RECONSTRAINING MASSIVE PIED-PIPING IN ENGLISH: A NON-INTERROGATIVE CP ANALYSIS

by

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DISSERTATION

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ABSTRACT

RECONSTRAINING MASSIVE PIED-PIPING IN ENGLISH:
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This dissertation focuses on the distribution of "massive pied-piping" (Heck 2008) constructions in English. Compared to other forms of *wh*-movement and pied-piping, broadly speaking, massive pied-piping is limited in the environments in which it may occur. The primary goals of this dissertations are to examine (i) whether massive piped-piping is restricted to non-subordinated clauses (cf. *wh*-movement), (ii) what effect prosody has on relative clause interpretations, and (iii) how the distribution of massive pied-piping can be explained given a wider pattern of acceptability. To address these questions, I combine traditional syntactic and semantic judgments with two psycholinguistic experiments that utilize a context-continuation plausibility judgment paradigm during spoken language comprehension. The results of these formal diagnostics and psycholinguistic experiments suggest that massive pied-piping cannot be restricted based on the non-subordinated status of the clause hosting the movement, and I argue that massive pied-piping is restricted to non-interrogative clauses.

To account for this new generalization, I present an analysis that combines a Q-based analysis of *wh*-movement (Cable 2010) with a two-stage, Focus/*wh*-Agreement process (Den Dikken 2003). While both interrogative and non-interrogative clauses can host simple *wh*-movement or pied-piping through QP-movement (motivated by Focus-agreement) under this analysis, massive pied-piping is disallowed in truly interrogative clauses as a result of an inability to establish a local Agreement relationship between the *wh*-features. In non-interrogative clauses, however, I argue that this relationship is never initiated due to an inherent lack of a *wh*-feature at the complementizer level; thereby, massive pied-piping is allowed to occur. In addition to accounting for the distribution of massive pied-piping, this analysis accounts for the unrestricted nature of simple *wh*-movement and forms of obligatory pied-piping without additional mechanisms.

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DEDICATION

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Dedicated to Nana,

for always seeing my potential

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CHAPTER 1

INTRODUCTION

One of the many questions that transformational grammars try to answer is how the surface forms of questions are derived from the same base form as declarative statements. When compared to polar questions (also known as *yes/no* questions), constituent questions (better known as *wh*-questions) are notably more complex. Following Chomsky (1977) and subsequent work, transformational grammar theories have argued that *wh*-fronting in questions and in relative clauses is the result of an Agreement operation between a *wh*-feature present on the complementizer and on the *wh*-word itself. As a result of this Agreement relationship, the *wh*-word is moved from its base position — where it appears in declarative forms — to the left edge of the question or relative clause.

While the *wh*-word is often the only thing that moves as a result of this Agreement relationship, there are cases in which the *wh*-word is accompanied by additional syntactic material. This movement of a larger syntactic unit has been referred to as "pied-piping", following Ross' (1967) original discussion of the phenomenon. Since Ross' discussion, various analyses have been proposed to account for the distribution of pied-piping. Each of these analyses have tried to answer different questions regarding pied-piping, including — but not limited to — what motivates the movement of the larger constituent, what restricts the size and shape of the constituent, and why do some syntactic environments allow a subset of pied-piping forms.

The focus of this dissertation is on the sub-type of pied-piping that Heck (2008) calls "massive pied-piping". While examples of massive pied-piping date back to Ross

(1986, 198), e.g., *Reports the height of the lettering on the covers of which the government prescribes should be abolished*, Heck's cataloging of the variety of pied-piping structures — and the environments in which they may occur — led him to the generalization that massive pied-piping is restricted to non-subordinated clauses.

As part of evidence for his non-subordinated restriction on massive pied-piping, Heck presents an asymmetry between restrictive and non-restrictive relative clauses, wherein massive pied-piping is more readily accepted in non-restrictive relative clauses. This particular asymmetry, however, is not wholly accepted in the syntactic literature. While this lack of consensus serves as motivation for this dissertation. The goal of this dissertation, therefore, is to address the following three questions:

1. Is massive pied-piping truly restricted to non-subordinated clauses?
2. Does prosody have an effect on relative clause interpretations?
3. How can the wider set of environments that allow massive pied-piping be accounted for?

As a guide to the direction that this dissertation will take, I provide a general summary of the chapters of this study. Chapter 2 presents a background on pied-piping and the general problems that it presents for transformational grammars. In this chapter, I focus briefly on earlier analyses of pied-piping, before moving to more modern analyses, which seek to not only explain the various forms of pied-piping but to also unify theories of pied-piping with *wh*-movement in a broad sense.

Chapter 3 focuses on cases where Heck's (2008) generalization on massive pied-piping fails to capture the wider set of environments in which the movement may occur. This chapter focus on three asymmetries: restrictive relative clauses versus non-restrictive relative clauses, truly interrogative matrix clause questions versus echo questions, and complements of factive predicates versus complements of interrogative predicates. These asymmetries show that massive pied-piping is possible in both sub-

ordinated and non-subordinated clauses. However, based on the similarities in the environments where massive pied-piping cannot occur, I present a revised generalization on massive pied-piping. This revised generalization restricts massive pied-piping to non-interrogative clauses.

As the judgments presented on massive pied-piping in subordinated contexts presented in Chapter 3 have been mixed, I also designed two experiments to test the effect of prosody on relative clause interpretation, which I present in Chapter 4. Since massive pied-piping constructions are already marked and less likely to be viewed as grammatical, these experiments focus instead on the semantic interpretation generated by context statements and the subsequent use of those interpretations on judgments of plausibility for continuation statement. In Experiment 1, which serves as a proof of concept, participants readily showed an ability to disambiguate between competing relative clause interpretations (restrictive versus non-restrictive) using prosody in relative clauses with *wh*-movement. Experiment 2 expands on this by introducing competing obligatory and massive pied-piping constructions as a structural factor. While the primary results of Experiment 2 fail to show the same robust effect of prosody in either of the structural conditions, a secondary analysis of highly distinguishing participants restores the effect of prosody for obligatory pied-piping, and it shows a potential trend for an effect of prosody for massive pied-piping as well.

Based on the evidence in Chapters 3 and 4, I propose an analysis in Chapter 5 to account for a non-interrogative clause restriction on massive pied-piping. This analysis builds upon Cable's (2010) Q-based movement analysis by combining it with the two-stage Focus/*wh*-Agreement operation proposed by Dikken (2003). This new analysis, which focuses on non-interrogative nature of the CP hosting massive pied-piping, not only explains how massive pied-piping can happen in restrictive relative clauses and complement clauses of factive predicates, but it also better explains the

forced, echo interpretation of matrix clause questions when massive pied-piping is present. While this analysis applies to massive pied-piping constructions, I show that it does not interfere with traditional *wh*-movement or obligatory pied-piping.

CHAPTER 2

REVIEW OF PIED-PIPING IN TRANSFORMATIONAL GRAMMAR

In this chapter, I present a brief overview of approaches used to deal with pied-piping. Despite being initially discussed over half a century ago, the proposed methods for dealing with pied-piping can be broken down into primarily two camps: feature percolation analyses and non-percolation analyses. I divide this chapter in two sections. In Section 2.1, I discuss Ross' (1967) original examples of pied-piping and the feature percolation analyses of Cowper (1987) and Grimshaw (1991). In Section 2.2, I cover the non-percolation analyses of Heck (2004, 2008), Cable (2007, 2010), and Richards (2019).

2.1 Early analyses of pied-piping

2.1.1 Ross (1967)

In the earliest work describing pied-piping, Ross (1967) provides cases where pied-piping is optional, as shown in the contrast between (1) and (2), and where it is obligatory, as shown in (3). The optional pied-piping present in (2) would later go on to be called "massive pied-piping" by Heck (2004, 2008) (or what Safir (1986) calls "heavy pied-piping"). This particular type of pied-piping and the problems that it presents will be the focus of the rest of this dissertation.

(1) *Wh*-movement (Ross 1967, 218)

Reports which the government prescribes the height of the lettering on the covers of are invariably boring.

(2) Optional pied-piping (Ross 1967, 219)

a. Reports the covers of which the government prescribes the height of the lettering on almost always put me to sleep.

b. Reports the lettering on the covers of which the government prescribes the height of are a shocking waste of public funds.

c. Reports the height of the lettering on the covers of which the government prescribes should be abolished.

(3) Obligatory pied-piping (Ross 1967, 211)

a. The boy whose guardian's employer we elected president ratted on us.

b. *The boy whose guardian's we elected employer president ratted on us.

c. *The boy whose we elected guardian's employer president ratted on us.

To account for the optionality and variable size of the massive pied-piping constructions in (2), Ross proposes the pied-piping convention, given in (4).

(4) The Pied-Piping Convention (Ross 1967, 206)

Any transformation which is stated in a way as to effect the reordering of some specified node NP, where this node is preceded and followed by variables in the structural index of the rule, may apply to this NP or to any non-coordinate NP which dominates it, as long as there are no occurrences of any coordinate node, nor of the node S, on the branch connecting the higher node and the specified node.

While Ross operates under an older theoretical model, this convention has been modified and expanded by Heck's (2008) generalization on recursive pied-piping. In

addition to the pied-piping convention, Ross also presents the Left Branch Condition, given here in (5).

(5) The Left Branch Condition (Ross 1967, 207)

No NP which is the left most constituent of a larger NP can be reordered out of this NP by a transformational rule.

The Left Branch Condition not only helps to explain why possessive constructions like the one present in (3) require pied-piping, but it has also helped to explain pied-piping by degree words, as presented in (6a). While I will not discuss the type of pied-piping present in (6a), it is worth noting the inversion of the AP and the determiner when comparing (6a) with its declarative form in (6b)

(6) Obligatory pied-piping by *wh*-degree (Ross 1967)

a. How tall a man did Sheila marry?

b. Sheila married that tall a man.

2.1.2 Cowper (1987)

Following Chomsky's (1977) theory of *wh*-movement, a number of approaches have attempted to explain how a larger constituent can be moved. Many of these models involve the concept of feature percolation, with Cowper (1987) being an early example of this. Borrowing from Di Sciullo & Williams (1987), Cowper, proposes that a [WH], whether positive or negative, can percolate up a syntactic structure, so long as head of the higher phrase is unmarked for the [WH] feature. Her analysis, in part, seeks to explain the asymmetries present in (7). Notably, while the NP or a superior PP can be pied-piped by the *wh*-word, a larger, dominating DP structure — following Abney (1987) — cannot be pied-piped in embedded questions.

(7) Limits of optional pied-piping in embedded questions (Cowper 1987, 322)

a. I wonder who they gave the prize to.

b. I wonder to whom they gave the prize.

c. I wonder which people they worked with.

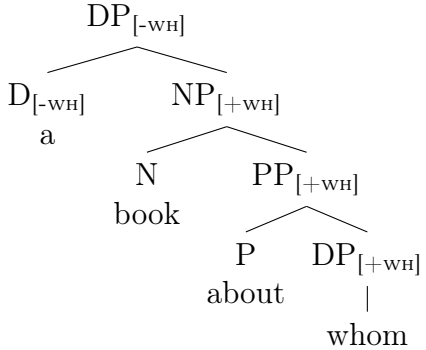
d. I wonder with which people they worked.

e. *I wonder the parents of which children they spoke to.

f. *I wonder to the parents of which children they spoke.

To account for this, Cowper proposes that *wh*-features — whether [+WH] or [-WH] — can percolate up from one node to the next, so long as they are not blocked by the presence of a contrasting *wh*-feature on the head of the phrase. She argues that non-*wh*- determiners *the* and *a* are intrinsically [-WH]. Consequently, even though [+WH] can percolate up from the *wh*-element through PPs and NPs whose heads are unmarked for [WH], the larger DP cannot be the target of *wh*-movement, as shown in the structure of (8). Contrastively, the possessive determiner *'s* under Abney's (1987) DP structure would be unmarked. This would allow the [+WH] feature to percolate up a recursive possessive structure.

(8) Feature percolation (Cowper 1987)

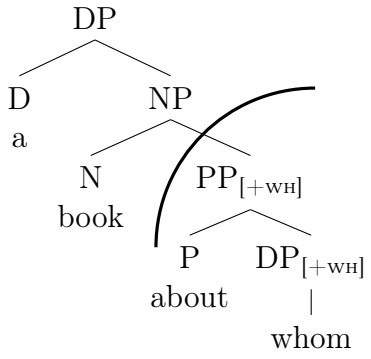


The difference between the availability of massive pied-piping in the relative clause examples in (2) and the unavailability of massive pied-piping in embedded questions in (7e) and (7f) is, as Cowper explains, due to the complementizer in relative clauses requiring a [-WH]. As such, the head of a massively pied-piped DP, which would be marked with [-WH], would be a candidate for *wh*-movement. If this is the case, however, it is unclear how object-extracted relative clauses target the *wh*-word for movement and not the subject DP, which would also bear a [-WH] feature.

2.1.3 Grimshaw (1991, 2000)

While Grimshaw (1991, 2000), like Cowper (1987), resorts to feature percolation to account for pied-piping constructions, her method of feature percolation differs. In Grimshaw's model, features do not percolate up based an unspecified [WH] feature, rather they percolate up based on her concept of the "extended projection". Under the extended projection analysis, a feature lower in a projection can project up to its maximal projection. Notably, Grimshaw treats NP, DP, and PP as one long projection, with the N serving as the lexical head for the larger projection, as shown in the structure given in (9). Here the [WH] feature from the DP can percolate up to the PP. It cannot percolate up into the NP, as the NP begins a separate extended projection.

(9) Extent of feature percolation (Grimshaw 1991, 2000)



In addition to features percolating up from one head to another, Grimshaw notes specifiers can also project their features up as well. This percolation of a feature by a specifier in a projection is what leads to the obligatory pied-piping by a DP specifier in Grimshaw's analysis. Since the element bearing the [WH] is a specifier position, this [WH] feature is passed up the projection, and it can continue to percolate up the structure, until it is blocked by a new lexical projection.

Grimshaw can account for the ungrammaticality of massive pied-piping in (7e) and (7f). In both examples, the [WH] can percolate up to the PP headed by *of*, as the PP is part of the same extended projection. It cannot be projected further up due to *parents* serving as the lexical head for another extended projection.

Grimshaw (2000) notably diverges from both Ross (1967) and Cowper (1987) in her treatment of relative clause. While she presents evidence for massive pied-piping in relative clause, she argues that these constructions are only possible in non-restrictive, or appositive, relative clauses. Due to *wh*-word having an anaphoric nature in non-restrictive relative clauses, rather than something more quantificational, Grimshaw says that "any phrase which contains [the] relative pronoun... can move" (128). As Heck (2008) points out, this is potentially problematic. While non-restrictive relative clauses can allow massive pied-piping in English, the simplification

of "XP contains the *wh*-pronoun" does not work for all pied-piped constituents. This particularly does not work as specified subjects block pied-piping, as noted by Nanni & Stillings (1978, 314), using the example presented in (10)

(10) a. The elegant parties, to be admitted to one of which was a privilege, had usually been held at Delmonico' s.

b. *The elegant parties, for us to be admitted to one of which was a privilege, had usually been held at Delmonico's.

This highlights a particular weakness of the feature percolation models for pied-piping, as noted by Heck (2008). Once feature percolation is allowed, it is difficult to constrain and regulate the pied-piped constituent.

2.2 Modern analyses of pied-piping

The three analyses of pied-piping in this section all try to account for the distributions of different types of pied-piping. The analyses discussed by section are that of Heck (2004, 2008) in Section 2.2.1, Cable (2007, 2010) in Section 2.2.2, and Richards (2019) in Section 2.2.3. All three of these approaches avoid the use of feature percolation in their attempt to regulate pied-piping.

2.2.1 Heck (2004, 2008): Optimality Theory analysis

Heck (2004, 2008) provides a very thorough discussion about the different types of pied-piping and the contexts in which each type of pied-piping may occur. His analysis of pied-piping seeks to explain the phenomenon without resorting to the necessity of feature percolation present in the analyses discussed above. In order

to do so, Heck instead provides an Optimality Theory (Prince & Smolensky 2004) approach to regulate when and where pied-piping may occur.

A number of the constraints that Heck (2008) utilizes are not inherently novel and have been used to discuss other syntactic phenomena. Following Chomsky (1995), Heck posits that the movement must be motivated by the checking of probes, a constraint he labels Feature Condition (FC) in (11a), and that movements must be motivated, which he constraints with Last Resort (RC) in (11b). Furthermore, Heck adopts the constraint Local Agree (LA), given in (11c), which prevents intervening projections from occurring between a probe and its goal after movement. The presence of pied-piping, Heck argues, is due to violations of LA in order to prevent violations of more highly ranked constraints.

(11) Heck's (2008) constraints on pied-piping

a. Feature Condition (189)

If β is a probe in Σ, then β must be checked on the Σ cycle.

b. Last Resort (189)

If γ moves within Σ, then γ must check some probe on the Σ cycle.

c. Local Agree (191)

For every active probe β, there is a different matching goal γ in Σ such that no XP dominates γ but not β.

The simple application of the above three constraints can be seen with *wh*-movement in the tableau presented in (12) below. The optimal candidate, O_1, has the *wh*-phrase *who* move up to Spec,CP. From this position, C, which bears a [WH] feature, may locally Agree with the *wh*-phrase that can check said feature. O_2 is sub-optimal because it violates LA as the *wh*-phrase has not moved up to Spec,CP

from its position in the derivation as Spec,TP. The third candidate, O_3, applies *wh*-movement, moving *who* to Spec,CP, but the [WH] feature is not checked on C. This violates FC. The constraint LR is not violated in any of the three candidates listed, but it could be assumed that movement of *you* (or any other constituent) to Spec,CP would elicit violation of LR, as such a movement would not check the [WH] feature.

(12) CP-cycle; short *wh*-movement (Heck 2008, 198)

Input: $C_{[*WH*]}$ + [$_{TP}$ who$_i$ [vP t_i adores+v you]] Num: {persona, a}	FC	LA	LR
→ O_1: [$_{CP}$ who$_i$ $C_{\lfloor\!\not*WH*\not\rfloor}$ [$_{TP}$ t'_i [vP t_i adores+v you]]]			
O_2: [$_{CP}$ $C_{\lfloor\!\not*WH*\not\rfloor}$ [$_{TP}$ who$_i$ [vP t_i adores+v you]]]		!*	
O_3: [$_{CP}$ who$_i$ $C_{[*WH*]}$ [$_{TP}$ t'_i [vP t_i adores+v you]]]	!*		

For instances where obligatory pied-piping occurs by a DP specifier, Heck posits that there is also the constraint Left Branch Condition (LBC), which, following Ross (1967, 1986), prevents extraction from the left branch of a derivation. Heck illustrates the usefulness of an LBC constraint in the tableau presented in (13).

(13) CP-cycle, short *wh*-movement with pied-piping (Heck 2008, 200)

Input: $C_{[*WH*]}$ + [$_{TP}$ [$_{DP}$ whose son] V ...] Num: {person, a}	LBC	FC	LA	LR
O_1: [$_{CP}$ whose$_i$ $C_{\lfloor\!\not*WH*\not\rfloor}$ [$_{TP}$ [$_{DP}$ t_i son] V ...]]	*!			
→ O_2: [$_{CP}$ [$_{DP}$ whose son]$_i$ $C_{\lfloor\!\not*WH*\not\rfloor}$ [$_{TP}$ t_i V ...]]			*	
O_3: [$_{CP}$ $C_{\lfloor\!\not*WH*\not\rfloor}$ [$_{TP}$ [$_{DP}$ whose son] V ...]]			**!	
O_4: [$_{CP}$ $C_{[*WH*]}$ [$_{TP}$ [$_{DP}$ whose son] V ...]]		*!		

Movement of the *wh*-phrase in O_1, violates LBC, as it is extracted from the leftward specifier of the larger DP. O_4 is equally problematic as the probe [*WH*] on C is not checked within the CP cycle, violating FC. Candidates O_2 and O_3 both check the probe [*WH*] on C, and neither violate LBC. The only difference between the candidates is that *whose son* moves in O_2. From its new position, the probe only passes through one maximal projection: the larger DP. This results in a single violation of LA. Contrastively, O_3 does not contain movement. However, the probe in this candidate must pass through two maximal projections: TP and the larger DP. For this, O_3 suffers two violations of LA. This leads to O_2 with its pied-piping being the optimal candidate, despite it's violation of LA.

While Heck's ordering of constraints appears to persuasively argue for an analysis that motivates obligatory pied-piping, massive pied-piping is clearly problematic for Heck's OT-based approach, as when given the option of moving the *wh*-phrase by itself or pied-piping a larger phrase, the grammar should always choose the *wh*-phrase by itself, in order to avoid violations of LA. Noting the asymmetry between the availability of massive pied-piping in matrix clause echo questions, shown here in (14), and general preference in the syntactic literature for non-restrictive interpretations for relative clauses with massive pied-piping, Heck provides his generalization on massive pied-piping, given in (15).

(14) Matrix/embedded clause asymmetry: massive pied-piping (Heck 2008, 169)

a. [$_{DP}$ Pictures of WHICH family] are t on sale?

b. *Horace asked [$_{DP}$ pictures of which family] t were on sale.

(15) Generalization on Massive Pied-Piping (Heck 2008, 297)

Massive pied-piping is only possible if a. and b. hold.

a. The CP whose specifier is the target of (primary) *wh*-movement is not subordinated.

b. In relative clauses, the pied-piper is selected by a D-element.

Notably, the generalization on massive pied-piping given above is just that, a generalization. Aside from providing his intervention generalization, which regulates the potential size and shape of the constituent that is pied-piped, Heck offers no hard syntactic analysis that results in the ungrammaticality of massive pied-piping in subordinated clause contexts, but not in non-subordinated clause contexts. The closest he does get to a syntactic analysis is his argument that "restrictive relative clauses and embedded interrogatives cannot exploit the option of *wh*-feature movement" (332) as a means of rescue, which is allowed by his mechanics in non-subordinated clauses.

While he argues in favor of massive pied-piping in non-restrictive relative clauses, but not restrictive relative clauses, Heck (2008) does note that some speakers of English can have restrictive relative clauses with massive pied-piping, citing Ross (1967, 1986), Stockwell et al. (1973), and Huddleston & Pullum (2002) as relevant examples. Additionally, he provides counterexamples of Italian restrictive relative clauses with massive pied-piping, taken from Cinque (1982). Heck writes off these counterexamples as coming from speakers for whom the partiality of subcat is markedly weaker (333). This, however, is problematic as massive pied-piping is still reported as ungrammatical in embedded clause questions, even if it is allowed in restrictive relative clauses. If the partiality of subcat is violable one type of subordinated CP, it should, predictably, be violable in the other.

2.2.2 Cable (2007, 2010): Q-based movement analysis

Cable (2007, 2010) presents an alternative analysis to pied-piping, based on the expression of Q-particles in languages like Tlingit, Sinhala, and Japanese. Admirably, one of the main goals of Cable's 'Q-based approach' to movement is to reduce all instantiations of pied-piping to the same mechanism that governs regular *wh*-movement. Under Cable's approach, *wh*-movement is not the result of a relationship between C and the *wh*-phrase. Rather, it is the result of an Agreement relationship between C and a QP containing the *wh*-phrase.

Cable's analysis draws heavily on data from Tlingit, which he notes requires the obligatory presence of both the Q-particle *sá* and a *wh*-word for matrix and embedded *wh*-questions, as well relative clause formations. The obligatoriness of the Q-particle *sá* is represented in (16).

(16) Obligatory Q-particle *sá* in Tlingit *wh*-questions (Cable 2010, 30)

a. Daa *(sá) aawax̲áa i éesh?
what Q he.ate.it your father
"What did your father eat?"

b. Goodéi *(sá) kk̲wagóot?
where.to Q I.will.go
"Where will I go?"

Cable also notes that the relationship between *sá* and the *wh*-phrase must be one in which the Q-particle c-commands the *wh*-phrase and the *wh*-phrase is c-commanded by the Q-particle, as expressed in (17) and (18). While *sá* appears immediately to the right of the fronted *wh*-phrase in (17a) and (18a), it is separated from the moved constituent by intervening material in (17b) and (18b). In the linear orders presented in (17b) and (18b), the material between the *wh*-phrase and *sá* do not form a constituent.

(17) Obligatory c-command of *wh*-element by Q-particle (Cable 2010, 32)

a. [Aadóo jeet] sá wé sakwnéin aawatee?
who hand.to Q that bread he.brought.it
"Who did he give the bread to?"

b. *[Aadóo jeet] wé sakwnéin sá aawatee?
who hand.to that bread Q he.brought.it

(18) a. [Goodéi] sá has oowajée wugootx̲ i shagóonich?
where.to Q they.think he.went your parents.ERG
"Where do your parent think he went?"

b. *[Goodéi] has oowajée wugootx̲ sá i shagóonich?
where.to they.think he.went Q your parents.ERG

Cable's constituencies for (18a) and (18b) are reflected in (19a) and (19b). The additional data presented in (19c) shows that stranding of *sá* is not possible, even if it were to c-command a trace of the *wh*-phrase. Lastly, (19d) is minimally different from the ungrammatical string presented in (19b), in that the embedded clause is pied-piped along with the *wh*-phrase. While *sá* is not immediately to the right of of the *wh*-phrase in (19d), *sá* would still c-command the *wh*-phrase, which is embedded in a larger phrase c-commanded by *sá*.

(19) No fronting of *wh*-element alone (Cable 2010, 39)

a. [[Goodéi sá]$_i$ [has oowajée [t_i wugootx̲] i shagóonich?
where.to Q they.think he.went your parents.ERG
"Where do your parents think he went?"

b. *[[Goodéi]$_i$ [has oowajée [t_i wugootx̲ sá] i shagóonich]]?
where.to they.think he.went Q your parents.ERG

c. *[[Goodéi]$_i$ [has oowajée [t_i sá wugootx̲] i shagóonich]]?
where.to they.think Q he.went your parents.ERG

d. [[Goodéi wugootx̲ sá]$_i$ [has oowajée t_i i shagóonich]]?
where.to he.went Q they.think your parents.ERG
"Where do your parents think he went?"

Cable proposes that the bi-lateral relationship between the Q-particle *sá* and the *wh*-words in (16) are not based on the syntactic configuration, but rather on the semantics of Q-particles and *wh*-words in all languages. Following Hagstrom (1998) and Yatsushiro (2001), Cable assumes that Q-particles "are variables over choice functions" (Cable 2010, 67) that take on the "normal semantic value of its sister" (Cable 2010, p. 68). As such, he claims that Q-particles are "focus-sensitive operators", following Beck (2006). In Beck's analysis, Q-particles, unlike all other focus-sensitive particles, do not take an ordinary semantic value for a sister (p. 13). As Beck also posits that logical forms require interpretability, she additionally provides the Principle of Interpretability, given in (20).

(20) Principle of Interpretability (Beck 2006, 16)
An LF must have an ordinary semantic value.

Cable (2010) proposes that *wh*-words lack ordinary semantic values, thus phrases containing them would have no ordinary semantic value. The Q-particle, which takes a constituent containing the *wh*-word as its complement, effectively takes the non-ordinary semantic value generated by the *wh*-word and converts it to an ordinary semantic value, which is interpretable at logical form. (For a more detailed explanation of the semantic relationship between the Tlingit Q-particle *sá* and *wh*-words, see Cable 2010, Section 2.7.) Cable further argues that the relationship between Q and the *wh*-phrase is present in all *wh*-fronting languages, even when no overt Q is present.

Cable's semantic argument might not seem necessary on the surface with simple *wh*-constructions, as one could explain these constructions with Agree between Q-particles like *sá* and *wh*-words. However, Cable notes that some languages, like

Tlingit, allow for pied-piping in ways that other *wh*-fronting languages would not allow. More specifically, Tlingit allows for pied-piping past syntactic islands, but English does not. This contrast is shown in (21) and (22).

(21) Pied-piping past islands in Tlingit (Cable 2010, 143)

a. [$_{NP}$ [$_{CP}$ Wáa kwligeyi] x̲áat] sá i tuwáa sigóo?
how it.is.big.REL fish Q your spirit.at it.is.happy
Literally: "A fish that is how big do you want?"

b. [$_{NP}$ [$_{CP}$ Daat yís] át] sákwshéiwégé?
what for thing Q.DUB?
Literally: "A thing for what is this?"

(22) No pied-piping past islands in English (Cable 2010, 144)

a. *[$_{DP}$ A fish [$_{CP}$ that is how big]] do you want?

b. *[$_{DP}$ A book [$_{CP}$ that who wrote]] did you buy?

English is not the only language that does not allow pied-piping past islands, and Cable (2010) labels languages like English and German, which do not allow the unrestricted massive pied-piping that Tlingit allows, as "limited pied-piping languages". To account for the differences between limited and unlimited pied-piping languages, Cable proposes featural differences on Q and wh between the two types of languages.

Cable proposes that in languages like English, where massive pied-piping is restricted and pied-piping past islands is disallowed, there is an Agreement relationship between Q and the *wh*-element. His argument is based on Kratzer & Shimoyama's (2002) proposal that some languages may have an uninterpretable Q-feature on the *wh*-element, while other languages do not (Cable 2010, 145). Following Pesetsky & Torrego's (2007) theory of feature valuation, languages in which *wh*-elements bear

an uninterpretable feature [Q] require that the uninterpretable feature be checked at LF. In languages where the *wh*-element does not bear an uninterpretable feature [Q], no process of Agree is necessary. Cable outlines this contrast by presenting feature specifications for both German and Japanese *wh*-elements and Q-particles, given in (23) and (24).

(23) Features present on *wh*-element (Cable 2010, 146)

a. German *wh*-word: $was_{\text{uQ[+]}}$

b. Japanese *wh*-word: *dare*

(24) Features present on Q (Cable 2010, 146)

a. German Q: $\varnothing_{\text{iQ[ ]}}$

b. Japanese Q: $ka_{\text{iQ[+]}}$

As presented in (23), the German *wh*-word *was* differs from the Japanese *wh*-word *dare*, in that the German *wh*-word has a valued but uninterpretable feature [Q], while the Japanese *wh*-word *dare* has no feature [Q]. Per Pesetsky & Torrego (2007), the uninterpretable feature [Q] on the German *was* must be matched with an interpretable feature [Q]. Cable posits that this condition is satisfied in German by the unpronounced Q-particle presented in (24). The German Q-particle has an interpretable feature [Q], which can be matched against the uninterpretable feature [Q] on the *wh*-word via Agree. This Agreement relationship is initiated due to the unvalued feature [Q] present on the phonologically null Q-particle. Contrastively, no Agreement relationship is required between the Japanese *wh*-word in (23) and the associated Q-particle in (24). Since the Japanese Q-particle *ka* is valued, no probe is initiated, and since the *wh*-word *dare* distinctly lacks the feature [Q], no matching of features is necessary.

Under this analysis, limited pied-piping languages like English would behave identically to German, and unlimited pied-piping languages like Tlingit would behave like Japanese. Cable summarizes the nature of limited pied-piping in (25).

(25) The nature of limited pied-piping (Cable 2010, 147)

If the Q-particle must Agree with the *wh*-word it c-commands, then a *wh*-word cannot be dominated in the sister of Q by islands or lexical categories. Thus limited pied-piping languages are those where Q/*wh*-Agreement must occur.

Cable (2010) acknowledges the issue of massive pied-piping in English and other limited pied-piping languages, but arrives, similar to Heck (2008), at the argument that the constraints on Agree are weakened in non-subordinated CPs. This allows for massive pied-piping in non-restrictive relative clauses. Cable does, however, note that the mechanics introduced with respect to the distribution of where the Q-particle may occur in Tlingit, which he generalizes with the QP-Intervention Condition given in (26), correlate to the availability of certain massive pied-piped constituents, but not others. Even in languages with no overt Q, like German, the QP-intervention condition can describe why things such as preposition stranding result in ungrammaticality, if prepositions represent function categories.

(26) QP-Intervention Condition (Cable 2010, 57)

A QP cannot intervene between a functional head F and a phrase selected by F.

This observation adds credibility to Cable's (2010) QP-based argument for pied-piping, by restricting the types of phrases that may be massively pied-piped, or where

they may be pied-piped from. Heck's (2008) generalization allowing non-subordinated clauses to allow massive pied-piping still remains a descriptively stipulative solution to the distrubition problem for Cable as well.

2.2.3 Richards (2019): Q-based movement with Contiguity Theory

Richards (2019) proposes an alternative theory of pied-piping that, in part, follows after Cable (2010). Unlike Cable, who proposes that QPs may adjoin or dominate the *wh*-phrase, Richards only assumes the possibility of the structure with the QP dominating the *wh*-phrase. Richards' (2019) analysis of pied-piping attempts to tackle the issue using Contiguity Theory (Richards 2010, 2016). As per Richards (2016), Richards (2019) posits that languages exists in two varieties as outlined in (27).

(27) Possible orderings between probes and goals (Richards 2019, 554)

a. In some languages, probes and goals must be nearly adjacent (cannot be linearly separated by any maximal projections) if the probe *precedes* the goal.

b. In other languages, probes and goals must be nearly adjacent (cannot be linearly separated by any maximal projections) if the probe *follows* the goal.

Under Richards' (2019) analysis, the availability of certain pied-piping structures are therefore determined by relationships between probes, their goals, and whether or not prosodic phrases intervene between the two. Based on the typology provided in (27), languages of the type given in (27a) would behave different

from languages of the type given in (27b), with respect to both regular *wh*-movement and pied-piping.

While Richards (2019) builds off of Cable's (2010) analysis, he notably diverges from Cable (2010) in the assumption of Q/*wh*-Agreement. While Cable posits that some languages have Q/*wh*-Agreement and others do not, Richards proposes that all languages have Q/*wh*-Agreement. Richards argues that the lack of an apparent Agreement relationship in Tlingit is an illusion. He proposes that because the Tlingit Q-particle *sá*, which would be the probe, follows the pied-piped constituent containing the *wh*-goal, the distance of Agreement between the probe and goal can be arbitrarily long, thus allowing Tlingit to pied-pipe past islands and appear to not have Q/*wh*-Agreement. This is because Tlingit has its parameter set for adjacent Agreement only when the probe precedes the goal, as in (27a). Because the Q-particle, which is the probe of Q/*wh*-Agreement, is a rightward head, the probe follows the goal, removing the need for probe-goal adjacency.

Richards argues that English (and similar limited pied-piping languages) also has its parameter set for adjacent Agreement only when the probe precedes the goal, as in (27a). In English, however, the Q-particle appears to the left of its sister. Following Richards (2016), pied-piping by Spec,DP is allowed, as the *wh*-phrase occurs along the left periphery of the clause, which is the prosodically active edge. Because "Generalized Contiguity" (Richards 2016) requires that the *wh*-phrase be "contiguity-prominent", it does not matter whether the *wh*-phrase is dominated by another phrasal node, as there is no phonological phrase between the *wh*-phrase and prosodically active left edge of the constituent being pied-piped. Massive pied-piping in English is generally ruled out by Contiguity Theory, as the goal cannot be adjacent to probe.

Richards (2019) also runs into the same issue as Heck (2008) and Cable (2010), regarding the availability of massive pied-piping in English. He also suggests the

possibility of massive pied-piping in non-restrictive relative clauses may be due to the lack of Q/*wh*-Agreement.

2.2.4 A commonality among modern approaches

While Heck (2004, 2008), Cable (2007, 2010), and Richards (2019) all seek to explain how pied-piping can occur and provide valid arguments for their theories, there is a flaw to all three approaches: the restriction on massive pied-piping remains somewhat stipulative. That is, all three provide a description of the environment where the regular rules restricting massive pied-piping no longer apply: in non-subordinated CPs. This is problematic for at least two reasons: (i) it suggests that QP/*wh*-movement is radically different between matrix and subordinate clauses, and (ii) speakers of English (and other limited pied-piping languages) do appear to allow restrictive relative clause interpretations, which could only be formed if the massive pied-piping occurred in a subordinated clause, as to be shown in Chapter 3.

CHAPTER 3

EVIDENCE AGAINST A NON-SUBORDINATED RESTRICTION[1]

In this chapter, I present evidence that is problematic for Heck's (2004, 2008) generalization on massive pied-piping. This generalization, which restricts massive pied-piping to non-subordinated clauses, makes certain predictions as to where the complex movement can occur. In Section 3.1 I show that massive pied-piping is possible in both restrictive and non-restrictive relative clauses. While not introducing revelatory new data, Section 3.2 discusses the matrix clause interrogative/echo question asymmetry, as it is important to the development of the analysis presented in Chapter 5. In Section 3.3, I present evidence of massive pied-piping in the embedded complements of factive verbs like *know*. Lastly, in Section 3.4, I propose an alternative generalization on massive pied-piping, based on the three asymmetries presented in this chapter. This alternative generalization replaces Heck's non-subordinated CP restriction on massive pied-piping with a non-interrogative CP restriction.

3.1 The relative clause asymmetry

While relative clauses can come in a variety of forms, the two types of interest with respect to massive pied-piping are restrictive and non-restrictive relative clauses. This chapter is less concerned with the internal structure of relative clause formation or how the two different relative clauses are adjoined to the larger structure. As I will be using the same diagnostics utilized by Safir (1986) and Demirdache (1991),

[1]This chapter is modified from my paper published in the Proceedings of the LSA, Amy (2020), to accommodate the format of this dissertation, and includes additional content not present in the paper.

I will follow Demirdache's analysis in which the CPs of restrictive relative clauses are adjoined to NPs while the CPs of non-restrictive relative clauses are adjoined to DPs, as shown in (28). While there are alternatives, such as De Vries' (2006) conjunction analysis for non-restrictive relatives, differences in these analyses do not directly relate to the (non-)subordinated status of the relative clauses in question, and are thus tangential to the focus of this dissertation.

(28) a. Restrictive adjunct b. Non-restrictive adjunct

In the following subsections, I use five diagnostics that distinguish between restrictive and non-restrictive relative clauses. These diagnostics are as follows: quantified NPs (3.1.1), weak crossover effects (3.1.2), licensing of parasitic gaps (3.1.3), bound variable interpretations (3.1.4), and the strength of truth conditions (3.1.5). Section 3.1.6 provides a summary of these results.

3.1.1 Quantified NPs

Restrictive and non-restrictive relative clauses behave differently with respect to whether or not they may co-occur with a quantifier (Ross 1967, 1986; Demirdache 1991). As shown in (29a), restrictive relative clauses may modify a quantified expression. This contrasts with the ungrammaticality of the quantifiers with the relative clause that is overtly marked as non-restrictive in (29b).

(29) Quantified NP asymmetry (Ross 1986, 262)

a. {Any/No/Every} student who wears socks is a swinger.

b. *{Any/No/Every} student, who wears socks, is a swinger.

Ross argues that this difference is due to the conjoined nature of non-restrictive relative clauses compared to the subordinated structure of restrictive relative clauses. He notes that (30a), the conjoined structure analog for (29b), is equally ungrammatical, as is the non-coordinated independent clauses of (30b). Demirdache (1991) argues that this ungrammaticality is due to the inability of the *wh*-word to behave as a bound variable in the non-restrictive relative clause, the conjoined clause, or the independent clause constructions, as the quantifier cannot effectively take scope over the non-subordinated clause containing the pronoun.

(30) a. *[{Any/No/Every} student]$_i$, and he$_i$ wears socks, is a swinger.

b. *[{Any/No/Every} student]$_i$ is a swinger. He$_i$ wears socks.

Heck's (2004, 2008) generalization on massive pied-piping would predict that quantified NP should not appear with massive pied-piping. This does not appear to be the case given in (31a). Here, the relative clause is modifying a quantified NP, just as its obligatory pied-piping counterpart does in (31b). This contrasts with the ungrammaticality of the non-restrictive relative clause given in (31c).

(31) a. Any student the parent of whom the teacher owed a favor passed the exam.

b. Any student whose parent the teacher owed a favor passed the exam.

c. *Any student, whose parent the teacher owed a favor, passed the exam.

3.1.2 Weak crossover

Safir (1986) and Demirdache (1991) both note that while restricted relative causes are subject to weak crossover effects, non-restrictive relative clauses are not. Weak crossover (Wasow 1972; Postal 1971) notably occurs when an operator moves over a co-indexed pronoun as the result of operator movement as schematized in (32). Weak crossover results in a difficulty in co-referencing the moved operator with the pronoun. For simplicity, this study will simply mark this difficulty as questionable.

(32) Weak crossover

?[$\text{Op}_i \ldots \text{pro}_i \ldots t_i$]

The asymmetry of weak crossover in non-restrictive and restrictive relative clauses has been noted in the literature (Higginbotham 1980; Safir 1986; Demirdache 1991; Lasnik & Stowell 1991). This asymmetry is displayed in (33). When the relative clause is restrictive, as shown in (33a), there is difficulty co-indexing the head of the relative clause and the relative pronoun with the possessive pronoun, *his*. When the relative clause is obligatorily non-restrictive when it modifies *John* in (33b), there is no difficulty co-indexing *John* with the relative pronoun and *his*, thus there is no weak crossover.

(33) Weak crossover effects (Safir 1986, 667)

a. ?A man_i who_i his_i wife loves t_i arrived early.

b. John_i, who_i his_i wife loves t_i, arrived early.

The above asymmetry does not apply when the movement does not cause the relative pronoun to cross over the possessive pronoun, as shown in (34). Here, there is no difficulty co-indexing either *a man* or *John* with the relative pronoun and the pos-

sessive pronoun in either the restrictive relative clause of (34a) or the non-restrictive relative clause of (34b).

(34) No crossover

a. A man$_i$ who$_i$ t_i loves his$_i$ wife arrived early.

b. John$_i$, who$_i$ t_i loves his$_i$ wife, arrived early.

While Demirdache (1991) deals with asymmetry by claiming that a non-restrictive is "interpreted at LF as an independent clause containing a resumptive pronoun" (p. 159), others have proposed alternative methods for allowing non-restrictives to obviate weak crossover effects, such as the approach taken by Safir (1986), in which co-indexation for non-restrictives occur in two separate stages, LF and LF′. While weak crossover can occur at LF, Safir (1986) proposes that the co-indexation between the relative pronoun and the crossed-over pronoun occurs at the later stage of LF', after the non-restrictive has merged with the DP it modifies. Regardless of the mechanisms that obviate weak crossover in non-restrictives, the main question here is how massive pied-piping relates to weak crossover. If massive pied-piping can only occur in non-restrictives, it should be expected that massive pied-piping would also obviate weak crossover effects like non-restrictives relative clauses.

In sentences where massive pied-piping can occur but does not, as exemplified in (35a), WCO effects can still be seen when only the relative pronoun *who* crosses over the co-indexed pronoun *his*. As a restrictive, this is not surprising given (33a). In (35a), there is difficulty in interpreting *the man* as the same individual represented by the possessive pronoun *his*. However, when the larger DP *the children of whom*, which contains the relative pronoun, is pied-piped in (35b), the interpretation where *a man* and *his* represent the same individual is accessible. In the massive pied-piping

construction of (35b), the effects of weak crossover are obviated in the same way as the non-restrictive relative clause construction in (33b).

(35) a. ?A man$_i$ [who$_i$ his$_i$ wife adores the children of t_i] arrived early.

b. A man$_i$ [[the children of whom$_i$]$_{\mathrm{k}}$ his$_i$ wife adores t_{k}] arrived early.

This appears to create a clear patterning of massive pied-piping as part of a non-restrictive relative clause. I would note, however, that in (35b), there is a difference between the constituents that are moved in (35a) and (35b), with respect to the crossed-over pronoun. In (35a), the operator is the constituent that is moved over the co-indexed pronoun. This moved element is co-indexed with the pronoun. In (35b), it is true that the operator is moved over the pronoun, but it does so nested within a larger DP. In this case, the moved constituent, which contains the co-indexed operator, and the pronoun, which is crossed over, are not co-indexed as the same individual. While the operator has moved over the pronoun, it is unclear whether this is allowed due to a non-restrictive interpretation of the relative clause or due to failure to recognize the moved constituent as sharing the identity of the pronoun.

The validity of interpreting massive pied-piping structures as non-restrictive relative clauses based solely on the ability to obviate weak crossover effects could and should be questioned, as non-restrictive relative clauses are still capable of showing weak crossover effects. Safir (1986) points out that in cases where the moved constituent containing the relative pronoun is co-indexed with the pronoun, as shown in asymmetry presented (36), weak crossover may still occur in non-restrictive relative clauses with massive pied-piping. With the lack of a crossover environment in (36a), the pied-piping of the larger constituent is grammatical, as it is moved from the sub-

ject position of Spec,TP. When the same constituent is moved from an object position in the crossover environment of (36b), weak crossover effects can be seen between *a sister of whom* and *her*. This contrasts the obviation of weak crossover seen earlier in (35b), where the relevant comparison is between *the children of whom* and *he*.

(36) Weak crossover in non-restrictive with massive pied-piping (Safir 1986, 669)

a. John, [a sister of whom]$_i$ t_i loved her$_i$ child, doesn't usually like kids.

b. ?John, [a sister of whom]$_i$ her$_i$ child t_i loved, doesn't usually like kids.

Safir (1986) points out that this problem not only affects massive pied-piping, but it also affects obligatory pied-piping by a DP specifier in non-restrictive relative clauses as well. When the pied-piped DP is co-indexed with the crossed-over possessive pronoun, as presented in (37a), there is difficulty processing this co-indexation. This difficulty disappears when the possessive pronoun is co-indexed with the relative pronoun inside the pied-piped constituent, as shown in (37b).

(37) Weak crossover in non-restrictive with obligatory pied-piping (Safir 1986, 681)

a. ?John, [whose$_i$ sister]$_j$ her$_j$ child t_j loved, doesn't usually like kids.

b. John, [whose$_i$ sister]$_j$ his$_i$ child t_j loved, doesn't usually like kids.

Because of the possibility of weak crossover in non-restrictive relative clauses like (36b) and (37a), obviation of weak crossover should not be the only test used to identify whether massive pied-piping results in a strictly non-restrictive reading. This is especially true if there is nothing the prevent possible interpretation of the relative clause as a non-restrictive. In order to provide a more clear finding for this diagnostic, the determiner *the* can be replaced with the quantifier *any*, which was shown in the previous section to be prohibited with non-restrictive relative clauses.

(38) a. ?Every man$_i$ who$_i$ his$_i$ parents adore the children of t_i is proud.

b. Every man$_i$ [whose$_i$ children]$_j$ his$_i$ parents adore t_j is proud.

c. Every man$_i$ [the children of whom$_i$]$_j$ his$_i$ parents adore t_j is proud.

As shown in (38), the forced restrictive relative clause only creates a weak cross over effect in the case of (38a), where only *wh*-fronting occurs. Contrastively, when pied-piping occurs, the weak crossover effect disappears. Notably, in both the case of obligatory pied-piping and massive pied-piping, in (38b) and (38c), respectively, the fronted constituent no longer shares its identity with the crossed over possessive pronoun. In effect, the pied-piped constituent shields the movement of the *wh*-operator from causing a crossover effect.

This supplemental data would suggest that even though massive pied-piping can obviate weak crossover as non-restrictive relative clauses can, the reasoning for this obviation could be due to differences in the binding relationships formed with *wh*-fronting versus those formed with pied-piping, or it could be due when or how co-indexation occurs with non-restrictive relative clauses. Because of this difference, additional diagnostics should be used to test whether massive pied-piping entails a non-restrictive reading.

3.1.3 Licensing of parasitic gaps

"Parasitic gap constructions" (Engdahl 1983) occur when a gap is allowed to appear in within a syntactic island. Notably, these types of gaps cannot appear on their own; they must co-occur with a true gap generated by a movement operation. While Safir (1986, 666) provides examples of massive pied-piping in an apparent restrictive relative clause context, shown here in (39), this example is more illustrative of the fact that, if massive pied-piping occurs, both the true gap and the parasitic

gap must be filled by pied-piped constituent. As such, this example is insufficient on its own.

(39) a. the report which Mary read without filing

b. the report the author of which Mary married without meeting

c. *the report the author of which Mary married without filing

d. *the report the author of which Mary filed without reading

Safir (1986) also notes that a parasitic gap can occur within a restrictive relative clause but not a non-restrictive relative clause when the true gap occurs outside of the relative clause. Demirdache (1991) argues that this is in part due to the main clause interpretation of the non-restrictive interpretation. Since non-restrictive relative clauses are in effect non-subordinated, the moved *wh*-phrase fails to A′-bind the parasitic gap in the non-subordinated, non-restrictive relative clause.

This asymmetry is drawn out in the availability of the parasitic relative clause in (40a) and unavailability of the parasitic gap in the non-restrictive relative clause in (40b). In both cases, the true gap, which is represented by the trace, is generated by extracting the object from a restrictive relative clause *who X admires t*. In (40a), the more deeply embedded relative clause *who knows* PG modifies *everyone*. As noted in 3.1.1, this quantified head forces an obligatory restrictive reading. Crucially, the gap is allowed here. When the more deeply embedded relative clause is obligatorily non-restrictive, modifying *Bill* in (40b), the presence of the gap is strictly disallowed. To prove that this is truly a case where the ungrammaticality is the result of an unlicensed parasitic gap, Safir (1986) provides the same non-restrictive construction with the parasitic gap's position filled a referring expression in (40c), and grammaticality is restored.

(40) Parasitic gap asymmetry (Safir 1986, 673)

a. John is a man [$_{\text{CP}}$ who$_i$ everyone [$_{\text{CP}}$ who knows PG$_i$] admires t_i].

b. *John is a man [$_{\text{CP}}$ who$_i$ Bill, [$_{\text{CP}}$ who knows PG$_i$] admires t_i].

c. John is a man [$_{\text{CP}}$ who$_i$ Bill, [$_{\text{CP}}$ who knows Mary] admires t_i].

Based on this evidence, it should hold that a parasitic gap should not be allowed when massive pied-piping is also present, given Heck's (2008) generalization on massive pied-piping. This is, however, not the case given (41a). Here the parasitic gap is allowed, just the same as it would be in the case of obligatory pied-piping in the obligatorily restrictive relative clause of (41b). Both (41a) and (41b) contrast with the ungrammaticality of the parasitic gap in the obligatorily non-restrictive relative clauses of (41c), which is formed with massive pied-piping, and (41d), which uses obligatory pied-piping, as both of the relative clauses in the latter two sub-examples modify *Congressman Gohmert*.

(41) a. Dr. Fauci doubts the effectiveness hydroxychloroquine$_i$, [$_{\text{CP}}$ which a few congressmen$_j$ [$_{\text{CP}}$ [the infections of whom$_j$]$_k$ a doctor had treated t_k with t_i] promote the use of t_i].

b. Dr. Fauci doubts the effectiveness hydroxychloroquine$_i$, [$_{\text{CP}}$ which every congressmen$_j$ [$_{\text{CP}}$ [whose$_j$ infection]$_k$ a doctor had treated t_k with t_i] promotes the use of t_i].

c. *Dr. Fauci doubts the effectiveness hydroxychloroquine$_i$, [$_{\text{CP}}$ which Congressman Gohmert$_j$, [$_{\text{CP}}$ the infection of whom$_j$]$_k$ a doctor had treated t_k with t_i,] promotes the use of t_i.

d. *Dr. Fauci doubts the effectiveness hydroxychloroquine$_i$, [$_{\text{CP}}$ which Congressman Gohmert$_j$, [$_{\text{CP}}$ [whose$_j$ infection]$_k$ a doctor had treated t_k with t_i,] promotes the use of t_i].

The licensing of the parasitic gap in (41a) can be taken as further evidence of the possibility of massive pied-piping in restrictive relative clauses.

3.1.4 Bound variables

Safir (1986) and Demirdache (1991) also point out that restrictive relative clauses license bound variable interpretations while non-restrictive relative clauses do not. This asymmetry is given in (42).

(42) Bound variable asymmetry (Safir 1986, 672)

a. [Every Christian]$_i$ forgives a man who warns him$_i$.

b. *[Every Christian]$_i$ forgives Bill, who warns him$_i$.

In the example above, the quantified expression *every Christian* is the matrix clause subject. From its position in Spec,TP, it can be assumed that this quantified expression should be able to bind any pronoun that it c-commands. This relationship is allowed between the quantified expression and the pronoun *him* in the restrictive relative clause of (42a), but not the non-restrictive relative clause in (42b).

In his analysis, Safir argues that the invisibility of the non-restrictive relative clause at LF leads to a failure to license the bound variable interpretation (1986, 672). When the non-restrictive relative clause is incorporated later at LF$'$, the window for variable binding has closed, making the bound variable interpretation impossible. Conversely, the restrictive relative clause would be visible at LF, which readily allows

the bound variable interpretation. Much to the same effect, Demirdache's (1991) analysis proposes that non-restrictive relative clause moves up to its non-subordinated position prior to the binding operation. From its raised position as an independent clause, the pronoun non-restrictive relative clause is unreachable by the quantified expression, blocking binding.

With respect to the generalization on massive pied-piping, it should be expected that a relative clause with massive pied-piping should prohibit a bound variable interpretation outside of the immediate CP. This, however, is not the case, as shown in (43). The massive pied-piping construction in (43a) allows the same bound variable interpretation as the restrictive with obligatory pied-piping given in (43b). This bound variable interpretation disappears when the relative clause is obligatorily non-restrictive in (43c).

(43) a. [Every professor]$_i$ hates the student the report of whom he$_i$ cannot understand.

b. [Every professor]$_i$ hates the student whose report he$_i$ cannot understand.

c. *[Every professor]$_i$ hates Bill, whose report he$_i$ cannot understand.

3.1.5 Strength of truth conditions

Demirdache (1991) notes an final difference between restrictive and non-restrictive relative clauses, namely that they have different truth conditions. While the two examples given in (44) are both grammatical, they do not mean the same thing.

(44) Truth condition asymmetry (Demirdache 1991, 118)

a. At the party, Mary danced with three boys who wore glasses.
(Boys danced with ≥ 3)

b. At the party, Mary danced with three boys, who wore glasses.
(Boys danced with = 3)

The restrictive relative clause construction of (44a) sets the lower limit for the total number of boys danced with in given situation. The sentence only makes a claim about the number of boys who were both danced with and wearing glasses. It is therefore possible that Mary could have danced with more than three boys, so long as only three of the boys wore glasses. Demirdache contrasts this with the exact number of boys danced with in the non-restrictive relative clause construction of (44b). Here the sentence is clear that the total number of boys danced with equals three, and the modification by the non-restrictive relative clause only serves as way to present additional information about those boys.

Demirdache (1991), following Evans (1980), argues that the non-restrictive interpretation has a referential "E-type interpretation", while the restrictive interpretation has a bound variable interpretation. She uses this as support of the structural differences between the proposes structures given in (28). With the lower attachment of restrictive relative clauses, it is possible for the numeral to scope over both head and relative clause. Such a configuration would allow for what I will informally call the "minimal" reading (≥ 3) of the restrictive relative clause in (44a). In the non-restrictive construction of (44b), the numeral would be integrated as part of the head with the relative clause attaching higher, thus the minimal reading would not apply. Rather, a much stronger "equative" reading (=3) is required.

If the generalization on massive pied-piping is valid, only the equative reading for relative clauses should be allowed when massive pied-piping occurs. The data in (45a) shows otherwise. While the equative reading of its non-restrictive sister in (45c) is allowed, the availability of the minimal reading that is in line with the restrictive

construction of (45b) is critical. Since it is possible to entertain the weaker truth conditions associated with minimal reading, the generalization on massive pied-piping is being violated here as well.

(45) a. Last year, the charity assisted three families the children of whom Mary teaches.
(Families assisted ≥ 3)

b. Last year, the charity assisted three families whose children Mary teaches.
(Families assisted ≥ 3)

c. Last year, the charity assisted three families, whose children Mary teaches.
(Families assisted $= 3$)

3.1.6 Summary

A summary of the diagnostics from Section 3.1.2 – 3.1.5 are presented in Table 3.1. Notably, massive pied-piping appears to pattern after both restrictive and non-restrictive relative clauses. The massive pied-piping constructions pattern after non-restrictive relative clauses with respect to showing some weak crossover effects and a preference for the equative reading, when dealing with the strength of truth conditions. However, massive pied-piping appears to pattern after the restrictive rel-

Table 3.1. Summary of relative clause diagnostics

	MPP	Restrictive	Non-Restrictive
Allows quantified NPs	✓	✓	×
Allows weak crossover	%	×	✓
Allows parasitic gaps	✓	✓	×
Allows bound variable interpretation	✓	✓	×
Strength of truth conditions	$= \gg \geq$	$\geq$	$=$

ative clauses in some aspects of weak crossover (namely that it shares weak crossover effects with obligatory pied-piping) and in three other diagnostics: modifying quantified NPs, licensing parasitic gaps, and allowing bound variable interpretations.

While the availability of weak crossover and the preference for equative truth conditional readings support the notion that massive pied-piping entails an obligatory non-restrictive interpretation, these results do not, on their own, support the obligatory, non-restrictive nature of massive pied-piping. In the examples provided in the previous Sections 3.1.2 and 3.1.5, the there are no structural restrictions that prevent the relative clause from being interpreted as either restrictive or non-restrictive. In these cases, the allowance weak crossover or the preference for equative reading could stem from the availability of the non-restrictive relative clause as a potential out. As such, accepting a non-restrictive structure for relative clauses with massive pied-piping might be ill-advised.

The availability of non-restrictive relative clause interpretations is strictly prohibited, however, in the examples provided for quantified NPs, parasitic gaps, and bound variable constructions. In these three constructions, the ungrammaticality of non-restrictive relative clause constructions is not due to the application of massive pied-piping. Rather the ungrammaticality results from other restrictions in the grammar. When the element that forces a non-restrictive relative clause interpretation is removed, and thereby allowing a restrictive relative clause construction, grammaticality is restored, regardless of whether pied-piping was used in the formation of the relative clause or not.

These results suggest that grammaticality judgements favoring non-restrictive interpretations for relative clauses with massive pied-piping could be due to some other preference. Regarding the truth condition readings discussed in Section 3.1.5, the willingness to allow the minimal truth condition reading of sentences like (45a)

improve when the sentence is delivered with a practiced restrictive prosody, and a stronger preference for the equative truth condition can be elicited when the relative clause is delivered with an exaggerated non-restrictive prosody. This preference is further explored in the experiments presented in Chapter 4.

Perhaps the greatest takeaway from the relative clause diagnostics is that structural conditions that prohibit non-restrictive relative clauses, such as when the relative clause modifies a quantified NP, a parasitic gap needs a licensor, or a variable must be bound, massive pied-piping can still occur. This would require the movement to occur in a subordinated clause, which contradicts the generalization on massive pied-piping. While this provides grounds to reject Heck's generalization, the evidence provided thus far from relative clauses does not provide sufficient evidence to generate an improved generalization.

3.2 The matrix clause asymmetry

Although marked, massive pied-piping is available in matrix clause questions. As noted in Section 2.2.1, this contrasts with the ungrammaticality of massive pied-piping in embedded clause questions, and the contrast itself is used by Heck (2008) in support of a non-subordinated restriction on massive pied-piping. However, in this section, I wish to focus more specifically on the asymmetry present between types of matrix clauses that allow *wh*-fronting and more specifically pied-piping.

As noted by Heck (2008), massive pied-piping is ungrammatical in truly interrogative matrix clause questions, as shown in (46a). This ungrammaticality can be removed, however, if the question is treated as echo question and given the corresponding prosody. This is shown in (46b), with the focus indicated on the *wh*-word.

(46) Matrix clause asymmetry (Heck 2008, 169)

a. *[$_{DP}$ Pictures of which family] are t on sale?

b. [$_{DP}$ Pictures of WHICH family] are t on sale?

While massive pied-piping requires this echo-question interpretation, simple *wh*-movements and non-massive pied-piping are possible in matrix clause interrogative questions, as shown in (47). It is possible to give these questions an echo interpretation as well, but this is not required, providing a clear contrast with the data presented in (46).

(47) No matrix clause asymmetry: *wh*-movement and obligatory pied-piping

a. [$_{DP}$ What] is t on sale?

b. [$_{DP}$ Which pictures] are t on sale?

c. [$_{DP}$ Which family's pictures] are t on sale?

While not clearly disproving Heck's (2008) generalization, this contrast should cause pause, as the non-subordinated nature of the matrix clause question does not allow massive pied-piping carte blanche. Rather, the grammaticality is still tied to something else. Heck admits to this, noting, "If echo-questions are not interrogatives in a syntactic sense (see Reis (1991)) and thus not subject to (all) constraints on *wh*-movement, then it is plausible that they are not subject to constraints on pied-piping either" (p. 169). While this logic works for this particular asymmetry, I argue that it is insufficient to explain wider set of asymmetries present in this chapter, and this contrast will be important for the alternative to Heck's generalization that I present in Section 3.4, as well as the formal syntactic analysis presented in Chapter 5.

3.3 A complement clause asymmetry

One of Heck's (2008) major arguments for a non-subordinated restriction on massive pied-piping was shown previously in the discussion of Cowper's (1987) feature-percolation analysis, namely that massive pied-piping cannot occur in embedded questions. While I agree with both Cowper and Heck that massive pied-piping cannot occur in embedded clause questions that serve as the complements of verbs like *wonder*, the grammaticality of massive pied-piping notably improves when the embedding verb is switched to *know*, as shown in the contrast present in (48).[2]

(48) a. I know [$_{DP}$ the poster of which pop star] Mary hung t in her office.

b. *I wonder [$_{DP}$ the poster of which pop star] Mary hung t in her office.

While the construction in (48a) are less palatable than their non-massive pied-piping counterparts (i.e., *I know which pop star's poster Mary hung in her office.* and its grammaticality less accepted, this markedness can be lessened if the sentence is preceded by a supporting context, as shown in (49). The benefit of the supportive context, however, only applies to cases where the massive pied-piping happens in the complement of *know*, (49a), but not *wonder*, (49b).

(49) Speaker A: Did you hear the latest gossip? Mary hung up a poster of some pop star in her office.

a. Speaker B: I know [$_{DP}$ the poster of which pop star] she hung up t. (I was in there this morning.)

b. Speaker B: *I wonder [$_{DP}$ the poster of which pop star] she hung up t.

[2]While reported here as acceptable, grammaticality judgments on examples like (48a) have been mixed. More importantly, however, is the contrast that, while (48a) has mixed levels of grammatical acceptability, ranging from marked but near impeccable to plainly ungrammatical, judgments of (48b) are categorically ungrammatical.

Following Heck's (2008) generalization on massive pied-piping, the grammaticality of (48a) is unexpected. However, it could be argued that the difference between the acceptability between (48a) and (48b) is not due to differences between *know* and *wonder*, with respect to the qualities of the clauses that they embedded, but rather due to the fact that *know*, unlike *wonder*, can take a DP complement, as shown in the contrast presented in (50). While this analysis may be plausibly on the surface, I argue against a DP analysis of the complement to the matrix clause verb in cases like (48a). I base this argument on limitations of the selection of determiners, s-selection requirements of comparable embedding verbs, and comparable constructions with *surprise*-type predicates.

(50) a. I know [$_{\text{DP}}$ the best recipe for chili].

b. *I wonder [$_{\text{DP}}$ the best recipe for chili].

When the complement to *know* is a DP, the DP can occur with a wide variety of determiners, as shown in (51). In this example, the definite determiner *the* in (51a), the indefinite determiner *a* in (51b), or the demonstrative determiner in (51c) may all be used.

(51) a. I know [$_{\text{DP}}$ the best recipe for chili].

b. I know [$_{\text{DP}}$ a great recipe for chili].

c. I know [$_{\text{DP}}$ this great recipe for chili].

However, when either of the latter two replace the definite determiner present in (48a), the result is ungrammaticality, shown in (52). If the DP were c-selected by the matrix clause verb as in (51), it is unclear why the same options are impossible in (52). The limitations on the determiner could, however, be explained by Cable's

(2010) Q-based analysis, as the QP hosting the movement creates an existential closure. This type of closure, when combined with the integration of the QP into the embedded clause, may require the presence of definite determiners within the QP for interpretation.

(52) a. *I know [$_{DP}$ a poster of which pop star] Mary hung t in her office.
b. *I know [$_{DP}$ this poster of which pop star] Mary hung t in her office.

In addition to the above c-selection restriction, s-selection restrictions also appear to be a relevant argument against a DP analysis of (48a). Since *know* s-selects for a wide variety of complements, it is not testable in this respect. *Know*, however, is not the only embedding verb that allows the massive pied-piping constructions like the present in (48a). *Tell* can also host the movement, while question-embedding counterpart *ask* cannot, as shown in contrast presented in (53).

(53) a. John told Sue [$_{DP}$ the poster of which pop star] Mary hung up t in her office.
b. *John asked Sue [$_{DP}$ the poster of which pop star] Mary hung up t in her office.

When presented with DP complements, *tell*, unlike *know*, has a much smaller set of DPs that it can s-select for. As shown in the contrasts present in (54), DP complements of *tell* must be of a communicative type. When the DP complements are concrete, physical objects, the statements become semantically odd.

(54) a. John told Mary {the answer to the question / a funny joke / a scary story}.

b. #John told Mary{the painting of Washington / a guy who knows a guy / Bob}.

If the complement of *tell* in (53a) is reduced to a determiner and noun, the result is the same semantic oddness present in (54b). This suggests that the embedding verbs *know* and *tell* in (48a) and (53a), respectively, are not taking DP complements but CP complements.

(55) #John told Sue [$_{\text{DP}}$ the poster].

The final diagnostic that I offer against a potential DP complement analysis is the c-selection restrictions of *surprise*-type predicates. Just as *tell* also allows cases of massive pied-piping, so too do predicates like *surprise*, as shown in (56). Notably, when *surprise* occurs with an expletive subject, it must take a CP complement rather than an DP complement, as shown in (57).

(56) It$_{\text{EXP}}$'s surprising [$_{\text{DP}}$ the poster of which pop star] Mary hung t in her office.

(57) *It$_{\text{EXP}}$'s surprising [$_{\text{DP}}$ the poster].

Since the constructions present in (48a), (53a), and (56) all disallow a DP analysis of the complement for various reasons, we are left with apparent cases of massive pied-piping in subordinated clauses, directly violating Heck's (2008) generalization. When combined with the relative clause and matrix clause asymmetries discussed in Sections 3.1 and 3.2 above, an alternate restriction is necessary to account for the distribution of massive pied-piping.

Table 3.2. Summary of grammaticality of massive pied-piping and non-subordinated status by clause type

	Grammaticality	Non-subordinated
Matrix clauses		
- True questions	*	Yes
- Echo questions	-	Yes
Relative clauses		
- Non-restrictive	-	Yes
- Restrictive	-	No
Complement clauses		
- Factive, *know*-type	-	No
- Interrogative, *wonder*-type	*	No

3.4 An alternative: A non-interrogative CP restriction

The environments in which massive pied-piping are grammatical and ungrammatical, along with the non-subordinated status of the CP hosting the movement, are given in Table 3.2. While the generalization on massive pied-piping predicts the availability of massive pied-piping in echo questions, non-restrictive relative clauses, and complements of verbs like *wonder*, it cannot fully explain why truly interrogative interpretations are disallowed in matrix clause questions, nor why some speakers allow massive pied-piping in restrictive relative clauses or complement clauses of factive predicates[3] like *know*.

While all of the environments listed in Table 3.2 are environments that allow *wh*-movement and can grammatically host obligatory pied-piping, I note that the environments in which massive pied-piping is ungrammatical share a common feature: true interrogativity. Therefore, I propose that the environments where massive pied-

[3]While I have labeled *know*, *tell*, and *surprise* collectively as factive predicates, this designation may not be wholly adequate, as *tell* can also take propositional complements that need not be fact. However, these "factive" predicates have previously been classified together. Ginzburg (1995a,b) refers to this broader class as "resolutive predicates". Unlike questions embedded under interrogative predicates, questions under resolutive predicates are resolved, i.e., have been answered.

piping is allowed (even where only by a subset of speakers) are not truly interrogative, despite being able to host *wh*-movement. Further, I propose that the generalization on massive pied-piping in (15) should be revised to focus on the non-interrogative nature of the CP hosting massive pied-piping, rather than the clause's non-subordinated status. This revision is formalized in (58).

(58) Revised Generalization on Massive Pied-Piping

Massive pied-piping is only possible if the CP whose specifier is the target of *wh*-movement is not interrogative.

Unlike Heck's (2008) generalization on massive pied-piping, this revised generalization would allow massive pied-piping in both restrictive and non-restrictive relative clauses, complements of factive predicates like *know*, and echo questions, while preventing it in complements of interrogative predicates like *wonder* or truly interrogative matrix clause questions. In Chapter 5, I provide an analysis of pied-piping that can account for this revised generalization.

CHAPTER 4

TWO EXPERIMENTS ON RELATIVE CLAUSE INTERPRETATION

In this chapter, I present evidence from psycholinguistic experiments on the use of prosody in the semantic interpretation of relative clause structures. These experiments are based on the differences between restrictive and non-restrictive relative clauses discussed in Chapter 3, particularly Section 3.1.5, which looks at the differing strength of truth conditions between restrictive and non-restrictive relative clauses. In Section 4.2, Experiment 1 focuses on applying these to simple relative clause formations where simple *wh*-movement occurs. Here, the results show a clear indication that prosody is used to disambiguate between restrictive and non-restrictive interpretations. In Section 4.3, Experiment 2 focuses on applying the same experimental framework to relative clauses formed with obligatory pied-piping and massive pied-piping. While the initial results of Experiment 2 fail to show an effect of prosody in relative clauses formed by obligatory pied-piping or massive pied-piping, the results of a post hoc analysis, which just looks at subjects who distinguish between restrictive and non-restrictive interpretations of relative clauses formed by obligatory pied-piping, shows a non-significant trend toward distinguishing between interpretations of relative clauses formed by massive pied-piping based on prosody.

4.1 Background

4.1.1 Quantitative studies of massive pied-piping

While not extensive, the body of quantitative research on massive pied-piping is growing. While they did not look at the massive pied-piping of DP, Cable & Harris

(2011) studied the acceptability of simple *wh*-movements with preposition stranding versus the pied-piping of prepositional phrases in matrix and complement clauses. The results of their study found both an effect of clause type — matrix clauses (e.g., *Who did he dance with?*) were rated as more acceptable than constructions with complement clauses (e.g., *I wonder who he danced with.*) — and an effect of dependency — preposition stranding was rated as more acceptable than pied-piping the preposition. Notably, Cable & Harris (2011) found an interaction between clause type and dependency, with a greater effect of clause type in the pied-piping condition than in the stranding condition. Based on this interaction, they assert that pied-piping of the preposition is massive pied-piping, as it falls under the patterns of acceptability for massive pied-piping discussed in Chapter 2.

In another study on massive pied-piping, Kotek & Erlewine (2016) tested intervention effects in non-restrictive relative clauses. In their study, they tested for differences in acceptability judgments between pied-piping size (simple *wh*-movement, massive pied-piping of a larger DP[1]) and the presence or lack of an intervener (e.g., *which we found* {*only one, a*} *copy of...*). Their results showed a main effect of intervention and an interaction of intervention with pied-piping size, with a significant reduction to acceptability in cases where massive pied-piping included an intervener. While neither this study nor Cable & Harris (2011) address the possibility of massive pied-piping in restrictive relative clauses, they both show marked effects that massive pied-piping have on the overall acceptability, even in the environments where they are argued in the syntactic literature to be more readily allowed.

[1]Kotek & Erlewine (2016) refer to the movement of just the *wh*-element as "small pied-piping" and the massive pied-piping of a larger DP as "large pied-piping".

4.1.2 Quantitative studies of prosody

Relative clause production. Restrictive and non-restrictive relative clause differ with respect to the prosody in which they are delivered. As noted in the syntactic literature, non-restrictive relative clauses are typically delivered with longer intonation breaks or "comma intonation" before and after the relative clause (Emonds 1976, 1979; Ross 1967, 1986; Potts 2007). This difference in intonational breaks is represented orthographically by commas delineating the left and right edges of a non-restrictive relative clause in writing.

The intonational breaks around non-restrictive relative clauses are not the only prosodic difference that set them apart from restrictive relative clauses. Garro & Parker (1982) quantified key differences between restrictive and non-restrictive relative clauses, which subjects had read aloud in a production experiment. In addition to the length of the intonational breaks or "comma prosody", they also found differences in vowel lengths and pitch contours between the two types of relative clauses in English. The prosodic breaks on both sides of the relative clause were "approximately ten times" longer in the non-restrictive condition than in the restrictive condition (157). With respect to vowel duration, the final vowel on the head of the relative clause and the final vowel in the relative clause were "approximately one and half times" longer in the non-restrictive condition than the restrictive condition. Additionally, the reported pitch contours differed between the relative clause types. The contour preceding non-restrictive was noted as being falling then rising, and the same was found for the pitch contour moving out of the relative clause. The general pitch contour for the restrictive relative clauses was notably marked by rising then falling pitch, both before and moving out of the relative clause.

Production studies relating to prosody and relative clause interpretation have focused on eliciting the prosodic differences described in Garro & Parker (1982), by

providing speakers with a context that biases either a restrictive or non-restrictive relative clause interpretation. Both Hirschberg & Avesani (1997) and Watson & Gibson (2004) tested the frequency in which the more marked non-restrictive relative clause prosody was used. Hirschberg & Avesani (1997) found that English speakers used non-restrictive relative clause prosody more often when the context was biased toward a non-restrictive relative clause (9/18 elicitations), than when biased towards a restrictive relative clause (4/18 elicitations). In Watson & Gibson's (2004) comparable experiment, they, too, manipulated context statements by providing a restrictive-biasing context (e.g., *A group of film critics praised a director at a banquet and another director at a film premiere.*) or non-restrictive-biasing context (e.g., *A group of film critics praised a director and a producer.*) and recorded how many relative clauses were produced with ToBI boundary break indexes of 4 in the continuation statements (e.g., *The director*(,) *who the critics praised at a banquet*(,) *insulted an actor from an action movie during an interview*) that followed. Their results, while significant by items, trended toward an effect restrictiveness by subjects, and this trend patterns after that of Hirschberg & Avesani (1997).

(Non-)Restrictive relative clause perception. The perception of prosody and how it relates relative clause interpretation is understudied, but some research has been done with other Germanic languages. Kaland & van Heuven (2010) tested Dutch and German speakers' ability to rate the acceptability of different prosodic constructions when they are paired with obligatorily restrictive and non-restrictive relative clauses. They note that Dutch speakers were sensitive to prosodic information when distinguishing relative clause types, showing separate, preferred pitch contours for restrictive and non-restrictive relative clauses, respectively. German speakers rated non-restrictive relatives higher than their restrictive counter parts across conditions, showing a distinct preference for non-restrictive relatives, independent of pitch con-

tour. While their results show variation across two languages, the results from the Dutch speakers suggests that prosodic information can be tied to preferences for one type of relative clause over the other.

Prosody and structural disambiguation. While English may lack a perception experiment analog on track with Kaland & van Heuven (2010), there are a number of comprehension studies that suggest that English speakers use prosodic information when presented with an ambiguous structure. Schafer et al. (1996) found that prosodic differences (focus/contrastive focus, (un-)accentuated relative clause) led to different attachment preferences, namely, which NP the relative clause modified. While not related to relative clauses, Warren et al. (2000) found that listeners could use prosodic information in a similar way to correctly disambiguate between high or low PP attachment in a forced-decision task at a rate that was better than chance. Schafer, Speer, et al. (2000) found that listeners also used prosodic information to correctly disambiguate between early and late closure continuation in a forced-choice task, when they were provided with an audio fragment with cooperating prosody. This collection of results suggests that English speakers do use prosodic information to disambiguate between competing structures, in some instances. Presumably, it should be plausible that English speakers use prosodic cues to distinguish between restrictive and non-restrictive relative clauses in a perception experiment.

4.1.3 Goals

The two experiments that follow investigate (i) whether prosody is used to disambiguate between restrictive and non-restrictive parses of relative clauses during language comprehension and (ii) whether disambiguating effects of prosody are still used when parsing relative clauses with pied-piped structures. In order to address these questions, the two experiments that are presented here invert the context-continuation

paradigm of Watson & Gibson (2004), by providing a context statement that contains a relative clause delivered with restrictive versus non-restrictive prosody, followed by a continuation that is plausible when the relative clause is parsed as a restrictive but not a non-restrictive relative clause. This inverted paradigm also parallels the studies of Schafer et al. (1996), Schafer, Carlson, et al. (2000), Schafer, Speer, et al. (2000), and Warren et al. (2000) that look into structural disambiguation effects of prosody.

The choice to focus on perception rather than production also lies in the less natural nature of massive pied-piping constructions. Further, given Watson & Gibson (2004) "Left-hand Side/Right-hand Side Boundary" hypothesis, which proposes that larger prosodic breaks are more likely to occur when the preceding and following constituent are large, the general size of a massively pied-piped constituent could bias production toward a non-restrictive delivery, regardless of context. By focusing on perception, this potential bias can be minimized.

4.2 Experiment 1

If English speakers use prosody to disambiguate between restrictive and non-restrictive relative clause parse, it should follow that speakers should interpret relative clause constructions presented with "comma prosody" (Emonds 1979) and other acoustical correlates associated with non-restrictive relative clauses (Garro & Parker 1982) differently than when the same constructions are presented with a less-marked restrictive relative clause prosody. Given the previous discussion of Demirdache's (1991) argument that the two types of relative clauses differ with respect to truth conditions (see Section 3.1.5), discourse continuations like (60) that follow after restrictive relative clauses like (59a) should allow the introduction of contrasting members of the set established by the head of the relative clause. Contrastively, non-restrictive rela-

tive clauses like (59b), which modify and provide information about the whole set of objects, should not allow the introduction of contrasting members to the set.

(59) a. *Wh-* non-restrictive relative clause context

Tony worked at only 4 restaurants, which were dives, during college.

b. *Wh-* restrictive relative clause context

Tony worked at only 4 restaurants which were dives during college.

(60) Continuation

During college, Tony also worked at several classy restaurants.

In this experiment, the participants were tasked with rating the plausibility of continuation statements like (60), after hearing context statements like those in (59). If participants use the prosodic differences between restrictive and non-restrictive relative clauses to build a semantic interpretation of the context statement, continuations following non-restrictive prosody contexts should be significantly lower than restrictive prosody contexts. As the examples in (59) are string ambiguous when spoken, both an implausible-biasing control context, (61a), and a plausible-biasing control context, (61b), were added for potential contrast.

(61) a. Implausible-biasing, bi-sentential control context

Tony worked at only 4 restaurants during college. These restaurants were dives.

b. Plausible-biasing, *that* restrictive relative control context

Tony worked at only 4 restaurants that were dives during college.

4.2.1 Method

4.2.1.1 Participants

Twenty-three (23) students from the University of Texas at Arlington participated in the experiment. These participants were volunteers recruited from classes in the Department of Linguistics and TESOL. All participants were native speakers of English.

4.2.1.2 Materials and design

Forty-eight (48) items were created for this experiment. Each item comprised a context statement and continuation statement pair. Each item appeared in four conditions, which were counterbalanced in a four-list design. In the bi-sentential control condition context, (61a), a second sentence provides supplement information that modifies the sentential object or the object of the preposition of the first sentence. In the *wh*-non-restrictive relative clause (*wh*-NRRC) condition, (59b), the same supplemental information is incorporated by modifying the object with a non-restrictive *wh*-relative clause. In the *wh*-restrictive relative clause (*wh*-RRC) condition, (59b), a restrictive *wh*-relative clause modified the object. Lastly, in the plausible-biasing, *that* restrictive relative clause (*that* RRC) condition, (61b), the object was modified with a restrictive relative clause featuring *that* as the relativizer. The continuation statement, (60), was held constant within each item.

The objects in the context statements were composed of a cardinal number and a plural noun, and each object was preceded by the focus element *only*. In the control condition, the object of the first sentence was the subject of a copular clause in the second sentence. In the remaining three conditions, the relative clauses were formed by the subject-extraction equivalents of the copular clause from the control condition.

The continuation statements were formed by inserting the adverb *also* between the subject and verb in the template used for the context statements. The *only*+NUMERAL construction was replaced with a *several* plus an adjective. The adjective used in each continuation statement contrasted the predicate nominative/adjective of the context statement's copula clause.

Recordings of a female native speaker of English producing the 48 context statements in each of the separate conditions were captured using a Zoom H2n Handy Recorder in a sound attenuated booth. For the control, *wh*-RRC, and *that* conditions, the speaker was encouraged to read each context statement naturally. For the *wh*-NRRC condition, the speaker was encouraged to use clausal prosodic breaks (defined as a TOBI break index of 4 (Silverman et al. 1992)) at the beginning and end of the relative clause and to incorporate rising pitch prior to the relative clause and in the clause final position of the relative clause, following Garro & Parker (1982). Figure 4.1 presents sample waveforms and spectrograms of the *wh*-NRRC and *wh*-RRC conditions to highlight this contrast.

To distract participants from the purpose of the experiment and to make sure they were attending to the task, forty-eight (48) filler items were generated. These filler items included context/continuation statement pairs that relied strictly on entailment relationships, i.e., prosodic cues were not relevant to the plausibility judgments. For each filler continuation statement, two context statements were created: one which would allow the continuation and one which would not. The filler items were divided into three categories, based on the type of structure involved in the context statement: *any/several*, *never/often*, and *more/fewer*. Sample filler items contexts and continuations are given in (62) – (64). While the *any/several* and *never/often* fillers were designed to be disallowed in contexts with negation (i.e., *any* and *never* contexts), the *more/fewer* fillers were counterbalanced so that half of the continua-

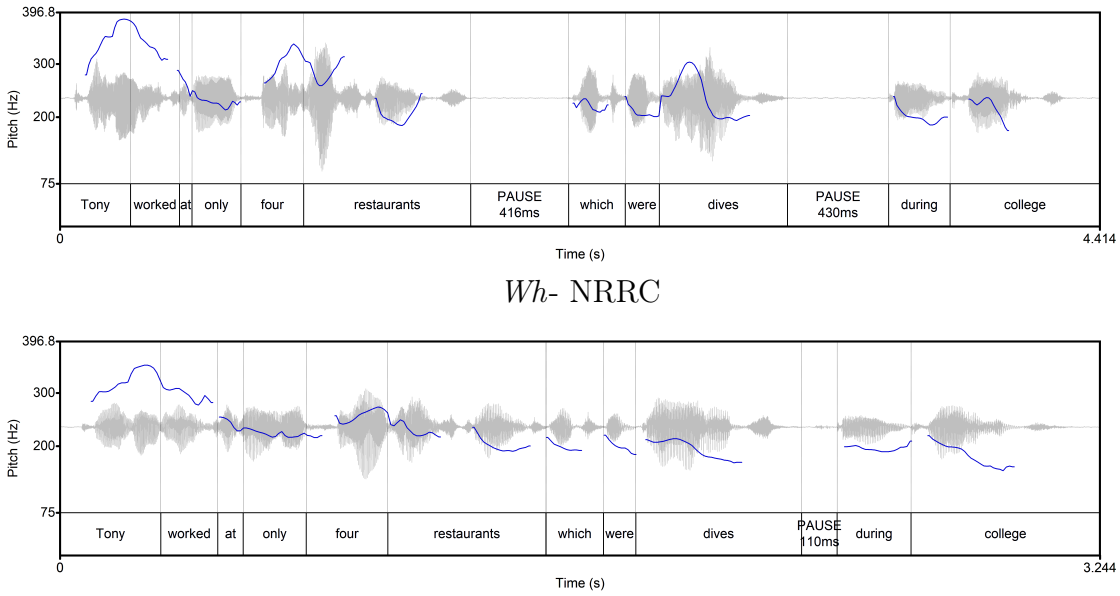


Figure 4.1. Sample waveforms (gray) and pitch traces (blue) for *wh*-NRRC and *wh*-RRC conditions, Experiment 1.

tions were plausible-biased by the *more* contexts and half were plausible-biased by the *fewer* contexts.

(62) a. *Never/Often* context

James {never, often} exercises during the summer.

b. *Never/Often* continuation

Sometimes, James jogs during the summer.

(63) a. *Any/Several* context

At the concert, George {didn't sing any of the, sang several} songs that he had written.

b. *Any/Several* continuation

At the concert, George sang a lullaby that he had written for his daughter.

(64) a. *More/Fewer* context

Only Tony had {more, fewer} than 6 dollars after paying for dinner.

b. *More/Fewer* continuation

Katherine had 9 dollars after paying for dinner.

The 48 experimental items were counterbalanced into four lists so that every participant saw each item in a single condition, with twelve items in each condition. The 48 filler items were counterbalanced into these lists so that every participant saw each item in a single condition, with eight items of each condition for the three different filler categories.

4.2.1.3 Procedure

The experiment was run using DMDX software (Forster & Forster 2003). For each trial, the participants were first shown a screen with the word "LISTEN" displayed in the center. At this time, the recording of the context statement for the given item would be presented through a pair of headphones. At the end of the recording, the participants would advance to a replay selection prompt. At this prompt, the participants read, "Press ENTER to hear again. Press SPACEBAR to continue." If the participants pressed the enter key, the context statement recording would be replayed, and, at the end of the recording, they would return to the replay selection prompt. The participants could replay the context statement as many times as they needed before advancing.

Once the spacebar had been pressed at the replay selection prompt, the continuation statement would appear on the screen with a 5-point Likert scale below. The endpoints of the scale were defined as 1 "completely implausible" and 5 "perfectly plausible". At this screen, the participants rated the plausibility of the continuation,

using the respective keys on the keyboard, based on the context that they had just heard. After the participants selected their plausibility rating for the continuation statement, the experiment would move on to the next trial. In addition to recording the plausibility rating for each item, DMDX also recorded how many times the continuation statement was replayed. The experiment was broken into twelve blocks, each consisting of eight items. At the beginning of the experiment, participants were given eight practice trials to acquaint them with keyboard controls for the experiment.

4.2.2 Results

Data Analysis. Three participants were removed from the analysis of the experimental items due to errors in the filler items. The error cutoffs were defined as mean ratings over 2.5 in the implausible-biasing context and under 3.5 in the plausible biasing context. Two of these participants were removed for rating continuations following implausible-biasing contexts in the more/fewer items over 2.5. The other participant was removed for rating continuations following plausible-biasing contexts in the more/fewer items below 3.5. (These three participants were included in the analysis of the filler items, however.) This resulted in twenty participants, with five participants per list, for the experimental items.

Separate ANOVAs were conducted by subjects (F_1) and items (F_2) with context type as a repeated measure and list/item group as a non-repeated factor to reduce the variability introduced by the counterbalanced list design (Pollatsek & Well 1995) for plausibility ratings, replay rates, and exposures. For the main analyses for plausibility ratings and exposures, the Greenhouse-Geisser correction was applied to the by-subjects analysis to correct for a violation of sphericity (Greenhouse & Geisser 1959). Separate ANOVAs were also conducted for plausibility for comparisons between each of the following contrasts: bi-sentential control/*wh*- NRRC, *wh*- NRRC/*wh*- RRC,

Table 4.1. Mean (SD) continuation plausibility ratings, context replay rates, and context exposures by context condition, Experiment 1

	Plausibility	Replay%	Exposures
Bi-sentential control	1.67 (0.69)	0.31 (0.28)	1.34 (0.32)
Wh- non-restrictive	2.71 (0.89)	0.31 (0.26)	1.35 (0.34)
Wh- restrictive	3.48 (1.01)	0.32 (0.27)	1.42 (0.55)
That restrictive	3.59 (0.92)	0.38 (0.28)	1.49 (0.45)

Plausibility: 1 = "completely implausible", 5 = "perfectly plausible".

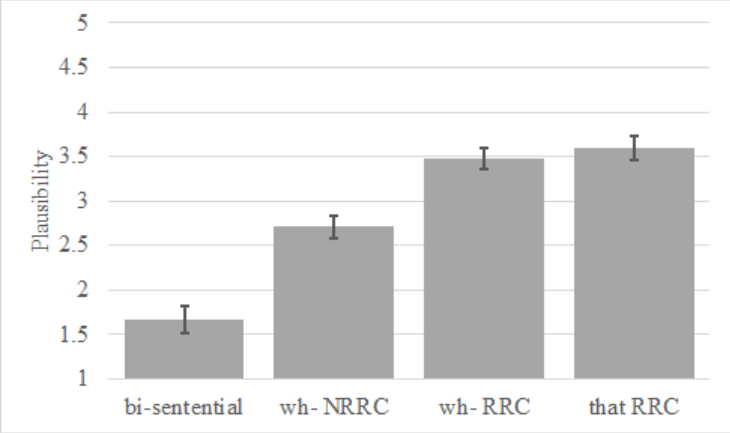


Figure 4.2. Mean plausibility ratings and corrected standard error of the mean for within-subjects designs, Experiment 1. Error bars show ±1 standard error of the mean for repeated measures (Cousineau 2005).

wh- NRRC/*that* RRC, and *wh-* RRC/*that* RRC. Mean plausibility ratings of continuation statements and both the mean replay rate and number of exposures to the context statements are presented in Table 4.1. The mean plausibility ratings for the continuation statements by context condition are also graphed in Figure 4.2.

Plausibility ratings. The mean plausibility ratings for the continuation statements of the filler items and the results of the ANOVAs of the three different contrasts are presented in Table 4.2. In all three contrasts, continuations that followed implausible-biasing contexts were rated significantly lower than continuations that followed plausible-biasing contexts. I interpret these results as a clear indicator that

Table 4.2. Mean (SD) plausibility ratings for continuation statements by context condition for filler items and corresponding analysis of variance results, Experiment 1

		Plausibility	F_1	F_2
Never, often	Implausible bias	1.30 (0.34)	2004.27***	2100.72***
	Plausible bias	4.90 (0.17)		
Not any, several	Implausible bias	1.16 (0.25)	3704.38***	4077.80***
	Plausible bias	4.78 (0.27)		
More, fewer	Implausible bias	1.55 (0.75)	160.87***	302.60***
	Plausible bias	4.46 (0.78)		

***$p < 0.001$.

Plausibility: 1 = "completely implausible", 5 = "perfectly plausible".

the participants were minimally capable of applying basic semantic entailments of the context statements to their rating of the plausibility of the relevant continuation.

For the main analysis of the experimental items, there was an overall effect of context on the plausibility rating of the continuation, $F_1(3, 48) = 34.69$, $p < 0.001$, $F_2(3, 132) = 115.56$, $p < 0.001$. In the planned comparisons, continuations were rated significantly lower when presented with the bi-sentential control context than the *wh*-NRRC condition, $F_1(1,16) = 26.46$, $p < 0.001$, $F_2(1,44) = 83.46$, $p < 0.001$. Continuations in the *wh*-NRRC were rated significantly lower than both the *wh*-RRC condition, $F_1(1,16) = 13.92$, $p < 0.01$, $F_2(1,44) = 44.85$, $p < 0.001$, and the *that* condition, $F_1(1,16) = 13.50$, $p < 0.01$, $F_2(1,44) = 44.44$, $p < 0.001$. There was no significant difference between the plausibility ratings in the *wh*-RRC and *that* contexts, $F_1(1,16) = 1.16$, $p = 0.297$, $F_2(1,44) = 0.76$, $p = 0.389$.

Replay rates and exposures. There was no overall effect of context type on replay rates, $F_1(3,48) = 1.81$, $p = 0.157$, $F_2(3,132) = 2.21$, $p = 0.09$. In pairwise comparisons, the *that* RRC condition had higher replay rates than both the bi-sentential control condition, $F_1(1,16) = 6.11$, $p < 0.05$, $F_2(1,44) = 4.27$, $p < 0.05$, and *wh*- RRC condition, $F_1(1,16) = 6.89$, $p < 0.05$, $F_2(1,44) = 4.35$, $p < 0.05$. The differences between

the *that RRC* and the *wh-* RRC conditions were not significant, $F_1(1,16) = 2.11$, $p = 0.166$, $F_2(1,44) = 3.57$, $p = 0.066$. No differences in replay rates were found between the bi-sentential control, *wh-* NRRC, and *wh-* RRC conditions (remaining F_1s < 2.11, F_2s < 3.57).

The effect of context type on overall exposures was significant by items, but not by subjects, $F_1(3,48) = 2.52$, $p = 0.106$, $F_2(3,132) = 4.81$, $p < 0.01$. In the pairwise comparisons, the *that* RRC condition had a greater number of average exposures to contexts than either the bi-sentential control condition, $F_1(1,16) = 9.44$, $p < 0.01$, $F_2(1,44) = 10.64$, $p < 0.01$, or the *wh-* NRRC condition, $F_1(1,16) = 11.17$, $p < 0.01$, $F_2(1,44) = 10.21$, $p < 0.01$. Again, no differences were found between the *that* RRC condition and the *wh-* RRC condition, $F_1(1,16) = 1.17$, $p = 0.296$, $F_2(1,44) = 2.01$, $p = 0.164$, nor were any of the results of the remaining comparisons significant (remaining F_1s < 1.17, F_2s < 2.01).

4.2.3 Discussion

The results show a three-way split between the four experimental conditions. Plausibility for continuations following bi-sentential control contexts statements ($M = 1.67$) were the lowest of all four conditions. This is not inherently surprising, as this condition was intended to serve as the lower baseline in the experiment. Given that non-restrictive relative clauses are argued to provide parenthetical information, it was somewhat surprising, however, that continuation statements following *wh-* NRRC contexts ($M = 2.67$) were rated significantly higher than those following bi-sentential control contexts. However, I offer that this difference might be in part due to differences between the two conditions. While the bi-sentential control is string-unambiguous as to its semantic interpretation, the *wh-* NRRC condition is still string-ambiguous. The lack of overlap between these two conditions could be due

to the non-restrictive prosody, on its own, failing to fully equate to contents of the relative clause to the same level as the independent clause in the bi-sentential control. Since the context statements could not be replayed after viewing the continuation statement, participants may also have hedged and chosen plausibility ratings closer to the middle of the scale if they were less sure of their initial interpretation of the string-ambiguous context statement.

More importantly, however, is the clear distinction found between the plausibility of continuations following the *wh-* NRRC condition and both the *wh-* RRC condition ($M = 3.53$) and the *that* RRC condition ($M = 3.70$). I interpret these results as a clear indicator that non-restrictive prosody is used to develop stronger truth condition interpretations than restrictive relative clause prosody. The lack of a significant difference between the *wh-* RRC condition and the *that* RRC condition is not surprising, given that both of these conditions should have the same semantic interpretation, despite the fact that the *that* RRC condition is unambiguous regarding the type of relative clause.

The results of this experiment confirm that acoustic correlates of non-restrictive relative clauses measured by Garro & Parker (1982) lead to the stronger truth condition interpretations of non-restrictive relative clauses noted by Demirdache (1991), when compared to their restrictive counterparts. Moreover, this experiment adds to the greater body of work showing the effect prosody has on disambiguating between competing interpretations (Schafer et al. 1996; Schafer, Carlson, et al. 2000; Schafer, Speer, et al. 2000; Warren et al. 2000).

Overall, the different pattern of results for the two *wh*-conditions follow a pattern similar to those found by Warren et al. (2000) for disambiguating PP-attachment and by Schafer, Speer, et al. (2000) for disambiguating between early/late closure constructions, namely prosody is used to disambiguate between two different parses.

Assuming Demirdache's (1991) analysis of differences between restrictive and non-restrictive relative clauses, the results of this study suggests that speakers of English use prosodic information when assigning the adjunction site of the relative clause. When non-restrictive prosody is heard, speakers show a preference for adjunction to a higher DP structure. This contrasts the adjunction to a lower NP structure when restrictive prosody is used.

This hedging may have also resulted from the presences of the temporal/locative adjunct present at the end of each context statement. As these adjuncts modified the main clause predicate, there were prosodic breaks after the relative clause in all three of the non-control conditions. These breaks were presented to disambiguate the attachment site of the adjunct and bias its attachment to the higher clause. Because of this, the purpose of the prosodic break at the end of the relative clause in the *wh*-conditions could have been ambiguous between being a marker of restrictive/non-restrictive or being a marker of attachment site for the adjunct that follows. This possible ambiguity may have contributed to the hedging of judgments in the *wh*-NRRC context, but there is no clear way to tell with the present results. With respect to the other two relative clause conditions, I would argue that hedging was not likely to occur. As *that* relatives are unambiguously restrictive, the interpretation of the break in this condition could only be associated with attachment of the adjunct. Given the lack of differences between the *wh*-RRC and *that* conditions, this possible ambiguity arguably has no significant effect on the *wh*-RRC condition.

Regarding replay rates and exposures to the context statements, I anticipated that these secondary measures would have been greater in the two *wh*-conditions, as subjects may have wanted to replay these contexts to potentially get a better ear for the given prosody. However, these two conditions did not differ from the clearly unambiguous bi-sentential control. More surprisingly, however was that the *that* RRC

condition had significantly higher replays rates ($M = 0.38$) and exposures ($M = 1.49$) that either the bi-sentential control condition ($M_{replay} = 0.31$, $M_{exposure} = 1.34$) or the *wh*- NRRC condition ($M_{replay} = 0.31$, $M_{exposure} = 1.35$). This could be potentially due to possible, temporary ambiguities present for the *that* RRC condition that would not be possible for either of the *wh*-conditions. At the point of integration, it is possible for *that* to not adjoin directly to the NP or DP preceding it. Rather it could be the head of its own DP, functioning as adjunct to the predicate, e.g., *Tony worked at only 4 restaurants that year*. This, however, would not be enough, on its own, to explain why there was no difference between the *that* RRC and *wh*- RRC conditions. If an increase in power led to a clear difference in replay rates and exposures between these two conditions, the above explanation would be more tenable.

4.3 Experiment 2

Experiment 1 shows clearly that prosodic information is used to disambiguate between restrictive and non-restrictive interpretations of *wh*-relative clauses. What remains to be seen, however, is whether this use of prosody extends to relative clauses with more complicated dependencies, namely where larger constituents are pied-piped. As discussed in the review of the syntactic literature on pied-piping in Chapter 2, the modern analysis of pied-piping presented by Heck (2008), Cable (2010), and Richards (2019) argue that massive pied-piping cannot occur in restrictive relative clauses. I counter the arguments against such a restriction in Chapter 3, particularly in Section 3.1.

In Experiment 2, I test between these two hypotheses using the same context-continuation judgment paradigm established in Experiment 1. Rather than contrasting massive pied-piping directly to simpler *wh*-movement in the relative clause, Experiment 2 tests massive pied-piping structures against obligatory pied-piping structure.

This manipulation was chosen as it preserved the filler-gap dependency between conditions, lessening the likelihood that differences could be attributed to difference in the size of the gap. This manipulation and the manipulation of prosody (restrictive, non-restrictive) leads to a 2×2 design, with the relevant constructions given in (65).

(65) a. Obligatory pied-piping, non-restrictive prosody
During casting, 7 actors, whose agents the director had trusted, landed important roles.

b. Obligatory pied-piping, restrictive prosody
During casting, 7 actors whose agents the director had trusted landed important roles.

c. Massive pied-piping, non-restrictive prosody
During casting, 7 actors, the agents of whom the director had trusted, landed important roles.

d. Massive pied-piping, restrictive prosody
During casting, 7 actors the agents of whom the director had trusted landed important roles.

e. Continuation
During casting, several other actors also landed important roles.

For the obligatory pied-piping conditions, Heck (2008), Cable (2010), and Richards (2019) would predict an effect of prosody, with continuations following non-restrictive prosody contexts to be rated as less plausible than those following restrictive prosody contexts. I would agree with this prediction as well. However, with the massive pied-piping contexts, strict readings of Heck, Cable, and Richards' analyses should predict no effect of context prosody on the plausibility of the continuation. If massive

pied-piping cannot occur in non-restrictive relative clauses, the structure alone should force a non-restrictive interpretation, and prosody should be inconsequential, leading to an overall interaction of structure and prosody. Based on the availability of the weaker truth conditions to massive pied-piping discussed in Section 3.1.5, I would predict prosody to have an effect in the massive pied-piping context condition.

4.3.1 Method

4.3.1.1 Participants

Forty-two (42) students from the University of Texas at Arlington participated in the experiment. These participants were volunteers recruited from classes in the Department of Linguistics and TESOL or were students from Department of Psychology who were participating for course credit. All participants were native speakers of English.

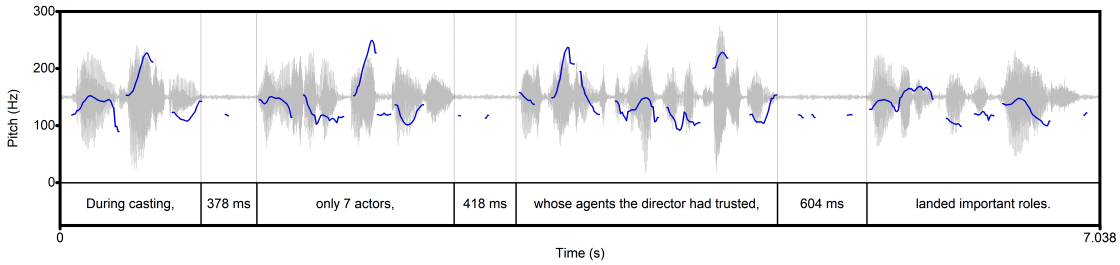
4.3.1.2 Materials and design

Forty-eight (48) experimental items were generated for the experiment. As with Experiment 1, these items consisted of a context statement and continuation statement pair. The context statements were manipulated to in a 2×2 factorial design with the factors of structure (massive pied-piping, obligatory pied-piping) and prosody (restrictive, non-restrictive), sample given in Table (65). Context statements followed the template of a fronted temporal/locative adjunct, a subject modified by an object-extracted relative clause, and a predicate. The subjects in all sentences consisted of a cardinal number followed by a noun and the relative clause. In the massive pied-piping condition, the fronted element was a massively pied-piped DP, e.g., *the clients of whom*. In the obligatory pied-piping condition, the fronted element was

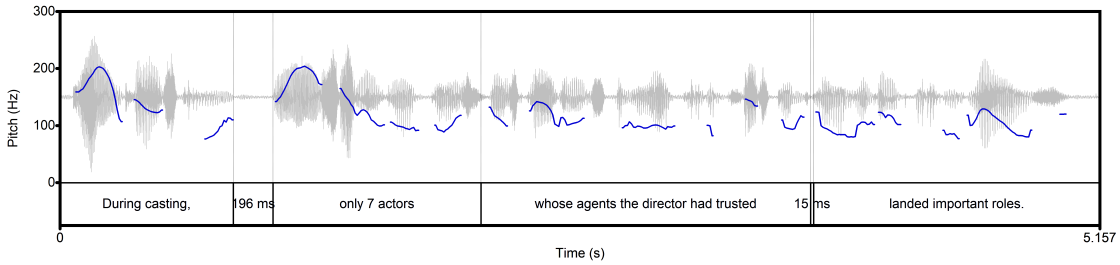
an obligatorily pied-piped possessor DP, e.g., *whose clients*. As with Experiment 1, the continuation statement was held constant across the four conditions for each item. The continuation statements followed a template in which they included the same fronted adjunct and predicate as the context statement. The subjects in the continuation statements replaced the cardinal number from the context statements with the words *several other*.

Recordings of a male native speaker of English producing the 48 context statements in each of the four conditions were captured using a Zoom H2n Handy Recorder in a sound attenuated booth. For the restrictive relative condition, the speaker was encouraged to read each context statement with the prosody matching that described by Garro & Parker (1982), paying special attention to using flat/falling pitch on the head of the relative clause and at the end of the relative clause and minimizing pause durations on both sides of the relative clause. For the non-restrictive relative clause prosody condition, the speaker was encouraged to read each context statement with the corresponding non-restrictive prosody in mind, incorporating rising pitch on the head of the relative clause and at the end of the relative clause and emphasizing the clausal prosodic breaks on both sides of the relative clause. Sample waveforms and pitch traces for the four context conditions are given in Figure 4.3.

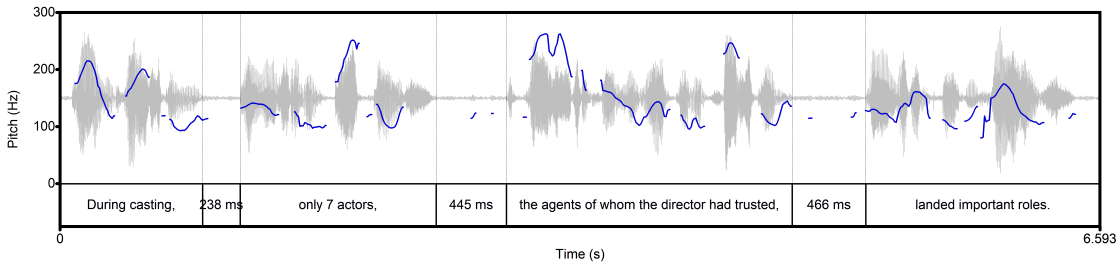
To distract the participants from the purpose of the experiment and to ensure participants attended to the task, forty-eight (48) filler items with the same entailment relationships between context statement and continuation statement as those used in Experiment 1 were created, with sixteen (16) items generated in each type. Sample filler items in the three different types are presented in (66)–(68). As all context statements in Experiment 1 started with proper names, the filler items were altered so that subjects were replaced with descriptive NPs to reduce the likelihood of participants identifying major differences between the filler and experimental items.



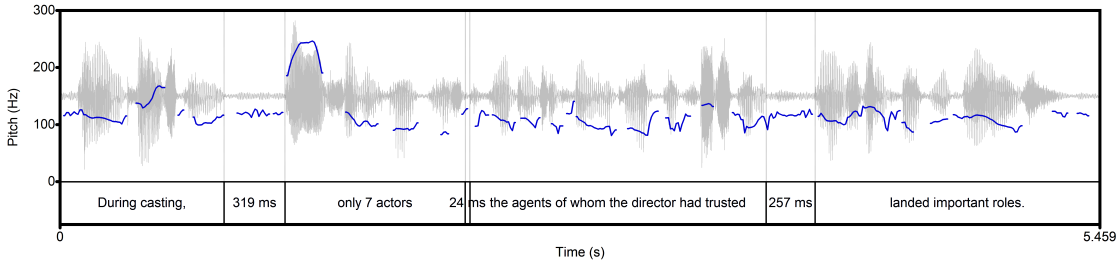
Obligatory pied-piping, non-restrictive prosody



Obligatory pied-piping, restrictive prosody



Massive pied-piping, non-restrictive prosody



Massive pied-piping, restrictive prosody

Figure 4.3. Sample waveforms (gray) and pitch traces (blue) for context statements, Experiment 2.

Filler items were recorded under the same environmental conditions as the experimental items, but no special considerations were made with respect to their prosodic delivery.

(66) a. *Never/Often* context

On its front page, the city newspaper {never, often} prints stories about the local schools.

b. *Never/Often* continuation

On its front page, the city newspaper will sometimes run a story about an outstanding teacher.

(67) a. *None/Some* context

At the Christmas party, {none, some} of the people that the man saw were people that he knew.

b. *None/Some* continuation

At the Christmas party, the man saw a co-worker that he knew from his office.

(68) a. *More/fewer* context

In January, the only police officer that made {more, fewer} than 100 arrests was a grumpy old sergeant.

b. *More/fewer* continuation

A different police officer, who was a rookie, made 150 arrests in January.

The 48 experimental items were counterbalanced into four lists so that every participant saw each item in a single condition, with twelve items in each condition. The 48 filler items were counterbalanced into these lists so that every participant

saw each item in a single condition, with eight items of each condition for the three different filler categories.

4.3.1.3 Procedure

The procedure was the same as Experiment 1.

4.3.2 Results

Data analysis. Five participants were removed from the analysis of the experimental items due to errors in the filler items. The error cutoffs were defined as mean ratings over 2.5 in the implausible-biasing context and under 3.5 in the plausible-biasing context. Two of these participants were removed for rating continuations following plausible-biasing contexts in the more/fewer items below 3.5. One participant was removed for rating continuations following implausible-biasing contexts in the more/fewer items above 2.5. The other two participants removed from the analysis had one or more errors in the more/few items, as well as one or more errors in the none/some or never/often conditions. (These five participants were included in the analysis of the filler items, however.) This resulted in thirty-seven (37) participants analyzed for the experimental items. Due to the odd number of participants, the lists were unbalanced (9 participants, List A; 9 participants, List B; 10 participants, List C; 9 participants, List D). The mean plausibility ratings of the continuation statements and both the mean replay rate and number of exposures to the context statements for each of the context condition are presented in Table 4.3. The mean plausibility ratings for each condition are also graphed in Figure 4.4.

Separate ANOVAs were conducted by subjects (F_1) and items (F_2) with context structure and context prosody as repeated measures and list/item group as a non-repeated factor to reduce the variability introduced by the counterbalanced list design

Table 4.3. Mean (SD) continuation plausibility ratings, context replay rates, and context exposures by context condition, Experiment 2 (n = 37)

	Plausibility	Replay%	Exposures
Obligatory pied-piping			
Non-restrictive prosody	1.99 (0.79)	0.39 (0.28)	1.50 (0.44)
Restrictive prosody	2.03 (0.86)	0.43 (0.31)	1.54 (0.43)
Massive pied-piping			
Non-restrictive prosody	1.90 (0.77)	0.42 (0.32)	1.59 (0.55)
Restrictive prosody	1.84 (0.78)	0.49 (0.78)	1.68 (0.52)

Plausibility: 1 = "completely implausible", 5 = "perfectly plausible".

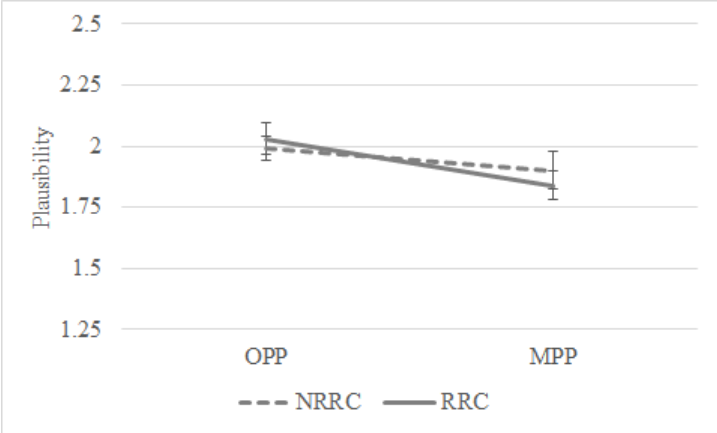


Figure 4.4. Mean plausibility ratings and corrected standard error of the mean for within-subjects designs, Experiment 2 (n = 37). Error bars show ±1 standard error of the mean for repeated measures.

(Pollatsek & Well 1995) for plausibility ratings, replay rates, and exposures. Separate ANOVAs were also conducted for simple effects within each structure and prosody condition.

Plausibility ratings. As with Experiment 1, filler items were analyzed. The mean plausibility rating for continuation statements by context condition are presented in Table 4.4, with their corresponding ANOVA results. Again, I interpret these results as an indicator of the participants general ability to use the semantic entailments from the context statements while rating the plausibility of the continuation statements.

Table 4.4. Mean (SD) plausibility ratings for continuation statements by context condition for filler items and corresponding analysis of variance results, Experiment 2

		Plausibility	F_1	F_2
Never, often	Implausible bias	1.35 (0.47)	1373.41***	1218.22***
	Plausible bias	4.73 (0.32)		
None, some	Implausible bias	1.22 (0.42)	1139.44***	4831.17***
	Plausible bias	4.78 (0.40)		
More, fewer	Implausible bias	1.46 (0.60)	325.02***	622.581***
	Plausible bias	4.43 (0.76)		

***$p < 0.001$.
Plausibility: 1 = "completely implausible", 5 = "perfectly plausible".

For the experimental items, there was a main effect of structure by items but not by subjects, $F_1(1,33) = 3.45$, $p = 0.072$, $F_2(1,44) = 9.34$, $p < 0.01$, wherein continuations following contexts with massive pied-piping were rated lower than those following obligatory pied-piping. There was no effect of prosody, nor was there an interaction between structure and prosody, all Fs < 1.

A simple main effect of structure was found in the restrictive prosody condition. Continuation statements that followed contexts with obligatory pied-piping ($M = 2.03$) were rated as more plausible than continuation statements that followed contexts with massive pied-piping ($M = 1.84$), $F_1(1,33) = 5.39$, $p < 0.05$, $F_2(1,44) = 4.46$, $p < 0.05$. There was no simple effect of structure in the non-restrictive prosody conditions, $F_1(1,33) = 0.81$, $p = 0.375$, $F_2(1,44) = 2.47$, $p = 0.123$. No simple effects prosody were found in either of the either of the structural conditions, all $Fs < 1$.

Replay rates and exposures. There was a main effect of structure for replay rates, $F_1(1,33) = 7.74$, $p < 0.01$, $F_2(1,44) = 5.84$, $p < 0.05$, where replays occurred more frequently with massive pied-piping context statements than with obligatory pied-piping context statements. There was also a main effect of prosody, where re-

plays occurred more frequently for context statements with restrictive prosody than contexts with non-restrictive prosody. $F_1(1,33) = 6.5$, $p < 0.05$, $F_2(1,44) = 8.05$, $p < 0.01$, No interaction between structure and prosody was found for replay rates, both Fs < 1.

The main effect of structure on replay rates was driven by the simple effect of structure in restrictive context condition. Here, contexts containing massive pied-piping constructions were replayed more frequently ($M = 0.49$) than contexts with obligatory pied-piping ($M = 0.43$), $F_1(1,33) = 6.88$, $p < 0.05$, $F_2(1,44) = 5.63$, $p < 0.05$. There was no simple effect of structure in the non-restrictive context conditions, $F_1(1,33) = 1.2$, $p = 0.281$, $F_2(1,44) = 0.93$, $p = 0.339$.

The main effect of prosody on replay rates is driven by a simple main effect of prosody in the massive pied-piping context condition. Massive pied-piping context statements were replayed more frequently when presented with restrictive prosody ($M = 0.49$) than when they were presented with non-restrictive prosody ($M = 0.42$), $F_1(1,33) = 9.07$, $p < 0.01$, $F_2(1,44) = 7.58$, $p < 0.01$. There was no simple main effect of prosody on the replay rates of context statements with obligatory pied-piping structures, $F_1(1,33) = 1.34$, $p = 0.256$, $F_2(1,44) = 1.58$, $p = 0.215$.

For average exposures to the context statements, there was a main effect of structure, with subjects being exposed to contexts containing massive pied-piping constructs to a greater degree than contexts containing obligatory pied-piping constructions, $F_1(1,33) = 14.75$, $p < 0.001$, $F_2(1,44) = 10$, $p < 0.01$. No main effect of prosody was found in the by subjects analysis, $F_1(1,33) = 3.56$, $p = 0.068$, but one was found in the by-items analysis, $F_2(1,44) = 4.25$, $p < 0.05$. Again, no interaction was present, both Fs < 1.

A simple main effect of structure was found in the restrictive prosody condition. Exposure to context statements containing massive pied-piping constructions

($M = 1.68$) was higher than the exposure to contexts statements containing obligatory pied-piping ($M = 1.54$), $F_1(1,33) = 10.87$, $p < 0.01$, $F_2(1,44) = 7.35$, $p < 0.01$. A similar contrast was found in the non-restrictive prosody condition by subjects, $F_1(1,33) = 5.48$, $p < 0.05$, but not by items, $F_2(1,44) = 3.24$, $p = 0.079$. No simple effect of prosody was found within the obligatory pied-piping context condition, $F_1(1,33) = 1.19$, $p = 0.283$, $F_2(1,44) = 1.05$, $p = 0.311$, nor was one found in the massive pied-piping condition, $F_1(1,33) = 3.33$, $p = 0.077$, $F_2(1,44) = 2.97$, $p = 0.092$.

4.3.3 Discussion

Unlike the results of Experiment 1, the results of Experiment 2 show no clear effects of prosody, even where it should have been predicted in the case of the obligatory pied-piping contexts. Regarding possible interpretations of this lack of effect between the two obligatory pied-piping conditions, one possible explanation is that obligatory pied-piping forces a non-restrictive reading as well, based on the rather low plausibility ratings for both contexts. This might seem somewhat plausible, as the obligatory pied-piping contexts with restrictive prosody had a mean plausibility rating of 2.03, which was lower than the mean plausibility rating for the *wh-* NRRC condition from Experiment 1. This direct comparison of results between Experiment 1 and Experiment 2 should be avoided, as the experiments tested separate subjects. Furthermore, in order to allow for a clear movement of the larger pied-piped constituents, Experiment 2 replaced the subject-extracted relative clauses from Experiment 1 with object-extracted relative clauses, which are markedly more difficult to process.

While there were significant effects of structure in both the replay rates and exposures, I would argue that these secondary measures may be more difficult to interpret. Given the results of Experiment 1, wherein the *that* RRC condition displayed higher replay rates and mean exposures to the contexts than the *wh-* NRRC

and bi-sentential control, I would suggest that effect of structure on replay rates and mean exposures be interpreted as temporary difficulty parsing the marked structure rather that an indicator of ungrammaticality.

4.3.3.1 Reanalysis of highly discriminating participants

Given the lack of a clear effect of prosody where it was predicted by the design of the experiment, namely between the non-restrictive and restrictive prosody conditions within the obligatory pied-piping condition, I reanalyzed the data to specifically look at just at the subjects who appeared to use prosody to disambiguate between competing interpretations of the relative clauses with obligatory pied-piping. As ratings for continuations on the experimental were generally lower than in Experiment 1, participants considered for this reanalysis also had to display a clear, categorical distinction between the plausible-biasing and implausible-biasing filler. By looking at these highly distinguishing subjects, I hoped to draw out more interpretable results by eliminating noise generated by the increased difficulty of this experiment.

Data analysis. More stringent cut-offs were applied across participants. Participants who did not disambiguate using prosody to disambiguate between obligatory pied-piping. For participants to be included in the reanalysis, their mean plausibility rating for the obligatory pied-piping, restrictive prosody condition had to be higher than their mean plausibility rating for the obligatory pied-piping condition. This removed 19 participants from the analysis. Additional subjects were screened for their ability to distinguish highly on the filler items. Participants who clearly distinguished between each of the three plausible/implausible-biasing contrasts remained in the analysis. Additional participants were cut if the difference between their mean for the plausible-biasing condition and their mean for the implausible-biasing condition was less than 3 in any of the filler contrasts ($M_{plausible} - M_{implausible} < 3$). This

Table 4.5. Mean (SD) continuation plausibility ratings, context replay rates, and context exposures by context condition, Experiment 2, highly discriminating participants (n = 13)

	Plausibility	Replay%	Exposures
Obligatory pied-piping			
Non-restrictive prosody	1.81 (0.90)	0.38 (0.31)	1.52 (0.36)
Restrictive prosody	2.31 (1.01)	0.41 (0.34)	1.55 (0.37)
Massive pied-piping			
Non-restrictive prosody	1.62 (0.71)	0.41 (0.34)	1.62 (0.48)
Restrictive prosody	1.81 (0.89)	0.53 (0.31)	1.70 (0.45)

Plausibility: 1 = "completely implausible", 5 = "perfectly plausible".

eliminated an additional 5 participants from the analysis, leaving the data for thirteen (13) participants to be analyzed. The initial ANOVAs conducted for Experiment 2 conducted again on this subset of the data. The mean plausibility ratings for the continuation statements and both the mean replay rates and average number of exposures to the context statements for each context condition are presented in Table 4.5. The mean plausibility ratings for the continuation statements is also graphed in Figure 4.5.

Plausibility ratings. In this sub-analysis, there were both main effects for structure on the plausibility rating of the continuation statements, $F_1(1,9) = 7.31$, $p < 0.05$, $F_2(1,44) = 10.21$, $p < 0.01$, and prosody, $F_1(1,9) = 13.19$, $p < 0.01$, $F_2(1,44) = 7.83$, $p < 0.01$. An interaction of structure and prosody was present in the by-subjects analysis, $F_1(1,9) = 9.86$, $p < 0.05$, but not in the by-items analysis, $F_2(1,44) = 0.99$, $p = 0.325$.

A simple main effect of structure was present between the restrictive prosody conditions, $F_1(1,9) = 19.51$, $p < 0.01$, $F_2(1,44) = 7.78$, $p < 0.01$, with continuation statements that followed context statements with obligatory pied-piping being rated higher than continuation statements that followed context statements with massive

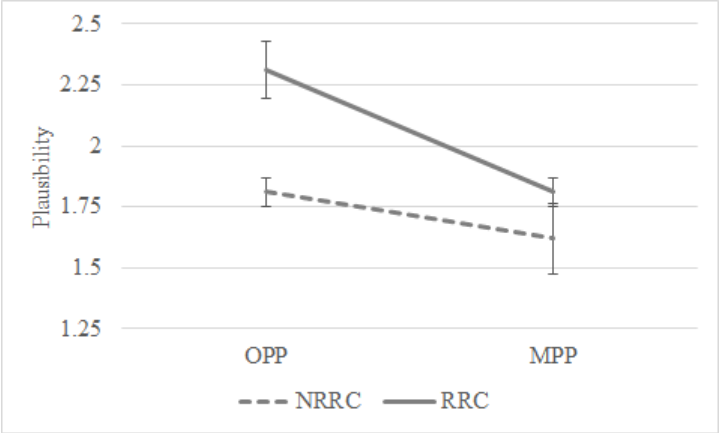


Figure 4.5. Mean plausibility ratings and corrected standard error of the mean for within-subjects designs, Experiment 2, highly discriminating participants (n = 13). Error bars show ±1 standard error of the mean for repeated measures.

pied-piping. No simple main effect of structure was found between the non-restrictive prosody conditions, $F_1(1,9) = 1.57$, $p = 0.242$, $F_2(1,44) = 3.77$, $p = 0.059$. A simple main effect of prosody was found between the obligatory pied-piping conditions, with continuation statements following restrictive prosody context statements rated as more plausible ($M = 2.31$) than continuations following non-restrictive prosody context statements ($M = 1.81$), $F_1(1,9) = 34.11$, $p < 0.001$, $F_2(1,44) = 6.68$, $p < 0.05$. No simple main effect of prosody was present between the massive pied-piping conditions, $F_1(1,9) = 2.5$, $p = 0.148$, $F_2(1,44) = 3.17$, $p = 0.082$.

Replay rates and exposures. For replay rates, there was a main effect of structure, with contexts in the massive pied-piping conditions being having a higher replay rate than contexts in the obligatory pied-piping condition, $F_1(1,9) = 9.89$, $p < 0.05$, $F_2(1,44) = 6.75$, $p < 0.05$. In the by-subjects analysis, there was also an effect of prosody, wherein restrictive prosody contexts were replayed more often, $F_1(1,9) = 5.66$, $p < 0.05$, but this was not significant by items, $F_2(1,44) = 3.23$,

$p = 0.079$. No interaction of structure and prosody was present. $F_1(1,9) = 1.54$, $p = 0.246$, $F_2(1,44) = 0.91$, $p = 0.346$.

The main effect of structure was driven by the simple effect in the restrictive prosody condition. Massive pied-piping contexts were replayed more frequently ($M = 0.53$) than obligatory pied-piping contexts ($M = 0.41$), $F_1(1,9) = 6.4$, $p < 0.05$, $F_2(1,44) = 5.27$, $p < 0.05$. No simple main effect of structure was found between the non-restrictive prosody conditions. $F_1(1,9) = 0.43$, $p = 0.53$, $F_2(1,44) = 1.27$, $p = 0.267$. The by-subjects main effect of prosody was likewise driven by the simple effect of prosody in the by-subjects analysis of the massive pied-piping contexts. Here, contexts were replayed more frequently in the restrictive prosody condition ($M = 0.53$) than in the non-restrictive prosody condition ($M = 0.41$), $F_1(1,9) = 5.75$, $p < 0.05$. However, by items, this difference was not significant, $F_2(1,44) = 3.2$, $p = 0.081$. No simple main effect of prosody was found between the obligatory pied-piping conditions, $F_1(1,9) = 0.32$, $p = 0.586$, $F_2(1,44) = 0.59$, $p = 0.446$.

With respect to the average exposure to the context statements, there was a main effect of structure, with massive pied-piping contexts having a greater number of overall exposures compared to obligatory pied-piping, $F_1(1,9) = 10.82$, $p < 0.01$, $F_2(1,44) = 4.65$, $p < 0.05$. No main effect of prosody was found, $F_1(1,9) = 1.83$, $p = 0.21$, $F_2(1,44) = 0.84$, $p = 0.365$, nor was there an interaction of structure and prosody, $F_1(1,9) = 1.39$, $p = 0.269$, $F_2(1,44) = 0.17$, $p = 0.686$.

For simple main effects, there was an effect of structure between the restrictive prosody conditions in the by-subjects analysis, with the massive pied-piping contexts having a greater exposure count ($M = 1.70$) than obligatory pied-piping contexts ($M = 1.55$), $F_1(1,9) = 6.76$, $p < 0.05$. This difference was not significant in the by-items analysis, $F_2(1,44) = 2.82$, $p = 0.1$. No simple main effect of structure was found in the non-restrictive prosody contexts, $F_1(1,9) = 0.82$, $p = 0.39$, $F_2(1,44) = 2.45$, $p =$

0.125. No simple main effect was found in either the obligatory pied-piping condition, $F_1(1,9) = 0.19$, $p = 0.676$, $F_2(1,44) = 0.24$, $p = 0.626$, or the massive pied-piping condition, $F_1(1,9) = 2.17$, $p = 0.175$, $F_2(1,44) = 0.74$, $p = 0.393$.

4.3.3.2 Discussion continued

By looking at the highly distinguishing subjects only, I was able to draw out the expected effect of prosody on the plausibility rating of continuations between the two obligatory pied-piping context conditions. While this effect was by the design of the additional cuts made to subjects, it also created a more interpretable picture of whether prosody was used in the massive pied-piping conditions as well.

While Heck (2008), Cable (2010), and Richards (2019) would predict an interaction of structure and prosody, this interaction was only present in the by-subjects analysis. If this by-subjects effect were to be paired with the lack of a simple main effect of prosody in the massive pied-piping conditions, this could be interpreted as potential evidence in favor of a forced, non-restrictive interpretation of massive pied-piping. Accepting this interpretation may be premature, particularly as the number of subjects considered for the reanalysis are notably low (n = 13). If additional highly distinguishing participants were introduced to the analysis, the additional power may be enough to draw out the weak trend toward an effect of prosody in the massive pied-piping condition.

Given the low percentage of highly distinguishing subjects in comparison to the overall number of participants for this second experiment, it would be worth revising the experiment to remove some of the inherent difficulties presented. One potential modification would be to return to subject-extracted relative clauses. By reducing the processing difficulties, future results may produce clearer and more interpretable

results with respect to whether prosody type affect the interpretation of relative clauses with massive pied-piping.

4.4 General Discussion

The two experiments presented in this chapter show varying levels in which prosody appears to affect the interpretations of relative clause constructions. While the simpler constructions presented in Experiment 1 showed clear indications that prosody was being used to disambiguate between entertaining a restrictive or non-restrictive interpretation, the initial results for Experiment 2 showed no effect of prosody, even in the case of obligatory pied-piping, where such an effect would be predicted.

While the effectiveness of the context-continuation judgment paradigm failed to deliver clear results to adjudicate between a non-subordinated CP restrictive on massive pied-piping and the non-interrogative restriction that I presented in Section 3.4, the experimental paradigm shows promise. The clear effects of context bias shown in filler items of both experiments and the clear effect of prosody in Experiment 1 would suggest that the paradigm can be used gather plausibility judgments for both overt entailment and more subtle effects. Future experiments using this paradigm will likely help to establish it limitations, while also testing a wider array of syntactic, semantic, and pragmatic dependencies.

CHAPTER 5

RESOLVING THE MASSIVE PIED-PIPING ASYMMETRIES[1]

In Chapter 3, I proposed a revision to Heck's (2008) generalization on massive pied-piping. My revision, restated here as (69), replaces Heck's non-subordinated restriction with a non-interrogative restriction. In Section 5.1, I show how this restriction corresponds with a wider set of syntactic and semantic phenomena. Based on these similarities, I propose the unification of a number of existing analyses, which I review in Section 5.2. Lastly, I show in Section 5.3 how combining these analyses allows us to explain the revised generalization.

(69) Revised Generalization on Massive Pied-Piping

Massive pied-piping is only possible if the CP whose specifier is the target of *wh*-movement is not interrogative.

5.1 Parallelism with other syntactic and semantic phenomena

While it may seem counterintuitive to propose that massive pied-piping is restricted to non-interrogative clauses, there are other syntactic and semantic phenomena upon which this distinction plays an important role. In the subsections that follow, I will show how interrogativity, or lack thereof, affects a wider array of phenomena, thus motivating the need for the analysis that I presented later in this chapter. The three phenomena that I will discuss are *wh*-exclamatives (5.1.1), T-to-

[1]This chapter is modified from my paper published in the Proceedings of the LSA, Amy (2020), to accommodate the format of this dissertation.

C movement in embedded clause in varieties of Irish English (5.1.2), and *wh-the-hell* constructions (5.1.3).

5.1.1 *Wh*-exclamatives

While massive pied-piping is one case where *wh*-movements, broadly speaking, fail to pattern uniformly across the board, another such case is with *wh*-exclamatives. As documented by Grimshaw (1979), the fronting of a *wh*-exclamative in a matrix clause with *wh*-exclamative cannot co-occur with subject-auxiliary inversion, as it does in *wh*-interrogative questions. This contrast is given in (70)

(70) Matrix *wh*-exclamatives/*wh*-interrogatives (Grimshaw 1979: 281)

a. What a fool he is t!

b. *What a fool is he t?

In addition to the lack of subject-auxiliary inversion, Grimshaw (1979) notes that fronting of a *wh*-exclamative is possible in complements of *surprise* and *know*-type verbs as shown in (71a) and (71b), but not *wonder*-types, as shown in (71c). Grimshaw also notes that unlike *know* and *wonder*-type verbs, *surprise*-type verbs may not take CP complements headed by *whether*, as shown in (72). If the presence of *whether* is an indication of interrogativity, this suggests that complements of *surprise*-type verbs cannot be interrogative.

(71) Embedded *wh*-exclamatives (Grimshaw 1979: 281)

a. I'm surprised at [$_{\text{DP}}$what a large house] he lives in t.

b. John knows [$_{\text{DP}}$ what a fool] he is t.

c. *I wonder [$_{\text{DP}}$what a large house] he lives in t.

(72) Embedded clauses headed by *whether* (Grimshaw 1979: 281)

a. *I was surprised at whether he lived in a large house.

b. John knows whether he is a fool.

c. I wonder whether he lives in a large house.

Even though *know*-type predicates can take complements headed by *whether*, the availability of wh-exclamatives in the complements of *know*-type predicates suggests that not all instances of *wh*-movement in complements of *know* need to occur within an interrogative, as the presence of *wh*-exclamatives are completely disallowed in both of the interrogative contexts above.

5.1.2 T-to-C movement in embedded clauses

While T-to-C movement occurs in English matrix clause questions, this movement is generally ungrammatical in embedded clause questions. However, as noted by McCloskey (2006), varieties of Irish English allow T-to-C movement in clauses embedded under what Ginzburg (1995a,b) calls "question-interrogative" predicates, as shown with *wonder* in (73a), but not under Ginzburg's "resolutive-interrogative" predicates, shown with *discover* in (73b), despite the fact that both allow *wh*-movement without T-to-C movement for English in general, as shown in (74).

(73) T-to-C movement in embedded clauses (McCloskey 2006)

a. I wonder what should we do. (101)

b. *The police discovered who had they beaten up. (88)

(74) a. I wonder what we should do.

b. The police discovered who they had beaten up.

Notably, the embedding predicates that allowed massive pied-piping in 3.3 (*know*, *tell*, and *surprise*) are resolutive-interrogatives, which are the same predicates that disallow T-to-C movement in embedded contexts in varieties of Irish English. Likewise, Ginzburg's question-interrogative predicates (e.g., *wonder* and *ask*) disallow massive pied-piping but allow T-to-C movement to occur in the embedded clauses in varieties of Irish English.

5.1.3 *Wh-the-hell* constructions

Looking at the distribution of massive pied-piping from a different angle, it shows a polar opposite behavior to the distribution of aggressively non-D-linked *wh-the-hell* constructions in embedded clauses, which are discussed by Den Dikken & Giannakidou (2002), presented here in (75). While the *wh-the-hell* construction is licensed in the complement of *wonder*, it is disallowed in complement clauses of *know*. Den Dikken & Giannakidou note that the inclusion of matrix clause negation can obviate the ungrammaticality in (75b), as shown in (75c), but this is due to the negation licensing the negative polarity item, *who the hell*.

(75) Licensing of *wh-the-hell* (Den Dikken & Giannakidou 2002: 34, 45)

a. I wonder [$_{\text{DP}}$ who the hell] t bought that book].

b. *I know [$_{\text{DP}}$ who the hell] t bought that book].

c. I don't know [$_{\text{DP}}$ who the hell] t bought that book].

While massive pied-piping appears to be ill-behaved when compared to simple *wh*-movement and its well-behaved obligatory pied-piping kin, it does appear to pattern alongside, or inversely with, other varieties of syntactic or semantic phenomena that have restrictions on where they may occur.

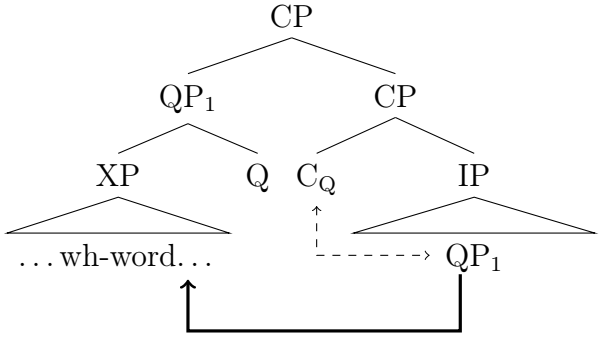
5.2 Combining existing frameworks

In order to account for where massive pied-piping can and cannot occur, I combine the existing frameworks put forth by Cable (2007, 2010) and Den Dikken (2003). While neither of these two frameworks can account for the revised generalization on massive pied-piping on their own, they each account for separate aspects of the problem presented by massive pied-piping.

5.2.1 Q-based movement

I previously covered the motivations for Cable's (2007, 2010) Q-based movement analysis of pied-piping in Section 2.2.2. As such, I will only briefly review the aspects of his analysis relevant to the movements of the QP in this section. Pied-piping, or rather all *wh*-movement, occurs under Cable's analysis as the movement of a QP. This movement is motivated by the presence of a feature [Q] on a complementizer and on the head of the QP, which Cable identifies as a Q-particle. As shown in (76), the QP moves to the Spec,CP as a result of the Agreement relationship initiated by the probe on C. This movement satisfies the Locality of Agree.

(76) Q-based movement analysis (Cable 2010: 141)



There are two main benefits to following this analysis. The first eliminates the distinction between *wh*-movement and pied-piping, as both are just different surface forces

of QP-movement. The second benefit is that the size of the pied-piped constituent is restricted by Cable's (2010) QP intervention condition, which was previously stated in (26) and is restated below in (77).

(77) QP-Intervention Condition (Cable 2010, 57)

A QP cannot intervene between a functional head F and a phrase selected by F.

The problem with Cable's (2010) Q-based movement analysis is that it has difficulty regulating which types of CPs can allow massive pied-piping in isolation. As discussed in Section 2.2.2, Cable accounts for restrictions on massive pied-piping in limited pied-piping languages like English, by arguing for a feature [WH] on the Q-particle and the *wh*-element. The problem with this QP-internal check is that it is unclear how the Q-particle that bears the feature [WH] is restricted to interrogative contexts, while the Q-particle that lacks this checking feature is restricted to non-interrogative contexts.

5.2.2 Two-stage Focus/*wh*-Agreement

The second framework used in this analysis is the one proposed by Den Dikken (2003). While Den Dikken is not concerned with pied-piping constructions, he is interested in differences between *wh*-movement in truly interrogative matrix clause questions, echo questions, and embedded clause asymmetries. In his analysis of *wh*-movement, Den Dikken argues for a two-stage *wh*-movement process. Under this process, *wh*-movement occurs first as Focus-movement, motivated by a feature [FOC] on the Focus head, and then a second *wh*-movement occurs as the result of the feature [WH] on a higher C head.

While both interrogative and echo questions employ *wh*-movement as a result of Focus-Agreement, Den Dikken (2003) argues that the feature [WH] is present on the higher C head for interrogative questions, but not on that of echo questions. Under this analysis, wh-Agreement only occurs in interrogative questions, but not in echo questions. The lack of the feature [WH] in echo questions can thus explain why the wh-phrase may appear *in situ* in echo questions. (Den Dikken also posits remnant fronting in the case of *wh- in situ* echo questions.) If this were to apply in conjunction with Q-based movement, it could be possible to account for the distribution of massive pied-piping.

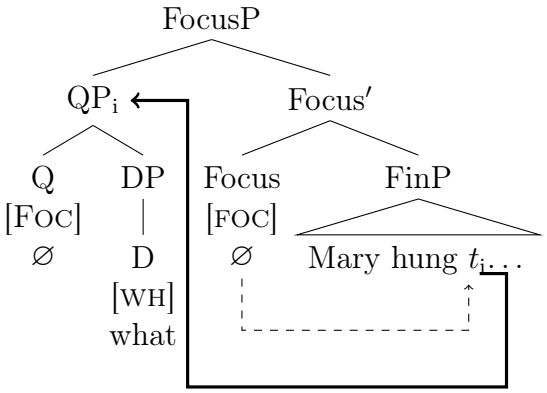
While Den Dikken's (2003) analysis can account for a separate asymmetry shown between truly interrogative matrix clause questions and echo questions, his analysis is incapable of dealing with pied-piping constructions of either the obligatory or optional massive pied-piping varieties. However, by merging Den Dikken's analysis with Cable's (2010), both the shape of the pied-piped constituent and the limited environments in which massive pied-piping occurs can be accounted for.

5.3 Applying the frameworks

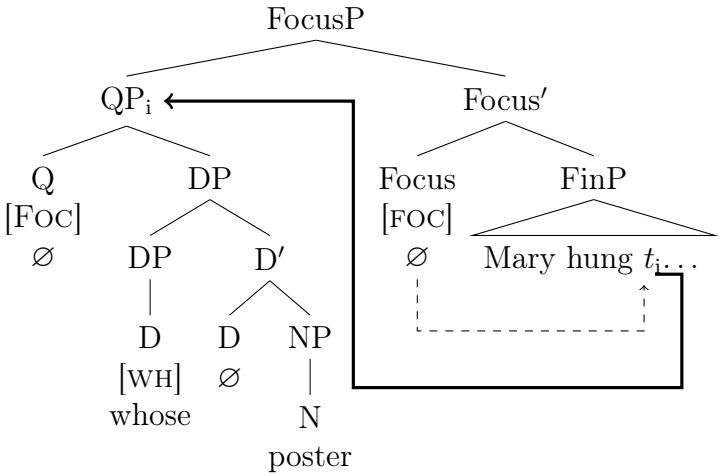
If we assume that *wh*-movement, widely construed, is the result of QP-movement, we can account for the size and shape of the constituent being pied-piped based on Cable's (2010) QP-Intervention Condition. However, rather than following's Cable's analysis to the letter, this conjoined analysis moves the QP to the Spec,FocP. This movement follows Den Dikken's (2003) analysis of *wh*-movement with respect to the landing site for the movement and the motivation for the movement, namely to satisfy the locality of Agree between the [+FOCUS] features on Focus and the Q-particle. This allows for the simple *wh*-movement in (78), obligatory pied-piping in (79), and

massive pied-piping in (80). At this stage of the derivation, there are no differences between the three cases.

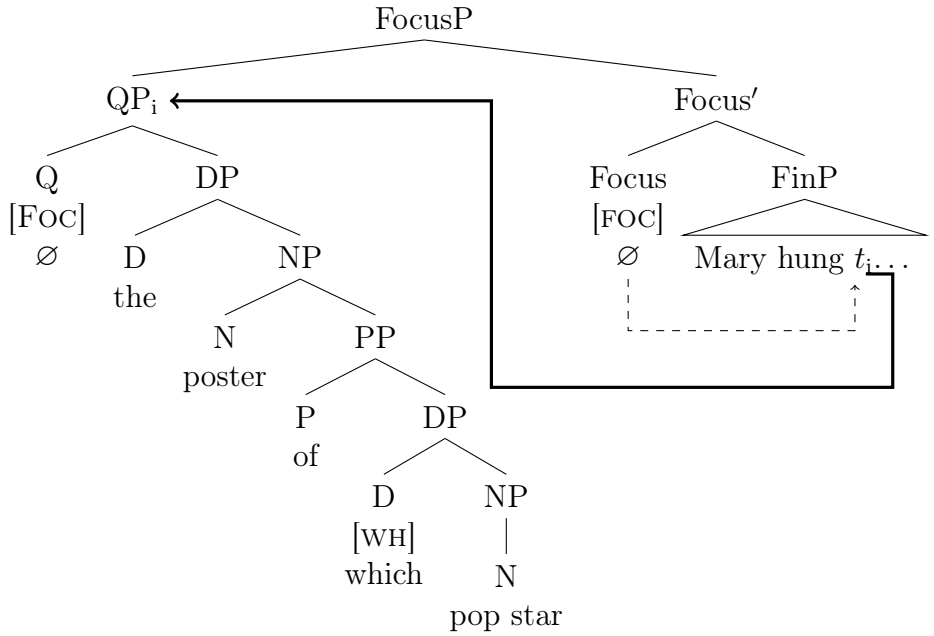
(78) *Wh*-movement to Spec,FocP



(79) Obligatory pied-piping to Spec,FocP.



(80) Massive pied-piping to Spec,FocP



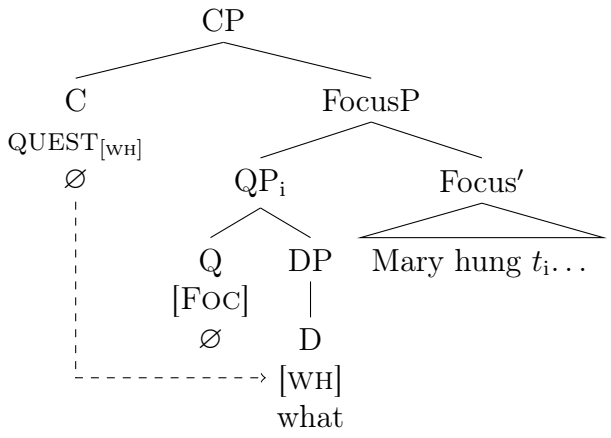
The real difference between massive pied-piping and other forms of QP movement boils down to the complementizer with which it is merged. Following Den Dikken (2003) (78), I assume that the complementizers of "truly interrogative" wh-questions have a [WH] feature, regardless of whether the question is subordinated or non-subordinated. I will also assume that the Q-operator adopted by Den Dikken is the same as the QUEST operator used by Krifka (1999) and McCloskey (2006) to provide the illocutionary force of a question. I further assume that the [WH] feature requires the presence of this operator.[2] Complementizers with QUEST operators can serve as the head of main clause questions or be c-selected for question predicates like *wonder* or *ask*.

In the derivation, when complementizer with the [WH] merges with FocP, the complementizer's [WH] initiates a probe for a corresponding feature in its complement.

[2]The QUEST operator may, however, occur without the [WH] feature, as this would be necessary in polar questions without *wh*-movement.

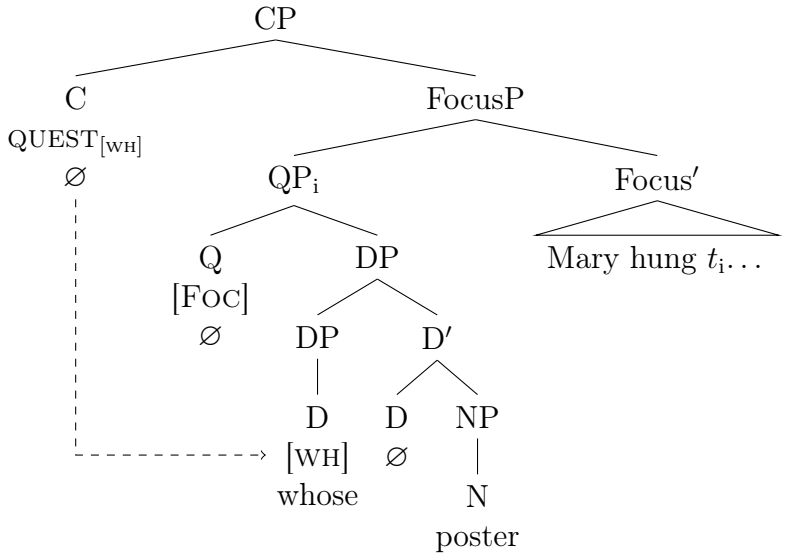
As shown in the derivation in (81), this [WH] is present on the first phonological unit within the complement. Following Richards' (2016) Contiguity Theory (and subsequently Richards' (2019) modification of Cable's (2010) QP-movement analysis of pied-piping), this puts the *wh*-word in a "continguity prominent" position. Due to the lack of intervening phonological content, the *wh*-word does not need to move for the locality of Agree to be satisfied. Thus, the derivation is allowed to continue.

(81) *Wh*-Agreement: *Wh*-movement



The same Agreement relationship holds true in cases of obligatory pied-piping, as shown in (82). Despite the fact that the *wh*-element is more deeply embedded in the hierarchical structure, no phonological content precedes it inside the QP. As such, it too is contiguity prominent, and the locality of Agree is satisfied.

(82) *Wh*-Agreement: Obligatory pied-piping

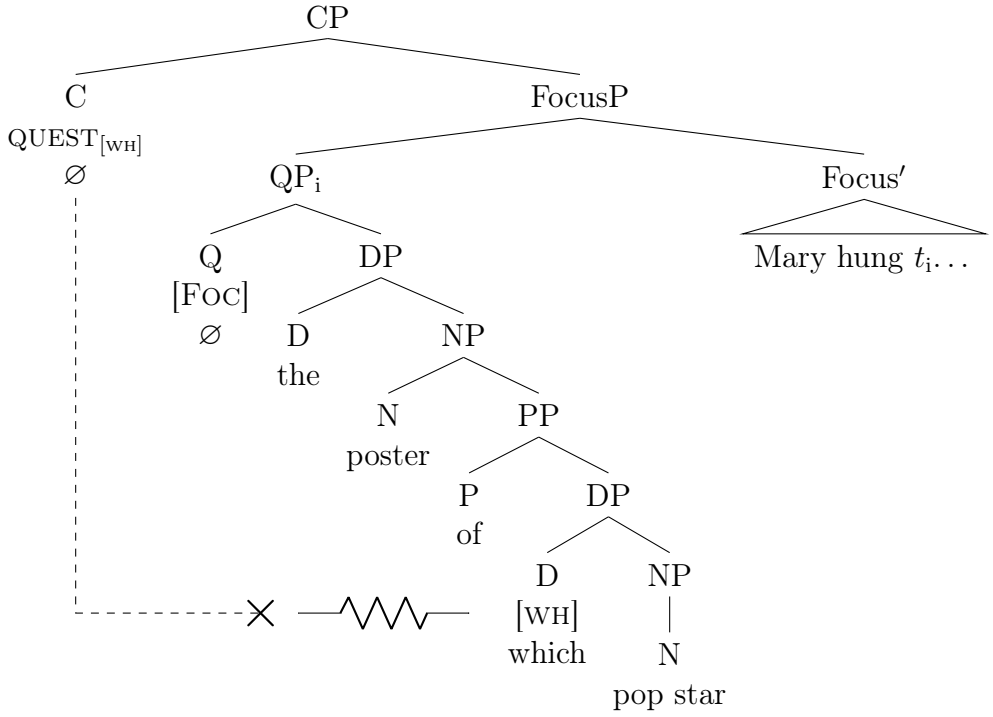


Either of the derivations given in (81) or (82) could readily serve as the complement to *wonder* or *ask*. It should be noted that the linear orders presented in (78) and (79) could not represent the linear order of matrix clause questions. However, Den Dikken's (2003) analysis already provides a solution to this problem. Under his framework, subject-auxiliary inversion is the results of a head-attracting feature on Foc.

The revised generalization on massive pied-piping would predict problems when the QP contains a massive pied-piping construction in interrogative clauses. While the movement of the QP was not problematic in (80), the massive pied-piping structure is problematic when FocP is merged with a complementizer hosting a QUEST operator with a [WH]. When the [WH] feature on the complementizer initiates its probe, it finds the compatible [WH] feature on the *wh*-element. However, unlike the cases above with simple *wh*-movement and obligatory pied-piping, the *wh*-element in the massive pied-piping structure is preceded by additional phonological content. This additional content prohibits the local Agreement relationship between the two [WH]

features, as the goal is not contiguity prominent. The only other option for Agreement would be to move the *wh*-word out of the QP. This should not be possible if moving a constituent freezes it Corver (2017). Since this cannot happen, the derivation crashes.

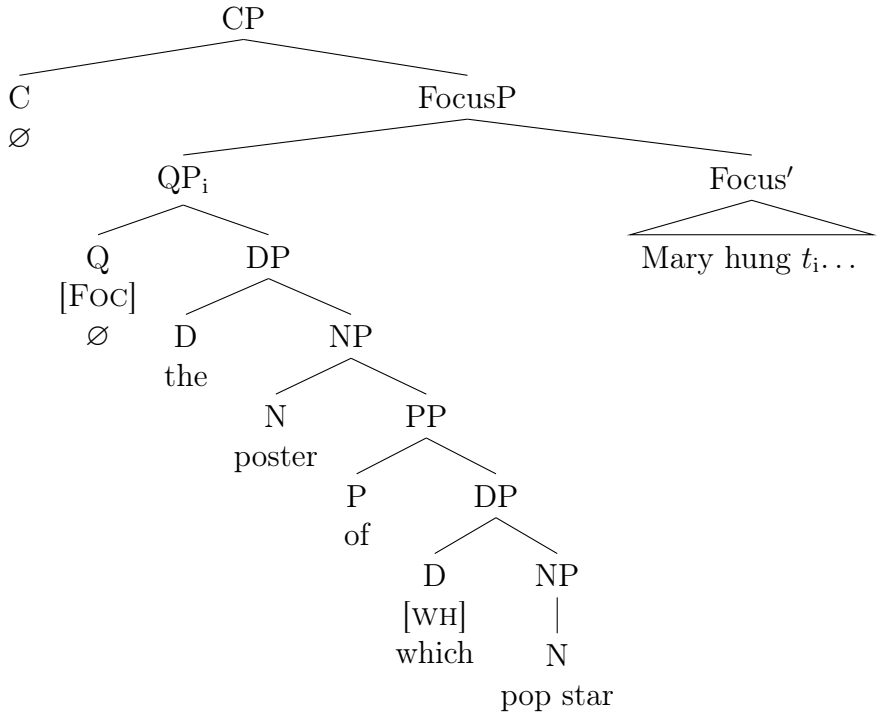
(83) *Wh*-Agreement failure: Massive pied-piping



Although an Agreement relationship fails here, just as it did in Richards (2019), there is a major difference between the relationship proposed here, and that proposed by Richards. Richards argues that there is always an Agreement relationship between Q and the *wh*-elements in questions, whereas C is seeking Agreement with the *wh*-element in (83). Richards' analysis without further detail would prohibit massive pied-piping completely. However, based on the evidence provided in Chapter 3, we still need for massive pied-piping to be possible in non-interrogative clauses.

These environments can allow massive pied-piping to pass because, unlike interrogative clauses, non-interrogative clauses lack a [WH], because they lack the requisite QUEST operator following Krifka (1999). Since the operator and feature are completely missing in the non-interrogative construction, no Agreement relationship is initiated by the complementizer, thus the derivation in (84) is allowed to continue.

(84) No *wh*-Agreement: Massive pied-piping



The above derivation could be incorporated directly as a complement of verbs like *know* and *surprise* or it could adjoin to a NP or DP to form either a restrictive or non-restrictive relative clause. Subject-auxiliary inversion in echo questions, as noted for true interrogative questions above, would result from T-to-Foc movement rather than T-to-C movement, following Den Dikken (2003).

One might question what prevents the structure of (84) from serving as the complement to an interrogative verb like *wonder* or *ask*. I would argue, following McCloskey (2006) and subsequently Krifka (1999), that these verbs require complements that serve as questions acts. Since these acts require a complementizer with a QUEST operator, merging (84) as the complement to *wonder* or *ask* would violate the selectional requirement of the verb.

5.4 A theoretical implication

I will note that the analysis provided here cannot account for pied-piping in all languages. As noted in Chapter 2, some languages like Tlingit allow unrestricted pied-pied. However, I would argue that this can be accounted for by following Cable's (2010) analysis a bit further. Notably, Cable argues that limited pied-piping languages, like English, have *wh*-Agreement between Q and the *wh*-element, thus allowing the variety of pied-piping possible in Tlingit. In my proposal above, I replace this Agreement with that between C and the *wh*-element. As such, I would suggest that languages with unrestricted pied-piping, such as Tlingit, simply do not have complementizers with a [WH] feature, and that *wh*-movement in these languages is the result of QP-movement as the result of Focus Agreement. The lack of *wh*-fronting in *wh-in-situ* would result from the lack of Focus-driven movement or be obscured by remnant fronting.

CHAPTER 6

CONCLUSION

6.1 Review

In this dissertation, I have shown how Heck's (2008) generalization, while on the right track in restricting massive pied-piping based on a quality of the CP hosting the movement, does not fully account for the wider distribution of where massive pied-piping may occur. As I have shown in Chapter 3, Heck's non-subordinated restriction cannot support the availability in massive pied-piping in restrictive relative clauses, as shown by evidence involving quantified NPs, licensing of parasitic gaps, bound variable interpretations, and the availability of weaker truth conditions. Furthermore, I show that massive pied-piping is also possible in embedded clause complements of factive predicates like *know*. Based on this evidence and the fact that massive pied-piping cannot occur in true matix clause interrogative questions, I proposed that the generalization on massive pied-piping be revised to restrict it to non-interrogative clauses.

The experimental evidence in Chapter 4 shows that English speakers actively use prosody to disambiguate between forming a restrictive or a non-restrictive relative clause interpretation during spoken language comprehension, when the relative clause is formed by simple *wh*-movement. While this has no immediate bearing on the question of massive pied-piping, it is in line with existing work on the effects of prosody on comprehension. Even though initial results for Experiment 2 were inconclusive, as I failed to find even the predicted effect of prosody in the obligatory pied-piping conditions, the results from the highly distinguishing subjects suggest that prosody

may still be used to disambiguate between restrictive and non-restrictive relative clauses, and I take it tentatively as confirmation that the relative clause diagnostics presented in Chapter 3 are on the right track.

Lastly, in Chapter 5, I presented my formal syntactic analysis account for the revised generalization on massive pied-piping. In this analysis, I used Cable's (2007; 2010) Q-based analysis of movement to account for both *wh*-movement and pied-piping and improved upon it by integrating in elements of Den Dikken's (2003) two-stage Focus/*wh*-Agreement process. By removing the [WH] from the Q-particle and transplanting it on interrogative complementizers with QUEST operator, the grammar can correctly predict where massive pied-piping can occur. Since both simple *wh*-movement and obligatory pied-piping results in QPs with *wh*-elements at the left periphery, they can agree readily with the [WH] on the complementizer, as they appear in a contiguity prominent position following Richards (2019). Contrastively, I show that the rightward embedding of the *wh*-element in massive pied-piping constructions disallows Agreement due to interference from competing phonological material and an inability to move the *wh*-element to a contiguity prominent position.

6.2 Prospects for continued study

While I make claims regarding the distribution of massive pied-piping in English, it would be ideal to test whether this is English-specific, or if it applies more broadly to other limited pied-piping. One particular area that may be more fruitful for this would be in examining the embedded clause asymmetry from Section 3.3 from a cross-linguistic approach, as most discussions of massive pied-piping focus on complements of interrogative predicates like *wonder*. While this may seem like a critical comment, I would say it is an honest oversight, as the examples in the literature

focusing on these embedded interrogative clauses are where we would most expect *wh*-movement to occur in the first place.

Additionally, it would be worth supplementing the traditional syntactic judgements from Chapter 3 with additional quantitative studies. While the results of Experiment 1 showed a clear indication that prosody was being used, the results of Experiment 2 were muddled. The *post hoc* analysis showed a potential trend of prosody in the massive pied-piping structures. With additional participants, this trend may end up being significant. However, given the ratio of highly distinguishing participant to the total number of participants and the lower plausibility ratings in general for Experiment 2, it may be more fruitful to retool or simply aspects of the experiment. One such simplification would be to return to the subject-extracted relative clause structures of Experiment 1 and deal with string-vacuous movement as a tradeoff.

Given that non-interrogative predicates like *know* take both DP and CP complement, it might also be possible to capture online behavioral measures such as reaction times in a self-paced reading task on constructions presented in (85). While both *know* and *recovered* can take DP complements, *recovered* cannot take a CP complement, which might be reflected in longer reading times on both the *wh*-word and after the embedded clause verb *stole* in (85a), when compared to (85b) with *knows* as the matrix clause verb. Contrastively, no differences might be predicted between the two relative clause constructions in (85c) and (85d).

(85) a. John recovered the picture of which president the arrogant thief stole t from the gallery.

b. John knows the picture of which president the arrogant thief stole t from the gallery.

c. John recovered the picture of the president the arrogant thief stole t from the gallery.

d. John knows the picture of the president the arrogant thief stole t from the gallery.

A similar experiment might look at differences between matrix interrogative and factive predicates, as shown in (86). If massive pied-piping is more acceptable embedded under factive predicates, we might expect shorter reaction times throughout the massively pied-piped constituent in the case of a factive predicate, (86a) than with an interrogative predicate, (86b). This may also be reflected in differences in reactions times immediately following the verbs and in the following spillover region. Such a difference around the gap sight would not be expected between the obligatory pied-piping constructions in (86c) and (86d), given that obligatory pied-piping is completely grammatical in both cases.

(86) a. John knows the portrait of which president the arrogant thief stole t from the gallery.

b. John wonders the portrait of which president the arrogant thief stole t from the gallery.

c. John knows which president's portrait the arrogant thief stole t from the gallery.

d. John wonders which president's portrait the arrogant thief stole t from the gallery.

Since both of these experiments involve online measures, they could eliminate the possible effect that the markedness of massive pied-piping might have on offline judgment tasks like the one presented in 4, as participants are would no longer be

tasked with making plausibility judgments. This might present additional, stronger evidence against Heck's (2008) generalization on massive pied-piping and provide additional support for the non-interrogative restriction presented in this dissertation.

APPENDIX A

EXPERIMENT 1: EXPERIMENTAL ITEMS

The following list contains the experimental items used for Experiment 1. Each item was manipulated so that the context statements were heard in four different forms. A complete paradigm is presented in (1). In the bi-sentential control condition, presented in (1a), the object of the first sentence appears as the subject of the second sentence, where it is modified with a copula clause. In the *wh-* non-restrictive relative clause condition, presented in (1b), modification of the object is done through a non-restrictive relative clause headed by the appropriate *wh*-element. The *wh-* restrictive relative clause condition, presented in (1c), modifies the object with a restrictive relative clause headed by the appropriate *wh*-element. The *that* restrictive relative clause, presented in (1d), modifies the object using a relative clause with a *that* relativizer. Lastly, the continuation statement, presented in (1e), includes the same predicate as the context statement forms, but the modifier of the object is changed to provide contrast.

(1) a. Bi-sentential control

James threw only 3 passes before being taken out of the game. These passes were intercepted.

b. *Wh-* non-restrictive relative clause

James threw only 3 passes, which were intercepted, before being taken out of the game.

c. *Wh-* restrictive relative clause

James threw only 3 passes which were intercepted before being taken out of the game.

d. *That* restrictive relative clause

James threw only 3 passes that were intercepted before being taken out of the game.

e. Continuation

Before being taken out of the game, James also threw several touchdown passes.

The items below have been simplified to include their bi-sentential control forms, presented in forms (a), and their continuations, presented in forms (b). The relative clause conditions can be reconstructed using the paradigm above.

(2) a. Mary beat only 4 players before being eliminated. These players were professionals.

b. Before being eliminated, Mary also beat several amateur players.

(3) a. John grabbed only 5 apples before leaving the store. These apples were red.

b. Before leaving the store, John also grabbed several green apples.

(4) a. Jennifer interviewed only 6 candidates before making her decision. These candidates were really good.

b. Before making her decision, Jennifer also interviewed several bad candidates.

(5) a. Robert adopted only 7 cats before realizing he was allergic. These cats were kittens.

b. Before realizing he was allergic, Robert also adopted several adult cats.

(6) a. Elizabeth interviewed only 8 scientists before writing her article. These scientists were previously unheard of.

b. Before writing her article, Elizabeth also interviewed several famous scientists.

(7) a. Michael graded only 8 papers before going to bed. These papers were sloppily-written.

b. Before going to bed, Michael also graded several neatly-written papers.

(8) a. Linda called only 7 mechanics before getting her car fixed. These mechanics were reputable.

b. Before getting her car fixed, Linda also called several shady mechanics.

(9) a. William talked to only 6 investors before getting a loan. These investors were interested.

b. Before getting a loan, William also talked to several indifferent investors.

(10) a. Susan wrote only 5 novels before retiring. These novels were thrilling.

b. Before retiring, Susan also wrote several boring novels.

(11) a. David had only 4 roommates before finding a place of his own. These roommates were slobs.

b. Before finding a place of his own, David also had several tidy roommates.

(12) a. Jessica photographed only 3 plants before leaving the garden. These plants were in bloom.

b. Before leaving the garden, Jessica also photographed several non-flowering plants.

(13) a. Richard sang for only 3 bands before signing his first record deal. These bands were good.

b. Before signing his first record deal, Richard also sang for several terrible bands.

(14) a. Sarah called only 4 venues before finding her ideal location. These venues were too expensive.

b. Before finding her ideal location, Sarah also called several affordable venues.

(15) a. Joseph fenced against only 5 competitors before he won the tournament. These competitors were left-handed.

b. Before he won the tournament, Joseph also fenced against several right-handed competitors.

(16) a. Karen ate only 6 cookies before getting full. These cookies were chocolate chip.

b. Before getting full, Karen also ate several peanut butter cookies.

(17) a. Thomas turned in only 7 assignments during the fall semester. These assignments were passable.

b. During the fall semester, Thomas also turned in several failing assignments.

(18) a. Nancy served only 8 customers during the lunch rush. These customers were polite.

b. During the lunch rush, Nancy also served several rude customers.

(19) a. Daniel toured only 8 houses during his search for a new home. These houses were new construction.

b. During his search for a new home, Daniel also toured several old houses.

(20) a. Lisa rooted for only 7 athletes during the Olympics. These athletes were American.

b. During the Olympics, Lisa also rooted for several German athletes.

(21) a. Matthew skipped only 6 questions during the exam. These questions were multiple choice.

b. During the exam, Matthew also skipped several fill-in-the blank questions.

(22) a. Sandra treated only 5 patients during her shift at the hospital. These patients were calm.

b. During her shift at the hospital, Sandra also treated several nervous patients.

(23) a. Tony worked at only 4 restaurants during college. These restaurants were dives.

b. During college, Tony also worked at several classy restaurants.

(24) a. Ashley taught only 3 students during fourth period. These students were excited.

b. During fourth period, Ashley also taught several bored students.

(25) a. Mark consulted only 3 advisors during his presidency. These advisors were knowledgeable.

b. During his presidency, Mark also consulted several incompetent advisors.

(26) a. Kimberly sold only 4 pies during the bake sale. These pies were coconut cream.

b. During the bake sale, Kimberly also sold several apple pies.

(27) a. Paul had only 5 partners during his business career. These partners were trustworthy.

b. During his business career, Paul also had several dishonest partners.

(28) a. Donna tried only 6 dishes during the potluck. These dishes were warm.

b. During the potluck, Donna also tried several cold dishes.

(29) a. Steven praised only 7 individuals during the ceremony. These individuals were present.

b. During the ceremony, Steven also praised several absent individuals.

(30) a. Carol proposed only 8 ideas during the meeting. These ideas were accepted.

b. During the meeting, Carol also proposed several rejected ideas.

(31) a. Andrew met only 8 actors during the casting call. These actors were inexperienced.

b. During the casting call, Andrew also met several veteran actors.

(32) a. Emily won only 7 medals during her Olympic career. These medals were silver.

b. During her Olympic career, Emily also won several gold medals.

(33) a. Kent acted in only 6 movies after moving to Hollywood. These movies were flops.

b. After moving to Hollywood, Kent also acted in several successful movies.

(34) a. Amanda hired only 5 employees after starting her own company. These employees were hard-working.

b. After starting her own company, Amanda also hired several lazy employees.

(35) a. George found only 4 nails after searching his garage. These nails were straight.

b. After searching his garage, George also found several bent nails.

(36) a. Helen kept up with only 3 friends after she became famous. These friends were from her high school.

b. After she became famous, Helen also kept up with several college friends.

(37) a. Joshua solved only 3 puzzles after claiming to be a genius. These puzzles were difficult.

b. After claiming to be a genius, Joshua also solved several easy puzzles.

(38) a. Melissa talked to only 4 lawyers after her accident. These lawyers were helpful.

b. After her accident, Melissa also talked to several useless lawyers.

(39) a. Kevin sold only 5 properties after getting his real estate license. These properties were commercial.

b. After getting his real estate license, Kevin also sold several residential properties.

(40) a. Laura worked with only 6 models after she started her modeling agency. These models were male.

b. After she started her modeling agency, Laura also worked with several female models.

(41) a. Brian defended only 7 clients after he became a lawyer. These clients were guilty.

b. After he became a lawyer, Brian also defended several innocent clients.

(42) a. Rebecca made only 8 investments after the financial crisis. These investments were risky.

b. After the financial crisis, Rebecca also made several safe investments.

(43) a. Jason had only 8 tenants after becoming a landlord. These tenants were long-term.

b. After becoming a landlord, Jason also had several short-term tenants.

(44) a. Amy reviewed only 7 documents after coming back from lunch. These documents were high-priority.

b. After coming back from lunch, Amy also reviewed several low-priority documents.

(45) a. Ryan fired only 6 employees after he was promoted. These employees were temporary hires.

b. After he was promoted, Ryan also fired several permanent employees.

(46) a. Anna applied for only 5 jobs after graduating. These jobs were full-time.

b. After graduating, Anna also applied for several part-time jobs.

(47) a. Jacob criticized only 4 senators after the government shutdown. These senators were Republicans.

b. After the government shutdown, Jacob also criticized several Democratic senators.

(48) a. Samantha bought only 3 pieces of furniture after moving into her house. These pieces of furniture were antiques.

b. After moving into her house, Samantha also bought several new pieces of furniture.

APPENDIX B

EXPERIMENT 2: EXPERIMENTAL ITEMS

The following list contains the experimental items used for Experiment 2. Each item was manipulated so that the context statement was heard in four different forms. A complete paradigm is presented in (1). The obligatory pied-piping context statements are presented in (1a) for restrictive prosody and in (1b) for non-restrictive prosody. Likewise, the massive pied-piping context statements for the restrictive and non-restrictive prosodies are in (1c) and (1d), respectively. The continuation statement is given in (1e).

(1) a. Obligatory pied-piping, restrictive prosody

Yesterday morning, 8 bus drivers whose routes the dispatcher redesigned had passengers complain.

b. Obligatory pied-piping, non-restrictive prosody

Yesterday morning, 8 bus drivers, whose routes the dispatcher redesigned, had passengers complain.

c. Massive pied-piping, restrictive prosody

Yesterday morning, 8 bus drivers the routes of whom the dispatcher redesigned had passengers complain.

d. Massive pied-piping, non-restrictive prosody

Yesterday morning, 8 bus drivers, the routes of whom the dispatcher redesigned, had passengers complain.

e. Continuation

Yesterday morning, several other bus drivers also had passengers complain.

The items below have been simplified to include the massive pied-piping, non-restrictive relative clause context statements, presented in forms (a), and the continuation state-

ments, presented in forms (b). The remaining context statements can be reconstructed using the paradigm above.

(2) a. After the jailbreak, 4 prisoners, the cells of whom the police had searched, were captured.

b. After the jailbreak, several other prisoners also were captured.

(3) a. During the battle, 5 ships, the captains of which the king had handpicked, were sunk.

b. During the battle, several other ships also were sunk.

(4) a. After the rehearsal, 6 dancers, the skills of whom the choreographer had criticized, quit the project.

b. After the rehearsal, several other dancers also quit the project.

(5) a. Over the weekend, 7 laptops, the screens of which the technician had recently replaced, were stolen.

b. Over the weekend, several other laptops also were stolen.

(6) a. Last semester, 8 students, the final essays of whom the professor could not understand, failed the class.

b. Last semester, several other students also failed the class.

(7) a. After the town hall meeting, 8 books, the authors of which several concerned parents disliked, were removed from the library.

b. After the town hall meeting, several other books also were removed from the library.

(8) a. During casting, 7 actors, the agents of whom the director had trusted, landed important roles.

b. During casting, several other actors also landed important roles.

(9) a. At the bake sale, 6 pies, the crusts of which the baker had accidentally burned, did not sell.

b. At the bake sale, several other pies also did not sell.

(10) a. Last school year, 5 teachers, the classes of whom the principle had observed, earned awards.

b. Last school year, several other teachers also earned awards.

(11) a. On the Antiques Roadshow, 4 rugs, the quality of which expert had praised, were fakes.

b. On the Antiques Roadshow, several other rugs also were fakes.

(12) a. In the article, 3 chefs, the restaurants of whom my parents have visited, were interviewed.

b. In the article, several other chefs also were interviewed.

(13) a. After the party, 3 cupcakes, the tops of which the girl had added sprinkles to, were left on the plate.

b. After the party, several other cupcakes also were left on the plate.

(14) a. During the talent show, 4 comedians, the routines of whom my mother found inappropriate, made it past the first round.

b. During the talent show, several other comedians also made it past the first round.

(15) a. On the exam, 5 questions, the answers to which the TA discussed during the review, were on the first page.

b. On the exam, several other questions also were on the first page.

(16) a. Last season, 6 farmers, the crops of whom the dust storm ravaged, took out sizeable loans.

b. Last season, several other farmers also took out sizeable loans.

(17) a. Two weeks after the hurricane, 7 small towns, the mayors of which the news interviewed, were still flooded.

b. Two weeks after the hurricane, several other small towns also were still flooded.

(18) a. Last fall, 8 hunters, the licenses of whom the warden had suspended, were caught poaching.

b. Last fall, several other hunters also were caught poaching.

(19) a. After being inspected, 8 apples, the flesh of which reckless handling had bruised, were discarded.

b. After being inspected, several other apples also were discarded.

(20) a. At the end of the circus, 7 clowns, the antics of whom the children had laughed at, came out for an encore.

b. At the end of the circus, several other clowns also came out for an encore.

(21) a. At the museum, 6 masterpieces, the artists of which the old curator had met, were on display.

b. At the museum, several other masterpieces also were on display.

(22) a. Last year, 5 ranchers, the cows of whom the vet vaccinated, reported having healthier calves.

b. Last year, several other ranchers also reported having healthier calves.

(23) a. Last weekend, 4 movies, the reviews of which the newspaper published, did well at the box office.

b. Last weekend, several other movies also did well at the box office.

(24) a. During the election, 3 candidates, the affairs of whom the media exposed, dropped out of the race.

b. During the election, several other candidates also dropped out of the race.

(25) a. During the airshow, 3 planes, the pilots of which the navy had trained, flew in the formation.

b. During the airshow, several other planes also flew in the formation.

(26) a. At the toy store, 4 teddy bears, the fur of whom the shop owner had brushed, sat above the counter.

b. At the toy store, several other teddy bears also sat above the counter.

(27) a. At the track, 5 cars, the engines of which the mechanics had suped up, qualified for the next race.

b. At the track, several other cars also qualified for the next race.

(28) a. After the mission, 6 soldiers, the orders of whom the captain had changed, were given medals.

b. After the mission, several other soldiers also were given medals.

(29) a. At the convention, 7 board games, the instructions of which the playtesters found confusing, received negative reviews.

b. At the convention, several other board games also received negative reviews.

(30) a. Yesterday morning, 8 bus drivers, the routes of whom the dispatcher redesigned, had passengers complain.

b. Yesterday morning, several other bus drivers also had passengers complain.

(31) a. During the concert, 8 songs, the lyrics of which everyone knew, were played.

b. During the concert, several other songs also were played.

(32) a. Last Friday, 7 lawyers, the clients of whom the judge had harshly sentenced, filed for appeals.

b. Last Friday, several other lawyers also filed for appeals.

(33) a. In the east hallway, 6 lockers, the doors of which students had vandalized, were repainted.

b. In the east hallway, several other lockers also were repainted.

(34) a. After the tournament, 5 coaches, the teams of whom the referees had unfairly penalized, filed complaints with the league.

b. After the tournament, several other coaches also filed complaints with the league.

(35) a. In game's update, 4 bugs, the effects of which many players exploited, were patched.

b. In game's update, several other bugs also were patched.

(36) a. After the audit, 3 accountants, the books of whom the IRS had seized, were charged with fraud.

b. After the audit, several other accountants also were charged with fraud.

(37) a. At the trade show, 3 inventions, the simplicity of which the judges had admired, received honorable mentions.

b. At the trade show, several other inventions also received honorable mentions.

(38) a. After the disaster, 4 scientists, the theories of whom the world had rejected, helped with the recovery effort.

b. After the disaster, several other scientists also helped with the recovery effort.

(39) a. After the wildfire, 5 trees, the trunks of which the blaze had severely damaged, were cut down by the rangers.

b. After the wildfire, several other trees also were cut down by the rangers.

(40) a. During the legislative session, 6 senators, the votes of whom both parties wanted, received praise from the president.

b. During the legislative session, several other senators also received praise from the president.

(41) a. Over the last five years, 7 products, the uses of which researchers discovered by accident, made the company money.

b. Over the last five years, several other products also made the company money.

(42) a. After the trial, 8 witnesses, the identities of whom the marshals kept secret, came out of hiding.

b. After the trial, several other witnesses also came out of hiding.

(43) a. In the basement, 8 light fixtures, the bulbs of which the maintenance man had recently replaced, started to flicker.

b. In the basement, several other light fixtures also started to flicker.

(44) a. At the Christmas party, 7 employees, the hard work of whom the CEO valued, were given bonuses.

b. At the Christmas party, several other employees also were given bonuses.

(45) a. After the investigation, 6 reports, the contents of which the authorities heavily redacted, were released to the public.

b. After the investigation, several other reports also were released to the public.

(46) a. During the expedition, 5 explorers, the reputations of whom the archeologists questioned, went missing.

b. During the expedition, several other explorers also went missing.

(47) a. At the concert, 4 musical pieces, the composers of which few people had heard of, were featured.

b. At the concert, several other musical pieces also were featured.

(48) a. At the jousting tournament, 3 knights, the armor of whom the famous blacksmith had forged, were knocked from their horses.

b. At the jousting tournament, several other knights also were knocked from their horses.

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