2017).

To sketch more fully the image of active scope processing given by this dissertation, I'll take this space to restate the general conditions on the deployment of QR in processing. First and most critically, the parser must encounter a quantifier. If there exists a scope sensitive element in the memory representation of the sentence, the parser immediately performs QR of the newly encountered quantifier within the clause containing that element. This captures contexts like Experiments 1 and 16 where scope sensitive material like another quantifier or *if* another conditional precedes the quantifier in question. If there is no such element in memory, the parser does not perform QR at this time. If the parser encounters a novel scope sensitive element which is c-commanded by the quantifier, QR is not performed unless that element is a quantifier. This captures the finding that polarity illusions can occur even when a pronoun lineally intervenes between the quantifier and the polarity item.

Note that if a quantifier is encountered, it should be raised via the rule for encountering a new quantifier, allowing for the immediate calculation of inverse scope when a quantifier c-commands another quantifier. Finally, if a scope sensitive element is encountered which is not c-commanded by the quantifier, perform QR. This captures the effect at the point of the polarity item as well as in the subject of the second conjunct of the ellipsis construction in Experiment 1. If any application of QR results in a movement which produces a novel interpretation and does not violate some other condition on movement, processing continues with the new scope structure. If the QR application does not yield a new interpretation, the QR application is reverted and processing continues. Finally, if the QR application satisfies Scope Economy but violates another condition on movement, the application of QR is immediately reverted and the quantifier is no longer considered as a target for quantifier raising.

In this version of the active scope processing, QR occurs when it has the potential to produce a novel interpretation, does not occur when the surface configuration is such that the quantifier already c-commands an incoming scope sensitive element, and is not attempted again if the application of QR is found to violate some other constraint on movement. This system, while somewhat complex, avoids issues of apparent precognition that arise with QR-avoidant models, minimizes applications of QR which are unlikely to satisfy Scope Economy, and prevents repeated violations of independent constraints on movement which could occur during QR.

6.4. Scope Economy and Quantifier Raising

This dissertation has approached the processing profile of quantification from the perspective that QR is the primary syntactic tool for adjusting the relative position of quantifiers, and that Scope Economy is a grammatical condition which limits the acceptability of derivations involving QR. This position was adopted for its predictive power. Scope Economy, at its core, requires a comparison of interpretations and derivations. If a derivation involving QR fails to yield a novel interpretation relative to a prior derivational step, the derivational step involving QR is not licensed and must be ruled out. On the assumption that interpretation is fed by structure, this creates a unique problem in the space of online sentence processing. Specifically, it means that in order to compare the relevant interpretations for a Scope Economy evaluation, both of the involved structures must be constructed. This means there is an inbuilt capacity for the parser to build ungrammatical structures. A perfectly coherent sequence of events would be for the parser to construct a representation containing QR, in order to evaluate that application of QR for Scope Economy, find that the interpretation does not change, and revert the QR application. The idea that the parser has the ability to build ungrammatical structures has been hotly debated in psycholinguistics research, but one that is required if a human grammar contains a version of Scope Economy which requires the comparison of interpretations (Clifton and Frazier 1989, Crain and Fodor 1985, Fodor 1978, 1981, Frazier, Ackerman, Baumann, Potter, and Yoshida 2015, Freedman and Forster 1985, Kazanina et al. 2007, Miller and Chomsky 1963, Phillips 1996, 2006, Phillips et al. 2011, Steedman 1996, Stowe 1992). Indeed, this is just what we observe in the experiments contained within this dissertation. In Experiment 1 we observe significant costs at specific quantifier regions where the application of QR would result in a Scope Economy violation and related reanalysis cost (Fodor and Ferreira 2013, Frazier 1979, Frazier and Clifton 1998, Schneider and Phillips 2001, Sturt 1996). Meanwhile, in the polarity illusion experiments show that the parser attempts to construct a scope configuration which is ungrammatical due to restrictions on the movement of negation and in the case of PPI, their anti-licensing conditions (Baker 1970, Collins 2017, Giannakidou

1997, Homer 2015, 2021, Ladusaw 1980, Postal 2000, Progovac 1994). Thus, the behavior of the sentence processor is consistent with a definition of Scope Economy that requires a comparison between interpretations. As previously discussed in this dissertation, attempts to recast Scope Economy as a processing preference for avoiding QR fail to predict the costs we observe in Experiment 1 for structures where QR would result in violations of Scope Economy (Anderson 2004, Tanaka 2015, Wurmbrand 2018). In this way, the data in this dissertation makes an argument for the existence of Scope Economy as a condition in grammar and for QR as a method by which the grammar can shift scope.

Taking seriously the evidence from processing as evidence for what should be going on in the grammar, the evidence offered in this dissertation suggests that future work should revisit the implications QR and Scope Economy have as features of grammar. In particular, I wish to identify two related issues which have been objects of some previous discussions of Scope Economy that should be revisited. The first is the role of the derivation in the computation of Scope Economy, and whether the interpretation comparison is made across two different derivations with the same materials, with respect to different stages of a single derivation, or if it can be restated as an operation which requires no true comparison. The second issue is the potential breakdown of modularity that emerges in the syntax-semantic interface, where Scope Economy requires interaction between the syntactic and interpretive modules. These two issues are tightly related and best addressed in tandem.

In a modular approach to syntax and semantic interpretation, it is thought that there are two separate cognitive systems which act on different elements, use different operations, and produce different outputs. The syntactic system takes primitive elements, words or features, in order to produce syntactic structures through the application of syntactic rules. The interpretative system then takes as input syntactic structures and utilizes a different set of operations which govern how these structures connect to thought and communication (Fox 2000). In this modular system, the application of syntactic operations is not conditioned by any sort of interpretation which is achieved by application of the syntactic operation. As Fox (2000) points out, this modular view is incompatible with Scope Economy in which QR, a syntactic operation, is conditioned by evaluations made in the interpretive module. As modularity has been a fruitful framework for the investigation of various language systems and their interfaces, I as well as Fox (2000) desire to avoid abandoning modularity. The solution offered by Fox (2000) is a proposed submodule of the semantic systems called the Deductive System, which is a highly limited formal deductive system intended to condition specific syntactic operations and is the only semantic system which can condition the application of syntactic rules. While more speculative than formal, the Deductive System proposed in Fox (2000) uses only the properties of logical words, including negation, quantifiers, and modals to perform limited calculations. This is primarily focused on identifying scopally commutative operators, something this dissertation has proposed as information potentially available in early processing based on the lexical features of particular quantifiers. This self-contained submodule, responsible only for a particular set of semantic features can, in principle, determine if an input structure is scopally commutative and thus can compute if Scope Economy would be violated by commutativity prior to performing QR. While something like the deductive system appears to be viable based on the observed pattern of QR in sentences with commutative operators, the effect of the employment of the deductive system bears less directly on modularity than it does on the issue of the derivation (Bhatt 2002). With the Deductive System there is no longer a comparison of interpretations, instead the structure is shipped to the Deductive System which serves to determine whether QR can be applied.

With respect to the derivation, this simplifies things as there is no longer a comparison. However, the question of modularity remains. If the Deductive System is indeed a part of the interpretive module, it appears that there is a clear chain of events required. The first step is to create some syntactic structure which contains no QR. This structure must then be passed through to the submodule, the Deductive System, which is housed in the interpretive module. The Deductive System determines whether the structure is scopally commutative or not. If it is scopally commutative, the structure is passed to the larger semantic module for further processing. If not, QR can and should be applied. However, if QR is indeed a syntactic operation, it appears this would require returning the structure to the syntactic module, where QR is an operation. This passing backward appears to be the same issue as is faced when interpretations are directly compared. This further invites the question of when the Deductive System is applied. Is it a gatekeeper to the interpretive module, being applied every time, and thus potentially vacuously in the case of structures which were passed back and had QR applied to them? Or is it only applied once, suggesting a much tighter linkage between the syntactic module and the operations of the Deductive System than appears to exist between the Deductive System and the rest of the interpretive module? With these questions it appears this proposal addresses the role of the derivation clearly, there is a single derivation which passes to the Deductive System and potentially is passed back, but does not clearly address the issue of the relation between modules. The Deductive System also appears to have something of a look ahead flavor. Rather than making use of QR, which exists for the purposes of producing scope structures, the Deductive System employs a separate proof system to evaluate the informativity of elements as if they were in a scope structure. In this way it appears to be something of a cross-module reduplication of effort, which is something that we should be keen to avoid.

At this juncture, I have no simple solution to offer on either of these issues. Indeed, part of the unique predictive power of Scope Economy in the realm of sentence processing is the apparent requirement that multiple structures are produced and compared directly. Thus, I would advocate for grammatical approaches which favor maintaining the evaluation of either multiple derivations or multiple steps of a single derivation. Some inspiration could be taken from approaches like multiple spell-out, which advocates for an interface which applies cyclically during the course of a derivation which is in line with the apparent cyclic sensitivity of QR to Scope Economy (Nunes and Uriagereka 2000, Uriagereka 1999a,b). To the question of modularity, the Deductive System does touch upon a potentially important notion that certain semantic properties appear different from others. Namely, that logical elements occupy a unique status compared to aspects of meaning which vary between languages and cultures. In this way, reconsidering the relation between the syntactic module, the interpretive module, and these aspects of meaning is likely necessary for developing an approach to Scope Economy which preserves the notion of modularity.

For future work in these areas, I believe that a holistic approach is required. Our understanding of the properties of the grammar can inform the development of targeted empirical investigations of processing behavior, like those featured in this dissertation. At the same time, our understanding of processing behavior can, with appropriate design considerations, inform the development of our theories of grammar as well as our theories of human sentence processing. With the two elements working together, we can gain insight into the interplay of performance and competence and the difference in the computational demands made by the two systems.

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APPENDIX A

Experimental Materials for Chapter 2

A.1. Experiment 1 Items

1a. At least one professor will recommend each student, and some deans will too because the nominations are due soon.
1b. At least one professor will recommend each student, and the deans will too because the nominations are due soon.
1c. That famous old professor will recommend each student, and some deans will too because the nominations are due soon.
1d. That famous old professor will recommend each student, and the deans will too because the nominations are due soon.
2a. At least one doctor will visit each patient, and some nurses will too because the hospital is barely busy.
2b. At least one doctor will visit each patient, and the nurses will too because the hospital is barely busy.
2c. That angry young doctor will visit each patient, and some nurses will too because the hospital is barely busy.
2d. That angry young doctor will visit each patient, and the nurses will too because the hospital is barely busy.
3a. At least one plumber will inspect each bathroom, and some janitors will too because the building was recently refinished.
3b. At least one plumber will inspect each bathroom, and the janitors will too because the building was recently refinished.
3c. That lazy bald plumber will inspect each bathroom, and some janitors will too because the building was recently refinished.
3d. That lazy bald plumber will inspect each bathroom, and the janitors will too because the building was recently refinished.
4a. At least one judge will review each case, and some lawyers will too because the evidence was suddenly overturned.
4b. At least one judge will review each case, and the lawyers will too because the evidence was suddenly overturned.
4c. That very clever judge will review each case, and some lawyers will too because the evidence was suddenly overturned.
4d. That very clever judge will review each case, and the lawyers will too because the evidence was suddenly overturned.
5a. At least one executive will evaluate each hire, and some managers will too because the company is being careful.

5b. At least on executive will evaluate each hire, and the managers will too because the company is being careful.
5c. That extremely serious executive will evaluate each hire, and some managers will too because the company is being careful.
5d. That extremely serious executive will evaluate each hire, and the managers will too because the company is being careful.
6a. At least one coach will attend each practice, and some players will too because the team wants to win.
6b. At least one coach will attend each practice, and the players will too because the team wants to win.
6c. That tall new coach will attend each practice, and some players will too because the team wants to win.
6d. That tall new coach will attend each practice, and the players will too because the team wants to win.
7a. At least one pianist will play each piece, and some guitarists will too because the music is highly enjoyable.
7b. At least one pianist will play each piece, and the guitarists will too because the music is highly enjoyable.
7c. That excited former pianist will play each piece, and some guitarists will too because the music is highly enjoyable.
7d. That excited former pianist will play each piece, and the guitarists will too because the music is highly enjoyable.
8a. At least one chef will taste each dish, and some waiters will too because the recipe needs more work.
8b. At least one chef will taste each dish, and the waiters will too because the recipe needs more work.
8c. That mean picky chef will taste each dish, and some waiters will too because the recipe needs more work.
8d. That mean picky chef will taste each dish, and the waiters will too because the recipe needs more work.
9a. At least one rapper will shout each chorus, and some fans will too because the song is high energy.
9b. At least one rapper will shout each chorus, and the fans will too because the song is high energy.
9c. That loud annoying rapper will shout each chorus, and some fans will too because the song is high energy.
9d. That loud annoying rapper will shout each chorus, and the fans will too because the song is high energy.
10a. At least one stylist will take each measurement, and some tailors will too because the fabric is extremely expensive.
10b. At least one stylist will take each measurement, and the tailors will too because the fabric is extremely expensive.
10c. That very traditional stylist will take each measurement, and some tailors will too because the fabric is extremely expensive.

10d. That very traditional stylist will take each measurement, and the tailors will too because the fabric is extremely expensive.
11a. At least one newscaster will tape each segment, and some correspondents will too because the network is notoriously cautious.
11b. At least one newscaster will tape each segment, and the correspondents will too because the network is notoriously cautious.
11c. That barely coherent newscaster will tape each segment, and some correspondents will too because the network is notoriously cautious.
11d. That barely coherent newscaster will tape each segment, and the correspondents will too because the network is notoriously cautious.
12a. At least one editor will read each story, and some journalists will too because the paper is under scrutiny.
12b. At least one editor will read each story, and the journalists will too because the paper is under scrutiny.
12c. That extremely rude editor will read each story, and some journalists will too because the paper is under scrutiny.
12d. That extremely rude editor will read each story, and the journalists will too because the paper is under scrutiny.
13a. At least one painter will examine each portrait, and some curators will too because the museum wants no forgeries.
13b. At least one painter will examine each portrait, and the curators will too because the museum wants no forgeries.
13c. That smart old painter will examine each portrait, and some curators will too because the museum wants no forgeries.
13d. That smart old painter will examine each portrait, and the curators will too because the museum wants no forgeries.
14a. At least one producer will edit each episode, and some writers will too because the director hates long stories.
14b. At least one producer will edit each episode, and the writers will too because the director hates long stories.
14c. That eager young producer will edit each episode, and some writers will too because the director hates long stories.
14d. That eager young producer will edit each episode, and the writers will too because the director hates long stories.
15a. At least one clown will scare each child, and some actors will too because the carnival is intentionally scary.
15b. At least one clown will scare each child, and the actors will too because the carnival is intentionally scary.
15c. That big scary clown will scare each child, and some actors will too because the carnival is intentionally scary.
15d. That big scary clown will scare each child, and the actors will too because the carnival is intentionally scary.
16a. At least one detective will follow each suspect, and some officers will too because the department suspects foul play.

16b. At least one detective will follow each suspect, and the officers will too because the department suspects foul play.
16c. That almost retired detective will follow each suspect, and some officers will too because the department suspects foul play.
16d. That almost retired detective will follow each suspect, and the officers will too because the department suspects foul play.
17a. At least one technician will explain each service, and some salesmen will too because the business needs a sale.
17b. At least one technician will explain each service, and the salesmen will too because the business needs a sale.
17c. That very nice technician will explain each service, and some salesmen will too because the business needs a sale.
17d. That very nice technician will explain each service, and the salesmen will too because the business needs a sale.
18a. At least one scientist will summarize each finding, and some assistants will too because the lab needs more publicity.
18b. At least one scientist will summarize each finding, and the assistants will too because the lab needs more publicity.
18c. That barely coherent scientist will summarize each finding, and some assistants will too because the lab needs more publicity.
18d. That barely coherent scientist will summarize each finding, and the assistants will too because the lab needs more publicity.
19a. At least one electrician will check each outlet, and some repairmen will too because the office keeps losing power.
19b. At least one electrician will check each outlet, and the repairmen will too because the office keeps losing power.
19c. That newly hired electrician will check each outlet, and some repairmen will too because the office keeps losing power.
19d. That newly hired electrician will check each outlet, and the repairmen will too because the office keeps losing power.
20a. At least one zookeeper will feed each animal, and some vets will too because the animals seem quite hungry.
20b. At least one zookeeper will feed each animal, and the vets will too because the animals seem quite hungry.
20c. That highly energetic zookeeper will feed each animal, and some vets will too because the animals seem quite hungry.
20d. That highly energetic zookeeper will feed each animal, and the vets will too because the animals seem quite hungry.
21a. At least one publisher will reject each novel, and some websites will too because the readers have lofty standards.
21b. At least one publisher will reject each novel, and the websites will too because the readers have lofty standards.
21c. That well regarded publisher will reject each novel, and some websites will too because the readers have lofty standards.

21d. That well regarded publisher will reject each novel, and the websites will too because the readers have lofty standards.
22a. At least one critic will sample each dish, and some foodies will too because the restaurant became famous overnight.
22b. At least one critic will sample each dish, and the foodies will too because the restaurant became famous overnight.
22c. That silly looking critic will sample each dish, and some foodies will too because the restaurant became famous overnight.
22d. That silly looking critic will sample each dish, and the foodies will too because the restaurant became famous overnight.
23a. At least one thief will scout each location, and some henchmen will too because the heist must go smoothly.
23b. At least one thief will scout each location, and the henchmen will too because the heist must go smoothly.
23c. That overly confident thief will scout each location, and some henchmen will too because the heist must go smoothly.
23d. That overly confident thief will scout each location, and the henchmen will too because the heist must go smoothly.
24a. At least one designer will criticize each pattern, and some decorators will too because the colors are clashing.
24b. At least one designer will criticize each pattern, and the decorators will too because the colors are clashing.
24c. That extremely trendy designer will criticize each pattern, and some decorators will too because the colors are clashing.
24d. That extremely trendy designer will criticize each pattern, and the decorators will too because the colors are clashing.

APPENDIX B

Experimental Materials for Chapter 3

B.1. Experiment 2 Items

1a. The senator who no farmer believed to be untrustworthy will ever vote yes on the smoking proposal.
1b. The senator who didn't believe the farmer to be untrustworthy will ever vote yes on the smoking proposal.
1c. No senator who the farmer believed to be untrustworthy will ever vote yes on the smoking proposal.
1d. The senator who the farmer believed to be untrustworthy will ever vote yes on new smoking proposition.
2a. The hunter who no fisherman believed to be respectable will ever shoot a brown bear.
2b. The hunter who didn't believe the fisherman to be respectable will ever shoot a brown bear.
2c. No hunter who the fisherman believed to be respectable will ever shoot a brown bear.
2d. The hunter who the fisherman believed to be respectable will ever shoot a brown bear.
3a. The artist who no curator remembered from the gallery will ever make a bronze sculpture.
3b. The artist who didn't remember the curator from the gallery will ever make a bronze sculpture.
3c. No artist who the curator remembered from the gallery will ever make a bronze sculpture.
3d. The artist who the curator remembered from the gallery will ever make a bronze sculpture.
4a. The professor who no dean remembered from the conference will ever win a teaching award.
4b. The professor who didn't remember the dean from the conference will ever win a teaching award.
4c. No professor who the dean remembered from the conference will ever win a teaching award.
4d. The professor who the dean remembered from the conference will ever win a teaching award.
5a. The soldier who no general invited to the task force will ever earn a combat medal.

5b. The soldier who didn't invite the general to the search party will ever earn a combat medal.
5c. No soldier who the general invited to the task force will ever earn a combat medal.
5d. The soldier who the general invited to the task force will ever earn a combat medal.
6a. The reporter who no candidate invited to the press pool will ever break a major story.
6b. The reporter who didn't invite the candidate to the press pool will ever break a major story.
6c. No reporter who the candidate invited to the press pool will ever break a major story.
6d. The reporter who the candidate invited to the press pool will ever break a major story.
7a. The pirate who no admiral recognized from the wanted poster will ever be arrested for stealing a ship.
7b. The pirate who didn't recognize the admiral from his portrait will ever be arrested for stealing a ship.
7c. No pirate who the admiral recognized from the wanted poster will ever be arrested for stealing a ship.
7d. The pirate who the admiral recognized from the wanted poster will ever be arrested for stealing a ship.
8a. The thief who no detective recognized from the news report will ever be caught red handed.
8b. The thief who didn't recognize the detective from the crime scene will ever be caught red handed.
8c. No thief who the detective recognized from the news report will ever be caught red handed.
8d. The thief who the detective recognized from the news report will ever be caught red handed.
9a. The lawyer who no criminal noticed approach the bench will ever run for governor.
9b. The lawyer who didn't notice the criminal had approached the bench will ever run for governor.
9c. No lawyer who the criminal noticed approach the bench will ever run for governor.
9d. The lawyer who the criminal noticed approach the bench will ever run for governor.
10a. The protester who no policeman noticed sneak past will ever support lower taxes.
10b. The protester who didn't notice the policeman walk by will ever support lower taxes.
10c. No protester who the policeman noticed sneak past will ever support lower taxes.
10d. The protester who the policeman noticed sneak past will ever support lower taxes.
11a. The hostage who no kidnapper realized was a veteran will ever escape without being spotted.
11b. The hostage who didn't realize the kidnapper was respectable will ever escape without being spotted.
11c. No hostage who the kidnapper realized was a veteran will ever escape without being spotted.

11d. The hostage who the kidnapper realized was a veteran will ever escape without being spotted.
12a. The pollster who no politician realized would predict the results will ever be unemployed
12b. The pollster who didn't realize the politician would win will ever be unemployed.
12c. No pollster who the politician realized would predict the results will ever be unemployed.
12d. The pollster who the politician realized would predict the results will ever be unemployed.
13a. The actor who no director predicted would be a star will ever play a supporting role.
13b. The actor who didn't predict the director would be famous will ever play a supporting role.
13c. No actor who the director predicted would be a star will ever play a supporting role.
13d. The actor who the director predicted would be a star will ever play a supporting role.
14a. The rancher who no cowboy predicted would have a good harvest will ever be hungry again.
14b. The rancher who didn't predict the cowboy would wrangle the bull will ever be hungry again.
14c. No rancher who the cowboy predicted would have a good harvest will ever be hungry again.
14d. The rancher who the cowboy predicted would have a good harvest will ever be hungry again.
15a. The lender who no banker recommended for home loans will ever raise interest rates.
15b. The lender who didn't recommend the banker for asset management will ever raise interest rates.
15c. No lender who the banker recommended for home loans will ever raise interest rates.
15d. The lender who the banker recommended for home loans will ever raise interest rates.
16a. The agent who no tourist recommended for travel planning will ever suggest a boring trip.
16b. The agent who didn't recommend the tourist go to Panama will ever suggest a boring trip.
16c. No agent who the tourist recommended for travel planning will ever suggest a boring trip.
16d. The agent who the tourist recommended for travel planning will ever suggest a boring trip.
17a. The painter who no sculptor said had a good eye will ever paint an impressionist sunset.

17b. The painter who didn't say the sculptor had a good eye will ever paint an impressionist sunset.
17c. No painter who the sculptor said had a good eye will ever paint an impressionist sunset.
17d. The painter who the sculptor said had a good eye will ever paint an impressionist sunset.
18a. The bully who no student said was mean will ever get a scholarship to Northwestern.
18b. The bully who didn't say the student was mean will ever get a scholarship to Northwestern.
18c. No bully who the student said was mean will ever get a scholarship to Northwestern.
18d. The bully who the student said was mean will ever get a scholarship to Northwestern.
19a. The patient who no trainer treated for a broken leg will ever give up on recovery.
19b. The patient who didn't treat the trainer to dinner will ever give up on recovery.
19c. No patient who the trainer treated for a broken leg will ever give up on recovery.
19d. The patient who the trainer treated for a broken leg will ever give up on recovery.
20a. The victim who no doctor treated after a car accident will ever drive again.
20b. The victim who didn't treat the doctor to lunch will ever drive again.
20c. No victim who the doctor treated after a car accident will ever drive again.
20d. The victim who the doctor treated after a car accident will ever drive again.
21a. The author who no reader knew from his oldest will ever buy books online.
21b. The author who didn't know the reader from their previous meeting will ever buy books online.
21c. No author who the reader knew from his oldest novel will ever buy books online.
21d. The author who the reader knew from his oldest novel will ever buy books online.
22a. The bailiff who no judge knew from the courthouse will ever commit a crime.
22b. The bailiff who didn't know the judge from the courthouse will ever commit a crime.
22c. No bailiff who the judge knew from the courthouse will ever commit a crime.
22d. The bailiff who the judge knew from the courthouse will ever commit a crime.
23a. The traitor who no jury speculated was guilty will ever be let go.
23b. The traitor who didn't speculate the jury was rigged will ever be let go.
23c. No traitor who the jury speculated was guilty will ever be let go.
23d. The traitor who the jury speculated was guilty will ever be let go.
24a. The player who no referee speculated was doping will ever have playing time.
24b. The player who didn't speculate the referee was paid off will ever have playing time.
24c. No player who the referee speculated was doping will ever have playing time.
24d. The player who the referee speculated was doping will ever have playing time.
25a. The fireman who no arsonist assumed would respond will ever miss a service call.
25b. The fireman who didn't assume the arsonist would respond will ever miss a service call.
25c. No fireman who the arsonist assumed would respond will ever miss a service call.
25d. The fireman who the arsonist assumed would respond will ever miss a service call.

26a. The skier who no snowboarder assumed would miss the season will ever skip a day with good snow.
26b. The skier who didn't assume the snowboarder would miss the season will ever skip a day with good snow.
26c. No skier who the snowboarder assumed would miss the season will ever skip a day with good snow.
26d. The skier who the snowboarder assumed would miss the season will ever skip a day with good snow.
27a. The sailor who no pilot thought was a hotshot would ever be too busy showing off.
27b. The sailor who didn't think the pilot was a hotshot would ever bee too busy showing off.
27c. No sailor who the pilot thought was a hotshot would ever be too busy showing off.
27d. The sailor who the pilot thought was a hotshot would ever be too busy showing off.
28a. The poet who no singer thought was verbose would ever improvise in a performance.
28b. The poet who didn't think the singer was verbose would ever improvise in a performance.
28c. No poet who the singer thought was verbose would ever improvise in a performance.
28d. The poet who the singer thought was verbose would ever improvise in a performance.
29a. The suspect who no investigator cleared of wrongdoing would ever trespass on government property.
29b. The suspect who didn't clear the investigator of wrongdoing would ever trespass on government property.
29c. No suspect who the investigator cleared of wrongdoing would ever trespass on government property.
29d. The suspect who the investigator cleared of wrongdoing would ever trespass on government property.
30a. The scammer who no sheriff cleared of involvement would ever run another con.
30b. The scammer who didn't clear the sheriff of involvement would ever run another con.
30c. No scammer who the sheriff cleared of involvement would ever run another con.
30d. The scammer who the sheriff cleared of involvement would ever run another con.
31a. The dancer who no teacher concluded was clumsy would ever perform center stage.
31b. The dancer who didn't conclude the teacher was clumsy would ever perform center stage.
31c. No dancer who the teacher concluded was clumsy would ever perform center stage.
31d. The dancer who the teacher concluded was clumsy would ever perform center stage.
32a. The apprentice who no blacksmith concluded was talented would ever open a smithy.
32b. The apprentice who didn't conclude the blacksmith was talented would ever open a smithy.
32c. No apprentice who the blacksmith concluded was talented would ever open a smithy.

32d. The apprentice who the blacksmith concluded was talented would ever open a smithy.

B.2. Experiment 3 Items

1a. The senator who no farmer believed to be untrustworthy will ever vote yes on the smoking proposal.
1b. The senator who did not believe the farmer to be untrustworthy will ever vote yes on the smoking proposal.
1c. No senator who the farmer believed to be untrustworthy will ever vote yes on the smoking proposal.
1d. The senator who the farmer believed to be untrustworthy will ever vote yes on new smoking proposition.
2a. The hunter who no fisherman believed to be respectable will ever shoot a brown bear.
2b. The hunter who did not believe the fisherman to be respectable will ever shoot a brown bear.
2c. No hunter who the fisherman believed to be respectable will ever shoot a brown bear.
2d. The hunter who the fisherman believed to be respectable will ever shoot a brown bear.
3a. The artist who no curator remembered from the gallery will ever make a bronze sculpture.
3b. The artist who did not remember the curator from the gallery will ever make a bronze sculpture.
3c. No artist who the curator remembered from the gallery will ever make a bronze sculpture.
3d. The artist who the curator remembered from the gallery will ever make a bronze sculpture.
4a. The professor who no dean remembered from the conference will ever win a teaching award.
4b. The professor who did not remember the dean from the conference will ever win a teaching award.
4c. No professor who the dean remembered from the conference will ever win a teaching award.
4d. The professor who the dean remembered from the conference will ever win a teaching award.
5a. The soldier who no general invited to the task force will ever earn a combat medal.
5b. The soldier who did not invite the general to the search party will ever earn a combat medal.
5c. No soldier who the general invited to the task force will ever earn a combat medal.
5d. The soldier who the general invited to the task force will ever earn a combat medal.
6a. The reporter who no candidate invited to the press pool will ever break a major story.

6b. The reporter who did not invite the candidate to the press pool will ever break a major story.
6c. No reporter who the candidate invited to the press pool will ever break a major story.
6d. The reporter who the candidate invited to the press pool will ever break a major story.
7a. The pirate who no admiral recognized from the wanted poster will ever be arrested for stealing a ship.
7b. The pirate who did not recognize the admiral from his portrait will ever be arrested for stealing a ship.
7c. No pirate who the admiral recognized from the wanted poster will ever be arrested for stealing a ship.
7d. The pirate who the admiral recognized from the wanted poster will ever be arrested for stealing a ship.
8a. The thief who no detective recognized from the news report will ever be caught red handed.
8b. The thief who did not recognize the detective from the crime scene will ever be caught red handed.
8c. No thief who the detective recognized from the news report will ever be caught red handed.
8d. The thief who the detective recognized from the news report will ever be caught red handed.
9a. The lawyer who no criminal noticed approach the bench will ever run for governor.
9b. The lawyer who did not notice the criminal had approached the bench will ever run for governor.
9c. No lawyer who the criminal noticed approach the bench will ever run for governor.
9d. The lawyer who the criminal noticed approach the bench will ever run for governor.
10a. The protester who no policeman noticed sneak past will ever support lower taxes.
10b. The protester who did not notice the policeman walk by will ever support lower taxes.
10c. No protester who the policeman noticed sneak past will ever support lower taxes.
10d. The protester who the policeman noticed sneak past will ever support lower taxes.
11a. The hostage who no kidnapper realized was a veteran will ever escape without being spotted.
11b. The hostage who did not realize the kidnapper was respectable will ever escape without being spotted.
11c. No hostage who the kidnapper realized was a veteran will ever escape without being spotted.
11d. The hostage who the kidnapper realized was a veteran will ever escape without being spotted.
12a. The pollster who no politician realized could predict the results will ever be unemployed
12b. The pollster who did not realize the politician could win will ever be unemployed.

12c. No pollster who the politician realized will predict the results will ever be unemployed.
12d. The pollster who the politician realized could predict the results will ever be unemployed.
13a. The actor who no director predicted will be a star will ever play a supporting role.
13b. The actor who did not predict the director will be famous will ever play a supporting role.
13c. No actor who the director predicted will be a star will ever play a supporting role.
13d. The actor who the director predicted will be a star will ever play a supporting role.
14a. The rancher who no cowboy predicted will have a good harvest will ever be hungry again.
14b. The rancher who did not predict the cowboy will wrangle the bull will ever be hungry again.
14c. No rancher who the cowboy predicted will have a good harvest will ever be hungry again.
14d. The rancher who the cowboy predicted will have a good harvest will ever be hungry again.
15a. The lender who no banker recommended for home loans will ever raise interest rates.
15b. The lender who did not recommend the banker for asset management will ever raise interest rates.
15c. No lender who the banker recommended for home loans will ever raise interest rates.
15d. The lender who the banker recommended for home loans will ever raise interest rates.
16a. The agent who no tourist recommended for travel planning will ever suggest a boring trip.
16b. The agent who did not recommend the tourist go to Panama will ever suggest a boring trip.
16c. No agent who the tourist recommended for travel planning will ever suggest a boring trip.
16d. The agent who the tourist recommended for travel planning will ever suggest a boring trip.
17a. The painter who no sculptor said had a good eye will ever paint an impressionist sunset.
17b. The painter who did not say the sculptor had a good eye will ever paint an impressionist sunset.
17c. No painter who the sculptor said had a good eye will ever paint an impressionist sunset.
17d. The painter who the sculptor said had a good eye will ever paint an impressionist sunset.
18a. The bully who no student said was mean will ever get a scholarship to Northwestern.
18b. The bully who did not say the student was mean will ever get a scholarship to Northwestern.

18c. No bully who the student said was mean will ever get a scholarship to Northwestern.
18d. The bully who the student said was mean will ever get a scholarship to Northwestern.
19a. The patient who no trainer treated for a broken leg will ever give up on recovery.
19b. The patient who did not treat the trainer to dinner will ever give up on recovery.
19c. No patient who the trainer treated for a broken leg will ever give up on recovery.
19d. The patient who the trainer treated for a broken leg will ever give up on recovery.
20a. The victim who no doctor treated after a car accident will ever drive again.
20b. The victim who did not treat the doctor to lunch will ever drive again.
20c. No victim who the doctor treated after a car accident will ever drive again.
20d. The victim who the doctor treated after a car accident will ever drive again.
21a. The author who no reader knew from his oldest will ever buy books online.
21b. The author who did not know the reader from their previous meeting will ever buy books online.
21c. No author who the reader knew from his oldest novel will ever buy books online.
21d. The author who the reader knew from his oldest novel will ever buy books online.
22a. The bailiff who no judge knew from the courthouse will ever commit a crime.
22b. The bailiff who did not know the judge from the courthouse will ever commit a crime.
22c. No bailiff who the judge knew from the courthouse will ever commit a crime.
22d. The bailiff who the judge knew from the courthouse will ever commit a crime.
23a. The traitor who no jury speculated was guilty will ever be let go.
23b. The traitor who did not speculate the jury was rigged will ever be let go.
23c. No traitor who the jury speculated was guilty will ever be let go.
23d. The traitor who the jury speculated was guilty will ever be let go.
24a. The player who no referee speculated was doping will ever have playing time.
24b. The player who did not speculate the referee was paid off will ever have playing time.
24c. No player who the referee speculated was doping will ever have playing time.
24d. The player who the referee speculated was doping will ever have playing time.
25a. The fireman who no arsonist assumed will respond will ever miss a service call.
25b. The fireman who did not assume the arsonist will respond will ever miss a service call.
25c. No fireman who the arsonist assumed will respond will ever miss a service call.
25d. The fireman who the arsonist assumed will respond will ever miss a service call.
26a. The skier who no snowboarder assumed will miss the season will ever skip a day with good snow.
26b. The skier who did not assume the snowboarder will miss the season will ever skip a day with good snow.
26c. No skier who the snowboarder assumed will miss the season will ever skip a day with good snow.
26d. The skier who the snowboarder assumed will miss the season will ever skip a day with good snow.
27a. The sailor who no pilot thought was a hotshot will ever be too busy showing off.

27b. The sailor who did not think the pilot was a hotshot will ever bee too busy showing off.
27c. No sailor who the pilot thought was a hotshot will ever be too busy showing off.
27d. The sailor who the pilot thought was a hotshot will ever be too busy showing off.
28a. The poet who no singer thought was verbose will ever improvise in a performance.
28b. The poet who did not think the singer was verbose will ever improvise in a performance.
28c. No poet who the singer thought was verbose will ever improvise in a performance.
28d. The poet who the singer thought was verbose will ever improvise in a performance.
29a. The suspect who no investigator cleared of wrongdoing will ever trespass on government property.
29b. The suspect who did not clear the investigator of wrongdoing will ever trespass on government property.
29c. No suspect who the investigator cleared of wrongdoing will ever trespass on government property.
29d. The suspect who the investigator cleared of wrongdoing will ever trespass on government property.
30a. The scammer who no sheriff cleared of involvement will ever run another con.
30b. The scammer who did not clear the sheriff of involvement will ever run another con.
30c. No scammer who the sheriff cleared of involvement will ever run another con.
30d. The scammer who the sheriff cleared of involvement will ever run another con.
31a. The dancer who no teacher concluded was clumsy will ever perform center stage.
31b. The dancer who did not conclude the teacher was clumsy will ever perform center stage.
31c. No dancer who the teacher concluded was clumsy will ever perform center stage.
31d. The dancer who the teacher concluded was clumsy will ever perform center stage.
32a. The apprentice who no blacksmith concluded was talented will ever open a smithy.
32b. The apprentice who did not conclude the blacksmith was talented will ever open a smithy.
32c. No apprentice who the blacksmith concluded was talented will ever open a smithy.
32d. The apprentice who the blacksmith concluded was talented will ever open a smithy.

B.3. Experiment 4 Items

1a. The senator who no farmer believed to be untrustworthy will ever vote yes on the smoking proposal.
1b. The senator who never believed the farmer to be untrustworthy will ever vote yes on the smoking proposal.
1c. No senator who the farmer believed to be untrustworthy will ever vote yes on the smoking proposal.
1d. The senator who the farmer believed to be untrustworthy will ever vote yes on new smoking proposition.

2a. The hunter who no fisherman believed to be respectable will ever shoot a brown bear.
2b. The hunter who never believed the fisherman to be respectable will ever shoot a brown bear.
2c. No hunter who the fisherman believed to be respectable will ever shoot a brown bear.
2d. The hunter who the fisherman believed to be respectable will ever shoot a brown bear.
3a. The artist who no curator remembered from the gallery will ever make a bronze sculpture.
3b. The artist who never remembered the curator from the gallery will ever make a bronze sculpture.
3c. No artist who the curator remembered from the gallery will ever make a bronze sculpture.
3d. The artist who the curator remembered from the gallery will ever make a bronze sculpture.
4a. The professor who no dean remembered from the conference will ever win a teaching award.
4b. The professor who never remembered the dean from the conference will ever win a teaching award.
4c. No professor who the dean remembered from the conference will ever win a teaching award.
4d. The professor who the dean remembered from the conference will ever win a teaching award.
5a. The soldier who no general invited to the task force will ever earn a combat medal.
5b. The soldier who never invited the general to the search party will ever earn a combat medal.
5c. No soldier who the general invited to the task force will ever earn a combat medal.
5d. The soldier who the general invited to the task force will ever earn a combat medal.
6a. The reporter who no candidate invited to the press pool will ever break a major story.
6b. The reporter who never invited the candidate to the press pool will ever break a major story.
6c. No reporter who the candidate invited to the press pool will ever break a major story.
6d. The reporter who the candidate invited to the press pool will ever break a major story.
7a. The pirate who no admiral recognized from the wanted poster will ever be arrested for stealing a ship.
7b. The pirate who never recognized the admiral from his portrait will ever be arrested for stealing a ship.
7c. No pirate who the admiral recognized from the wanted poster will ever be arrested for stealing a ship.

7d. The pirate who the admiral recognized from the wanted poster will ever be arrested for stealing a ship.
8a. The thief who no detective recognized from the news report will ever be caught red handed.
8b. The thief who never recognized the detective from the crime scene will ever be caught red handed.
8c. No thief who the detective recognized from the news report will ever be caught red handed.
8d. The thief who the detective recognized from the news report will ever be caught red handed.
9a. The lawyer who no criminal noticed approach the bench will ever run for governor.
9b. The lawyer who never noticed the criminal had approached the bench will ever run for governor.
9c. No lawyer who the criminal noticed approach the bench will ever run for governor.
9d. The lawyer who the criminal noticed approach the bench will ever run for governor.
10a. The protester who no policeman noticed sneak past will ever support lower taxes.
10b. The protester who never noticed the policeman walk by will ever support lower taxes.
10c. No protester who the policeman noticed sneak past will ever support lower taxes.
10d. The protester who the policeman noticed sneak past will ever support lower taxes.
11a. The hostage who no kidnapper realized was a veteran will ever escape without being spotted.
11b. The hostage who never realized the kidnapper was respectable will ever escape without being spotted.
11c. No hostage who the kidnapper realized was a veteran will ever escape without being spotted.
11d. The hostage who the kidnapper realized was a veteran will ever escape without being spotted.
12a. The pollster who no politician realized could predict the results will ever be unemployed
12b. The pollster who never realized the politician could win will ever be unemployed.
12c. No pollster who the politician realized could predict the results will ever be unemployed.
12d. The pollster who the politician realized could predicted the results will ever be unemployed.
13a. The actor who no director predicted will be a star will ever play a supporting role.
13b. The actor who never predicted the director will be famous will ever play a supporting role.
13c. No actor who the director predicted will be a star will ever play a supporting role.
13d. The actor who the director predicted will be a star will ever play a supporting role.
14a. The rancher who no cowboy predicted will have a good harvest will ever be hungry again.
14b. The rancher who never predicted the cowboy will wrangle the bull will ever be hungry again.

14c. No rancher who the cowboy predicted will have a good harvest will ever be hungry again.
14d. The rancher who the cowboy predicted will have a good harvest will ever be hungry again.
15a. The lender who no banker recommended for home loans will ever raise interest rates.
15b. The lender who never recommended the banker for asset management will ever raise interest rates.
15c. No lender who the banker recommended for home loans will ever raise interest rates.
15d. The lender who the banker recommended for home loans will ever raise interest rates.
16a. The agent who no tourist recommended for travel planning will ever suggest a boring trip.
16b. The agent who never recommended the tourist go to Panama will ever suggest a boring trip.
16c. No agent who the tourist recommended for travel planning will ever suggest a boring trip.
16d. The agent who the tourist recommended for travel planning will ever suggest a boring trip.
17a. The painter who no sculptor said had a good eye will ever paint an impressionist sunset.
17b. The painter who never said the sculptor had a good eye will ever paint an impressionist sunset.
17c. No painter who the sculptor said had a good eye will ever paint an impressionist sunset.
17d. The painter who the sculptor said had a good eye will ever paint an impressionist sunset.
18a. The bully who no student said was mean will ever get a scholarship to Northwestern.
18b. The bully who never said the student was mean will ever get a scholarship to Northwestern.
18c. No bully who the student said was mean will ever get a scholarship to Northwestern.
18d. The bully who the student said was mean will ever get a scholarship to Northwestern.
19a. The patient who no trainer treated for a broken leg will ever give up on recovery.
19b. The patient who never treated the trainer to dinner will ever give up on recovery.
19c. No patient who the trainer treated for a broken leg will ever give up on recovery.
19d. The patient who the trainer treated for a broken leg will ever give up on recovery.
20a. The victim who no doctor treated after a car accident will ever drive again.
20b. The victim who never treated the doctor to lunch will ever drive again.
20c. No victim who the doctor treated after a car accident will ever drive again.
20d. The victim who the doctor treated after a car accident will ever drive again.
21a. The author who no reader knew from his oldest novel will ever buy books online.
21b. The author who never knew the reader from their previous meeting will ever buy books online.

21c. No author who the reader knew from his oldest novel will ever buy books online.
21d. The author who the reader knew from his oldest novel will ever buy books online.
22a. The bailiff who no judge knew from the courthouse will ever commit a crime.
22b. The bailiff who never knew the judge from the courthouse will ever commit a crime.
22c. No bailiff who the judge knew from the courthouse will ever commit a crime.
22d. The bailiff who the judge knew from the courthouse will ever commit a crime.
23a. The traitor who no jury speculated was guilty will ever be let go.
23b. The traitor who never speculated the jury was rigged will ever be let go.
23c. No traitor who the jury speculated was guilty will ever be let go.
23d. The traitor who the jury speculated was guilty will ever be let go.
24a. The player who no referee speculated was doping will ever have playing time.
24b. The player who never speculated the referee was paid off will ever have playing time.
24c. No player who the referee speculated was doping will ever have playing time.
24d. The player who the referee speculated was doping will ever have playing time.
25a. The fireman who no arsonist assumed will respond will ever miss a service call.
25b. The fireman who never assumed the arsonist will respond will ever miss a service call.
25c. No fireman who the arsonist assumed will respond will ever miss a service call.
25d. The fireman who the arsonist assumed will respond will ever miss a service call.
26a. The skier who no snowboarder assumed will miss the season will ever skip a day with good snow.
26b. The skier who never assumed the snowboarder will miss the season will ever skip a day with good snow.
26c. No skier who the snowboarder assumed will miss the season will ever skip a day with good snow.
26d. The skier who the snowboarder assumed will miss the season will ever skip a day with good snow.
27a. The sailor who no pilot thought was a hotshot will ever be too busy showing off.
27b. The sailor who never thought the pilot was a hotshot will ever bee too busy showing off.
27c. No sailor who the pilot thought was a hotshot will ever be too busy showing off.
27d. The sailor who the pilot thought was a hotshot will ever be too busy showing off.
28a. The poet who no singer thought was verbose will ever improvise in a performance.
28b. The poet who never thought the singer was verbose will ever improvise in a performance.
28c. No poet who the singer thought was verbose will ever improvise in a performance.
28d. The poet who the singer thought was verbose will ever improvise in a performance.
29a. The suspect who no investigator cleared of wrongdoing will ever trespass on government property.
29b. The suspect who never cleared the investigator of wrongdoing will ever trespass on government property.

29c. No suspect who the investigator cleared of wrongdoing will ever trespass on government property.
29d. The suspect who the investigator cleared of wrongdoing will ever trespass on government property.
30a. The scammer who no sheriff cleared of involvement will ever run another con.
30b. The scammer who never cleared the sheriff of involvement will ever run another con.
30c. No scammer who the sheriff cleared of involvement will ever run another con.
30d. The scammer who the sheriff cleared of involvement will ever run another con.
31a. The dancer who no teacher concluded was clumsy will ever perform center stage.
31b. The dancer who never concluded the teacher was clumsy will ever perform center stage.
31c. No dancer who the teacher concluded was clumsy will ever perform center stage.
31d. The dancer who the teacher concluded was clumsy will ever perform center stage.
32a. The apprentice who no blacksmith concluded was talented will ever open a smithy.
32b. The apprentice who never concluded the blacksmith was talented will ever open a smithy.
32c. No apprentice who the blacksmith concluded was talented will ever open a smithy.
32d. The apprentice who the blacksmith concluded was talented will ever open a smithy.

B.4. Experiment 5 Items

1a. The hunter who the fisherman remembered would go camping will ever shoot a bear with a bow.
1b. No hunter who the fisherman remembered would go camping will ever shoot a bear with a bow.
1c. The hunter who the fisherman forgot would go camping will ever shoot a bear with a bow.
1d. The hunter who no fisherman remembered would go camping will ever shoot a bear with a bow.
2a. The congressman who the voter remembered would lie will ever vote for a budget increase.
2b. No congressman who the voter remembered will lie will ever vote for a budget increase.
2c. The congressman who the voter forgot would lie will ever vote for a budget increase.
2d. The congressman who no voter remembered would lie will ever vote for a budget increase.
3a. The artist who the musician remembered would complain will ever win a creativity award.
3b. No artist who the musician remembered would complain will ever win a creativity award.
3c. The artist who the musician forgot would complain will ever win a creativity award.
3d. The artist who no musician forgot would complain will ever win a creativity award.

4a. The scientist who the dean remembered would work hard will ever publish a bad paper.
4b. No scientist who the dean remembered would work had will ever publish a bad paper.
4c. The scientist who the dean forgot would work hard will ever publish a bad paper.
4d. The scientist who no dean remembered would work hard will ever publish a bad paper.
5a. The hostage who the kidnapper believed would cry will ever manage to escape.
5b. No hostage who the kidnapper believed would cry will ever manage to escape.
5c. The hostage who the kidnapper doubted would cry will ever manage to escape.
5d. The hostage who no kidnapper believed would cry will ever manage to escape.
6a. The investor who the lender believed would fold will ever make money on stocks.
6b. No investor who the lender believed would fold will ever make money on stocks.
6c. The investor who the lender doubted would fold will ever make money on stocks.
6d. The investor who no lender believed would fold will ever make money on stocks.
7a. The soldier who the general believed would desert will ever report late for duty.
7b. No soldier who the general believed would desert will ever report late for duty.
7c. The soldier who the general doubted would desert will ever report late for duty.
7d. The soldier who no general believed would desert will ever report late for duty.
8a. The candidate who the committee believed would succeed will ever have bad recommendations.
8b. No candidate who the committee believed would succeed will ever have bad recommendations.
8c. The candidate who the doubted would succeed will ever have bad recommendations.
8d. The candidate who no committee believed would succeed will ever have bad recommendations.
9a. The reader who the author agreed would understand will ever finish a novel.
9b. No reader who the author agreed would understand will ever finish a novel.
9c. The reader who the author refuted would understand will ever finish a novel.
9d. The reader who no author agreed would understand will ever finish a novel.
10a. The tourist who the vendor agreed would get lost will ever pay full price.
10b. No tourist who the vendor agreed would get lost will ever pay full price.
10c. The tourist who the vendor refuted would get lost will ever pay full price.
10d. The tourist who no vendor agreed would get lost will ever pay full price.
11a. The electrician who the plumber agreed would finish up will ever complete a job late.
11b. No electrician who the plumber agreed would finish up will ever complete a job late.
11c. The electrician who the plumber refuted would finish up will ever complete a job late.
11d. The electrician who no plumber agreed would finish up will ever complete a job late.
12a. The painter who the sculptor agreed would pay will ever create a masterpiece.
12b. No painter who the sculptor agreed would pay will ever create a masterpiece.

12c. The painter who the sculptor refuted would pay will ever create a masterpiece.
12d. The painter who no sculptor agreed would pay will ever create a masterpiece.
13a. The farmer who the rancher was disappointed would drive a tractor will ever plant soybeans.
13b. No farmer who the rancher was disappointed would drive a tractor will ever plant soybeans.
13c. The farmer who the rancher was amazed would drive a tractor will ever plant soybeans.
13d. The farmer who no rancher was amazed would drive a tractor will ever plant soybeans.
14a. The pirate who the admiral was disappointed would be a criminal will ever steal a ship.
14b. No pirate who the admiral was disappointed would be a criminal will ever steal a ship.
14c. The pirate who the admiral was amazed would be a criminal will ever steal a ship.
14d. The pirate who no admiral was disappointed would be a criminal will ever steal a ship.
15a. The salesman who the negotiator was disappointed would give up will ever make a good deal.
15b. No salesman who the negotiator was disappointed would give up will ever make a good deal.
15c. The salesman who the negotiator was amazed would give up will ever make good deal.
15d. The salesman who no negotiator was disappointed would give up will ever make a good deal.
16a. The client who the banker was disappointed would transfer will ever default on a loan.
16b. No client who the banker was disappointed would transfer will ever default on a loan.
16c. The client who the banker was amazed would transfer will ever default on a loan.
16d. The client who no banker was disappointed would transfer will ever default on a loan.
17a. The actor who the director confessed would get the part will ever be an understudy.
17b. No actor who the director confessed would get the part will ever be an understudy.
17c. The actor who the director denied would get the part will ever be an understudy.
17d. The actor who no director confessed would get the part will ever be an understudy.
18a. The sponsor who the agent confessed would be small will ever sell branded shoes.
18b. No sponsor who the agent confessed would be small will ever sell branded shoes
18c. The sponsor who the agent denied would be small will ever sell branded shoes.
18d. The sponsor who no agent confessed would be small will ever sell branded shoes.
19a. The politician who the pollster confessed would lose will ever be slandered by the press.
19b. No politician who the pollster confessed would lose will ever be slandered by the press.

19c. The politician who the pollster denied would lose will ever be slandered by the press.
19d. The politician who no pollster confessed would lose will ever be slandered by the press.
20a. The populist who the governor confessed would sway voters will ever lose an election.
20b. No populist who the governor confessed would sway voters will ever lose an election.
20c. The populist who the governor denied would sway voters will ever lose an election.
20d. The populist who no governor confessed would sway voters will ever lose an election.
21a. The librarian who the curator was glad would manage the collection will ever write a book.
21b. No librarian who the curator was glad would manage the collection will ever write a book.
21c. The librarian who the curator was surprised would manage the collection will ever write a book.
21d. The librarian who no curator was glad would manage the collection will ever write a book.
22a. The protester who the guard was glad would go home will ever go to court.
22b. No protester who the guard was glad would go home will ever go to court.
22c. The protester who the guard was surprised would go home will ever go to court.
22d. The protester who no guard was glad would go home will ever go to court.
23a. The judge who the bailiff was glad would preside over the hearing will ever be late to work.
23b. No judge who the bailiff was glad would preside over the hearing will ever be late to work.
23c. The judge who the bailiff was surprised would preside over the hearing will ever be late to work.
23d. The judge who no bailiff was glad would preside over the hearing will ever be late to work.
24a. The criminal who the lawyer was glad would be charged will ever be found guilty.
24b. No criminal who the lawyer was glad would be charged will ever be found guilty.
24c. The criminal who the lawyer was surprised would be charged will ever be found guilty.
24d. The criminal who no lawyer was glad would be charged will ever be found guilty.

B.5. Experiment 6 Items

1a. The captain who no angler believed to be untrustworthy will ever navigate through a hurricane.
1b. The captain who none of the anglers believed to be untrustworthy will ever navigate through a hurricane.

1c. No captain who the angler believed to be untrustworthy will ever navigate through a hurricane.
1d. The captain who the angler believed to be untrustworthy will ever navigate through a hurricane.
2a. The producer who no superstar believed to be respectable will ever make a blockbuster hit.
2b. The producer who none of the superstars believed to be respectable will ever make a blockbuster hit.
2c. No producer who the superstar believed to be respectable will ever make a blockbuster hit.
2d. The producer who the superstar believed to be respectable will ever make a blockbuster hit.
3a. The daredevil who no stuntman remembered from the rally will ever break a leg during a trick.
3b. The daredevil who none of the stuntmen remembered from the rally will ever break a leg during a trick.
3c. No daredevil who the stuntman remembered from the rally will ever break a leg during a trick.
3d. The daredevil who the stuntman remembered from the rally will ever break a leg during a trick.
4a. The cartoonist who no editor remembered from yesterday’s paper will ever shy away from a difficult topic.
4b. The cartoonist who none of the editors remembered from yesterday’s paper will ever shy away from a difficult topic.
4c. No cartoonist who the editor remembered from yesterday’s paper will ever shy away from a difficult topic.
4d. The cartoonist who the editor remembered from yesterday’s paper will ever shy away from a difficult topic.
5a. The exorcist who no conjurer invited to the seance will ever banish a major demon.
5b. The exorcist who none of the conjurers invited to the seance will ever banish a major demon.
5c. No exorcist who the conjurer invited to the seance will ever banish a major demon.
5d. The exorcist who the conjurer invited to the seance will ever banish a major demon.
6a. The comedian who no jokester invited to the comedy club will ever tell a joke that lands poorly.
6b. The comedian who none of the jokesters invited to the comedy club will ever tell a joke that lands poorly.
6c. No comedian who the jokester invited to the comedy club will ever tell a joke that lands poorly.
6d. The comedian who the jokester invited to the comedy club will ever tell a joke that lands poorly.
7a. The assassin who no guard recognized from the wanted poster will ever be captured with ease.

7b. The assassin who none of the guards recognized from the wanted poster will ever be captured with ease.
7c. No assassin who the guard recognized from the wanted poster will ever be captured with ease.
7d. The assassin who the guard recognized from the wanted poster will ever be captured with ease.
8a. The tanner who no butcher recognized from the open air market will ever work with alligator leather.
8b. The tanner who none of the butchers recognized from the open air market will ever work with alligator leather.
8c. No tanner who the butcher recognized from the open air market will ever work with alligator leather.
8d. The tanner who the butcher recognized from the open air market will ever work with alligator leather.
9a. The ambassador who no envoy noticed approach the consulate will ever be expelled from a country.
9b. The ambassador who none of the envoys noticed approach the consulate will ever be expelled from a country.
9c. No ambassador who the envoy noticed approach the consulate will ever be expelled from a country.
9d. The ambassador who the envoy noticed approach the consulate will ever be expelled from a country.
10a. The parishioner who no minister noticed was missing will ever experience a crisis of faith.
10b. The parishioner who none of the ministers noticed was missing will ever experience a crisis of faith.
10c. No parishioner who the minister noticed was missing will ever experience a crisis of faith.
10d. The parishioner who the minister noticed was missing will ever experience a crisis of faith.
11a. The mountaineer who no hiker realized was a professional will ever climb without a rope.
11b. The mountaineer who none of the hikers realized was a professional will ever climb without a rope.
11c. No mountaineer who the hiker realized was a professional will ever climb without a rope.
11d. The mountaineer who the hiker realized was a professional will ever climb without a rope.
12a. The arbiter who no supervisor realized was overworked will ever fail to resolve a dispute
12b. The arbiter who none of the supervisors realized was overworked will ever fail to resolve a dispute.
12c. No arbiter who the supervisor realized was overworked will ever fail to resolve a dispute.

12d. The arbiter who the supervisor realized was overworked will ever fail to resolve a dispute.
13a. The custodian who no sweeper predicted would clean the main floor will ever leave a spot of dust behind.
13b. The custodian who none of the sweepers predicted would clean the main floor will ever leave a spot of dust behind.
13c. No custodian who the sweeper predicted would clean the main floor will ever leave a spot of dust behind.
13d. The custodian who the sweeper predicted would clean the main floor will ever leave a spot of dust behind.
14a. The mortician who no undertaker predicted slack off will ever arrive to work early.
14b. The mortician who none of the undertakers predicted slack off will ever arrive to work early.
14c. No mortician who the undertaker predicted slack off will ever arrive to work early.
14d. The mortician who the undertaker predicted slack off will ever arrive to work early.
15a. The tyrant who no lieutenant recommended a leadership position will ever treat people kindly.
15b. The tyrant who none of the lieutenants recommended a leadership position will ever treat people kindly.
15c. No tyrant who the lieutenant recommended a leadership position will ever treat people kindly.
15d. The tyrant who the lieutenant recommended a leadership position will ever treat people kindly.
16a. The golfer who no caddie recommended a new club to will ever hit three over par.
16b. The golfer who none of the caddies recommended a new club to will ever hit three over par.
16c. No golfer who the caddie recommended a new club to will ever hit three over par.
16d. The golfer who the caddie recommended a new club to will ever hit three over par.
17a. The cyclist who no cabbie said should have braked will ever stop at a stop sign.
17b. The cyclist who none of the cabbies said should have braked will ever stop at a stop sign.
17c. No cyclist who the cabbie said should have braked will ever stop at a stop sign.
17d. The cyclist who the cabbie said should have braked will ever stop at a stop sign.
18a. The astronaut who no cosmonaut said was a team peddler will ever jeopardize a space walk.
18b. The astronaut who none of the cosmonauts said was a team peddler will ever jeopardize a space walk.
18c. No astronaut who the cosmonaut said was a team peddler will ever jeopardize a space walk.
18d. The astronaut who the cosmonaut said was a team peddler will ever jeopardize a space walk.
19a. The corsair who no viking treated like a jerk will ever pillage a village.
19b. The corsair who none of the vikings treated like a jerk will ever pillage a village.
19c. No corsair who the viking treated like a jerk will ever pillage a village.

19d. The corsair who the viking treated like a jerk will ever pillage a village.
20a. The clown who no mime treated like an amateur will ever disappoint an eager crowd.
20b. The clown who none of the mimes treated like an amateur will ever disappoint an eager crowd.
20c. No clown who the mime treated like an amateur will ever disappoint an eager crowd.
20d. The clown who the mime treated like an amateur will ever disappoint an eager crowd.
21a. The gangster who no mobster knew to be a brute will ever commit and elegant crime.
21b. The gangster who none of the mobsters knew to be a brute will ever commit and elegant crime.
21c. No gangster who the mobster knew to be a brute will ever commit and elegant crime.
21d. The gangster who the mobster knew to be a brute will ever commit and elegant crime.
22a. The biologist who no psychiatrist knew from the laboratory will ever conduct a peculiar experience.
22b. The biologist who none of the psychiatrists knew from the laboratory will ever conduct a peculiar experience.
22c. No biologist who the psychiatrist knew from the laboratory will ever conduct a peculiar experience.
22d. The biologist who the psychiatrist knew from the laboratory will ever conduct a peculiar experience.
23a. The ghost who no psychic speculated was haunting a house will ever be put to rest.
23b. The ghost who none of the psychics speculated was haunting a house will ever be put to rest.
23c. No ghost who the psychic speculated was haunting a house will ever be put to rest.
23d. The ghost who the psychic speculated was haunting a house will ever be put to rest.
24a. The peddler who no trickster speculated was planning a heist will ever make a sale in peace.
24b. The peddler who none of the tricksters speculated was planning a heist will ever make a sale in peace.
24c. No peddler who the trickster speculated was planning a heist will ever make a sale in peace.
24d. The peddler who the trickster speculated was planning a heist will ever make a sale in peace.
25a. The mechant who no capitalist assumed would advertise aggressively will ever accept a late payment.
25b. The mechant who none of the capitalists assumed would advertise aggressively will ever accept a late payment.
25c. No mechant who the capitalist assumed would advertise aggressively will ever accept a late payment.

25d. The mechant who the capitalist assumed would advertise aggressively will ever accept a late payment.
26a. The samurai who no snowboarder assumed would complete the mission will ever bring shame upon the kingdom.
26b. The samurai who none of the shogun assumed would complete the mission will ever bring shame upon the kingdom.
26c. No samurai who the snowboarder assumed would complete the mission will ever bring shame upon the kingdom.
26d. The samurai who the snowboarder assumed would complete the mission will ever bring shame upon the kingdom.
27a. The philosopher who no sage thought was exceedingly wise will ever present a theory of ethics.
27b. The philosopher who none of the sages thought was exceedingly wise will ever present a theory of ethics.
27c. No philosopher who the sage thought was exceedingly wise will ever present a theory of ethics.
27d. The philosopher who the sage thought was exceedingly wise will ever present a theory of ethics.
28a. The outlaw who no teller thought was ready to rob the bank will ever spend the cash freely.
28b. The outlaw who none of the tellers thought was ready to rob the bank will ever spend the cash freely.
28c. No outlaw who the teller thought was ready to rob the bank will ever spend the cash freely.
28d. The outlaw who the teller thought was ready to rob the bank will ever spend the cash freely.
29a. The tailor who no couturier cleared for the fashion show will ever design an garish suit.
29b. The tailor who none of the couturiers cleared for the fashion show will ever design an garish suit.
29c. No tailor who the couturier cleared for the fashion show will ever design an garish suit.
29d. The tailor who the couturier cleared for the fashion show will ever design an garish suit.
30a. The employee who no boss cleared for duty will ever steal office supplies.
30b. The employee who none of the bosses cleared for duty will ever steal office supplies.
30c. No employee who the boss cleared for duty will ever steal office supplies.
30d. The employee who the boss cleared for duty will ever steal office supplies.
31a. The regular who no barkeep concluded was drunk will ever pass out in the street.
31b. The regular who none of the barkeeps concluded was drunk will ever pass out in the street.
31c. No regular who the barkeep concluded was drunk will ever pass out in the street.
31d. The regular who the barkeep concluded was drunk will ever pass out in the street.

32a. The bandit who no officer concluded was hiding in the woods will ever escape across a river.
32b. The bandit who none of the officers concluded was hiding in the woods will ever escape across a river.
32c. No bandit who the officer concluded was hiding in the woods will ever escape across a river.
32d. The bandit who the officer concluded was hiding in the woods will ever escape across a river.

B.6. Experiment 7 Items

1a. The senator who no farmer believed to be untrustworthy will ever vote yes on the smoking proposal.
1b. The senator who believed no farmer to be untrustworthy will ever vote yes on the smoking proposal.
1c. No senator who the farmer believed to be untrustworthy will ever vote yes on the smoking proposal.
1d. The senator who the farmer believed to be untrustworthy will ever vote yes on new smoking proposition.
2a. The hunter who no fisherman believed to be respectable will ever shoot a brown bear.
2b. The hunter who believed no fisherman to be respectable will ever shoot a brown bear.
2c. No hunter who the fisherman believed to be respectable will ever shoot a brown bear.
2d. The hunter who the fisherman believed to be respectable will ever shoot a brown bear.
3a. The artist who no curator remembered well enough to recognize ever make a bronze sculpture.
3b. The artist who remembered no curator well enough to recognize will ever make a bronze sculpture.
3c. No artist who the curator remembered well enough to recognize will ever make a bronze sculpture.
3d. The artist who the curator remembered well enough to recognize will ever make a bronze sculpture.
4a. The professor who no dean remembered fondly as a mentor will ever win a teaching award.
4b. The professor who remembered no dean fondly as a mentor will ever win a teaching award.
4c. No professor who the dean remembered fondly as a mentor will ever win a teaching award.
4d. The professor who the dean remembered fondly as a mentor will ever win a teaching award.
5a. The soldier who no general invited to curry favor will ever earn a combat medal.

5b. The soldier who invited no general to curry favor will ever earn a combat medal.
5c. No soldier who the general invited to curry favor will ever earn a combat medal.
5d. The soldier who the general invited to curry favor will ever earn a combat medal.
6a. The reporter who no candidate invited to the press pool will ever break a major story.
6b. The reporter who invited no candidate to the press pool will ever break a major story.
6c. No reporter who the candidate invited to the press pool will ever break a major story.
6d. The reporter who the candidate invited to the press pool will ever break a major story.
7a. The pirate who no admiral suspected of trickery will ever be arrested for stealing a ship.
7b. The pirate who suspected no admiral of trickery will ever be arrested for stealing a ship.
7c. No pirate who the admiral suspected of trickery will ever be arrested for stealing a ship.
7d. The pirate who the admiral suspected of trickery will ever be arrested for stealing a ship.
8a. The thief who no detective suspected was watching will ever be caught red handed.
8b. The thief who suspected no detective was watching will ever be caught red handed.
8c. No thief who the detective suspected was watching will ever be caught red handed.
8d. The thief who the detective suspected was watching will ever be caught red handed.
9a. The lawyer who no criminal noticed approach the bench will ever run for governor.
9b. The lawyer who noticed no criminal had approached the bench will ever run for governor.
9c. No lawyer who the criminal noticed approach the bench will ever run for governor.
9d. The lawyer who the criminal noticed approach the bench will ever run for governor.
10a. The protester who no policeman noticed sneak past will ever support lower taxes.
10b. The protester who noticed no policeman walk by will ever support lower taxes.
10c. No protester who the policeman noticed sneak past will ever support lower taxes.
10d. The protester who the policeman noticed sneak past will ever support lower taxes.
11a. The hostage who no kidnapper realized was a veteran will ever escape without being spotted.
11b. The hostage who realized no kidnapper was respectable will ever escape without being spotted.
11c. No hostage who the kidnapper realized was a veteran will ever escape without being spotted.
11d. The hostage who the kidnapper realized was a veteran will ever escape without being spotted.
12a. The pollster who no politician realized could predict the results will ever be unemployed
12b. The pollster who realized no politician could win will ever be unemployed.

12c. No pollster who the politician realized could predict the results will ever be unemployed.
12d. The pollster who the politician realized could predicted the results will ever be unemployed.
13a. The actor who no director predicted will be a star will ever play a supporting role.
13b. The actor who predicted no director will be famous will ever play a supporting role.
13c. No actor who the director predicted will be a star will ever play a supporting role.
13d. The actor who the director predicted will be a star will ever play a supporting role.
14a. The rancher who no cowboy predicted will have a good harvest will ever be hungry again.
14b. The rancher who predicted no cowboy will wrangle the bull will ever be hungry again.
14c. No rancher who the cowboy predicted will have a good harvest will ever be hungry again.
14d. The rancher who the cowboy predicted will have a good harvest will ever be hungry again.
15a. The lender who no banker recommended for home loans will ever raise interest rates.
15b. The lender who recommended no banker for asset management will ever raise interest rates.
15c. No lender who the banker recommended for home loans will ever raise interest rates.
15d. The lender who the banker recommended for home loans will ever raise interest rates.
16a. The agent who no tourist recommended for travel planning will ever suggest a boring trip.
16b. The agent who recommended no tourist go to Panama will ever suggest a boring trip.
16c. No agent who the tourist recommended for travel planning will ever suggest a boring trip.
16d. The agent who the tourist recommended for travel planning will ever suggest a boring trip.
17a. The painter who no sculptor said had a good eye will ever paint an impressionist sunset.
17b. The painter who said no sculptor had a good eye will ever paint an impressionist sunset.
17c. No painter who the sculptor said had a good eye will ever paint an impressionist sunset.
17d. The painter who the sculptor said had a good eye will ever paint an impressionist sunset.
18a. The bully who no student said was mean will ever get a scholarship to Northwestern.
18b. The bully who said no student was mean will ever get a scholarship to Northwestern.
18c. No bully who the student said was mean will ever get a scholarship to Northwestern.

18d. The bully who the student said was mean will ever get a scholarship to Northwestern.
19a. The patient who no trainer treated for a broken leg will ever give up on recovery.
19b. The patient who treated no trainer to dinner will ever give up on recovery.
19c. No patient who the trainer treated for a broken leg will ever give up on recovery.
19d. The patient who the trainer treated for a broken leg will ever give up on recovery.
20a. The victim who no doctor treated after a car accident will ever drive again.
20b. The victim who treated no doctor to lunch will ever drive again.
20c. No victim who the doctor treated after a car accident will ever drive again.
20d. The victim who the doctor treated after a car accident will ever drive again.
21a. The author who no reader knew to be verbose will ever buy books online.
21b. The author who knew no reader to be verbose will ever buy books online.
21c. No author who the reader knew to be verbose will ever buy books online.
21d. The author who the reader knew to be verbose will ever buy books online.
22a. The bailiff who no judge knew to be uncivil will ever commit a crime.
22b. The bailiff who knew no judge to be uncivil will ever commit a crime.
22c. No bailiff who the judge knew to be uncivil will ever commit a crime.
22d. The bailiff who the judge knew to be uncivil will ever commit a crime.
23a. The traitor who no jury speculated was guilty will ever be let go.
23b. The traitor who speculated no jury was rigged will ever be let go.
23c. No traitor who the jury speculated was guilty will ever be let go.
23d. The traitor who the jury speculated was guilty will ever be let go.
24a. The player who no referee speculated was doping will ever have playing time.
24b. The player who speculated no referee was paid off will ever have playing time.
24c. No player who the referee speculated was doping will ever have playing time.
24d. The player who the referee speculated was doping will ever have playing time.
25a. The fireman who no arsonist assumed will respond will ever miss a service call.
25b. The fireman who assumed no arsonist will respond will ever miss a service call.
25c. No fireman who the arsonist assumed will respond will ever miss a service call.
25d. The fireman who the arsonist assumed will respond will ever miss a service call.
26a. The skier who no snowboarder assumed will miss the season will ever skip a day with good snow.
26b. The skier who assumed no snowboarder will miss the season will ever skip a day with good snow.
26c. No skier who the snowboarder assumed will miss the season will ever skip a day with good snow.
26d. The skier who the snowboarder assumed will miss the season will ever skip a day with good snow.
27a. The sailor who no pilot thought was a hotshot will ever be too busy showing off.
27b. The sailor who thought no pilot was a hotshot will ever be too busy showing off.
27c. No sailor who the pilot thought was a hotshot will ever be too busy showing off.
27d. The sailor who the pilot thought was a hotshot will ever be too busy showing off.
28a. The poet who no singer thought was verbose will ever improvise in a performance.
28b. The poet who thought no singer was verbose will ever improvise in a performance.
28c. No poet who the singer thought was verbose will ever improvise in a performance.

28d. The poet who the singer thought was verbose will ever improvise in a performance.
29a. The suspect who no investigator cleared of wrongdoing will ever trespass on government property.
29b. The suspect who cleared no investigator of wrongdoing will ever trespass on government property.
29c. No suspect who the investigator cleared of wrongdoing will ever trespass on government property.
29d. The suspect who the investigator cleared of wrongdoing will ever trespass on government property.
30a. The scammer who no sheriff cleared of involvement will ever run another con.
30b. The scammer who cleared no sheriff of involvement will ever run another con.
30c. No scammer who the sheriff cleared of involvement will ever run another con.
30d. The scammer who the sheriff cleared of involvement will ever run another con.
31a. The dancer who no teacher concluded was clumsy will ever perform center stage.
31b. The dancer who concluded no teacher was clumsy will ever perform center stage.
31c. No dancer who the teacher concluded was clumsy will ever perform center stage.
31d. The dancer who the teacher concluded was clumsy will ever perform center stage.
32a. The apprentice who no blacksmith concluded was talented will ever open a smithy.
32b. The apprentice who concluded no blacksmith was talented will ever open a smithy.
32c. No apprentice who the blacksmith concluded was talented will ever open a smithy.
32d. The apprentice who the blacksmith concluded was talented will ever open a smithy.

B.7. Experiment 8 Items

1a. No hunter who the fisherman believed to be trustworthy will ever shoot a bear.
1b. The hunter who the fisherman believed to be trustworthy will ever shoot a bear.
1c. The hunter who believed no fisherman to be trustworthy will ever shoot a bear.
1d. The hunter who believed not a single fisherman to be trustworthy will ever shoot a bear.
1e. The hunter who no fisherman believed to be trustworthy will ever shoot a bear.
1f. The hunter who not a single fisherman believed to be trustworthy will ever shoot a bear.
2a. No senator who the farmer believed to be respectable will ever vote yes on the smoking proposal.
2b. The senator who the farmer believed to be respectable will ever vote yes on new smoking proposition.
2c. The senator who believed no farmer to be respectable will ever vote yes on the smoking proposal.
2d. The senator who believed not a single farmer to be respectable will ever vote yes on the smoking proposal.
2e. The senator who no farmer believed to be respectable will ever vote yes on the smoking proposal.
2f. The senator who not a single farmer believed to be respectable will ever vote yes on the smoking proposal.

3a. No artist who the curator remembered well enough to recognize will ever make a bronze sculpture.
3b. The artist who the curator remembered well enough to recognize will ever make a bronze sculpture.
3c. The artist who remembered no curator well enough to recognize will ever make a bronze sculpture.
3d. The artist who remembered not a single curator well enough to recognize will ever make a bronze sculpture.
3e. The artist who no curator remembered well enough to recognize will ever make a bronze sculpture.
3f. The artist who not a single curator remembered well enough to recognize will ever make a bronze sculpture.
4a. No professor who the dean remembered fondly as a mentor will ever win a teaching award.
4b. The professor who the dean remembered fondly as a mentor will ever win a teaching award.
4c. The professor who remembered no dean fondly as a mentor will ever win a teaching award.
4d. The professor who remembered not a single dean fondly as a mentor will ever win a teaching award.
4e. The professor who no dean remembered fondly as a mentor will ever win a teaching award.
4f. The professor who not a single dean remembered fondly as a mentor will ever win a teaching award.
5a. No soldier who the general invited to curry favor will ever earn a combat medal.
5b. The soldier who the general invited to curry favor will ever earn a combat medal.
5c. The soldier who invited no general to curry favor will ever earn a combat medal.
5d. The soldier who invited not a single general to curry favor will ever earn a combat medal.
5e. The soldier who no general invited to curry favor will ever earn a combat medal.
5f. The soldier who not a single general invited to curry favor will ever earn a combat medal.
6a. No reporter who the candidate invited to the press pool will ever break a major story.
6b. The reporter who the candidate invited to the press pool will ever break a major story.
6c. The reporter who invited no candidate to the press pool will ever break a major story.
6d. The report who invited not a single candidate to the press pool will ever break a major story.
6e. The reporter who no candidate invited to the press pool will ever break a major story.
6f. The reporter who not a single candidate invited to the press pool will ever break a major story.

7a. No pirate who the admiral suspected of trickery will ever be arrested for stealing a ship.
7b. The pirate who the admiral suspected of trickery will ever be arrested for stealing a ship.
7c. The pirate who suspected no admiral of trickery will ever be arrested for stealing a ship.
7d. The pirate who suspected not a single admiral of trickery will ever be arrested for stealing a ship.
7e. The pirate who no admiral suspected of trickery will ever be arrested for stealing a ship.
7f. The pirate who not a single admiral suspected of trickery will ever be arrested for stealing a ship.
8a. No thief who the detective suspected for a while will ever be caught red handed.
8b. The thief who the detective suspected for a while will ever be caught red handed.
8c. The thief who suspected no detective for a while will ever be caught red handed.
8d. The thief who suspected not a single detective for a while will ever be caught red handed.
8e. The thief who no detective suspected for a while will ever be caught red handed.
8f. The thief who not a single detective suspected for a while will ever be caught red handed.
9a. No lawyer who noticed the criminal approach the bench will ever run for governor.
9b. The lawyer who noticed the criminal approach the bench will ever run for governor.
9c. The lawyer who noticed no criminal approach the bench will ever run for governor.
9d. The lawyer who noticed not a single criminal approach the bench will ever run for governor.
9e. The lawyer who no criminal noticed approach the bench will ever run for governor.
9f. The lawyer who not a single criminal noticed approach the bench will ever run for governor.
10a. No protester who the policeman noticed sneak past will ever support lower taxes.
10b. The protester who the policeman noticed sneak past will ever support lower taxes.
10c. The protester who noticed no policeman sneak past will ever support lower taxes.
10d. The protester who noticed not a single policeman sneak past will ever support lower taxes.
10e. The protester who no policeman noticed sneak past will ever support lower taxes.
10f. The protester who not a single policeman noticed sneak past will ever support lower taxes.
11a. No hostage who the kidnapper realized was brave will ever escape without being spotted.
11b. The hostage who the kidnapper realized was brave will ever escape without being spotted.
11c. The hostage who realized no kidnapper was brave will ever escape without being spotted.
11d. The hostage who realized not a single kidnapper was brave will ever escape without being spotted.

11e. The hostage who no kidnapper realized was brave will ever escape without being spotted.
11f. The hostage who not a single kidnapper realized was brave will ever escape without being spotted.
12a. No pollster who realized no politician could predict the results will ever be unemployed.
12b. The pollster who realized the politician could predict the results will ever be unemployed.
12c. The pollster who realized no politician could predict the results will ever be unemployed.
12d. The pollster who realized not a single politician could predict the results will ever be unemployed.
12e. The pollster who no politician realized could predict the results will ever be unemployed.
12f. The pollster who not a single politician realized could predict the results will ever be unemployed.
13a. No actor who the director predicted would be a star will ever play a supporting role.
13b. The actor who the director predicted would be a star will ever play a supporting role.
13c. The actor who predicted no director would be a star will ever play a supporting role.
13d. The actor who predicted not a single director would be a star will ever play a supporting role.
13e. The actor who no director predicted would be a star will ever play a supporting role.
13f. The actor who not a single director predicted would be a star will ever play a supporting role.
14a. No rancher who the cowboy predicted would wrangle the bull will ever be hungry again.
14b. The rancher who the cowboy predicted would wrangle the bull will ever be hungry again.
14c. The rancher who predicted no cowboy would wrangle the bull will ever be hungry again.
14d. The rancher who predicted not a single cowboy would wrangle the bull will ever be hungry again.
14e. The rancher who no cowboy predicted would wrangle the bull will ever be hungry again.
14f. The rancher who not a single cowboy predicted would wrangle the bull will ever be hungry again.
15a. No lender who the banker recommended for home loans will ever raise interest rates.
15b. The lender who the banker recommended for home loans will ever raise interest rates.

15c. The lender who recommended no banker for home loans will ever raise interest rates.
15d. The lender who recommended not a single banker for home loans will ever raise interest rates.
15e. The lender who no banker recommended for home loans will ever raise interest rates.
15f. The lender who not a single banker recommended for home loans will ever raise interest rates
16a. No agent who the concierge recommended for day planning will ever suggest a boring trip.
16b. The agent who the concierge recommended for day planning will ever suggest a boring trip.
16c. The agent who recommended no concierge for day planning will ever suggest a boring trip.
16d. The agent who recommended not a single concierge for day planning will ever suggest a boring trip.
16e. The agent who no concierge recommended for day planning will ever suggest a boring trip.
16f. the agent who not a single concierge recommended for day planning will ever suggest a boring trip.
17a. No painter who the sculptor said had a good eye will ever paint an impressionist sunset.
17b. The painter who the sculptor said had a good eye will ever paint an impressionist sunset.
17c. The painter who said no sculptor had a good eye will ever paint an impressionist sunset.
17d. The painter who said not a single sculptor had a good eye will ever paint an impressionist sunset.
17e. The painter who no sculptor said had a good eye will ever paint an impressionist sunset.
17f. The painter who not a single sculptor said had a good eye will ever paint an impressionist sunset.
18a. No bully who the student said was mean will ever get a scholarship to Northwestern.
18b. The bully who the student said was mean will ever get a scholarship to Northwestern.
18c. The bully who said no student was mean will ever get a scholarship to Northwestern.
18d. The bully who said not a single student was mean will ever get a scholarship to Northwestern.
18e. The bully who no student said was mean will ever get a scholarship to Northwestern.
18f. The bully who not a single student said was mean will ever get a scholarship to Northwestern.
19a. No patient who the trainer treated unkindly will ever give up on recovery.
19b. The patient who the trainer treated unkindly will ever give up on recovery.
19c. The patient who treated no trainer unkindly will ever give up on recovery.
19d. The patient who treated not a single trainer unkindly will ever give up on recovery.

19e. The patient who no trainer treated unkindly will ever give up on recovery.
19f. The patient who not a single trainer treated unkindly will ever give up on recovery.
20a. No victim who the doctor treated to lunch will ever drive again.
20b. The victim who the doctor treated to lunch will ever drive again.
20c. The victim who treated no doctor to lunch will ever drive again.
20d. The victim who treated not a single doctor to lunch will ever drive again.
20e. The victim who no doctor treated to lunch will ever drive again.
20f. The victim who not a single doctor treated to lunch will ever drive again.
21a. No author who the reader knew to be verbose will ever buy books online.
21b. The author who the reader knew to be verbose will ever buy books online.
21c. The author who knew no reader to be verbose will ever buy books online.
21d. The author who knew not a single reader to be verbose will ever buy books online.
21e. The author who no reader knew to be verbose will ever buy books online.
21f. The author who not a single reader knew to be verbose will ever buy books online.
22a. No bailiff who the judge knew to be uncivil will ever commit a crime.
22b. The bailiff who the judge knew to be uncivil will ever commit a crime.
22c. The bailiff who knew no judge to be uncivil will ever commit a crime.
22d. The bailiff who knew not a single judge to be uncivil will ever commit a crime.
22e. The bailiff who no judge knew to be uncivil will ever commit a crime.
22f. The bailiff who not a single judge knew to be uncivil will ever commit a crime.
23a. No traitor who the jury speculated was dishonest will ever be let go.
23b. The traitor who the jury speculated was dishonest will ever be let go.
23c. The traitor who speculated no jury was dishonest will ever be let go.
23d. The traitor who speculated not a single jury was dishonest will ever be let go.
23e. The traitor who no jury speculated was dishonest will ever be let go.
23f. The traitor who not a single jury speculated was dishonest will ever be let go.
24a. No player who the referee speculated was paid off will ever have playing time.
24b. The player who the referee speculated was paid off will ever have playing time.
24c. The player who speculated no referee was paid off will ever have playing time.
24d. The player who speculated not a single referee was paid off will ever have playing time.
24e. The player who no referee speculated was paid off will ever have playing time.
24f. The player who not a single referee speculated was paid off will ever have playing time.
25a. No fireman who the arsonist assumed would respond will ever miss a service call.
25b. The fireman who the arsonist assumed would respond will ever miss a service call.
25c. The fireman who assumed no arsonist would respond will ever miss a service call.
25d. The fireman who assumed not a single arsonist would respond will ever miss a service call.
25e. The fireman who no arsonist assumed would respond will ever miss a service call.
25f. The fireman who not a single arsonist assumed would respond will ever miss a service call.
26a. No skier who the snowboarder assumed would miss the season will ever skip a day with good snow.

26b. The skier who the snowboarder assumed would miss the season will ever skip a day with good snow.
26c. The skier who assumed no snowboarder would miss the season will ever skip a day with good snow.
26d. The skier who assumed not a single snowboarder would miss the season will ever skip a day with good snow.
26e. The skier who no snowboarder assumed would miss the season will ever skip a day with good snow.
26f. The skier who not a single snowboarder assumed would miss the season will ever skip a day with good snow.
27a. No sailor who the pilot thought was a hotshot will ever be too busy showing off.
27b. The sailor who the pilot thought was a hotshot will ever be too busy showing off.
27c. The sailor who thought no pilot was a hotshot will ever be too busy showing off.
27d. The sailor who thought not a single pilot was a hotshot will ever be too busy showing off.
27e. The sailor who no pilot thought was a hotshot will ever be too busy showing off.
27f. The sailor who not a single pilot thought was a hotshot will ever be too busy showing off.
28a. No poet who the singer thought was talented will ever improvise in a performance.
28b. The poet who the singer thought was talented will ever improvise in a performance.
28c. The poet who thought no singer was talented will ever improvise in a performance.
28d. The poet who thought not a single singer was talented will ever improvise in a performance.
28e. The poet who no singer thought was talented will ever improvise in a performance.
28f. The poet who not a single singer thought was talented will ever improvise in a performance.
29a. No suspect who the investigator cleared of wrongdoing would ever trespass on government property.
29b. The suspect who the investigator cleared of wrongdoing would ever trespass on government property.
29c. The suspect who cleared no investigator of wrongdoing would ever trespass on government property.
29d. The suspect who cleared not a single investigator of wrongdoing would ever trespass on government property.
29e. The suspect who no investigator cleared of wrongdoing would ever trespass on government property.
29f. The suspect who not a single investigator cleared of wrongdoing would ever trespass on government property.
30a. No scammer who the sheriff cleared of involvement will ever run another con.
30b. The scammer who the sheriff cleared of involvement will ever run another con.
30c. The scammer who cleared no sheriff of involvement will ever run another con.
30d. The scammer who cleared not a single sheriff of involvement will ever run another con.
30e. The scammer who no sheriff cleared of involvement will ever run another con.

30f. The scammer who not a single sheriff cleared of involvement will ever run another con.
31a. No dancer who the teacher concluded was clumsy will ever perform center stage.
31b. The dancer who the teacher concluded was clumsy will ever perform center stage.
31c. The dancer who concluded no teacher was clumsy will ever perform center stage.
31d. The dancer who concluded not a single teacher was clumsy will ever perform center stage.
31e. The dancer who no teacher concluded was clumsy will ever perform center stage.
31f. The dancer who not a single teacher concluded was clumsy will ever perform center stage.
32a. No apprentice who the blacksmith concluded had potential will ever open a smithy.
32b. The apprentice who the blacksmith concluded had potential will ever open a smithy.
32c. The apprentice who concluded no blacksmith had potential will ever open a smithy.
32d. The apprentice who concluded not a single blacksmith had potential will ever open a smithy.
32e. The apprentice who no blacksmith concluded had potential will ever open a smithy.
32f. The apprentice who not a single blacksmith concluded had potential will ever open a smithy.
33a. No trucker who the analyst suggested was underperforming will ever retire early.
33b. The trucker who the analyst suggested was underperforming will ever retire early.
33c. The trucker who suggested no analyst was underperforming will ever retire early.
33d. The trucker who suggested not a single analyst was underperforming will ever retire early.
33e. The trucker who no analyst suggested was underperforming will ever retire early.
33f. The trucker who not a single analyst suggested was underperforming will ever retire early.
34a. No bellhop who the doorman suggested could work harder will ever help out after hours.
34b. The bellhop who the doorman suggested could work harder will ever help out after hours.
34c. The bellhop who suggested no doorman could work harder will ever help out after hours.
34d. The bellhop who suggested not a single doorman could work harder will ever help out after hours.
34e. The bellhop who no doorman suggested could work harder will ever help out after hours.
34f. The bellhop who not a single doorman suggested could work harder will ever help out after hours.
35a. No contractor who the architect proposed for the job will ever question the design choices.
35b. The contractor who the architect proposed for the job will ever question the design choices.
35c. The contractor who proposed no architect for the job will ever question the design choices.

35d. The contractor who proposed not a single architect for the job will ever question the design choices.
35e. The contractor who no architect proposed for the job will ever question the design choices.
35f. The contractor who not a single architect proposed for the job will ever question the design choices.
36a. No manufacturer who the inventor proposed for production will ever miss a shipment.
36b. The manufacturer who the inventor proposed for production will ever miss a shipment.
36c. The manufacturer who proposed no inventor for production will ever miss a shipment.
36d. The manufacturer who proposed not a single inventor for production will ever miss a shipment.
36e. The manufacturer who no inventor proposed for production will ever miss a shipment.
36f. The manufacturer who not a single inventor proposed for production will ever miss a shipment.

B.8. Experiment 9 Items

1a. The senator who no farmer believed to be untrustworthy will ever vote yes on the smoking proposal.
1b. The senator who believed no farmer to be untrustworthy will ever vote yes on the smoking proposal.
1c. No senator who the farmer believed to be untrustworthy will ever vote yes on the smoking proposal.
1d. The senator who didn't believe the farmer to be untrustworthy will ever vote yes on the smoking proposal.
1e. The senator who the farmer believed to be untrustworthy will ever vote yes on new smoking proposal.
2a. The hunter who no fisherman believed to be respectable will ever shoot a brown bear.
2b. The hunter who believed no fisherman to be respectable will ever shoot a brown bear.
2c. No hunter who the fisherman believed to be respectable will ever shoot a brown bear.
2d. The hunter who didn't believe the fisherman to be respectable will ever shoot a brown bear.
2e. The hunter who the fisherman believed to be respectable will ever shoot a brown bear.
3a. The artist who no curator remembered well enough to recognize ever make a bronze sculpture.

3b. The artist who remembered no curator well enough to recognize will ever make a bronze sculpture.
3c. No artist who the curator remembered well enough to recognize will ever make a bronze sculpture.
3d. The artist who didn't remember the curator well enough to recognize will ever make a bronze sculpture.
3e. The artist who the curator remembered well enough to recognize will ever make a bronze sculpture.
4a. The professor who no dean remembered fondly as a mentor will ever win a teaching award.
4b. The professor who remembered no dean fondly as a mentor will ever win a teaching award.
4c. No professor who the dean remembered fondly as a mentor will ever win a teaching award.
4d. The professor who didn't remember the dean fondly as a mentor will ever win a teaching award.
4e. The professor who the dean remembered fondly as a mentor will ever win a teaching award.
5a. The soldier who no general invited to curry favor will ever earn a combat medal.
5b. The soldier who invited no general to curry favor will ever earn a combat medal.
5c. No soldier who the general invited to curry favor will ever earn a combat medal.
5d. The soldier who didn't invite the general to curry favor will ever earn a combat medal.
5e. The soldier who the general invited to curry favor will ever earn a combat medal.
6a. The reporter who no candidate invited to the press pool will ever break a major story.
6b. The reporter who invited no candidate to the press pool will ever break a major story.
6c. No reporter who the candidate invited to the press pool will ever break a major story.
6d. The reporter who didn't invite the candidate to the press pool will ever break a major story.
6e. The reporter who the candidate invited to the press pool will ever break a major story.
7a. The pirate who no admiral suspected of trickery will ever be arrested for stealing a ship.
7b. The pirate who suspected no admiral of trickery will ever be arrested for stealing a ship.
7c. No pirate who the admiral suspected of trickery will ever be arrested for stealing a ship.
7d. The pirate who didn't suspect the admiral of trickery will ever be arrested for stealing a ship.
7e. The pirate who the admiral suspected of trickery will ever be arrested for stealing a ship.

8a. The thief who no detective suspected was watching will ever be caught red handed.
8b. The thief who suspected no detective was watching will ever be caught red handed.
8c. No thief who the detective suspected was watching will ever be caught red handed.
8d. The thief who didn't suspect the detective was watching will ever be caught red handed.
8e. The thief who the detective suspected was watching will ever be caught red handed.
9a. The lawyer who no criminal noticed approach the bench will ever run for governor.
9b. The lawyer who noticed no criminal approach the bench will ever run for governor.
9c. No lawyer who the criminal noticed approach the bench will ever run for governor.
9d. The lawyer who didn't notice the criminal approach the bench will ever run for governor.
9e. The lawyer who the criminal noticed approach the bench will ever run for governor.
10a. The protester who no policeman noticed sneak past will ever support lower taxes.
10b. The protester who noticed no policeman sneak past will ever support lower taxes.
10c. No protester who the policeman noticed sneak past will ever support lower taxes.
10d. The protester who didn't notice the policeman sneak past will ever support lower taxes.
10e. The protester who the policeman noticed sneak past will ever support lower taxes.
11a. The hostage who no kidnapper realized was respectable will ever escape without being spotted.
11b. The hostage who realized no kidnapper was respectable will ever escape without being spotted.
11c. No hostage who the kidnapper realized was respectable will ever escape without being spotted.
11d. The hostage who didn't realize the kidnapper was respectable will ever escape without being spotted.
11e. The hostage who the kidnapper realized was respectable will ever escape without being spotted.
12a. The pollster who no politician realized could predict the results will ever be unemployed
12b. The pollster who realized no politician predict the results win will ever be unemployed.
12c. No pollster who the politician realized could predict the results will ever be unemployed.
12d. The pollster who didn't realize the politician could predict the results will ever be unemployed.
12e. The pollster who the politician realized could predict the results will ever be unemployed.
13a. The actor who no director predicted would be a star will ever play a supporting role.
13b. The actor who predicted no director would a star will ever play a supporting role.
13c. No actor who the director predicted would be a star will ever play a supporting role.

13d. The actor who didn't predict the director would be a star will ever play a supporting role.
13e. The actor who the director predicted would be a star will ever play a supporting role.
14a. The rancher who no cowboy predicted would wrangle the bull will ever be hungry again.
14b. The rancher who predicted no cowboy would wrangle the bull will ever be hungry again.
14c. No rancher who the cowboy predicted would wrangle the bull will ever be hungry again.
14d. The rancher who didn't predict the cowboy would wrangle the bull will ever be hungry again.
14e. The rancher who the cowboy predicted would wrangle the bull will ever be hungry again.
15a. The lender who no banker recommended for home loans will ever raise interest rates.
15b. The lender who recommended no banker for home loans will ever raise interest rates.
15c. No lender who the banker recommended for home loans will ever raise interest rates.
15d. The lender who didn't recommend the banker for home loans will ever raise interest rates.
15e. The lender who the banker recommended for home loans will ever raise interest rates.
16a. The agent who no concierge recommended for day planning will ever suggest a boring trip.
16b. The agent who recommended no concierge for day planning will ever suggest a boring trip.
16c. No agent who the concierge recommended for day planning will ever suggest a boring trip.
16d. The agent who didn't recommend the concierge for day planning will ever suggest a boring trip.
16e. The agent who the concierge recommended for day planning will ever suggest a boring trip.
17a. The painter who no sculptor said had a good eye will ever paint an impressionist sunset.
17b. The painter who said no sculptor had a good eye will ever paint an impressionist sunset.
17c. No painter who the sculptor said had a good eye will ever paint an impressionist sunset.
17d. The painter who didn't say the sculptor had a good eye will ever paint an impressionist sunset.
17e. The painter who the sculptor said had a good eye will ever paint an impressionist sunset.

18a. The bully who no student said was mean will ever get a scholarship to Northwestern.
18b. The bully who said no student was mean will ever get a scholarship to Northwestern.
18c. No bully who the student said was mean will ever get a scholarship to Northwestern.
18d. The bully who didn't say the student was mean will ever get a scholarship to Northwestern.
18e. The bully who the student said was mean will ever get a scholarship to Northwestern.
19a. The patient who no trainer treated unkindly will ever give up on recovery.
19b. The patient who treated no trainer unkindly will ever give up on recovery.
19c. No patient who the trainer treated unkindly will ever give up on recovery.
19d. The patient who didn't treat the trainer unkindly will ever give up on recovery.
19e. The patient who the trainer treated for a broken leg will ever give up on recovery.
20a. The victim who no doctor treated to lunch will ever drive again.
20b. The victim who treated no doctor to lunch will ever drive again.
20c. No victim who the doctor treated to lunch will ever drive again.
20d. The victim who didn't treat the doctor to lunch will ever drive again.
20e. The victim who the doctor treated to lunch will ever drive again.
21a. The author who no reader knew to be verbose will ever buy books online.
21b. The author who knew no reader to be verbose will ever buy books online.
21c. No author who the reader knew to be verbose will ever buy books online.
21d. The author who didn't know the reader to be verbose will ever buy books online.
21e. The author who the reader knew to be verbose will ever buy books online.
22a. The bailiff who no judge knew to be uncivil will ever commit a crime.
22b. The bailiff who knew no judge to be uncivil will ever commit a crime.
22c. No bailiff who the judge knew to be uncivil will ever commit a crime.
22d. The bailiff who didn't know the judge to be uncivil will ever commit a crime.
22e. The bailiff who the judge knew to be uncivil will ever commit a crime.
23a. The traitor who no jury speculated was dishonest will ever be let go.
23b. The traitor who speculated no jury was dishonest will ever be let go.
23c. No traitor who the jury speculated was dishonest will ever be let go.
23d. The traitor who didn't speculate the jury was dishonest will ever be let go.
23e. The traitor who the jury speculated was dishonest will ever be let go.
24a. The player who no referee speculated was paid off will ever have playing time.
24b. The player who speculated no referee was paid off will ever have playing time.
24c. No player who the referee speculated was paid off will ever have playing time.
24d. The player who didn't speculate the referee was paid off will ever have playing time.
24e. The player who the referee speculated was paid off will ever have playing time.
25a. The fireman who no arsonist assumed would respond will ever miss a service call.
25b. The fireman who assumed no arsonist would respond will ever miss a service call.
25c. No fireman who the arsonist assumed would respond will ever miss a service call.
25d. The fireman who didn't assume the arsonist would respond will ever miss a service call.
25e. The fireman who the arsonist assumed would respond will ever miss a service call.

26a. The skier who no snowboarder assumed would miss the season will ever skip a day with good snow.
26b. The skier who assumed no snowboarder would miss the season will ever skip a day with good snow.
26c. No skier who the snowboarder assumed would miss the season will ever skip a day with good snow.
26d. The skier who didn't assume the snowboarder would miss the season will ever skip a day with good snow.
26e. The skier who the snowboarder assumed would miss the season will ever skip a day with good snow.
27a. The sailor who no pilot thought was a hotshot will ever be too busy showing off.
27b. The sailor who thought no pilot was a hotshot will ever be too busy showing off.
27c. No sailor who the pilot thought was a hotshot will ever be too busy showing off.
27d. The sailor who didn't think the pilot was a hotshot would ever bee too busy showing off.
27e. The sailor who the pilot thought was a hotshot will ever be too busy showing off.
28a. The poet who no singer thought was verbose will ever improvise in a performance.
28b. The poet who thought no singer was talented will ever improvise in a performance.
28c. No poet who the singer thought was talented will ever improvise in a performance.
28d. The poet who didn't think the singer was talented would ever improvise in a performance.
28e. The poet who the singer thought was talented will ever improvise in a performance.
29a. The suspect who no investigator cleared of wrongdoing will ever trespass on government property.
29b. The suspect who cleared no investigator of wrongdoing will ever trespass on government property.
29c. No suspect who the investigator cleared of wrongdoing will ever trespass on government property.
29d. The suspect who didn't clear the investigator of wrongdoing would ever trespass on government property.
29e. The suspect who the investigator cleared of wrongdoing will ever trespass on government property.
30a. The scammer who no sheriff cleared of involvement will ever run another con.
30b. The scammer who cleared no sheriff of involvement will ever run another con.
30c. No scammer who the sheriff cleared of involvement will ever run another con.
30d. The scammer who didn't clear the sheriff of involvement would ever run another con.
30e. The scammer who the sheriff cleared of involvement will ever run another con.
31a. The dancer who no teacher concluded was clumsy will ever perform center stage.
31b. The dancer who concluded no teacher was clumsy will ever perform center stage.
31c. No dancer who the teacher concluded was clumsy will ever perform center stage.
31d. The dancer who didn't conclude the teacher was clumsy would ever perform center stage.
31e. The dancer who the teacher concluded was clumsy will ever perform center stage.

32a. The apprentice who no blacksmith concluded had potential will ever open a smithy.
32b. The apprentice who concluded no blacksmith had potential will ever open a smithy.
32c. No apprentice who the blacksmith concluded had potential will ever open a smithy.
32d. The apprentice who didn't conclude the blacksmith had potential would ever open a smithy.
32e. The apprentice who the blacksmith concluded had potential will ever open a smithy.
33a. The trucker who no analyst suggested was underperforming will ever retire early.
33b. The trucker who suggested no analyst was underperforming will ever retire early.
33c. No trucker who the analyst suggested was underperforming will ever retire early.
33d. The trucker who didn't suggest the analyst was underperforming will ever retire early.
33e. The trucker who the analyst suggested was underperforming will ever retire early.
34a. The bellhop who no doorman suggested could work harder will ever help out after hours.
34b. The bellhop who suggested no doorman could work harder will ever help out after hours.
34c. No bellhop who the doorman suggested could work harder will ever help out after hours.
34d. The bellhop who didn't suggest the doorman could work harder will ever help out after hours.
34e. The bellhop who the doorman suggested could work harder will ever help out after hours.
35a. The contractor who no architect proposed to hire will ever question the design choices.
35b. The contractor who proposed no architect for the job will ever question the design choices.
35c. No contractor who the architect proposed for the job will ever question the design choices.
35d. The contractor who didn't propose the architect for the job will ever question the design choices.
35e. The contractor who the architect proposed for the job will ever question the designs choices.
36a. The manufacturer who no inventor proposed for production will ever miss a shipment.
36b. The manufacturer who proposed no inventor for production will ever miss a shipment.
36c. No manufacturer who the inventor proposed for production will ever miss a shipment.
36d. The manufacturer who didn't propose the inventor for production will ever miss a shipment.
36e. The manufacturer who the inventor proposed for production will ever miss a shipment.
37a. The organizer who no speaker scheduled for last week will ever change the agenda.
37b. The organizer who scheduled no speaker for last week will ever change the agenda.

37c. No organizer who the speaker scheduled for last week will ever change the agenda.
37d. The organizer who didn't schedule the speaker for last week will ever change the agenda.
37e. The organizer who the speaker scheduled for last week will ever change the agenda.
38a. The pianist who no promoter scheduled for the concert series will ever criticize the venue.
38b. The pianist who scheduled no promoter for the concert series will ever criticize the venue.
38c. No pianist who the promoter scheduled for the concert series will ever criticize the venue.
38d. The pianist who didn't schedule the promoter for the concert series will ever criticize the venue.
38e. The pianist who no promoter scheduled for the concert series will ever criticize the venue.
39a. The pupil who no tutor considered to be attentive will ever fail a test.
39b. The pupil who considered no tutor to be attentive will ever fail a test.
39c. No pupil who the tutor considered to be attentive will ever fail a test.
39d. The pupil who didn't consider the tutor to be attentive will ever fail a test.
39e. The pupil who the tutor considered to be attentive will ever fail a test.
40a. The crook who no swindler considered to be an ally will ever betray an accomplice.
40b. The crook who considered no swindler to be an ally will ever betray an accomplice.
40c. No crook who the swindler considered to be an ally will ever betray an accomplice.
40d. The crook who didn't consider the swindler to be an ally will ever betray an accomplice.
40e. The crook who the swindler considered to be an ally will ever betray an accomplice.

B.9. Experiment 10 Items

1a. The senator who no farmer had met at the rally will ever vote for the taxes on gas sales.
1b. The senator who had met no farmer at the rally will ever vote for the taxes on gas sales.
1c. The senator who the farmer had met at the rally will ever vote for the taxes on gas sales.
1d. The senator who had met the farmer at the rally will ever vote for the taxes on gas sales.
2a. The hunter who no fisherman had stalked through the woods will ever shoot a bear in a preserve.
2b. The hunter who had stalked no fisherman through the woods will ever shoot a bear in a preserve.
2c. The hunter who the fisherman had stalked through the woods will ever shoot a bear in a preserve.
2d. The hunter who had stalked the fisherman through the woods will ever shoot a bear in a preserve.

3a. The artist who no curator had remembered from the gallery will ever make a sculpture of a friend.
3b. The artist who had remembered no curator from the gallery will ever make a sculpture of a friend.
3c. The artist who the curator had remembered from the gallery will ever make a sculpture of a friend.
3d. The artist who had remembered the curator from the gallery will ever make a sculpture of a friend.
4a. The professor who no dean had encountered at the conference will ever win an award from the academy.
4b. The professor who had encountered no dean at the conference will ever win an award from the academy.
4c. The professor who the dean had encountered at the conference will ever win an award from the academy.
4d. The professor who had encountered the dean at the conference will ever win an award from the academy.
5a. The soldier who no general had invited to the meeting will ever earn a medal for dedicated service.
5b. The soldier who had invited no general to the meeting will ever earn a medal for dedicated service.
5c. The soldier who the general had invited to the meeting will ever earn a medal for dedicated service.
5d. The soldier who had invited the general to the meeting will ever earn a medal for dedicated service.
6a. The reporter who no candidate had annoyed during the interview will ever publish a policy with many details.
6b. The reporter who had annoyed no candidate during the interview will ever publish a policy with many details.
6c. The reporter who the candidate had annoyed during the interview will ever publish a policy with many details.
6d. The reporter who had annoyed the candidate during the interview will ever publish a policy with many details.
7a. The pirate who no admiral had followed across the sea will ever lose a ship in a hurricane.
7b. The pirate who had followed no admiral across the sea will ever lose a ship in a hurricane.
7c. The pirate who the admiral had followed across the sea will ever lose a ship in a hurricane.
7d. The pirate who had followed the admiral across the sea will ever lose a ship in a hurricane.
8a. The thief who no detective had tracked during the investigation will ever leave a clue at the scene.
8b. The thief who had tracked no detective during the investigation will ever leave a clue at the scene.

8c. The thief who the detective had tracked during the investigation will ever leave a clue at the scene.
8d. The thief who had tracked the detective during the investigation will ever leave a clue at the scene.
9a. The lawyer who no criminal had noticed during the trial will ever run for governor of North Dakota.
9b. The lawyer who had noticed no criminal during the trial will ever run for governor of North Dakota.
9c. The lawyer who the criminal had noticed during the trial will ever run for governor of North Dakota.
9d. The lawyer who had noticed the criminal during the trial will ever run for governor of North Dakota.
10a. The protester who no policeman had monitored at the demonstration will ever steal a sign from an activist.
10b. The protester who had monitored no policeman at the demonstration will ever steal a sign from an activist.
10c. The protester who the policeman had monitored at the demonstration will ever steal a sign from an activist.
10d. The protester who had monitored the policeman at the demonstration will ever steal a sign from an activist.
11a. The hostage who no kidnapper had seen across the room will ever make an escape with some help.
11b. The hostage who had seen no kidnapper across the room will ever make an escape with some help.
11c. The hostage who the kidnapper had seen across the room will ever make an escape with some help.
11d. The hostage who had seen the kidnapper across the room will ever make an escape with some help.
12a. The pollster who no politician had bothered with constant updates will ever predict the race with high accuracy
12b. The pollster who had bothered no politician with constant updates win will ever predict the race with high accuracy.
12c. The pollster who the politician had bothered with constant updates will ever predict the race with high accuracy
12d. The pollster who had bothered the politician with constant updates win will ever predict the race with high accuracy.
13a. The actor who no director had supported in the theater will ever land a part in a movie.
13b. The actor who had supported no director in the theater will ever land a part in a movie.
13c. The actor who the director had supported in the theater will ever land a part in a movie.
13d. The actor who had supported the director in the theater will ever land a part in a movie.

14a. The rancher who no cowboy had attacked outside the farm will ever file a report with the police.
14b. The rancher who had attacked no cowboy outside the farm will ever file a report with the police.
14c. The rancher who the cowboy had attacked outside the farm will ever file a report with the police.
14d. The rancher who had attacked the cowboy outside the farm will ever file a report with the police.
15a. The lender who no banker had recommended during the recession will ever open an account with low rates.
15b. The lender who had recommended no banker during the recession will ever open an account with low rates.
15c. The lender who the banker had recommended during the recession will ever open an account with low rates.
15d. The lender who had recommended the banker during the recession will ever open an account with low rates.
16a. The doorman who no concierge had recognized from the hotel will ever suggest a trip to the museum.
16b. The doorman who had recognized no concierge from the hotel will ever suggest a trip to the museum.
16c. The doorman who the concierge had recognized from the hotel will ever suggest a trip to the museum.
16d. The doorman who had recognized the concierge from the hotel will ever suggest a trip to the museum.
17a. The painter who no sculptor had fought for artistic notoriety will ever paint a portrait with a horse.
17b. The painter who had fought no sculptor for artistic notoriety will ever paint a portrait with a horse.
17c. The painter who the sculptor had fought for artistic notoriety will ever paint a portrait with a horse.
17d. The painter who had fought the sculptor for artistic notoriety will ever paint a portrait with a horse.
18a. The bully who no student had tripped in the hallway will ever get a scholarship to a university.
18b. The bully who had tripped no student in the hallway will ever get a scholarship to a university.
18c. The bully who the student had tripped in the hallway will ever get a scholarship to a university.
18d. The bully who had tripped the student in the hallway will ever get a scholarship to a university.
19a. The patient who no trainer had respected for many years will ever sprain an ankle on the treadmill.
19b. The patient who had respected no trainer for many years will ever sprain an ankle on the treadmill.

19c. The patient who the trainer had respected for many years will ever sprain an ankle on the treadmill.
19d. The patient who had respected the trainer for many years will ever sprain an ankle on the treadmill.
20a. The victim who no doctor had berated with harsh words will ever ride a horse to the hopsital.
20b. The victim who had berated no doctor with harsh words will ever ride a horse to the hopsital.
20c. The victim who the doctor had berated with harsh words will ever ride a horse to the hopsital.
20d. The victim who had berated the doctor with harsh words will ever ride a horse to the hopsital.
21a. The author who no reader had known from the library will ever buy a book over the internet.
21b. The author who had known no reader from the library will ever buy a book over the internet.
21c. The author who the reader had known from the library will ever buy a book over the internet.
21d. The author who had known the reader from the library will ever buy a book over the internet.
22a. The bailiff who no judge had suspected while at work will ever commit a crime outside the courthouse.
22b. The bailiff who had suspected no judge while at work will ever commit a crime outside the courthouse.
22c. The bailiff who the judge had suspected while at work will ever commit a crime outside the courthouse.
22d. The bailiff who had suspected the judge while at work will ever commit a crime outside the courthouse.
23a. The traitor who no jury had hated with a passion will ever go to jail for the crime.
23b. The traitor who had hated no jury with a passion will ever go to jail for the crime.
23c. The traitor who the jury had hated with a passion will ever go to jail for the crime.
23d. The traitor who had hated the jury with a passion will ever go to jail for the crime.
24a. The player who no referee had contacted before the game will ever fool the crowd with an argument.
24b. The player who had contacted no referee before the game will ever fool the crowd with an argument.
24c. The player who the referee had contacted before the game will ever fool the crowd with an argument.
24d. The player who had contacted the referee before the game will ever fool the crowd with an argument.
25a. The fireman who no arsonist had rescued from the fire will ever miss a report of a blaze .
25b. The fireman who had rescued no arsonist from the fire will ever miss a report of a blaze .

25c. The fireman who the arsonist had rescued from the fire will ever miss a report of a blaze .
25d. The fireman who had rescued the arsonist from the fire will ever miss a report of a blaze .
26a. The skier who no snowboarder had pushed down the hill will ever skip a day with good snow.
26b. The skier who had pushed no snowboarder down the hill will ever skip a day with good snow.
26c. The skier who the snowboarder had pushed down the hill will ever skip a day with good snow.
26d. The skier who had pushed the snowboarder down the hill will ever skip a day with good snow.
27a. The sailor who no pilot had tolerated in the service will ever leave the ship in a hurry.
27b. The sailor who had tolerated no pilot in the service will ever leave the ship in a hurry.
27c. The sailor who the pilot had tolerated in the service will ever leave the ship in a hurry.
27d. The sailor who had tolerated the pilot in the service will ever leave the ship in a hurry.
28a. The poet who no singer admired from a distance will ever improvise a verse for the audience.
28b. The poet who admired no singer was talented will ever improvise a verse for the audience.
28c. The poet who the singer admired from a distance will ever improvise a verse for the audience.
28d. The poet who admired the singer was talented will ever improvise a verse for the audience.
29a. The suspect who no investigator had avoided during the case will ever make a confession on the radio.
29b. The suspect who had avoided no investigator during the case will ever make a confession on the radio.
29c. The suspect who the investigator had avoided during the case will ever make a confession on the radio.
29d. The suspect who had avoided the investigator during the case will ever make a confession on the radio.
30a. The scammer who no sheriff had passed on the highway will ever drive a car off the interstate.
30b. The scammer who had passed no sheriff on the highway will ever drive a car off the interstate.
30c. The scammer who the sheriff had passed on the highway will ever drive a car off the interstate.
30d. The scammer who had passed the sheriff on the highway will ever drive a car off the interstate.

31a. The dancer who no teacher had despised out of jealousy will ever perform on stage for a crowd.
31b. The dancer who had despised no teacher out of jealousy will ever perform on stage for a crowd.
31c. The dancer who the teacher had despised out of jealousy will ever perform on stage for a crowd.
31d. The dancer who had despised the teacher out of jealousy will ever perform on stage for a crowd.
32a. The apprentice who no blacksmith had watched in the smithy will ever open a shop across the street.
32b. The apprentice who had watched no blacksmith in the smithy will ever open a shop across the street.
32c. The apprentice who the blacksmith had watched in the smithy will ever open a shop across the street.
32d. The apprentice who had watched the blacksmith in the smithy will ever open a shop across the street.

APPENDIX C

Experimental Materials for Chapter 4

C.1. Experiment 11 Items

1a. No hunter that the fisherman trusted with a secret will ever shoot a bear.
1b. No hunter that the fisherman trusted with a secret will still shoot a bear.
1c. The hunter that the fisherman trusted with a secret will ever shoot a bear.
1d. The hunter that the fisherman trusted with a secret will still shoot a bear.
1e. The hunter that no fisherman trusted with a secret will ever shoot a bear.
1f. The hunter that no fisherman trusted with a secret will still shoot a bear.
2a. No congressman that the voter remembered from a commercial will ever vote for a budget.
2b. No congressman that the voter remembered from a commercial will still vote for a budget.
2c. The congressman that the voter remembered from a commercial will ever vote for a budget.
2d. The congressman that the voter remembered from a commercial will still vote for a budget.
2e. The congressman that no voter remembered from a commercial will ever vote for a budget.
2f. The congressman that no voter remembered from a commercial will still vote for a budget.
3a. No musician that the artist recalled from the radio will ever win an award .
3b. No musician that the artist recalled from the radio will still win an award.
3c. The musician that the artist recalled from the radio will ever win an award .
3d. The musician that the artist recalled from the radio will still win an award.
3e. The musician that no artist recalled from the radio will ever win an award.
3f. The musician that no artist recalled from the radio will still win an award.
4a. No scientist that the dean respected as a teacher will ever publish a bad paper.
4b. No scientist that the dean respected as a teacher will still publish a bad paper.
4c. The scientist that the dean respected as a teacher will ever publish a bad paper.
4d. The scientist that the dean respected as a teacher will still publish a bad paper.
4e. The scientist that no dean respected as a teacher will ever publish a bad paper.
4f. The scientist that no dean respected as a teacher will still publish a bad paper.
5a. No hostage that the kidnapper noticed walk past will ever create a distraction.
5b. No hostage that the kidnapper noticed walk past will still create a distraction.
5c. The hostage that the kidnapper noticed walk past will ever create a distraction.
5d. The hostage that the kidnapper noticed walk past will still create a distraction.

5e. The hostage that no kidnapper noticed walk past will ever create a distraction.
5f. The hostage that no kidnapper noticed walk past will still create a distraction.
6a. No investor that the lender identified by her handwriting will ever dump a stock.
6b. No investor that the lender identified by her handwriting will still dump a stock.
6c. The investor that the lender identified by her handwriting will ever dump a stock.
6d. The investor that the lender identified by her handwriting will still dump a stock.
6e. The investor that no lender identified by her handwriting will ever dump a stock.
6f. The investor that no lender identified by her handwriting will still dump a stock.
7a. No politician that the pollster knew from the news will ever run a campaign.
7b. No politician that the pollster knew from the news will still run a campaign.
7c. The politician that the pollster knew from the news will ever run a campaign.
7d. The politician that the pollster knew from the news will still run a campaign.
7e. The politician that no pollster knew from the news will ever run a campaign.
7f. The politician that no pollster knew from the news will still run a campaign.
8a. No populist that the governor recognized the influence of will ever lose an election.
8b. No populist that the governor recognized the influence of will still lose an election.
8c. The populist that the governor recognized the influence of will ever lose an election.
8d. The populist that the governor recognized the influence of will still lose an election.
8e. The populist that no governor recognized the influence of will ever lose an election.
8f. The populist that no governor recognized the influence of will still lose an election.
9a. No soldier that the general believed to be tough will ever wash a tank.
9b. No soldier that the general believed to be tough will still wash a tank.
9c. The soldier that the general believed to be tough will ever wash a tank.
9d. The soldier that the general believed to be tough will still wash a tank.
9e. The soldier that no general believed to be tough will ever wash a tank.
9f. The soldier that no general believed to be tough will still wash a tank.
10a. No candidate that the committee invited to interview will ever submit a resume.
10b. No candidate that the committee invited to interview will still submit a resume.
10c. The candidate that the committee invited to interview will ever submit a resume.
10d. The candidate that the committee invited to interview will still submit a resume.
10e. The candidate that no committee invited to interview will ever submit a resume.
10f. The candidate that no committee invited to interview will still submit a resume.
11a. No author that the reader predicted would go far will ever write a play.
11b. No author that the reader predicted would go far will still write a play.
11c. The author that the reader predicted would go far will ever write a play.
11d. The author that the reader predicted would go far will still write a play.
11e. The author that no reader predicted would go far will ever write a play.
11f. The author that no reader predicted would go far will still write a play.
12a. No tourist that the vendor tricked out of a dollar will ever visit a temple.
12b. No tourist that the vendor tricked out of a dollar will still visit a temple.
12c. The tourist that the vendor tricked out of a dollar will ever visit a temple.
12d. The tourist that the vendor tricked out of a dollar will still visit a temple.
12e. The tourist that no vendor tricked out of a dollar will ever visit a temple.
12f. The tourist that no vendor tricked out of a dollar will still visit a temple.

13a. No electrician that the plumber said was incompetent will ever botch a job.
13b. No electrician that the plumber said was incompetent will still botch a job.
13c. The electrician that the plumber said was incompetent will ever botch a job.
13d. The electrician that the plumber said was incompetent will still botch a job.
13e. The electrician that no plumber said was incompetent will ever botch a jab.
13f. The electrician that no plumber said was incompetent will still botch a job.
14a. No patient that the doctor treated for a broken leg will ever be seriously ill.
14b. No patient that the doctor treated for a broken leg will still be seriously ill.
14c. The patient that the doctor treated for a broken leg will ever be seriously ill.
14d. The patient that the doctor treated for a broken leg will still be seriously ill.
14e. The patient that no doctor treated for a broken leg will ever be seriously ill.
14f. The patient that no doctor treated for a broken leg will still be seriously ill.
15a. No librarian that the curator liked as a friend will ever review a book.
15b. No librarian that the curator liked as a friend will still review a book.
15c. The librarian that the curator liked as a friend will review a book.
15d. The librarian that the curator liked as a friend will still review a book.
15e. The librarian that no curator liked as a friend will ever review a book.
15f. The librarian that no curator liked as a friend will still review a book.
16a. No protester that the guard understood to be a good person will ever block a road.
16b. No protester that the guard understood to be a good person will still block a road.
16c. The protester that the guard understood to be a good person will ever block a road.
16d. The protester that the guard understood to be a good person will still block a road.
16e. The protester that no guard understood to be a good person will ever block a road.
16f. The protester that no guard understood to be a good person will still block a road.
17a. No farmer that the rancher recalled from the town meeting has at all plowed a field.
17b. No farmer that the rancher recalled from the town meeting has already plowed a field.
17c. The farmer that the rancher recalled from the town meeting has at all plowed a field.
17d. The farmer that the rancher recalled from the town meeting has already plowed a field.
17e. The farmer that no rancher recalled from the town meeting has at all plowed a field.
17f. The farmer that no rancher recalled from the town meeting has already plowed a field.
18a. No pirate that the admiral respected as a sailor has at all plotted a course.
18b. No pirate that the admiral respected as a sailor has already navigated a sea.
18c. The pirate that the admiral respected as a sailor has at all plotted a course.
18d. The pirate that the admiral respected as a sailor has already navigated a sea.
18e. The pirate that no admiral respected as a sailor has at all plotted a course.
18f. The pirate that no admiral respected as a sailor has already navigated a sea.
19a. No salesman that the negotiator noticed slip up has at all made a deal.
19b. No salesman that the negotiator noticed slip up has already made a deal.
19c. The salesman that the negotiator noticed slip up has at all made a deal.
19d. The salesman that the negotiator noticed slip up has already made a deal.

19e. The salesman that no negotiator noticed slip up has at all made a deal.
19f. The salesman that no negotiator noticed slip up has already made a deal.
20a. No client that the banker identified by his account number has at all repaid a loan.
20b. No client that the banker identified by his account number has already repaid a loan.
20c. The client that the banker identified by his account number has at all repaid a loan.
20d. The client that the banker identified by his account number has already repaid a loan.
20e. The client that no banker identified by his account number has at all repaid a loan.
20f. The client that no banker identified by his account number has already repaid a loan.
21a. No actor that the director knew from the local theater has at all prepared a monologue.
21b. No actor that the director knew from the local theater has already prepared a monologue.
21c. The actor that the director knew from the local theater has at all prepared a monologue.
21d. The actor that the director knew from the local theater has already prepared a monologue.
21e. The actor that no director knew from the local theater has at all prepared a monologue.
21f. The actor that no director knew from the local theater has already prepared a monologue.
22a. No sponsor that the agent recognized as a genius has at all marketed a product.
22b. No sponsor that the agent recognized as a genius has already marketed a product.
22c. The sponsor that the agent recognized as a genius has at all marketed a product.
22d. The sponsor that the agent recognized as a genius has already marketed a product.
22e. The sponsor that no agent recognized as a genius has at all marketed a product..
22f. The sponsor that no agent recognized as a genius has already marketed a product.
23a. No judge that the bailiff liked for his swiftness has at all tried a case.
23b. No judge that the bailiff liked for his swiftness has already tried a case.
23c. The judge that the bailiff liked for his swiftness has at all tried a case.
23d. The judge that the bailiff liked for his swiftness has already tried a case.
23e. The judge that no bailiff liked for his swiftness has at all tried a case.
23f. The judge that no bailiff liked for his swiftness has already tried a case.
24a. No criminal that the lawyer tricked into a confession has at all robbed a bank.
24b. No criminal that the lawyer tricked into a confession has already robbed a bank.
24c. The criminal that the lawyer tricked into a confession has at all robbed a bank.
24d. The criminal that the lawyer tricked into a confession has already robbed a bank.
24e. The criminal that no lawyer tricked into a confession has at all robbed a bank.
24f. The criminal that no lawyer tricked into a confession has already robbed a bank.
25a. No dancer that the ballerina trusted to catch her has at all learned the choreography.
25b. No dancer that the ballerina trusted to catch her has already learned the choreography.

25c. The dancer that the ballerina trusted to catch her has at all learned the choreography.
25d. The dancer that the ballerina trusted to catch her has already learned the choreography.
25e. The dancer that no ballerina trusted to catch her has at all learned the choreography.
25f. The dancer that no ballerina trusted to catch her has already learned the choreography.
26a. No poet that the singer remembered from the open mic has at all prepared for a performance.
26b. No poet that the singer remembered from the open mic has already prepared for a performance.
26c. The poet that the singer remembered from the open mic has at all prepared for a performance.
26d. The poet that the singer remembered from the open mic has already prepared for a performance.
26e. The poet that no singer remembered from the open mic has at all prepared for a performance.
26f. The poet that no singer remembered from the open mic has already prepared for a performance.
27a. No foreman that the architect believed to be competent has at all laid the foundation.
27b. No foreman that the architect believed to be competent has already laid the foundation.
27c. The foreman that the architect believed to be competent has at all laid the foundation.
27d. The foreman that the architect believed to be competent has already laid the foundation.
27e. The foreman that no architect believed to be competent has at all laid the foundation.
27f. The foreman that no architect believed to be competent has already laid the foundation.
28a. No painter that the sculptor invited to the gallery has at all painted a masterpiece.
28b. No painter that the sculptor invited to the gallery has already painted a masterpiece.
28c. The painter that the sculptor invited to the gallery has at all painted a masterpiece.
28d. The painter that the sculptor invited to the gallery has already painted a masterpiece.
28e. The painter that no sculptor invited to the gallery has at all painted a masterpiece.
28f. The painter that no sculptor invited to the gallery has already painted a masterpiece.
29a. No programmer that the technician predicted would make a mistake has at all written a script.
29b. No programmer that the technician predicted would make a mistake has already written a script.
29c. The programmer that the technician predicted would make a mistake has at all written a script.
29d. The programmer that the technician predicted would make a mistake has already written a script.
29e. The programmer that no technician predicted would make a mistake has at all written a script.

29f. The programmer that no technician predicted would make a mistake has already written a script.
30a. No detective that the fireman said was stubborn has at all investigated the fire.
30b. No detective that the fireman said was stubborn has already investigated the fire.
30c. The detective that the fireman said was stubborn has at all investigated the fire.
30d. The detective that the fireman said was stubborn has already investigated the fire.
30e. The detective that no fireman said was stubborn has at all investigated the fire.
30f. The detective that no fireman said was stubborn has already investigated the fire.
31a. No widow that the nurse treated for many years has at all taken her medication.
31b. No widow that the nurse treated for many years has already taken her medication.
31c. The widow that the nurse treated for many years has at all taken her medication.
31d. The widow that the nurse treated for many years has already taken her medication.
31e. The widow that no nurse treated for many years has at all taken her medication.
31f. The widow that no nurse treated for many years has already taken her medication.
32a. No employee that the manager understood to be unambitious has at all cleaned the office.
32b. No employee that the manager understood to be unambitious has already cleaned the office.
32c. The employee that the manager understood to be unambitious has at all cleaned the office.
32d. The employee that the manager understood to be unambitious has already cleaned the office.
32e. The employee that no manager understood to be unambitious has at all cleaned the office.
32f. The employee that no manager understood to be unambitious has already cleaned the office.

C.2. Experiment 12 Items

1a. No hunter that the fisherman trusted with a secret will ever shoot a bear with a bow.
1b. No hunter that the fisherman trusted with a secret will still shoot a bear with a bow.
1c. The hunter that the fisherman trusted with a secret will ever shoot a bear with a bow.
1d. The hunter that the fisherman trusted with a secret will still shoot a bear with a bow.
1e. The hunter that no fisherman trusted with a secret will ever shoot a bear with a bow.
1f. The hunter that no fisherman trusted with a secret will still shoot a bear with a bow.
2a. No congressman that the voter remembered from a commercial will ever vote for an increase in the federal budget.
2b. No congressman that the voter remembered from a commercial will still vote for an increase in the federal budget.
2c. The congressman that the voter remembered from a commercial will ever vote for an increase in the federal budget.

2d. The congressman that the voter remembered from a commercial will still vote for an increase in the federal budget.
2e. The congressman that no voter remembered from a commercial will ever vote for an increase in the federal budget.
2f. The congressman that no voter remembered from a commercial will still vote for an increase in the federal budget.
3a. No musician that the artist recalled from the radio will ever win an award for a hit song.
3b. No musician that the artist recalled from the radio will still win an award for a hit song.
3c. The musician that the artist recalled from the radio will ever win an award for a hit song.
3d. The musician that the artist recalled from the radio will still win an award for a hit song.
3e. The musician that no artist recalled from the radio will ever win an award for a hit song.
3f. The musician that no artist recalled from the radio will still win an award for a hit song.
4a. No scientist that the dean respected as a teacher will ever publish a bad paper on the topic of whales.
4b. No scientist that the dean respected as a teacher will still publish a bad paper on the topic of whales.
4c. The scientist that the dean respected as a teacher will ever publish a bad paper on the topic of whales.
4d. The scientist that the dean respected as a teacher will still publish a bad paper on the topic of whales.
4e. The scientist that no dean respected as a teacher will ever publish a bad paper on the topic of whales.
4f. The scientist that no dean respected as a teacher will still publish a bad paper on the topic of whales.
5a. No hostage that the kidnapper noticed walk past will ever create a distraction by shouting loudly.
5b. No hostage that the kidnapper noticed walk past will still create a distraction by shouting loudly.
5c. The hostage that the kidnapper noticed walk past will ever create a distraction by shouting loudly.
5d. The hostage that the kidnapper noticed walk past will still create a distraction by shouting loudly.
5e. The hostage that no kidnapper noticed walk past will ever create a distraction by shouting loudly.
5f. The hostage that no kidnapper noticed walk past will still create a distraction by shouting loudly.
6a. No investor that the lender identified by her handwriting will ever dump a stock for personal gain.

6b. No investor that the lender identified by her handwriting will still dump a stock for personal gain.
6c. The investor that the lender identified by her handwriting will ever dump a stock for personal gain.
6d. The investor that the lender identified by her handwriting will still dump a stock for personal gain.
6e. The investor that no lender identified by her handwriting will ever dump a stock for personal gain.
6f. The investor that no lender identified by her handwriting will still dump a stock for personal gain.
7a. No politician that the pollster knew from the news will ever run a fierce campaign for president.
7b. No politician that the pollster knew from the news will still run a fierce campaign for president.
7c. The politician that the pollster knew from the news will ever run a fierce campaign for president.
7d. The politician that the pollster knew from the news will still run a fierce campaign for president.
7e. The politician that no pollster knew from the news will ever run a fierce campaign for president.
7f. The politician that no pollster knew from the news will still run a fierce campaign for president.
8a. No populist that the governor recognized the influence of will ever lose an election fair and square.
8b. No populist that the governor recognized the influence of will still lose an election fair and square.
8c. The populist that the governor recognized the influence of will ever lose an election fair and square.
8d. The populist that the governor recognized the influence of will still lose an election fair and square.
8e. The populist that no governor recognized the influence of will ever lose an election fair and square.
8f. The populist that no governor recognized the influence of will still lose an election fair and square.
9a. No soldier that the general believed to be tough will ever wash a tank with floral soap.
9b. No soldier that the general believed to be tough will still wash a tank with floral soap.
9c. The soldier that the general believed to be tough will ever wash a tank with floral soap.
9d. The soldier that the general believed to be tough will still wash a tank with floral soap.
9e. The soldier that no general believed to be tough will ever wash a tank with floral soap.

9f. The soldier that no general believed to be tough will still wash a tank with floral soap.
10a. No candidate that the committee invited to interview will ever submit a well organized resume.
10b. No candidate that the committee invited to interview will still submit a well organized resume.
10c. The candidate that the committee invited to interview will ever submit a well organized resume.
10d. The candidate that the committee invited to interview will still submit a well organized resume.
10e. The candidate that no committee invited to interview will ever submit a well organized resume.
10f. The candidate that no committee invited to interview will still submit a well organized resume.
11a. No author that the reader predicted would go far will ever write a comedic play about a wedding.
11b. No author that the reader predicted would go far will still write a comedic play about a wedding.
11c. The author that the reader predicted would go far will ever write a comedic play about a wedding.
11d. The author that the reader predicted would go far will still write a comedic play about a wedding.
11e. The author that no reader predicted would go far will ever write a comedic play about a wedding.
11f. The author that no reader predicted would go far will still write a comedic play about a wedding.
12a. No tourist that the vendor tricked out of a dollar will ever visit a temple to learn about the culture.
12b. No tourist that the vendor tricked out of a dollar will still visit a temple to learn about the culture.
12c. The tourist that the vendor tricked out of a dollar will ever visit a temple to learn about the culture.
12d. The tourist that the vendor tricked out of a dollar will still visit a temple to learn about the culture.
12e. The tourist that no vendor tricked out of a dollar will ever visit a temple to learn about the culture.
12f. The tourist that no vendor tricked out of a dollar will still visit a temple to learn about the culture.
13a. No electrician that the plumber said was incompetent will ever botch a job for a wealthy client.
13b. No electrician that the plumber said was incompetent will still botch a job for a wealthy client.
13c. The electrician that the plumber said was incompetent will ever botch a job for a wealthy client.

13d. The electrician that the plumber said was incompetent will still botch a job for a wealthy client.
13e. The electrician that no plumber said was incompetent will ever botch a job for a wealthy client.
13f. The electrician that no plumber said was incompetent will still botch a job for a wealthy client.
14a. No patient that the doctor treated for a broken leg will ever be seriously ill for many years.
14b. No patient that the doctor treated for a broken leg will still be seriously ill for many years.
14c. The patient that the doctor treated for a broken leg will ever be seriously ill for many years.
14d. The patient that the doctor treated for a broken leg will still be seriously ill for many years.
14e. The patient that no doctor treated for a broken leg will ever be seriously ill for many years.
14f. The patient that no doctor treated for a broken leg will still be seriously ill for many years.
15a. No librarian that the curator liked as a friend will ever review a book about famous authors.
15b. No librarian that the curator liked as a friend will still review a book about famous authors.
15c. The librarian that the curator liked as a friend will ever review a book about famous authors.
15d. The librarian that the curator liked as a friend will still review a book about famous authors.
15e. The librarian that no curator liked as a friend will ever review a book about famous authors.
15f. The librarian that no curator liked as a friend will still review a book about famous authors.
16a. No protester that the guard understood to be a good person will ever block a road in a busy area.
16b. No protester that the guard understood to be a good person will still block a road in a busy area.
16c. The protester that the guard understood to be a good person will ever block a road in a busy area.
16d. The protester that the guard understood to be a good person will still block a road in a busy area.
16e. The protester that no guard understood to be a good person will ever block a road in a busy area.
16f. The protester that no guard understood to be a good person will still block a road in a busy area.
17a. No farmer that the rancher recalled from the town meeting will ever plow a field to prepare for new crops.

17b. No farmer that the rancher recalled from the town meeting will still plow a field to prepare for new crops.
17c. The farmer that the rancher recalled from the town meeting will ever plow a field to prepare for new crops.
17d. The farmer that the rancher recalled from the town meeting will still plow a field to prepare for new crops.
17e. The farmer that no rancher recalled from the town meeting will ever plow a field to prepare for new crops.
17f. The farmer that no rancher recalled from the town meeting will still plow a field to prepare for new crops.
18a. No pirate that the admiral respected as a sailor will ever plot a course through the rough waters.
18b. No pirate that the admiral respected as a sailor will still plot a course through the rough waters.
18c. The pirate that the admiral respected as a sailor will ever plot a course through the rough waters.
18d. The pirate that the admiral respected as a sailor will still plot a course through the rough waters.
18e. The pirate that no admiral respected as a sailor will ever plot a course through the rough waters.
18f. The pirate that no admiral respected as a sailor will still plot a course through the rough waters.
19a. No salesman that the negotiator noticed slip up will ever make a smart investment deal.
19b. No salesman that the negotiator noticed slip up will still make a smart investment deal.
19c. The salesman that the negotiator noticed slip up will ever make a smart investment deal.
19d. The salesman that the negotiator noticed slip up will still make a smart investment deal.
19e. The salesman that no negotiator noticed slip up will ever make a smart investment deal.
19f. The salesman that no negotiator noticed slip up will still make a smart investment deal.
20a. No client that the banker identified by his account number will ever repay a loan in a timely fashion.
20b. No client that the banker identified by his account number will still repay a loan in a timely fashion.
20c. The client that the banker identified by his account number will ever repay a loan in a timely fashion.
20d. The client that the banker identified by his account number will still repay a loan in a timely fashion.
20e. The client that no banker identified by his account number will ever repay a loan in a timely fashion.

20f. The client that no banker identified by his account number will still repay a loan in a timely fashion.
21a. No actor that the director knew from the local theater will ever prepare a monologue to showcase his talent.
21b. No actor that the director knew from the local theater will still prepare a monologue to showcase his talent.
21c. The actor that the director knew from the local theater will ever prepare a monologue to showcase his talent.
21d. The actor that the director knew from the local theater will still prepare a monologue to showcase his talent.
21e. The actor that no director knew from the local theater will ever prepare a monologue to showcase his talent.
21f. The actor that no director knew from the local theater will still prepare a monologue to showcase his talent.
22a. No sponsor that the agent recognized as a genius will ever market a product outside of the United States.
22b. No sponsor that the agent recognized as a genius will still market a product outside of the United States.
22c. The sponsor that the agent recognized as a genius will ever market a product outside of the United States.
22d. The sponsor that the agent recognized as a genius will still market a product outside of the United States.
22e. The sponsor that no agent recognized as a genius will ever market a product outside of the United States.
22f. The sponsor that no agent recognized as a genius will still market a product outside of the United States.
23a. No judge that the bailiff liked for his swiftness will ever try a case without video evidence.
23b. No judge that the bailiff liked for his swiftness will still try a case without video evidence.
23c. The judge that the bailiff liked for his swiftness will ever try a case without video evidence.
23d. The judge that the bailiff liked for his swiftness will still try a case without video evidence.
23e. The judge that no bailiff liked for his swiftness will ever try a case without video evidence.
23f. The judge that no bailiff liked for his swiftness will still try a case without video evidence.
24a. No criminal that the lawyer tricked into a confession will ever rob a bank in broad daylight.
24b. No criminal that the lawyer tricked into a confession will still rob a bank in broad daylight.
24c. The criminal that the lawyer tricked into a confession will ever rob a bank in broad daylight.

24d. The criminal that the lawyer tricked into a confession will still rob a bank in broad daylight.
24e. The criminal that no lawyer tricked into a confession will ever rob a bank in broad daylight.
24f. The criminal that no lawyer tricked into a confession will still rob a bank in broad daylight.
25a. No dancer that the ballerina trusted to catch her will ever learn the choreography for the new show.
25b. No dancer that the ballerina trusted to catch her will still learn the choreography for the new show.
25c. The dancer that the ballerina trusted to catch her will ever learn the choreography for the new show.
25d. The dancer that the ballerina trusted to catch her will still learn the choreography for the new show.
25e. The dancer that no ballerina trusted to catch her will ever learn the choreography for the new show.
25f. The dancer that no ballerina trusted to catch her will still learn the choreography for the new show.
26a. No poet that the singer remembered from the open mic will ever prepare for a performance of her new collection.
26b. No poet that the singer remembered from the open mic will still prepare for a performance of her new collection.
26c. The poet that the singer remembered from the open mic will ever prepare for a performance of her new collection.
26d. The poet that the singer remembered from the open mic will still prepare for a performance of her new collection.
26e. The poet that no singer remembered from the open mic will ever prepare for a performance of her new collection.
26f. The poet that no singer remembered from the open mic will still prepare for a performance of her new collection.
27a. No foreman that the architect believed to be lazy will ever lay the foundation for the new high-rise.
27b. No foreman that the architect believed to be lazy will still lay the foundation for the new high-rise.
27c. The foreman that the architect believed to be lazy will ever lay the foundation for the new high-rise.
27d. The foreman that the architect believed to be lazy will still lay the foundation for the new high-rise.
27e. The foreman that no architect believed to be lazy will ever lay the foundation for the new high-rise.
27f. The foreman that no architect believed to be lazy will still lay the foundation for the new high-rise.
28a. No painter that the sculptor invited to the gallery will ever paint a much revered masterpiece.

28b. No painter that the sculptor invited to the gallery will still paint a much revered masterpiece.
28c. The painter that the sculptor invited to the gallery will ever paint a much revered masterpiece.
28d. The painter that the sculptor invited to the gallery will still paint a much revered masterpiece.
28e. The painter that no sculptor invited to the gallery will ever paint a much revered masterpiece.
28f. The painter that no sculptor invited to the gallery will still paint a much revered masterpiece.
29a. No programmer that the technician predicted would make a mistake will ever write a script to make her job easier.
29b. No programmer that the technician predicted would make a mistake will still write a script to make her job easier.
29c. The programmer that the technician predicted would make a mistake will ever write a script to make her job easier.
29d. The programmer that the technician predicted would make a mistake will still write a script to make her job easier.
29e. The programmer that no technician predicted would make a mistake will ever write a script to make her job easier.
29f. The programmer that no technician predicted would make a mistake will still write a script to make her job easier.
30a. No detective that the fireman said was stubborn will ever investigate the fire on main street.
30b. No detective that the fireman said was stubborn will still investigate the fire on main street.
30c. The detective that the fireman said was stubborn will ever investigate the fire on main street.
30d. The detective that the fireman said was stubborn will still investigate the fire on main street.
30e. The detective that no fireman said was stubborn will ever investigate the fire on main street.
30f. The detective that no fireman said was stubborn will still investigate the fire on main street.
31a. No widow that the nurse treated for many years will ever take her medication for the day.
31b. No widow that the nurse treated for many years will still take her medication for the day.
31c. The widow that the nurse treated for many years will ever take her medication for the day.
31d. The widow that the nurse treated for many years will still take her medication for the day.
31e. The widow that no nurse treated for many years will ever take her medication for the day.

31f. The widow that no nurse treated for many years will still take her medication for the day.
32a. No employee that the manager understood to be unambitious will ever clean the office from top to bottom.
32b. No employee that the manager understood to be unambitious will still clean the office from top to bottom.
32c. The employee that the manager understood to be unambitious will ever clean the office from top to bottom.
32d. The employee that the manager understood to be unambitious will still clean the office from top to bottom.
32e. The employee that no manager understood to be unambitious will ever clean the office from top to bottom.
32f. The employee that no manager understood to be unambitious will still clean the office from top to bottom.
33a. No clown that the ringmaster suspected of thievery will ever receive the combination to a safe.
33b. No clown that the ringmaster suspected of thievery will still receive the combination to a safe.
33c. The clown that the ringmaster suspected of thievery will ever receive the combination to a safe.
33d. The clown that the ringmaster suspected of thievery will still receive the combination to a safe.
33e. The clown that no ringmaster suspected of thievery will ever receive the combination to a safe.
33f. The clown that no ringmaster suspected of thievery will still receive the combination to a safe.
34a. No assistant that the magician allowed to use the saw will ever cut a wire accidentally during a show.
34b. No assistant that the magician allowed to use the saw will still cut a wire accidentally during a show.
34c. The assistant that the magician allowed to use the saw will ever cut a wire accidentally during a show.
34d. The assistant that the magician allowed to use the saw will still cut a wire accidentally during a show.
34e. The assistant that no magician allowed to use the saw will ever cut a wire accidentally during a show.
34f. The assistant that no magician allowed to use the saw will still cut a wire accidentally during a show.
35a. No blacksmith that the apprentice learned from will ever develop a new smithing technique.
35b. No blacksmith that the apprentice learned from will still develop a new smithing technique.
35c. The blacksmith that the apprentice learned from will ever develop a new smithing technique.

35d. The blacksmith that the apprentice learned from will still develop a new smithing technique.
35e. The blacksmith that no apprentice learned from will ever develop a new smithing technique.
35f. The blacksmith that no apprentice learned from will still develop a new smithing technique.
36a. No prospector that the cowboy shared a drink with will ever reveal the location of a secret mine.
36b. No prospector that the cowboy shared a drink with will still reveal the location of a secret mine.
36c. The prospector that the cowboy shared a drink with will ever reveal the location of a secret mine.
36d. The prospector that the cowboy shared a drink with will still reveal the location of a secret mine.
36e. The prospector that no cowboy shared a drink with will ever reveal the location of a secret mine.
36f. The prospector that no cowboy shared a drink with will still reveal the location of a secret mine.

C.3. Experiment 13 Items

1a . No hunter that the fisherman trusted with a secret will still shoot a bear with a bow.
1b . The hunter that no fisherman trusted with a secret will still shoot a bear with a bow.
1c . The hunter that the fisherman trusted with a secret will still shoot a bear with a bow.
1d . No hunter that the fisherman trusted with a secret will ever shoot a bear with a bow.
1e . The hunter that no fisherman trusted with a secret will ever shoot a bear with a bow.
1f . The hunter that the fisherman trusted with a secret will ever shoot a bear with a bow.
2a . No congressman that the voter remembered from a commercial will still support an increase in the budget.
2b . The congressman that no voter remembered from a commercial will still support an increase in the budget.
2c . The congressman that the voter remembered from a commercial will still support an increase in the budget.
2d . No congressman that the voter remembered from a commercial will ever support an increase in the budget.
2e . The congressman that no voter remembered from a commercial will ever support an increase in the budget.

2f . The congressman that the voter remembered from a commercial will ever support an increase in the budget.

3a . No musician that the artist recalled from the radio will still win an award for a song.

3b . The musician that no artist recalled from the radio will still win an award for a song.

3c . The musician that the artist recalled from the radio will still win an award for a song.

3d . No musician that the artist recalled from the radio will ever win an award for a song.

3e . The musician that no artist recalled from the radio will ever win an award for a song.

3f . The musician that the artist recalled from the radio will ever win an award for a song.

4a . No scientist that the dean respected as a teacher will still publish a paper about blue whales.

4b . The scientist that no dean respected as a teacher will still publish a paper about blue whales.

4c . The scientist that the dean respected as a teacher will still publish a paper about blue whales.

4d . No scientist that the dean respected as a teacher will ever publish a paper about blue whales.

4e . The scientist that no dean respected as a teacher will ever publish a paper about blue whales.

4f . The scientist that the dean respected as a teacher will ever publish a paper about blue whales.

5a . No hostage that the kidnapper noticed walk past quietly will still create a distraction by shouting loudly.

5b . The hostage that no kidnapper noticed walk past quietly will still create a distraction by shouting loudly.

5c . The hostage that the kidnapper noticed walk past quietly will still create a distraction by shouting loudly.

5d . No hostage that the kidnapper noticed walk past quietly will ever create a distraction by shouting loudly.

5,MatrixTheEver . The hostage that no kidnapper noticed walk past quietly will ever create a distraction by shouting loudly.

5f . The hostage that the kidnapper noticed walk past quietly will ever create a distraction by shouting loudly.

6a . No investor that the lender identified by her handwriting will still dump a stock for personal gain.

6b . The investor that no lender identified by her handwriting will still dump a stock for personal gain.

6c . The investor that the lender identified by her handwriting will still dump a stock for personal gain.

6d . No investor that the lender identified by her handwriting will ever dump a stock for personal gain.

6e . The investor that no lender identified by her handwriting will ever dump a stock for personal gain.

6f . The investor that the lender identified by her handwriting will ever dump a stock for personal gain.

7a . No politician that the pollster knew from the news will still run a campaign for the presidency.

7b . The politician that no pollster knew from the news will still run a campaign for the presidency.

7c . The politician that the pollster knew from the news will still run a campaign for the presidency.

7d . No politician that the pollster knew from the news will ever run a campaign for the presidency.

7e . The politician that no pollster knew from the news will ever run a campaign for the presidency.

7f . The politician that the pollster knew from the news will ever run a campaign for the presidency.

8a . No populist that the governor recognized the influence of will still lose an election fair and square.

8b . The populist that no governor recognized the influence of will still lose an election fair and square.

8c . The populist that the governor recognized the influence of will still lose an election fair and square.

8d . No populist that the governor recognized the influence of will ever lose an election fair and square.

8e . The populist that no governor recognized the influence of will ever lose an election fair and square.

8f . The populist that the governor recognized the influence of will ever lose an election fair and square.

9a . No soldier that the general believed to be tough will still wash a tank with floral soap.

9b . The soldier that no general believed to be tough will still wash a tank with floral soap.

9c . The soldier that the general believed to be tough will still wash a tank with floral soap.

9d . No soldier that the general believed to be tough will ever wash a tank with floral soap.

9e . The soldier that no general believed to be tough will ever wash a tank with floral soap.

9f . The soldier that the general believed to be tough will ever wash a tank with floral soap.

10a . No candidate that the committee invited to the interview will still submit a resume with little experience.

10b . The candidate that no committee invited to the interview will still submit a resume with little experience.
10c . The candidate that the committee invited to the interview will still submit a resume with little experience.
10d . No candidate that the committee invited to the interview will ever submit a resume with little experience.
10e . The candidate that no committee invited to the interview will ever submit a resume with little experience.
10f . The candidate that the committee invited to the interview will ever submit a resume with little experience.
11a . No author that the reader predicted would go far will still write a play about a wedding.
11b . The author that no reader predicted would go far will still write a play about a wedding.
11c . The author that the reader predicted would go far will still write a play about a wedding.
11d . No author that the reader predicted would go far will ever write a play about a wedding.
11e . The author that no reader predicted would go far will ever write a play about a wedding.
11f . The author that the reader predicted would go far will ever write a play about a wedding.
12a . No tourist that the vendor tricked into wasting money will still visit a temple while on vacation.
12b . The tourist that no vendor tricked into wasting money will still visit a temple while on vacation.
12c . The tourist that the vendor tricked into wasting money will still visit a temple while on vacation.
12d . No tourist that the vendor tricked into wasting money will ever visit a temple while on vacation.
12e . The tourist that no vendor tricked into wasting money will ever visit a temple while on vacation.
12f . The tourist that the vendor tricked into wasting money will ever visit a temple while on vacation.
13a . No electrician that the plumber said was very incompetent will still botch a job for a client.
13b . The electrician that no plumber said was very incompetent will still botch a job for a client.
13c . The electrician that the plumber said was very incompetent will still botch a job for a client.
13d . No electrician that the plumber said was very incompetent will ever botch a job for a client.
13e . The electrician that no plumber said was very incompetent will ever botch a job for a client.

13f . The electrician that the plumber said was very incompetent will ever botch a job for a client.
14a . No patient that the doctor treated in the hospital will still be seriously ill for many years.
14b . The patient that no doctor treated in the hospital will still be seriously ill for many years.
14c . The patient that the doctor treated in the hospital will still be seriously ill for many years.
14d . No patient that the doctor treated in the hospital will ever be seriously ill for many years.
14e . The patient that no doctor treated in the hospital will ever be seriously ill for many years.
14f . The patient that the doctor treated in the hospital will ever be seriously ill for many years.
15a . No librarian that the curator liked as a friend will still review a book about famous authors.
15b . The librarian that no curator liked as a friend will still review a book about famous authors.
15c . The librarian that the curator liked as a friend will still review a book about famous authors.
15d . No librarian that the curator liked as a friend will ever review a book about famous authors.
15e . The librarian that no curator liked as a friend will ever review a book about famous authors.
15f . The librarian that the curator liked as a friend will ever review a book about famous authors.
16a . No protester that the guard believed to be kind will still block a road outside the courthouse.
16b . The protester that no guard believed to be kind will still block a road outside the courthouse.
16c . The protester that the guard believed to be kind will still block a road outside the courthouse.
16d . No protester that the guard believed to be kind will ever block a road outside the courthouse.
16e . The protester that no guard believed to be kind will ever block a road outside the courthouse.
16f . The protester that the guard believed to be kind will ever block a road outside the courthouse.
17a . No farmer that the rancher recalled from the meeting will still plow a field and plant soybeans.
17b . The farmer that no rancher recalled from the meeting will still plow a field and plant soybeans.
17c . The farmer that the rancher recalled from the meeting will still plow a field and plant soybeans.

17d . No farmer that the rancher recalled from the meeting will ever plow a field and plant soybeans.
17e . The farmer that no rancher recalled from the meeting will ever plow a field and plant soybeans.
17f . The farmer that the rancher recalled from the meeting will ever plow a field and plant soybeans.
18a . No pirate that the admiral respected as a sailor will still plot a course through rough waters.
18b . The pirate that no admiral respected as a sailor will still plot a course through rough waters.
18c . The pirate that the admiral respected as a sailor will still plot a course through rough waters.
18d . No pirate that the admiral respected as a sailor will ever plot a course through rough waters.
18e . The pirate that no admiral respected as a sailor will ever plot a course through rough waters.
18f . The pirate that the admiral respected as a sailor will ever plot a course through rough waters.
19a . No salesman that the negotiator noticed make a mistake will still make a investment in bad stocks.
19b . The salesman that no negotiator noticed make a mistake will still make a investment in bad stocks.
19c . The salesman that the negotiator noticed make a mistake will still make a investment in bad stocks.
19d . No salesman that the negotiator noticed make a mistake will ever make a investment in bad stocks.
19e . The salesman that no negotiator noticed make a mistake will ever make a investment in bad stocks.
19f . The salesman that the negotiator noticed make a mistake will ever make a investment in bad stocks.
20a . No client that the banker identified by his accent will still repay a loan in record time.
20b . The client that no banker identified by his accent will still repay a loan in record time.
20c . The client that the banker identified by his accent will still repay a loan in record time.
20d . No client that the banker identified by his accent will ever repay a loan in record time.
20e . The client that no banker identified by his accent will ever repay a loan in record time.
20f . The client that the banker identified by his accent will ever repay a loan in record time.
21a . No actor that the director knew from the theater will still prepare a monologue for the audition.

21b . The actor that no director knew from the theater will still prepare a monologue for the audition.
21c . The actor that the director knew from the theater will still prepare a monologue for the audition.
21d . No actor that the director knew from the theater will ever prepare a monologue for the audition.
21e . The actor that no director knew from the theater will ever prepare a monologue for the audition.
21f . The actor that the director knew from the theater will ever prepare a monologue for the audition.
22a . No sponsor that the agent recognized as a genius will still market a product to casual fans.
22b . The sponsor that no agent recognized as a genius will still market a product to casual fans.
22c . The sponsor that the agent recognized as a genius will still market a product to casual fans.
22d . No sponsor that the agent recognized as a genius will ever market a product to casual fans.
22e . The sponsor that no agent recognized as a genius will ever market a product to casual fans.
22f . The sponsor that the agent recognized as a genius will ever market a product to casual fans.
23a . No judge that the bailiff liked for his swiftness will still try a case without video evidence.
23b . The judge that no bailiff liked for his swiftness will still try a case without video evidence.
23c . The judge that the bailiff liked for his swiftness will still try a case without video evidence.
23d . No judge that the bailiff liked for his swiftness will ever try a case without video evidence.
23e . The judge that no bailiff liked for his swiftness will ever try a case without video evidence.
23f . The judge that the bailiff liked for his swiftness will ever try a case without video evidence.
24a . No criminal that the lawyer tricked into a confession will still rob a bank in broad daylight.
24b . The criminal that no lawyer tricked into a confession will still rob a bank in broad daylight.
24c . The criminal that the lawyer tricked into a confession will still rob a bank in broad daylight.
24d . No criminal that the lawyer tricked into a confession will ever rob a bank in broad daylight.
24e . The criminal that no lawyer tricked into a confession will ever rob a bank in broad daylight.

24f . The criminal that the lawyer tricked into a confession will ever rob a bank in broad daylight.
25a . No dancer that the ballerina trusted to catch her will still learn the choreography for the show.
25b . The dancer that no ballerina trusted to catch her will still learn the choreography for the show.
25c . The dancer that the ballerina trusted to catch her will still learn the choreography for the show.
25d . No dancer that the ballerina trusted to catch her will ever learn the choreography for the show.
25e . The dancer that no ballerina trusted to catch her will ever learn the choreography for the show.
25f . The dancer that the ballerina trusted to catch her will ever learn the choreography for the show.
26a . No poet that the singer remembered from the opera will still write a poem about the evening.
26b . The poet that no singer remembered from the opera will still write a poem about the evening.
26c . The poet that the singer remembered from the opera will still write a poem about the evening.
26d . No poet that the singer remembered from the opera will ever write a poem about the evening.
26e . The poet that no singer remembered from the opera will ever write a poem about the evening.
26f . The poet that the singer remembered from the opera will ever write a poem about the evening.
27a . No foreman that the architect believed to be lazy will still lay the foundation for the skyscraper.
27b . The foreman that no architect believed to be lazy will still lay the foundation for the skyscraper.
27c . The foreman that the architect believed to be lazy will still lay the foundation for the skyscraper.
27d . No foreman that the architect believed to be lazy will ever lay the foundation for the skyscraper.
27e . The foreman that no architect believed to be lazy will ever lay the foundation for the skyscraper.
27f . The foreman that the architect believed to be lazy will ever lay the foundation for the skyscraper.
28a . No painter that the sculptor invited to the gallery will still paint a masterpiece without a brush.
28b . The painter that no sculptor invited to the gallery will still paint a masterpiece without a brush.
28c . The painter that the sculptor invited to the gallery will still paint a masterpiece without a brush.

28d . No painter that the sculptor invited to the gallery will ever paint a masterpiece without a brush.
28e . The painter that no sculptor invited to the gallery will ever paint a masterpiece without a brush.
28f . The painter that the sculptor invited to the gallery will ever paint a masterpiece without a brush.
29a . No programmer that the technician predicted would slip up will still write a script to automate tasks.
29b . The programmer that no technician predicted would slip up will still write a script to automate tasks.
29c . The programmer that the technician predicted would slip up will still write a script to automate tasks.
29d . No programmer that the technician predicted would slip up will ever write a script to automate tasks.
29e . The programmer that no technician predicted would slip up will ever write a script to automate tasks.
29f . The programmer that the technician predicted would slip up will ever write a script to automate tasks.
30a . No detective that the fireman said was quite stubborn will still investigate the fire on main street.
30b . The detective that no fireman said was quite stubborn will still investigate the fire on main street.
30c . The detective that the fireman said was quite stubborn will still investigate the fire on main street.
30d . No detective that the fireman said was quite stubborn will ever investigate the fire on main street.
30e . The detective that no fireman said was quite stubborn will ever investigate the fire on main street.
30f . The detective that the fireman said was quite stubborn will ever investigate the fire on main street.
31a . No widow that the nurse treated for many years will still take her medication for the day.
31b . The widow that no nurse treated for many years will still take her medication for the day.
31c . The widow that the nurse treated for many years will still take her medication for the day.
31d . No widow that the nurse treated for many years will ever take her medication for the day.
31e . The widow that no nurse treated for many years will ever take her medication for the day.
31f . The widow that the nurse treated for many years will ever take her medication for the day.
32a . No employee that the manager understood to be unambitious will still clean the office until it's spotless.

32b . The employee that no manager understood to be unambitious will still clean the office until it's spotless.
32c . The employee that the manager understood to be unambitious will still clean the office until it's spotless.
32d . No employee that the manager understood to be unambitious will ever clean the office until it's spotless.
32e . The employee that no manager understood to be unambitious will ever clean the office until it's spotless.
32f . The employee that the manager understood to be unambitious will ever clean the office until it's spotless.
33a . No clown that the ringmaster suspected of criminal activity will still receive the combination to a safe.
33b . The clown that no ringmaster suspected of criminal activity will still receive the combination to a safe.
33c . The clown that the ringmaster suspected of criminal activity will still receive the combination to a safe.
33d . No clown that the ringmaster suspected of criminal activity will ever receive the combination to a safe.
33e . The clown that no ringmaster suspected of criminal activity will ever receive the combination to a safe.
33f . The clown that the ringmaster suspected of criminal activity will ever receive the combination to a safe.
34a . No assistant that the magician allowed up on stage will still cut a wire during a show.
34b . The assistant that no magician allowed up on stage will still cut a wire during a show.
34c . The assistant that the magician allowed up on stage will still cut a wire during a show.
34d . No assistant that the magician allowed up on stage will ever cut a wire during a show.
34e . The assistant that no magician allowed up on stage will ever cut a wire during a show.
34f . The assistant that the magician allowed up on stage will ever cut a wire during a show.
35a . No blacksmith that the apprentice learned the trade from will still develop a technique for heating silver.
35b . The blacksmith that no apprentice learned the trade from will still develop a technique for heating silver.
35c . The blacksmith that the apprentice learned the trade from will still develop a technique for heating silver.
35d . No blacksmith that the apprentice learned the trade from will ever develop a technique for heating silver.
35e . The blacksmith that no apprentice learned the trade from will ever develop a technique for heating silver.

35f . The blacksmith that the apprentice learned the trade from will ever develop a technique for heating silver.
36a . No prospector that the cowboy shared a drink with will still reveal the location of the gold.
36b . The prospector that no cowboy shared a drink with will still reveal the location of the gold.
36c . The prospector that the cowboy shared a drink with will still reveal the location of the gold.
36d . No prospector that the cowboy shared a drink with will ever reveal the location of the gold.
36e . The prospector that no cowboy shared a drink with will ever reveal the location of the gold.
36f . The prospector that the cowboy shared a drink with will ever reveal the location of the gold.

C.4. Experiment 14 Items

1a. The rowdy teen who the uptight classmate begrudgingly followed will still skip school.
1b. The rowdy teen who no uptight classmate begrudgingly followed will still skip school.
1c. The rowdy teen who the uptight classmate didn't begrudgingly follow will still skip school.
1d. No rowdy teen who the uptight classmate begrudgingly followed will still skip school.
2a. The youthful monarch who the greedy uncle unjustly banished will still return home.
2b. The youthful monarch who no greedy uncle unjustly banished will still return home.
2c. The youthful monarch who the greedy uncle didn't unjustly banish will still return home.
2d. No youthful monarch who the greedy uncle unjustly banished will still return home.
3a. The scrappy pugilist who the Russian fighter eagerly challenged will still emerge entirely unscathed.
3b. The scrappy pugilist who no Russian fighter eagerly challenged will still emerge entirely unscathed.
3c. The scrappy pugilist who the Russian fighter didn't eagerly challenge will still emerge entirely unscathed.
3d. No scrappy pugilist who the Russian fighter eagerly challenged will still emerge entirely unscathed.
4a. The eccentric chemist who the aggressive commander roundly dismissed will still attend meetings.
4b. The eccentric chemist who no aggressive commander roundly dismissed will still attend meetings.

4c. The eccentric chemist who the aggressive commander didn't roundly dismiss will still attend meetings.
4d. No eccentric chemist who the aggressive commander roundly dismissed will still attend meetings.
5a. The lonely prisoner who the older inmate quickly befriended will still escape prison.
5b. The lonely prisoner who no older inmate quickly befriended will still escape prison.
5c. The lonely prisoner who the older inmate didn't quickly befriend will still escape prison.
5d. No lonely prisoner who the older inmate quickly befriended will still escape prison.
6a. The ghostly psychologist who the disturbed youngster unknowingly summoned will still depart eventually.
6b. The ghostly psychologist who no disturbed youngster unknowingly summoned will still depart eventually.
6c. The ghostly psychologist who the disturbed youngster didn't unknowingly summon will still depart eventually.
6d. No ghostly psychologist who the disturbed youngster unknowingly summoned will still depart eventually.
7a. The complacent bowler who the crabby millionaire rudely robbed will still remain unfazed.
7b. The complacent bowler who no crabby millionaire rudely robbed will still remain unfazed.
7c. The complacent bowler who the crabby millionaire didn't rudely rob will still remain unfazed.
7d. No complacent bowler who the crabby millionaire rudely robbed will still remain unfazed.
8a. The brash mafioso who the promising racketeer boldly deceived will still turn traitor.
8b. The brash mafioso who no promising racketeer boldly deceived will still turn traitor.
8c. The brash mafioso who the promising racketeer didn't boldly deceive will still turn traitor.
8d. No brash mafioso who the promising racketeer boldly deceived will still turn traitor.
9a. The overbearing parent who the moody daughter silently resented will still control everything.
9b. The overbearing parent who no moody daughter silently resented will still control everything.
9c. The overbearing parent who the moody daughter didn't silently resent will still control everything.
9d. No overbearing parent who the moody daughter silently resented will still control everything.
10a. The corporate executive who the stylish butler dotingly served will still fight crime.
10b. The corporate executive who no stylish butler dotingly served will still fight crime.
10c. The corporate executive who the stylish butler didn't dotingly serve will still fight crime.

10d. No corporate executive who the stylish butler dotingly served will still fight crime.
11a. The rambling cannibal who the intrepid sleuth shockingly arrested will still get away.
11b. The rambling cannibal who no intrepid sleuth shockingly arrested will still get away.
11c. The rambling cannibal who the intrepid didn't sleuth shockingly arrest will still get away.
11d. No rambling cannibal who the intrepid sleuth shockingly arrested will still get away.
12a. The contemporary renegade who the disgraced physicist curiously mentored will still go back.
12b. The contemporary renegade who no disgraced physicist curiously mentored will still go back.
12c. The contemporary renegade who the disgraced physicist didn't curiously mentor will still go back.
12d. No contemporary renegade who the disgraced physicist curiously mentored will still go back.
13a. The hungry alien who the annoying pipsqueak carefully protected will still phone home.
13b. The hungry alien who no annoying pipsqueak carefully protected will still phone home.
13c. The hungry alien who the annoying pipsqueak didn't carefully protect will still phone home.
13d. No hungry alien who the annoying pipsqueak carefully protected will still phone home.
14a. The dapper spy who the seductive operative stealthily followed will still save everyone.
14b. The dapper spy who no seductive operative stealthily followed will still save everyone.
14c. The dapper spy who the seductive operative didn't stealthily follow will still save everyone.
14d. No dapper spy who the seductive operative stealthily followed will still save everyone.
15a. The captive commando who the courageous marine bravely freed will still weep joyfully.
15b. The captive commando who no courageous marine bravely freed will still weep joyfully.
15c. The captive commando who the courageous marine didn't bravely free will still weep joyfully.
15d. No captive commando who the courageous marine bravely freed will still weep joyfully.
16a. The angry gladiator who the ferocious warrior triumphantly defeated will still shout loudly.

16b. The angry gladiator who no ferocious warrior triumphantly defeated will still shout loudly.
16c. The angry gladiator who the ferocious warrior didn't triumphantly defeat will still shout loudly.
16d. No angry gladiator who the ferocious warrior triumphantly defeated will still shout loudly.
17a. The clueless hunk who the smarmy inventor perpetually chided will still become stronger.
17b. The clueless hunk who no smarmy inventor perpetually chided will still become stronger.
17c. The clueless hunk who the smarmy inventor didn't perpetually chide will still become stronger.
17d. No clueless hunk who the smarmy inventor perpetually chided will still become stronger.
18a. The dim-witted burglar who the devious child consistently thwarted will still give up.
18b. The dim-witted burglar who no devious child consistently thwarted will still give up.
18c. The dim-witted burglar who the devious child didn't consistently thwart will still give up.
18d. No dim-witted burglar who the devious child consistently thwarted will still give up.
19a. The flirty secretary who the prudish manager wrongfully fired will still get justice.
19b. The flirty secretary who no prudish manager wrongfully fired will still get justice.
19c. The flirty secretary who the prudish manager didn't wrongfully fire will still get justice.
19d. No flirty secretary who the prudish manager wrongfully fired will still get justice.
20a. The gifted student who the bored slacker viciously teased will still drop out.
20b. The gifted student who no bored slacker viciously teased will still drop out.
20c. The gifted student who the bored slacker didn't viciously tease will still drop out.
20d. No gifted student who the bored slacker viciously teased will still drop out.
21a. The visionary craftsman who the starry-eyed pupil feverishly worshipped will still teach harshly.
21b. The visionary craftsman who no starry-eyed pupil feverishly worshipped will still teach harshly.
21c. The visionary craftsman who the starry-eyed pupil didn't feverishly worship will still teach harshly.
21d. No visionary craftsman who the starry-eyed pupil feverishly worshipped will still teach harshly.
22a. The entitled nobleman who the insidious shaman treacherously hexed will still recover quickly.
22b. The entitled nobleman who no insidious shaman treacherously hexed will still recover quickly.

22c. The entitled nobleman who the insidious didn't shaman treacherously hex will still recover quickly.
22d. No entitled nobleman who the insidious shaman treacherously hexed will still recover quickly.
23a. The honest puppeteer who the real boy innocently misled will still grieve openly.
23b. The honest puppeteer who no real boy innocently misled will still grieve openly.
23c. The honest puppeteer who the real boy didn't innocently mislead will still grieve openly.
23d. No honest puppeteer who the real boy innocently misled will still grieve openly.
24a. The headless horseman who the superstitious educator foolishly taunted will still get revenge.
24b. The headless horseman who no superstitious educator foolishly taunted will still get revenge.
24c. The headless horseman who the superstitious educator didn't foolishly taunt will still get revenge.
24d. No headless horseman who the superstitious educator foolishly taunted will still get revenge.

APPENDIX D

Experimental Materials for Chapter 5

D.1. Experiment 15 Items

1a. That the senator will sponsor the bill about smoking didn't still annoy the farmer.
1b. That the senator didn't sponsor the bill about smoking will still annoy the farmer.
1c. That no senator will sponsor the bill about smoking will still annoy the farmer.
1d. That the senator will sponsor the bill about smoking will still annoy the farmer.
2a. That the hunter will see the warning about bears didn't still surprise the warden.
2b. That the hunter didn't see the warning about bears will still surprise the warden.
2c. That no hunter will see the warning about bears will still surprise the warden.
2d. That the hunter will see the warning about bears will still surprise the warden.
3a. That the musician will play the cello with gusto didn't still disappoint the director.
3b. That the musician didn't play the cello with gusto will still disappoint the director.
3c. That no musician will play the cello with gusto will still disappoint the director.
3d. That the musician will play the cello with gusto will still disappoint the director.
4a. That the dean will remember the meeting about students didn't still shock the professor.
4b. That the dean didn't remember the meeting about students will still shock the professor.
4c. That no dean will remember the meeting about students will still shock the professor.
4d. That the dean will remember the meeting about students will still shock the professor.
5a. That the hostage will escape the room with ease didn't still enrage the kidnapper.
5b. That the hostage didn't escape the room with ease will still enrage the kidnapper.
5c. That no hostage will escape the room with ease will still enrage the kidnapper.
5d. That the hostage will escape the room with ease will still enrage the kidnapper.
6a. That the employee will quit the company over Zoom didn't still irritate the manager
6b. That the employee didn't quit the company over Zoom will still irritate the manager
6c. That no employee will quit the company over Zoom will still irritate the manager
6d. That the employee will quit the company over Zoom will still irritate the manager
7a. That the politician will resign from office in shame didn't still delight the reporter.
7b. That the politician didn't resign from office in shame will still delight the reporter.
7c. That no politician will resign from office in shame will still delight the reporter.
7d. That the politician will resign from office in shame will still delight the reporter.
8a. That the general will endorse the strategy early on didn't still trouble the will soldier.

8b. That the general didn't endorse the strategy early on will still trouble the will soldier.
8c. That no general will endorse the strategy early on will still trouble the will soldier.
8d. That the general will endorse the strategy early on will still trouble the will soldier.
9a. That the author will complete the chapter due yesterday didn't still frustrate the publisher.
9b. That the author didn't complete the chapter due yesterday will still frustrate the publisher.
9c. That no author will complete the chapter due yesterday will still frustrate the publisher.
9d. That the author will complete the chapter due yesterday will still frustrate the publisher.
10a. That the tourist will visit the temple this week didn't still please the monk.
10b. That the tourist didn't visit the temple this week will still please the monk.
10c. That no tourist will visit the temple this week will still please the monk.
10d. That the tourist will visit the temple this week will still please the monk.
11a. That the electrician will disconnect the wires and batteries didn't still perplex the plumber.
11b. That the electrician didn't disconnect the wires and batteries will still perplex the plumber.
11c. That no electrician will disconnect the wires and batteries will still perplex the plumber.
11d. That the electrician will disconnect the wires and batteries will still perplex the plumber.
12a. That the doctor will cure the disease with medicine didn't still amaze the shaman.
12b. That the doctor didn't cure the disease with medicine will still amaze the shaman.
12c. That no doctor will cure the disease with medicine will still amaze the shaman.
12d. That the doctor will cure the disease with medicine will still amaze the shaman.
13a. That the librarian will lose the book about whales didn't still upset the biologist.
13b. That the librarian didn't lose the book about whales will still upset the biologist.
13c. That no librarian will lose the book about whales will still upset the biologist.
13d. That the librarian will lose the book about whales will still upset the biologist.
14a. That the pirate will capture the ship at sea didn't still astonish the sailor.
14b. That the pirate didn't capture the ship at sea will still astonish the sailor.
14c. That no pirate will capture the ship at sea will still astonish the sailor.
14d. That the pirate will capture the ship at sea will still astonish the sailor.
15a. That the salesman will sell the car with dents didn't still sicken the manufacturer.
15b. That the salesman didn't sell the car with dents will still sicken the manufacturer
15c. That no salesman will sell the car with dents will still sicken the manufacturer.
15d. That the salesman will sell the car with dents will still sicken the manufacturer
16a. That the banker will freeze the accounts last week didn't still distress the client.
16b. That the banker didn't freeze the accounts last week will still distress the client.
16c. That no banker will freeze the accounts last week will still distress the client.
16d. That the banker will freeze the accounts last week will still distress the client.

17a. That the agent will steal the documents about plutonium didn't still startle the spy.
17b. That the agent didn't steal the documents about plutonium will still startle the spy.
17c. That no agent will steal the documents about plutonium will still startle the spy.
17d. That the agent will steal the documents about plutonium will still startle the spy.
18a. That the lawyer will take the case about drugs didn't still unsettle the judge.
18b. That the lawyer didn't take the case about drugs will still unsettle the judge.
18c. That no lawyer will take the case about drugs will still unsettle the judge.
18d. That the lawyer will take the case about drugs will still unsettle the judge.
19a. That the director will change the steps and tempo didn't still appease the dancer.
19b. That the director didn't change the steps and tempo will still appease the dancer.
19c. That no director will change the steps and tempo will still appease the dancer.
19d. That the director will change the steps and tempo will still appease the dancer.
20a. That the guitarist will tune the instrument before playing didn't still dishearten the singer.
20b. That the guitarist didn't tune the instrument before playing will still dishearten the singer.
20c. That no guitarist will tune the instrument before playing will still dishearten the singer.
20d. That the guitarist will tune the instrument before playing will still dishearten the singer.
21a. That the supervisor will leave the room before work didn't still offend the technician.
21b. That the supervisor didn't leave the room before work will still offend the technician.
21c. That no supervisor will leave the room before work will still offend the technician.
21d. That the supervisor will leave the room before work will still offend the technician.
22a. That the fireman will stop the flames with water didn't still impress the homeowner.
22b. That the fireman didn't stop the flames with water will still impress the homeowner.
22c. That no fireman will stop the flames with water will still impress the homeowner.
22d. That the fireman will stop the flames with water will still impress the homeowner.
23a. That the ringmaster will scare the child by yelling didn't stun the crowd.
23b. That the ringmaster didn't scare the child by yelling will still stun the crowd.
23c. That no ringmaster will scare the child by yelling will still stun the crowd.
23d. That the ringmaster will scare the child by yelling will still stun the crowd.
24a. That the cowboy will defeat the bandits at cards didn't still amuse the sheriff.
24b. That the cowboy didn't defeat the bandits at cards will still amuse the sheriff.
24c. That no cowboy will defeat the bandits at cards will still amuse the sheriff.
24d. That the cowboy will defeat the bandits at cards will still amuse the sheriff.
25a. That the blacksmith will make the weapon with steel didn't still demoralize the army.
25b. That the blacksmith didn't make the weapons with steel will still demoralize the army.
25c. That no blacksmith will make the weapon with steel will still demoralize the army.
25d. That the blacksmith will make the weapons with steel will still demoralize the army.
26a. That the assistant will prepare the trick with cards didn't still startle the magician.

26b. That the assistant didn't prepare the trick with cards will still startle the magician.
26c. That no assistant will prepare the trick with cards will still startle the magician.
26d. That the assistant will prepare the trick with cards will still startle the magician.
27a. That no agent will plant the evidence of wrongdoing didn't still infuriate the ambassador.
27b. That the agent didn't plant the evidence of wrongdoing will still infuriate the ambassador.
27c. That no agent will plant the evidence of wrongdoing will still infuriate the ambassador.
27d. That the agent will plant the evidence of wrongdoing will still infuriate the ambassador.
28a. That the secretary will misplace the report about earnings didn't still puzzle the accountant.
28b. That the secretary didn't misplace the report about earnings will still puzzle the accountant.
28c. That no secretary will misplace the report about earnings will still puzzle the accountant.
28d. That the secretary will misplace the report about earnings will still puzzle the accountant.
29a. That the warrior will finish the quest for gold didn't still dishearten the princess.
29b. That the warrior didn't finish the quest for gold will still dishearten the princess.
29c. That no warrior will finish the quest for gold will still dishearten the princess.
29d. That the warrior will finish the quest for gold will still dishearten the princess.
30a. That the journalist will file the article about tennis didn't still offend the superstar.
30b. That the journalist didn't file the article about tennis will still offend the superstar.
30c. That no journalist will file the article about tennis will still offend the superstar.
30d. That the journalist will file the article about tennis will still offend the superstar.
31a. That the witch will drink the potion of flight didn't still dismay the wizard.
31b. That the witch didn't drink the potion of flight will still dismay the wizard.
31c. That no witch will drink the potion of flight will still dismay the wizard.
31d. That the witch will drink the potion of flight will still dismay the wizard.
32a. That the rancher will gather the animals together inside didn't still concern the shepherd.
32b. That the rancher didn't gather the animals together inside will still concern the shepherd.
32c. That no rancher will gather the animals together inside will still concern the shepherd.
32d. That the rancher will gather the animals together inside will still concern the shepherd.

D.2. Experiment 16 Items

1a. If no senator will raise the taxes, the farmer will still trust the government to balance budgets.

1b. If the senator won't raise the taxes, the farmer will still trust the government to balance budgets.
1c. If the senator will raise the taxes, no farmer will still trust the government to balance budgets.
1d. If the senator will raise the taxes, the farmer will still trust the government to balance budgets.
2a. If no hunter will shoot a bear, the fisherman will still visit the river during mating season.
2b. If the hunter won't shoot a bear, the fisherman will still visit the river during mating season.
2c. If the hunter will shoot a bear, no fisherman will still visit the river during mating season.
2d. If the hunter will shoot a bear, the fisherman will still visit the river during mating season.
3a. If no musician will play the gallery, the painter will still enjoy the party in total silence.
3b. If the musician won't play the gallery, the painter will still enjoy the party in total silence.
3c. If the musician will play the gallery, no painter will still enjoy the party in total silence.
3d. If the musician will play the gallery, the painter will still enjoy the party in total silence.
4a. If no dean will support the department, the scientist will still renovate the lab with expensive materials.
4b. If the dean won't support the department, the scientist will still renovate the lab with expensive materials.
4c. If the dean will support the department, no scientist will still renovate the lab with expensive materials.
4d. If the dean will support the department, the scientist will still renovate the lab with expensive materials.
5a. If no hostage will cut the ropes, the kidnapper will still ignore the negotiator for too long.
5b. If the hostage won't cut the ropes, the kidnapper will still ignore the negotiator for too long.
5c. If the hostage will cut the ropes, no kidnapper will still ignore the negotiator for too long.
5d. If the hostage will cut the ropes, the kidnapper will still ignore the negotiator for too long.
6a. If no investor will dump the stock, the lender will still forgive the loan during the downturn.
6b. If the investor won't dump the stock, the lender will still forgive the loan during the downturn.
6c. If the investor will dump the stock, no lender will still forgive the loan during the downturn.

6d. If the investor will dump the stock, the lender will still forgive the loan during the downturn.
7a. If no pollster will predict a victory, the politician will still abandon the race near the end.
7b. If the pollster won't predict a victory, the politician will still abandon the race near the end.
7c. If the pollster will predict a victory, no politician will still abandon the race near the end.
7d. If the pollster will predict a victory, the politician will still abandon the race near the end.
8a. If no general will endorse the strategy, the soldier will still complete the mission with clear determination.
8b. If the general won't endorse the strategy, the soldier will still complete the mission with clear determination.
8c. If the general will endorse the strategy, no soldier will still complete the mission with clear determination.
8d. If the general will endorse the strategy, the soldier will still complete the mission with clear determination.
9a. If no author will finish the chapter, the editor will still bother the agent for progress updates.
9b. If the author won't finish the chapter, the editor will still bother the agent for progress updates.
9c. If the author will finish the chapter, no editor will still bother the agent for progress updates.
9d. If the author will finish the chapter, the editor will still bother the agent for progress updates.
10a. If no tourist will visit the temple, the vendor will still sell the trinket with religious imagery.
10b. If the tourist won't visit the temple, the vendor will still sell the trinket with religious imagery.
10c. If the tourist will visit the temple, no vendor will still sell the trinket with religious imagery.
10d. If the tourist will visit the temple, the vendor will still sell the trinket with religious imagery.
11a. If no electrician will disconnect the wires, the plumber will still be in danger while testing pipes.
11b. If the electrician won't disconnect the wires, the plumber will still be in danger while testing pipes.
11c. If the electrician will disconnect the wires, no plumber will still be in danger while testing pipes.
11d. If the electrician will disconnect the wires, the plumber will still be in danger while testing pipes.
12a. If no doctor will cure the disease, the patient will still sue the hospital for poor treatment.

12b. If the doctor won't cure the disease, the patient will still sue the hospital for poor treatment.
12c. If the doctor will cure the disease, no patient will still sue the hospital for poor treatment.
12d. If the doctor will cure the disease, the patient will still sue the hospital for poor treatment.
13a. If no librarian will lose the book, the student will still borrow the novel about the knight.
13b. If the librarian won't lose the book, the student will still borrow the novel about the knight.
13c. If the librarian will lose the book, no student will still borrow the novel about the knight.
13d. If the librarian will lose the book, the student will still borrow the novel about the knight.
14a. If no admiral will capture the ship, the pirate will still escape from justice with the treasure.
14b. If the admiral won't capture the ship, the pirate will still escape from justice with the treasure.
14c. If the admiral will capture the ship, no pirate will still escape from justice with the treasure.
14d. If the admiral will capture the ship, the pirate will still escape from justice with the treasure.
15a. If no salesman will break the merchandise, the manufacturer will still make a profit on the goods.
15b. If the salesman won't break the merchandise, the manufacturer will still make a profit on the goods.
15c. If the salesman will break the merchandise, no manufacturer will still make a profit on the goods.
15d. If the salesman will break the merchandise, the manufacturer will still make a profit on the goods.
16a. If no banker will freeze the accounts, the client will still withdraw the money before the weekend.
16b. If the banker won't freeze the accounts, the client will still withdraw the money before the weekend.
16c. If the banker will freeze the accounts, no client will still withdraw the money before the weekend.
16d. If the banker will freeze the accounts, the client will still withdraw the money before the weekend.
17a. If no agent will sabotage the deal, the athlete will still promote the beverage during the game.
17b. If the agent won't sabotage the deal, the athlete will still promote the beverage during the game.
17c. If the agent will sabotage the deal, no athlete will still promote the beverage during the game.

17d. If the agent will sabotage the deal, the athlete will still promote the beverage during the game.
18a. If no lawyer will take the case, the criminal will still go to court for the trial.
18b. If the lawyer won't take the case, the criminal will still go to court for the trial.
18c. If the lawyer will take the case, no criminal will still go to court for the trial.
18d. If the lawyer will take the case, the criminal will still go to court for the trial.
19a. If no choreographer will change the steps, the dancer will still perform the piece with good technique.
19b. If the choreographer won't change the steps, the dancer will still perform the piece with good technique.
19c. If the choreographer will change the steps, no dancer will still perform the piece with good technique.
19d. If the choreographer will change the steps, the dancer will still perform the piece with good technique.
20a. If no guitarist will tune the instrument, the singer will still sound off key during the concert.
20b. If the guitarist won't tune the instrument, the singer will still sound off key during the concert.
20c. If the guitarist will tune the instrument, no singer will still sound off key during the concert.
20d. If the guitarist will tune the instrument, the singer will still sound off key during the concert.
21a. If no manager will leave the room, the technician will still give more effort to the project.
21b. If the manager won't leave the room, the technician will still give more effort to the project.
21c. If the manager will leave the room, no technician will still give more effort to the project.
21d. If the manager will leave the room, the technician will still give more effort to the project.
22a. If no fireman will stop the flames, the homeowner will still sell the house at a loss.
22b. If the fireman won't stop the flames, the homeowner will still sell the house at a loss.
22c. If the fireman will stop the flames, no homeowner will still sell the house at a loss.
22d. If the fireman will stop the flames, the homeowner will still sell the house at a loss.
23a. If no ringmaster will scare the child, the clown will still throw a pie at the crowd.
23b. If the ringmaster won't scare the child, the clown will still throw a pie at the crowd.
23c. If the ringmaster will scare the child, no clown will still throw a pie at the crowd.
23d. If the ringmaster will scare the child, the clown will still throw a pie at the crowd.
24a. If no cowboy will beat the bandits, the prospector will still surrender the gold to a criminal.
24b. If the cowboy won't beat the bandits, the prospector will still surrender the gold to a criminal.

24c. If the cowboy will beat the bandits, no prospector will still surrender the gold to a criminal.
24d. If the cowboy will beat the bandits, the prospector will still surrender the gold to a criminal.
25a. If no blacksmith will make the weapons, the commander will still attack the town with the army.
25b. If the blacksmith won't make the weapons, the commander will still attack the town with the army.
25c. If the blacksmith will make the weapons, no commander will still attack the town with the army.
25d. If the blacksmith will make the weapons, the commander will still attack the town with the army.
26a. If no assistant will prepare the trick, the magician will still produce the rabbit from the hat.
26b. If the assistant won't prepare the trick, the magician will still produce the rabbit from the hat.
26c. If the assistant will prepare the trick, no magician will still produce the rabbit from the hat.
26d. If the assistant will prepare the trick, the magician will still produce the rabbit from the hat.
27a. If no spy will plant the evidence, the ambassador will still face criminal charges outside the embassy.
27b. If the spy won't plant the evidence, the ambassador will still face criminal charges outside the embassy.
27c. If the spy will plant the evidence, no ambassador will still face criminal charges outside the embassy.
27d. If the spy will plant the evidence, the ambassador will still face criminal charges outside the embassy.
28a. If no secretary will misplace the report, the businessman will still evaluate the company with good information.
28b. If the secretary won't misplace the report, the businessman will still evaluate the company with good information.
28c. If the secretary will misplace the report, no businessman will still evaluate the company with good information.
28d. If the secretary will misplace the report, the businessman will still evaluate the company with good information.
29a. If no warrior will complete the quest, the princess will still marry the monarch with bad hair.
29b. If the warrior won't complete the quest, the princess will still marry the monarch with bad hair.
29c. If the warrior will complete the quest, no princess will still marry the monarch with bad hair.
29d. If the warrior will complete the quest, the princess will still marry the monarch with bad hair.

30a. If no reporter will file the story, the pundit will still break the news on live television.
30b. If the reporter won't file the story, the pundit will still break the news on live television.
30c. If the reporter will file the story, no pundit will still break the news on live television.
30d. If the reporter will file the story, the pundit will still break the news on live television.
31a. If no shaman will lift the curse, the child will still vanish from the town during the night.
31b. If the shaman won't lift the curse, the child will still vanish from the town during the night.
31c. If the shaman will lift the curse, no child will still vanish from town during the night.
31d. If the shaman will lift the curse, the child will still vanish from town during the night.
32a. If no horseman will startle the animals, the rancher will still gather the herd in the pen.
32b. If the horseman won't startle the animals, the rancher will still gather the herd in the pen.
32c. If the horseman will startle the animals, no rancher will still gather the herd in the pen.
32d. If the horseman will startle the animals, the rancher will still gather the herd in the pen.

D.3. Experiment 17 Items

1a. The carpenter who none of the salesmen said believed him about the tool will still build a house in the suburbs.
1b. The carpenter who one of the salesmen said believed him about the tool will still build a house in the suburbs.
1c. The carpenter who none of the salesmen said believed her about the tool will still build a house in the suburbs.
1d. The carpenter who one of the salesmen said believed her about the tool will still build a house in the suburbs.
2a. The engineer who none of the repairmen said watched him during the shift will still cause a scene on the factory floor.
2b. The engineer who one of the repairmen said watched him during the shift will still cause a scene on the factory floor.
2c. The engineer who none of the repairmen said watched her during the shift will still cause a scene on the factory floor.
2d. The engineer who one of the repairmen said watched her during the shift will still cause a scene on the factory floor.
3a. The lawyer who none of the councilmen said consulted him about the dispute will still sue the city as a response.

3b. The lawyer who one of the councilmen said consulted him about the dispute will still sue the city as a response.
3c. The lawyer who none of the councilmen said consulted her about the dispute will still sue the city as a response.
3d. The lawyer who one of the councilmen said consulted her about the dispute will still sue the city as a response.
4a. The mechanic who none of the fishermen said found him in the newspaper will still catch a fish on the boat.
4b. The mechanic who one of the fishermen said found him in the newspaper will still catch a fish on the boat.
4c. The mechanic who none of the fishermen said found her in the newspaper will still catch a fish on the boat.
4d. The mechanic who one of the fishermen said found her in the newspaper will still catch a fish on the boat.
5a. The patron who none of the waiters said thanked him with a tip will still eat a chicken at a restaurant.
5b. The patron who one of the waiters said thanked him with a tip will still eat a chicken at a restaurant.
5c. The patron who none of the waiters said thanked her with a tip will still eat a chicken at a restaurant.
5d. The patron who one of the waiters said thanked her with a tip will still eat a chicken at a restaurant.
6a. The maid who none of the queens said served her at the tavern will still clean the table with a rag.
6b. The maid who one of the queens said served her at the tavern will still clean the table with a rag.
6c. The maid who none of the queens said served him at the tavern will still clean the table with a rag.
6d. The maid who one of the queens said served him at the tavern will still clean the table with a rag.
7a. The dancer who none of the actresses divulged envied her for many years will still lose a shoe while on stage.
7b. The dancer who one of the actresses divulged envied her for many years will still lose a shoe while on stage.
7c. The dancer who none of the actresses divulged envied him for many years will still lose a shoe while on stage.
7d. The dancer who one of the actresses divulged envied him for many years will still lose a shoe while on stage.
8a. The bride who none of the seamstresses divulged insulted her during the fitting will still embarrass the groom with a speech.
8b. The bride who one of the seamstresses divulged insulted her during the fitting will still embarrass the groom with a speech.
8c. The bride who none of the seamstresses divulged insulted him during the fitting will still embarrass the groom with a speech.

8d. The bride who one of the seamstresses divulged insulted him during the fitting will still embarrass the groom with a speech.
9a. The babysitter who none of the mothers divulged called her during the evening will still watch the child with minimal trouble.
9b. The babysitter who one of the mothers divulged called her during the evening will still watch the child with minimal trouble.
9c. The babysitter who none of the mothers divulged called him during the evening will still watch the child with minimal trouble.
9d. The babysitter who one of the mothers divulged called him during the evening will still watch the child with minimal trouble.
10a. The priestess who none of the nuns divulged undermined her in the church will still perform a rite with a talisman.
10b. The priestess who one of the nuns divulged undermined her in the church will still perform a rite with a talisman.
10c. The priestess who none of the nuns divulged undermined him in the church will still perform a rite with a talisman.
10d. The priestess who one of the nuns divulged undermined him in the church will still perform a rite with a talisman.
11a. The environmentalist who none of the huntresses divulged questioned her about the trees will still track a rabbit through the woods.
11b. The environmentalist who one of the huntresss divulged questioned her about the trees will still track a rabbit through the woods.
11c. The environmentalist who none of the huntresses divulged questioned him about the trees will still track a rabbit through the woods.
11d. The environmentalist who one of the huntresss divulged questioned him about the trees will still track a rabbit through the woods.
12a. The witch who none of the enchantresses divulged sassed her during the lesson will still cast a spell on a frog.
12b. The witch who one of the enchantresses divulged sassed her during the lesson will still cast a spell on a frog.
12c. The witch who none of the enchantresses divulged sassed him during the lesson will still cast a spell on a frog.
12d. The witch who one of the enchantresses divulged sassed him during the lesson will still cast a spell on a frog.
13a. The editor who none of the paperboys believed supported him at work will still return a draft with zero edits.
13b. The editor who one of the paperboys believed supported him at work will still return a draft with zero edits.
13c. The editor who none of the paperboys believed supported her at work will still return a draft with zero edits.
13d. The editor who one of the paperboys believed supported her at work will still return a draft with zero edits.
14a. The driver who none of the postmen believed fooled him outside the office will still deliver a package in the city.

14b. The driver who one of the postmen believed fooled him outside the office will still deliver a package in the city.
14c. The driver who none of the postmen believed fooled her outside the office will still deliver a package in the city.
14d. The driver who one of the postmen believed fooled her outside the office will still deliver a package in the city.
15a. The concierge who none of the doormen believed despised him since the beginning will still lend a hand after work hours.
15b. The concierge who one of the doormen believed despised him since the beginning will still lend a hand after work hours.
15c. The concierge who none of the doormen believed despised her since the beginning will still lend a hand after work hours.
15d. The concierge who one of the doormen believed despised her since the beginning will still lend a hand after work hours.
16a. The general who none of the axmen believed commanded him to do battle will still charge the enemy during a fight.
16b. The general who one of the axmen believed commanded him to do battle will still charge the enemy during a fight.
16c. The general who none of the axmen believed commanded her to do battle will still charge the enemy during a fight.
16d. The general who one of the axmen believed commanded her to do battle will still charge the enemy during a fight.
17a. The scientist who none of the madmen believed ignored him out of spite will still build a laser out of scrap.
17b. The scientist who one of the madmen believed ignored him out of spite will still build a laser out of scrap.
17c. The scientist who none of the madmen believed ignored her out of spite will still build a laser out of scrap.
17d. The scientist who one of the madmen believed ignored her out of spite will still build a laser out of scrap.
18a. The admiral who none of the oarsmen believed helped him many years ago will still abandon the ship in a storm.
18b. The admiral who one of the oarsmen believed helped him many years ago will still abandon the ship in a storm.
18c. The admiral who none of the oarsmen believed helped her many years ago will still abandon the ship in a storm.
18d. The admiral who one of the oarsmen believed helped her many years ago will still abandon the ship in a storm.
19a. The handmaid who none of the princesses said defended her to the court will still earn a title in the realm.
19b. The handmaid who one of the princesses said defended her to the court will still earn a title in the realm.
19c. The handmaid who none of the princesses said defended him to the court will still earn a title in the realm.

19d. The handmaid who one of the princesses said defended him to the court will still earn a title in the realm.
20a. The bachelorette who none of the widows claimed impressed her with a story will still meet a man at a party.
20b. The bachelorette who one of the widows claimed impressed her with a story will still meet a man at a party.
20c. The bachelorette who none of the widows claimed impressed him with a story will still meet a man at a party.
20d. The bachelorette who one of the widows claimed impressed him with a story will still meet a man at a party.
21a. The mistress who none of the nannies claimed evaded her at the dance will still fool a man with a smile.
21b. The mistress who one of the nannies claimed evaded her at the dance will still fool a man with a smile.
21c. The mistress who none of the nannies claimed evaded him at the dance will still fool a man with a smile.
21d. The mistress who one of the nannies claimed evaded him at the dance will still fool a man with a smile.
22a. The designer who none of the fashionistas claimed paid her with a check will still make an outfit for the children.
22b. The designer who one of the fashionistas claimed paid her with a check will still make an outfit for the children.
22c. The designer who none of the fashionistas claimed paid him with a check will still make an outfit for the children.
22d. The designer who one of the fashionistas claimed paid him with a check will still make an outfit for the children.
23a. The aunt who none of the nieces claimed offended her with a comment will still get to host Thanksgiving dinner.
23b. The aunt who one of the nieces claimed offended her with a comment will still get to host Thanksgiving dinner.
23c. The aunt who none of the nieces claimed offended him with a comment will still get to host Thanksgiving dinner.
23d. The aunt who one of the nieces claimed offended him with a comment will still get to host Thanksgiving dinner.
24a. The clerk who none of the grandmothers claimed pinched her on the cheek will still report a customer for being rude.
24b. The clerk who one of the grandmothers claimed pinched her on the cheek will still report a customer for being rude.
24c. The clerk who none of the grandmothers claimed pinched him on the cheek will still report a customer for being rude.
24d. The clerk who one of the grandmothers claimed pinched him on the cheek will still report a customer for being rude.

D.4. Experiment 18 Items

1a. The carpenter who none of the salesmen said believed him about the tool will still build a house in the suburbs.
1b. The carpenter who none of the salesmen said believed her about the tool will still build a house in the suburbs.
1c. The carpenter who none of the salesmen said believed him will still build a house in the suburbs.
1d. The carpenter who none of the salesmen said believed her will still build a house in the suburbs.
2a. The engineer who none of the repairmen said watched him during the shift will still cause a scene on the factory floor.
2b. The engineer who none of the repairmen said watched her during the shift will still cause a scene on the factory floor.
2c. The engineer who none of the repairmen said watched him will still cause a scene on the factory floor.
2d. The engineer who none of the repairmen said watched her will still cause a scene on the factory floor.
3a. The lawyer who none of the councilmen said consulted him about the dispute will still sue the city as a response.
3b. The lawyer who none of the councilmen said consulted her about the dispute will still sue the city as a response.
3c. The lawyer who none of the councilmen said consulted him will still sue the city as a response.
3d. The lawyer who none of the councilmen said consulted her will still sue the city as a response.
4a. The mechanic who none of the fishermen said found him in the newspaper will still catch a fish on the boat.
4b. The mechanic who none of the fishermen said found her in the newspaper will still catch a fish on the boat.
4c. The mechanic who none of the fishermen said found him will still catch a fish on the boat.
4d. The mechanic who none of the fishermen said found her will still catch a fish on the boat.
5a. The patron who none of the waiters said thanked him with a tip will still eat a chicken at a restaurant.
5b. The patron who none of the waiters said thanked her with a tip will still eat a chicken at a restaurant.
5c. The patron who none of the waiters said thanked him will still eat a chicken at a restaurant.
5d. The patron who none of the waiters said thanked her will still eat a chicken at a restaurant.
6a. The maid who none of the queens said served her at the tavern will still clean the table with a rag.

6b. The maid who none of the queens said served him at the tavern will still clean the table with a rag.
6c. The maid who none of the queens said served her will still clean the table with a rag.
6d. The maid who none of the queens said served him will still clean the table with a rag.
7a. The dancer who none of the actresses divulged envied her for many years will still lose a shoe while on stage.
7b. The dancer who none of the actresses divulged envied him for many years will still lose a shoe while on stage.
7c. The dancer who none of the actresses divulged envied her will still lose a shoe while on stage.
7d. The dancer who none of the actresses divulged envied him will still lose a shoe while on stage.
8a. The bride who none of the seamstresses divulged insulted her during the fitting will still embarrass the groom with a speech.
8b. The bride who none of the seamstresses divulged insulted him during the fitting will still embarrass the groom with a speech.
8c. The bride who none of the seamstresses divulged insulted her will still embarrass the groom with a speech.
8d. The bride who none of the seamstresses divulged insulted him will still embarrass the groom with a speech.
9a. The babysitter who none of the mothers divulged called her during the evening will still watch the child with minimal trouble.
9b. The babysitter who none of the mothers divulged called him during the evening will still watch the child with minimal trouble.
9c. The babysitter who none of the mothers divulged called her will still watch the child with minimal trouble.
9d. The babysitter who none of the mothers divulged called him will still watch the child with minimal trouble.
10a. The priestess who none of the nuns divulged undermined her in the church will still perform a rite with a talisman.
10b. The priestess who none of the nuns divulged undermined him in the church will still perform a rite with a talisman.
10c. The priestess who none of the nuns divulged undermined her will still perform a rite with a talisman.
10d. The priestess who none of the nuns divulged undermined him will still perform a rite with a talisman.
11a. The environmentalist who none of the huntresses divulged questioned her about the trees will still track a rabbit through the woods.
11b. The environmentalist who none of the huntresses divulged questioned him about the trees will still track a rabbit through the woods.
11c. The environmentalist who none of the huntresses divulged questioned her will still track a rabbit through the woods.

11d. The environmentalist who none of the huntresses divulged questioned him will still track a rabbit through the woods.
12a. The witch who none of the enchantresses divulged sassed her during the lesson will still cast a spell on a frog.
12b. The witch who none of the enchantresses divulged sassed him during the lesson will still cast a spell on a frog.
12c. The witch who none of the enchantresses divulged sassed her will still cast a spell on a frog.
12d. The witch who none of the enchantresses divulged sassed him will still cast a spell on a frog.
13a. The editor who none of the paperboys believed supported him as a worker will still return a draft with zero edits.
13b. The editor who none of the paperboys believed supported her as a worker will still return a draft with zero edits.
13c. The editor who none of the paperboys believed supported him will still return a draft with zero edits.
13d. The editor who none of the paperboys believed supported her will still return a draft with zero edits.
14a. The driver who none of the postmen believed fooled him outside the office will still deliver a package in the city.
14b. The driver who none of the postmen believed fooled her outside the office will still deliver a package in the city.
14c. The driver who none of the postmen believed fooled him will still deliver a package in the city.
14d. The driver who none of the postmen believed fooled her will still deliver a package in the city.
15a. The concierge who none of the doormen believed despised him since the beginning will still lend a hand after work hours.
15b. The concierge who none of the doormen believed despised her since the beginning will still lend a hand after work hours.
15c. The concierge who none of the doormen believed despised him will still lend a hand after work hours.
15d. The concierge who none of the doormen believed despised her will still lend a hand after work hours.
16a. The general who none of the axmen believed commanded him to do battle will still charge the enemy during a fight.
16b. The general who none of the axmen believed commanded her to do battle will still charge the enemy during a fight.
16c. The general who none of the axmen believed commanded him will still charge the enemy during a fight.
16d. The general who none of the axmen believed commanded her will still charge the enemy during a fight.
17a. The scientist who none of the madmen believed ignored him out of spite will still build a laser out of scrap.

17b. The scientist who none of the madmen believed ignored her out of spite will still build a laser out of scrap.
17c. The scientist who none of the madmen believed ignored him will still build a laser out of scrap.
17d. The scientist who none of the madmen believed ignored her will still build a laser out of scrap.
18a. The admiral who none of the oarsmen believed helped him many years ago will still abandon the ship in a storm.
18b. The admiral who none of the oarsmen believed helped her many years ago will still abandon the ship in a storm.
18c. The admiral who none of the oarsmen believed helped him will still abandon the ship in a storm.
18d. The admiral who none of the oarsmen believed helped her will still abandon the ship in a storm.
19a. The handmaid who none of the princesses said defended her to the court will still earn a title in the realm.
19b. The handmaid who none of the princesses said defended him to the court will still earn a title in the realm.
19c. The handmaid who none of the princesses said defended her will still earn a title in the realm.
19d. The handmaid who none of the princesses said defended him will still earn a title in the realm.
20a. The bachelorette who none of the widows claimed impressed her with a story will still meet a man at a party.
20b. The bachelorette who none of the widows claimed impressed him with a story will still meet a man at a party.
20c. The bachelorette who none of the widows claimed impressed her will still meet a man at a party.
20d. The bachelorette who none of the widows claimed impressed him will still meet a man at a party.
21a. The mistress who none of the nannies claimed evaded her at the dance will still fool a man with a smile.
21b. The mistress who none of the nannies claimed evaded him at the dance will still fool a man with a smile.
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