Composing Questions

by

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Abstract

This dissertation motivates a new syntax and semantics for simplex and multiple *wh*-questions, concentrating on English and German data. The proposed theory combines Cable's (2007; 2010) Q-based syntax for *wh*-movement and pied-piping with a new and simple semantics that combines ingredients familiar from the literature in a novel way. I model the pair-list reading of the question as denoting a family of questions (Roberts, 1996; Hagstrom, 1998; Krifka, 2001; Büring, 2003; Fox, 2012; Nicolae, 2013, a.o.), and derive the pair-list and single-pair readings of the question from minimally different LFs. This theory naturally fits with existing analyses of the presuppositions of questions and with Beck's (2006) theory of focus intervention effects.

The proposed syntax-semantics leads to a new descriptive generalization for focus intervention effects. I present novel data that the previously assumed strict correlation between intervention and superiority in English (Pesetsky, 2000) is incorrect. Instead, intervention occurs whenever the relation between a *wh*-word and its associated Q-particle is disrupted at LF. This happens in superiority-violating questions, inside overt and covert pied-piping constituents, and in superiority-obeying questions whenever covert *wh*-movement is restricted to a position below an intervener. Furthermore, intervention can be avoided in superiority-violating questions if the in-situ *wh* is given wide scope above an intervener through non-interrogative movement.

Finally, I present arguments from offline judgments as well as from online sentence processing that in-situ *wh*-phrases in English superiority-obeying questions undergo covert movement, but in-situ *wh*-phrases in superiority-violating questions are truly in-situ at LF. I furthermore argue that the covert movement step of the in-situ *wh* should be modeled as *covert scrambling* instead of the unbounded movement to the interrogative complementizer that is traditionally assumed. Movement targets the first position where a *wh* is interpretable, and is only extended in extraordinary cases, for example in order to avoid a structure that would be an intervention effect, or in order to allow for ellipsis resolution. This makes the behavior of English parallel to that of German. I argue that this is advantageous for the acquisition of questions and intervention, and helps to account for our understanding of the cross-linguistic typology of multiple questions.

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⁂

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To my grandparents and their families,
who history has forgotten.

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s	World
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italic	*Wh*-word
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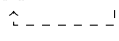	Covert movement
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The thesis, in the form of a haiku

Simple semantics
But a more complex syntax
So many questions.

Chapter 1

Background

In a language like English, the formation of a constituent question involves at least two steps. First, a structure is formed in which a *wh-phrase* is produced in an argument position of a predicate, (1a).[1] Second, that *wh*-phrase is *overtly moved* to the left edge of the sentence, (1b). In a *multiple question* only one *wh*-phrase is pronounced at the left edge of the sentence, while the remaining *wh*-phrase(s) are pronounced in-situ, in what appears to be their base-generated positions, (1c). In *wh*-in-situ languages, all *wh* phrases in a question appear in their base positions, including in simplex questions such as (2).

(1) ***Wh*-in-situ in a *wh*-movement language (English):**

a. Fred introduced *which* student to Mary?

b. *Which* student did Fred introduce ____ to Mary?

c. *Which* student did Fred introduce ____ to *which* professor?

(2) ***Wh*-in-situ in a *wh*-in-situ language (Japanese):**

John-ga *nani*-o katta no?
John-NOM what-ACC bought Q

'What did John buy?'

The question in (1c) exemplifies a *superiority-obeying* structure, which the base-generated *higher wh* is overtly fronted. In addition to such questions, English also allows for *superiority-violating* structures, where the base-generated *lower wh*-phrase is fronted. These two question types show an asymmetry with regard to *intervention effects*: an *intervener* such as *only* or negation occurring above the in-situ *wh*-phrase in a multiple question

[1] In this dissertation I will limit my attention to *wh*-questions with *wh*-arguments rather than *wh*-adjuncts.

induces ungrammaticality in superiority-violating questions but not in superiority-obeying questions:

(3) **Superiority-violating questions are subject to intervention effects:**

a. Superiority-obeying, no intervener:
✓ *Which* student did Fred introduce ____ to *which* professor?

b. Superiority-violating, no intervener:
✓ *Which* professor did Fred introduce *which* student to ____?

c. Superiority-obeying, intervener:
✓ *Which* student did **only** Fred introduce ____ to *which* professor?

d. Superiority-violating, intervener:
* *Which* professor did **only** Fred introduce *which* student to ____?

This dissertation motivates a new syntax and semantics for *wh*-questions. My goal is to combine Cable's (2007; 2010) syntactic theory of *wh*-movement and pied-piping with a simple semantics for questions, building on established ingredients in the literature. This proposal is able to derive the readings of multiple *wh*-questions in a principled way, while naturally fitting with existing analyses of the presuppositions of the question (Dayal, 1996) and with Beck's (2006) theory of intervention effects. After presenting the core proposal, the remainder of the dissertation offers a detailed exploration of the syntax, semantics, and processing of in-situ *wh*-phrases, focusing in particular on English multiple *wh*-questions.

The emerging picture is one in which in-situ *wh*-phrases undergo *partial wh-movement* to positions other than interrogative C, where they are interpreted using in-situ composition. I suggest that this movement step should be modeled as *covert scrambling*, and that the analysis of English and German multiple questions is parallel with the single exception of whether the in-situ *wh* undergoes *overt* or *covert* scrambling. I argue that this view is more parsimonious than previous approaches and furthermore allows for better understanding of the acquisition of multiple questions and intervention effects.

Throughout, I use the phenomenon of intervention effects to diagnose areas in the question where movement has occurred and areas where in-situ composition is used. I offer evidence for the view that intervention happen when a *wh*-in-situ occurs below an intervener, and is unable to (overtly or covertly) move above it at LF.

The notions of covert movement and focus alternatives, superiority, intervention effects, pied-piping, and readings of multiple questions will be introduced in more detail

in the remainder of this chapter. Section 1.1 introduces the two mainstream approaches to *wh*-in-situ: covert movement and focus-alternatives composition. Section 1.2 discusses the single-pair and pair-list readings of multiple questions. Section 1.3 discusses superiority effects. Section 1.4 presents Beck's (2006) theory of intervention effects in multiple *wh*-questions. Section 1.5 introduces the syntax and semantics of Cable's (2010) theory of Q-particles. Finally, section 1.6 surveys two arguments from the previous literature that support the covert movement analysis of *wh*-in-situ.

1.1 Two approaches to the syntax of multiple questions

1.1.1 Two types of semantics for questions

The literature offers two main approaches to the semantics of questions. Groenendijk and Stokhof's (1984) approach takes questions to denote *partitions*. The intention of a question is a function from worlds to sets of worlds which maps every world to the set of worlds that are equivalent to it with respect to the property denoted by the question. We can illustrate this semantics for a question such as *who came?*, with a domain consisting of just two individuals, John and Mary. The propositions that the question operates on are given in (4b), the meaning of the question is given in (4c), and the partition induced by the question is given in (4d).

(4) **Groenendijk and Stokhof's semantics for questions**

a. *Who* came?

b. Domain: {John, Mary}, p_1 = John came, p_2 = Mary came

c. $\lambda w'.\ \lambda w$ [($\lambda x.\ x$ came in w) = ($\lambda x.\ x$ came in w')]

d.

$p_1 = 1, p_2 = 1$	$p_1 = 1, p_2 = 0$	$p_1 = 0, p_2 = 1$	$p_1 = 0, p_2 = 0$

The answer to the question is its extension in the world of evaluation w_0—that is, the set of proposition that coincide with w_0 in terms of who came. If both John and Mary came, then the true answer is the leftmost cell in the partition; if John came but Mary didn't the answer is the second cell in the partition; and so one.

In this dissertation, I do not use Groenendijk and Stokhof's (1984) proposal but instead adopt the other mainstream approach to question semantics, the Hamblin/Karttunen approach (Hamblin, 1973; Karttunen, 1977). Under this approach, questions denote sets of

propositions, denoting the possible answers to the question. This is illustrated in example (5), where (5c) shows the meaning of the question, and (5d) shows the set of possible answers to the question given our domain.[2]

(5) **The Hamblin/Karttunen semantics for questions**

a. *Who* came?

b. Domain: {John, Mary}

c. $\lambda p_{\langle s,t \rangle}$. $\exists x$ [x is a person in w_0 & $p = x$ came]

d. {John came in w_0, Mary came in w_0}

Note furthermore that a simplex question like *who came* has, alongside its meaning, a presupposition, that its Hamblin/Karttunen denotation has a maximally informative member (Dayal, 1996). I return to a discussion of this point in section 1.2.

Turning our attention next to the syntax-semantics of multiple *wh*-questions, the literature provides two approaches to the interpretation of in-situ *wh*-phrases in a multiple question in languages like German and English: *covert movement* and *in-situ interpretation*. Under the covert movement approach, all *wh*-phrases must be structurally adjacent to the head that interprets them in the CP periphery. This approach thus predicts covert movement of in-situ *wh*-phrases as a prerequisite for their interpretation. The in-situ approach invokes a mechanism that interprets *wh*-phrases without any movement. Below is a brief description of the two approaches.

1.1.2 The covert movement approach

Covert movement is typically viewed as a language- or construction-specific variant of overt movement. In particular, many researchers have proposed that (phonologically) in-situ *wh*-phrases as in (1c) covertly move to C at LF in the same way that overt *wh*-movement is observed in (1b–c). Under this approach to questions, *wh*-phrases must be at the CP edge in order to be able to make their contribution to the meaning of the question. Consequently, no *wh*-phrase may remain in situ at LF; instead, all *wh*-phrases occur syntactically next to the complementizer, regardless of where they are pronounced (cf. Karttunen 1977; Aoun et al. 1981; Huang 1982b,a; Nishigauchi 1986; Lasnik and Saito 1992; Hornstein 1995;

[2]Note that it is possible to derive the partitions used in Groenendijk and Stokhof's (1984) semantics from a Hamblin/Karttunen semantics: we can define a function that will take an Hamblin/Karttunen denotation and yield an equivalence relation, or partition, on any set of possible worlds (see Heim, 1994; Fox, 2012).

Hagstrom 1998; Pesetsky 2000; Richards 2001; Beck 2006; Cable 2007, 2010). The LF proposed under this approach for the question in (1c) is schematized in (6).[3]

(6) **The covert movement approach to *wh*-in-situ:**
Which student [*which* professor [C [Fred introduced ____ to ____]]]

Pesetsky (2000) presents an argument for covert *wh*-movement in English multiple questions based on the fact that both overt and covert *wh*-movement obey the same command condition. The trace position must be c-commanded by the C to which the *wh*-phrase moves.

(7) **Command condition on overt and covert *wh*-movement:**
   a. [Give a book to John] I can guess [*who* C will ____]!
   cf. I can guess who will give a book to John!
   b. * [Give a book to t_i] I can guess [who_i C Mary will ____]!
   cf. I can guess who Mary will give a book to!
   c. * [Give a book to whom] I can guess [*who* C will ____]!
   cf. I can guess who will give a book to whom!

The ungrammaticality of (7b–c) reflects a command requirement on movement. Pesetsky notes that a similar condition does not appear to affect pronouns when they function as bound variables, as (8) demonstrates. It appears that the semantics can in fact interpret a fronted VP in its (reconstructed) base position.

(8) **Command condition is not semantic:**
[Give a book to his mother] I can guess *who* will ____!

Under the *covert movement* approach to *wh*-in-situ, then, the LF representation of *Who gave what to whom?* looks as in (9b), where all three *wh*-phrases have undergone *wh*-movement. Strike-throughs indicate the pronunciation pattern.

(9) **English multiple questions: LF and pronunciation:**
   a. *Who* gave *what* to *whom*?
   b. [*who* ~~*what whom*~~ [~~*who*~~ gave *what* to *whom*]]

[3]Here and throughout, straight arrows indicate overt movement, dashed arrows indicate covert movement, and curly arrows indicate an area in which in-situ composition is used. These arrows are used here as a notational convenience only.

Modeling English multiple *wh*-questions in this way is supported by the behavior of multiple questions in Slavic languages (cf. Lasnik and Saito, 1984; Rudin, 1985; Pesetsky, 1987, among others). In these languages the covert instances of *wh*-movement posited for English can be overt. That is, the proposed LF for English multiple questions as in (9b) differs e.g. from its Bulgarian counterpart (10b) only in how its *wh*-chains are pronounced.

(10) **Bulgarian multiple questions: LF and pronunciation:**

a. *Koj kakvo* na *kogo* dade?
who what to whom gave
'Who gave what to whom?'

b. [*koj kakvo na kogo* [~~*koj kakvo na kogo*~~ dade]]

English and Bulgarian multiple questions, then, have identical LFs. What distinguishes these two languages (and others that follow patterns such as exemplified by these two languages) are pronunciation rule that govern the PF representations of English, (11), and Bulgarian, (12), respectively (cf. Pesetsky, 1998, 2000):

(11) **Pronunciation rule (English):**
Pronounce the highest *wh*-phrase in Spec,CP in its high position, all other *wh*-phrases in their trace positions.

(12) **Pronunciation rule (Bulgarian):**
Pronounce all *wh*-phrases in Spec,CP in their high position, leave them unpronounced in their trace positions.

The covert movement approach thus predicts pervasive covert movement in multiple *wh*-questions. Moreover, movement is always triggered for one and the same reason—the semantic needs of the *wh*-phrases themselves—and it always targets the same syntactic position at LF: C.

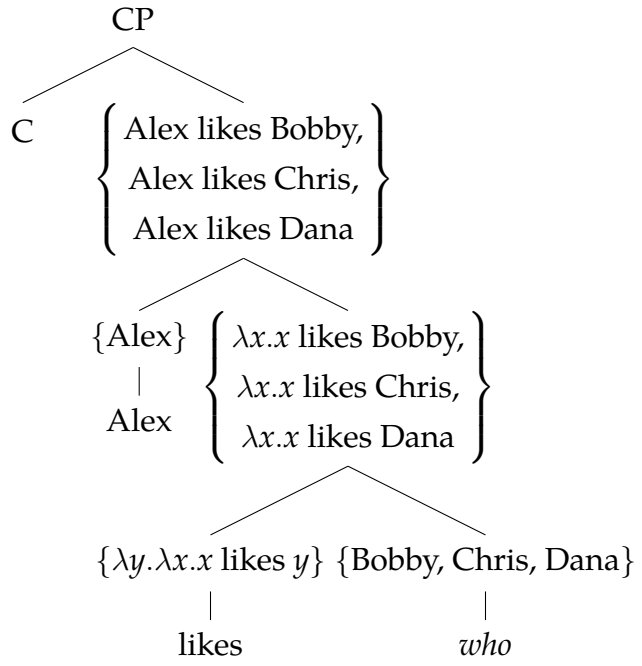
1.1.3 The in-situ approach

Alongside the covert movement approach to *wh*-in-situ, a second popular approach is the *in-situ approach* to *wh*-in-situ. Under the in-situ approach to questions, no (overt or covert) movement is required in order to assign interrogative meaning to a structure containing *wh*-elements (cf. Baker, 1970; Hamblin, 1973; É Kiss, 1986; Engdahl, 1986; Nishigauchi,

1986, 1990; Cheng, 1991; Tsai, 1994; Chomsky, 1995; Reinhart, 1997, 1998; Kratzer and Shimoyama, 2002; Shimoyama, 2006). The meaning of a question like (14) can be calculated through a mechanism that passes the meanings of *wh*-words up the structure until they reach C, where they can be interpreted.[4]

Rooth-Hamblin alternatives are a parallel mode of semantic interpretation, where a *focus-semantic value* can be computed compositionally for each syntactic node, in parallel to its ordinary semantic value. This computation has been argued to supply operators such as focus operators and question complementizers with a relevant set of alternative denotations or propositions (Hamblin, 1973; Rooth, 1985, 1992, a.o.). Consider the LF representation for the *wh*-in-situ pseudo-English question "Alex likes *who*?" in (13) below. Focus-semantic values—also referred to as *alternatives*—are given for each node.

(13) **A toy LF of question interpretation via Rooth-Hamblin alternative computation:**



In (13), the *wh*-phrase *who* has a focus-semantic value corresponding to relevant individuals in its domain—here, the animate individuals Bobby, Chris, and Dana.[5] These *alter-*

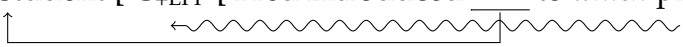
[4]Alternative mechanisms for in-situ interpretation involves the use of choice-functions (Reinhart, 1997), or unselective binding (Nishigauchi, 1986, 1990). Here I do not discuss this mechanism in detail. As will become clear in subsequent sections, there are theories of intervention effects that rely on the use of alternative-computation in certain regions of a question, but there is no theory I am familiar with that uses choice-functions and is able to explain intervention effects. I will leave open the question of whether it is possible to relate intervention effects to a choice-function analysis of *wh*-in-situ.

[5]See also section 1.5 for more details on the semantics of *wh*-words like *who* and *what*.

natives compose pointwise at each nonterminal node,[6] resulting in the complement of the interrogative C having a set of propositions as its focus-semantic value.[7] The interrogative C then computes the question denotation using these alternatives in its complement, so that these alternative propositions correspond to possible (weak) answers to the question. In this way, the focus-semantic value provided by the in-situ *wh*-phrase is interpreted by the interrogative C. This yields the appropriate question semantics without establishing a syntactically local relationship between the *wh*-phrase and C.

From this perspective, there is no reason to expect any instances of *wh*-movement that are caused by the semantic needs of the *wh*-words themselves. Even the fact that English questions require overt fronting of one *wh*-phrase is unexpected. To explain this fact, a purely syntactic mechanism must be invoked, unrelated to interrogative semantics, for example an 'EPP' feature requiring C to have a filled specifier (Chomsky, 1981):

(14) **The in-situ approach to *wh*-in-situ:**



In the current literature on interrogative syntax-semantics, both approaches to *wh*-in-situ surveyed here are commonly adopted and used. Moreover, some recent theories make use of both mechanisms within the same language and even in the derivation of the same question (e.g. Pesetsky, 2000; Beck, 2006; Cable, 2010; Kotek, 2014b). The semantic proposal developed in this dissertation is compatible with both a covert movement and an in-situ syntax for *wh*-in-situ. The syntax I motivate, however, requires both covert movement and in-situ composition, applied in a different order than normally assumed, for the interpretation of *wh*-in-situ.

1.2 Presuppositions and the meaning of questions

The literature recognizes three different readings of multiple *wh*-questions: the pair-list, single-pair, and echo-question reading (Wachowicz, 1974; Pope, 1976; Bolinger, 1978; Comorovski, 1989; Dayal, 1996). This dissertation concentrates on the first two readings, and

[6] Here I will not be presenting computations of Rooth-Hamblin alternatives beyond the toy example in (13). I refer the reader to Hamblin (1973); Rooth (1985, 1992) and subsequent work on the technical details of Rooth-Hamblin (focus) alternative computation.

[7] The semantic denotations here must be interpreted intensionally. World variables are not illustrated here to simplify the presentation.

will not discuss the last one. To see the difference between the single-pair answer and the pair-list answer to a question, consider two situations in which the multiple *wh*-question *who cooked what?* can occur and the answers it admits in those situations.

Suppose that we are in a context in which we know that one person ate exactly one dish, but we are ignorant as to who was doing the eating and what they ate. In that case, we might ask (15a) in order to find out the identity of the single person-dish pair given in the context. This is the single-pair reading of the question, with the possible answer in (15b).

(15) **Single-pair answer to a multiple question:**

a. *Who* ate *what*?

b. Fred ate the beans.

Next suppose that we are in a context in which there are several dishes on the table, and we know that several people have been eating them. We can then ask the question in (16). In this case, we are interested in the proper pairing between two sets that are given in the discourse. Crucially, this reading presupposes that there are at least two pairs in the list. This is the pair-list reading of the question.

(16) **Pair-list answer to a multiple question:**

a. *Who* ate *what*?

b. Fred ate the beans, Mary ate the eggplant, and John ate the broccoli.

At this point it is useful to note that we could ask questions about our context, in which multiple people ate multiple things, in one of two ways. As Jackendoff (1972) points out, "we presuppose ... that there were a number of people and a number of different things to eat, and that various people ate various things. Speaker A in the discourse is asking questions of the form *Who ate what?*:"

(17) **A discourse strategy for discussing *'who are what?'*:**

a. *What* did Fred eat?

b. *What* did Mary eat?

c. *What* did John eat?

⋮

In such cases, the conversation is keyed on the people in the discourse. Büring (2003) develops a theory of question-answer congruence that explains the pitch associated with

the answer to such questions. Concentrating in (18) on just one such subquestion in the discourse above, we might provide the answer that Fred ate the beans. Here, *Fred* is the (contrastive) *topic* and *the beans* are the *focus*. This corresponds to the pronunciation scheme described in (18), from Büring (2003).

(18) **Sub-question keyed on 'Fred':**
Q: Well, what about FRED? What did HE eat?
A: FRED_{CT} ate the BEANS_{F}

Formally, when describing the meaning of the questions in (17), we have here a 'family of questions,' ordered by the higher *wh*-word in the question, *who*. Below I illustrate this state of affairs with the more complex question *which guest ate which dish?*, which will allow us to compare superiority-obeying and superiority-violating word orders. For the question above, the corresponding family of questions is given in (19)

(19) **Family of questions denotation keyed on 'guests':**
$[\![\textit{which}\ \text{guest ate}\ \textit{which}\ \text{dish?}]\!] = \{\{x\ \text{ate}\ y : y \in \textit{dish}\} :\ x \in \textit{guest}\}$
$\approx$ {What did Fred eat? What did Mary eat? What did John eat?}

Here, the discourse is structured in such a way that we ask a question about each person in the context, namely what they ate. Notice that alternatively we could structure our discourse based on the dishes and ask for each one, who ate them:

(20) **Another discourse strategy for discussing '*who ate what?*':**
a. *Who* ate the beans?
b. *Who* ate the eggplant?
c. *Who* ate the broccoli?
⋮

Focusing on just one sub-question again, we notice that although we can provide the same string as the answer to the question, the pitch that is associated with the answer is different.[8] Here, *Fred* is the *focus* and *the beans* are the (contrastive) *topic*. This corresponds to the pronunciation scheme described in (21), again from Büring (2003).

[8] As Büring (2003) notes, this way of answering the question assumes that the issue is not completely settled, and there are other questions with a similar structure that are still under discussion.

(21) **Sub-question keyed on 'the beans':**

Q: Well, what about the BEANS? Who ate THEM?

A: FRED_{F} ate the BEANS_{CT}

Formally, the 'family of questions' described by (20) is now ordered by the lower *wh*. Using again the question *which guest ate which dish?*, we can now describe this question with a superiority-violating word order:

(22) **Family of questions denotation keyed 'dishes':**

$[\![\textit{which}$ dish did $\textit{which}$ guest eat?$]\!] = \{\{x$ ate $y : x \in \textit{guest}\} : \ y \in \textit{dish}\}$

$\approx$ {Who ate the beans? Who ate the eggplant? Who ate the broccoli?}

Dayal (2002) shows that pair-list readings presuppose (a) *Exhaustivity*: every member of the set quantified over by the overtly moved *wh* is paired with a member of the set quantified over by the in-situ *wh*; and (b) *Point-wise uniqueness* (*functionhood*): every member of the set quantified over by the overtly moved *wh* is paired with no more than one member of the set quantified over by the in-situ *wh*. Within the family of questions analysis of multiple questions, we predict *exhaustivity* to apply to member of the outer set in e.g. (19), and *uniqueness* to apply to the inner set. We will see in section 2.3.3 that this will be a useful way of describing the meanings of multiple questions and deriving their presuppositions.

The exhaustivity and uniqueness presuppositions are illustrated in examples (23)-(24) (from Fox 2012).

The context in (23a) allows for a pair-list answer (as well as a single-pair) because it is possible to give an exhaustive answer that accounts for each of the children. In the context in (23b), on the other hand, to give a pair-list answer we would be forced to assume that two kids are assigned to the same chair, making this reading deviant. Hence only a single-pair answer is felicitous in this context.

The context in (24a) allows for a unique chore to be assigned to each boy, but (24b) leaves one chore that is not assigned to any boy, or else the 1:1 pairing is lost. Hence only a single-pair answer is felicitous in this context.[9]

[9]Note the importance of using singular *which*-phrases, to ensure that we are dealing with a pair-list reading. If a plural *which*phrase is used, e.g. *which boys will do which chores?*, it is possible to give a single-pair answer where each member of the pair is a plurality: *John, Tom and Bill will set the table, sweep the floor, and do the dishes (respectively).*

(23) **Exhaustivity presupposition:**

a. Guess *which* one of these 3 kids will sit on *which* of these 4 chairs.
Good with a single-pair answer and with a pair-list answer.

b. Guess *which* one of these 4 kids will sit on *which* of these 3 chairs.
Only good with a single-pair answer.

(24) **Uniqueness presupposition:**

The Jones family (3 boys) will not sit down for dinner before the boys do all of the chores.

a. I wonder *which* one of the 3 boys will do *which* one of the 3 chores.

b. # I wonder *which* one of the 3 boys will do *which* one of the 4 chores.
Suggests that the boys will not do all of the chores.

See Jackendoff (1972); Roberts (1996); Büring (2003); Constant (2014), and citations therein, for further discussion of contrastive topics and question-answer congruence. Further discussion of this issue is beyond the scope of this dissertation.

1.3 Superiority effects

Wh-phrases of different levels of complexity may sometimes have varying degrees of freedom in the movement operations that apply to them. In English, for example, superiority-violating multiple questions as in (25b) lead to ungrammaticality (Chomsky, 1973).

(25) **Superiority effect (English):**

a. *Who* ____ bought *what*?

b. * *What* did *who* buy ____?

An early description of this phenomenon is given in Kuno and Robinson (1972):

(26) **Kuno and Robinson's constraint:**
A *wh*-word cannot be preposed crossing over another *wh*.

Following this proposal, superiority violations are explained by a principle such as Attract Closest, requiring an ordering of movement operations (Relativized Minimality: Rizzi 1990, 2001; Frampton 1991; Minimal Link Condition, MLC: Chomsky 1995, 2000). Here I adopt a version of Attract Closest inspired by Pesetsky (2000) under which it is Agree, not Attract, that is subject to strict locality, (27). This principle induces a strict ordering on Agree operations, such that higher targets must be Agreed with before lower

targets may be attended to. An Attract operation may be triggered immediately following an Agree operation (Chomsky, 1998, 1999).

(27) **Definition: Agree with Closest**
A Probe K can Agree with a goal α only if there is no goal β that is closer to K than α is. (α is closer to K than β iff α asymmetrically c-commands β, and K c-commands both α and β).

(28) **Definition: C-command**
Node A c-commands node B if and only if the first branching node that dominates A also dominates B, and A does not dominate B and B does not dominate A.

(29) **Definition: Asymmetric c-command**
Node A asymmetrically c-commands node B if and only if A c-commands B and B does not c-command A.

If we assume that in English multiple questions, all *wh*-phrases must move to C by LF in an order preserving manner (tucking in, Richards 1997), we require a pronunciation rule as in (11) mentioned above to derive the surface word-order we in fact observe in English multiple questions: Pronounce the highest interrogative phrase in Spec,CP in its high position, all other *wh*-phrases in their trace positions.

We derive (25a) from a structure in which *who* and *what* are Agreed with and Attracted to C in order: [who_1 [$what_2$ [C ... t_1 ... t_2]]]. There is no derivation that could allow *what* to occupy the highest specifier of C: to arrive at such a structure we must either leave *who* in situ and attract *what* over it: *[$what_2$ [C ... who_1 ... t_2]]], or we must cross movement paths instead of tucking in when we move *what* following the movement of *who*: *[$what_2$ [who_1 [C ... t_1 ... t_2]]]. As a result, (25b) is predicted to be ungrammatical.

Pesetsky (1987), citing Chomsky (1973), observes that English questions with D-linked *wh*-phrases allow superiority violations in cases where simplex *wh*-words do not.

(30) **D-linked questions can violate superiority:**
a. *Which* person ____ bought *which* book?
b. *Which* book did *which* person buy ____?

Pesetsky proposes to explain the grammaticality of (30) by assuming that in the case of D-linked English questions, unlike with non-D-linked questions, it suffices that just one interrogative phrase move to C at LF (Pesetsky 2000). Hence, the superiority-obeying (30a)

can be derived from a structure in which both *wh*-phrases move to C at LF, just as in the case of (25a). The superiority-violating (30b) is derived from a structure in which both *wh*-phrases have been Agreed with but only the lower one has undergone movement, leaving the higher *wh*-phrase in situ.[10] The schematic description of superiority-obeying questions and superiority-violating questions is given in (31).

(31) **LF representations of superiority-obeying and superiority-violating questions:**

a. $[_{CP}\ wh_1\ wh_2\ [\ C\ [_{TP}\ ...\ t_1\ ...\ t_2\ ]]]$ superiority-obeying

b. $[_{CP}\ wh_2\ [\ C\ [_{TP}\ ...\ wh_1\ ...\ t_2\ ]]]$ superiority-violating

Other languages are reported not to exhibit superiority effects, even with simplex *wh*-phrases. In German, for example, it has been reported that both the superiority-obeying question (32a) and the superiority-violating question (32b) are grammatical, although several authors still report a preference for the superiority-obeying word-order over the violating word-order (e.g. Featherston, 2005b).

(32) **Superiority effect (German):**

a. *Wer* hat *was* gekauft?
who has what bought
'Who bought what?'

b. *Was* hat *wer* gekauft?
what has who bought
'What did who buy?'

Pesetsky (2000) argues that in German, only one *wh*-phrase can be hosted in Spec,CP, and all other *wh*-phrases must remain in-situ. A derivation as proposed for English D-linked superiority-violating questions is used for all German questions. As we will see below, this proposal is thus able to predict that in German, all questions are subject to intervention effects, but in English only superiority-violating questions exhibit such effects.

[10] Although not explicitly discussed in Pesetsky (2000), the in-situ *wh* must then be interpreted using an in-situ interpretation mechanism of some kind.

1.4 Intervention effects in multiple questions

1.4.1 The data

Pesetsky (2000) reports a correlation between superiority and *intervention effects* in English and German multiple questions with D-linked *wh*-phrases, a phenomenon was first noted by É Kiss (1986) for English, Rizzi (1990) for German. Motivating examples are given in (33): (33a–b) show that English generally allows both superiority-obeying questions and superiority-violating questions with D-linked *wh*-phrases. Examples (33c–d) show that when certain interveners—here, negation—are introduced into the questions, only the superiority-obeying structure is grammatical. The superiority-violating question becomes unavailable.[11]

(33) **D-linked superiority-violating questions possible but subject to intervention:**

a. *Which* boy ____ read *which* book? ✓ sup.-obeying, no intervener

b. *Which* book did *which* boy read ____? ✓ sup.-violating, no intervener

c. *Which* boy did**n't** ____ read *which* book? ✓ sup.-obeying, intervener

d. * *Which* book did**n't** *which* boy read ____? * sup.-violating, intervener

Other operators that give rise to an intervention effect include **only**, **very few**, **never**, and **no one**, as shown in examples (34)–(37) below from Pesetsky (2000).

(34) **Intervention effect with *only* only affects superiority-violating question:**

a. *Which* girl did **only** Mary introduce ____ to *which* boy?

b. * *Which* boy did **only** Mary introduce *which* girl to ____?

(35) **Intervention effect with *very few* only affects superiority-violating question:**

a. *Which* picture did **very few** children want to show ____ to *which* teacher?

b. * *Which* teacher did **very few** children want to show *which* picture to ____?

(36) **Intervention effect with *never* only affects superiority-violating question:**

a. *Which* student did he **never** claim ____ would talk about *which* topic?

b. * *Which* topic did he **never** claim *which* student would talk about ____?

[11] Beck (2006) and Pesetsky (2000) report that in cases of intervention in multiple *wh*-questions such as (33), some speakers report that the question is ungrammatical while some others report that the question's single-pair reading is maintained but its pair-list reading is lost. Beck (1996a) reports that some speakers find the question incomprehensible (uninterpretable) rather than simply ungrammatical. I will discuss the status of the single-pair and pair-list readings of questions with interveners in section 6.5.

(37) **Intervention effect with *no one* only affects superiority-violating question:**

a. *Which* book did **no one** give to *which* student?

b. * *Which* student did **no one** give *which* book to ___?

In German, both superiority-violating questions and superiority-obeying questions are subject to intervention effects. Thus we observe an intervention effect in the superiority-obeying (38a), where the negative quantifier **niemand** (*no one*) occurs above the in-situ *wh*-phrase *wo* (*where*).[12] A similar question with a name (*Luise*) instead of a quantifier is grammatical, (38b). Moreover, intervention is avoided by overt scrambling the lower *wh*-phrase above the intervener, (38c) (cf. Beck, 1996a; Beck and Kim, 1997, a.o.).

(38) **Intervention effects in superiority-obeying question in German:**

a. * *Wen* hat **niemand** *wo* gesehen?
whom has nobody where seen
'Where did nobody see whom?'

b. *Wen* hat Luise *wo* gesehen?
whom has Luise where seen
'Where did Luise see whom?'

c. *Wen* hat *wo* **niemand** gesehen?
whom has where nobody seen
'Where did nobody see whom?'

Cross-linguistically, intervention effects have been found in *wh*-fronting languages as well as in *wh*-in-situ languages, and several competing theories have been proposed to explain the phenomenon (cf. Beck, 1996a, 2006; Beck and Kim, 1997; Kim, 2002; Pesetsky, 2000; Tomioka, 2007a,b; Cable, 2010; Mayr, to appear, see also Hoji 1985; Rizzi 1990; Hagstrom 1998; Soh 2005). For a language that uses both a movement and a in-situ strategies for the formation of questions and overtly exemplify the behavior assumed here, see Kobele and Torrence (2006).

The characterization of the set of interveners has been a source of debate in recent literature. Beck (2006) and Beck and Kim (2006) identify a number of focus-sensitive operators, including **only**, **also**, **even**, sentential negation, and negative quantifiers such as **no one,**

[12]Note that an equivalent structure in English, e.g. (37a) is grammatical despite the presence of a potential intervener—**no one**—above the in-situ *wh*-phrase *which student*.

never, few as a cross-linguistically stable set of interveners.[13] In addition, quantifiers such as **every** and quantificational adverbs such as **often** and **always** also act as interveners. A recent proposal, which describes the set of interveners as non-additive quantifiers, is given in Mayr (2010, to appear).[14]

1.4.2 Intervention: An informal description

As we have seen, Pesetsky (2000) argues that superiority-obeying questions and superiority-violating questions are derived from different structures. Of particular importance is the location of the (phonologically) in-situ *wh*-phrase: the in-situ *wh*-phrase covertly moves to C at LF in an English superiority-obeying question, but remains in its base-generated position in a superiority-violating question. The resulting structures for English are given in (39a–b). In German, all (phonologically) in-situ *wh*-phrases remain in-situ at LF, yielding the schema in (39b) for all German multiple questions.

(39) **LF representations of superiority-obeying and superiority-violating questions:**

a. $[_{CP}\ wh_1\ wh_2\ [\ C\ [_{TP}\ ...\ t_1\ ...\ t_2\ ]]]$ superiority-obeying

b. $[_{CP}\ wh_2\ [\ C\ [_{TP}\ ...\ wh_1\ ...\ t_2\ ]]]$ superiority-violating

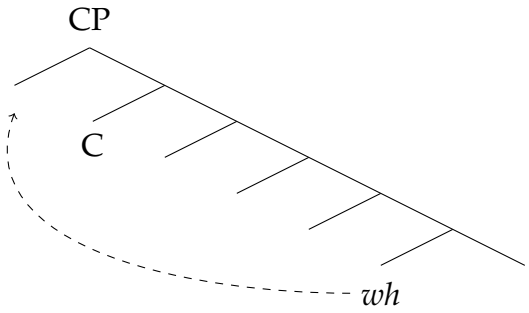
Beck (2006) proposes that when the (phonologically) in-situ *wh*-phrase does not undergo covert movement (wh_1 in 39b), it is interpreted via Rooth-Hamblin alternative computation (Hamblin, 1973; Kratzer and Shimoyama, 2002, a.o.). These two strategies for establishing a relation between the interrogative C and *wh* and assigning *wh* a semantics are schematized in (40a,b) respectively. Both strategies have been independently proposed in the literature for the analysis of (phonologically) in-situ *wh*-phrases, and are widely used in current research on the syntax and semantics of multiple *wh*-questions.

[13] Büring (1996a) argues that sentential negation is not a focus-sensitive operator, possibly raising a problem for the theory in Beck (2006). He argues that apparent focus-sensitive effects of the interpretation of negation in declaratives can be reduced to sentences with different prosody being congruent to different questions under discussion. (A similar argument is made in Beaver and Clark (2008, chapter 3).) I note, however, that these arguments are based solely on the contribution of negation in declaratives. A full investigation of the potential effects of focus on negation in interrogatives is outside of the scope of this dissertation. Here I simply follow Pesetsky (2000) and Beck (2006) who show that sentential negation in English patterns with the other items as an intervener.

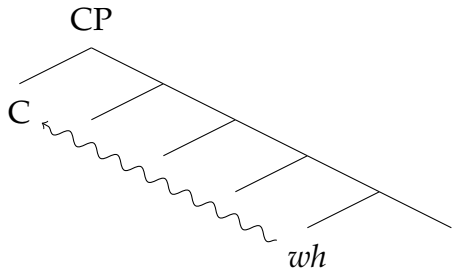
[14] I will not discuss this proposal in detail here, but see footnote 10 in Chapter 3 for additional discussion.

(40) **Two ways to interpret in-situ *wh*:**

a. Covert movement:



b. Rooth-Hamblin alternatives:



Beck (2006) argues that the Rooth-Hamblin alternative computation strategy of interpreting *wh*-phrases is subject to intervention effects:

(41) **Description of an intervention effect:**
When a focus-sensitive operator occurs between an LF-in-situ *wh*-word and its associated C, the operator disrupts the projection of the *wh*-word's alternatives. As a result, the *wh*-word cannot be interpreted by C, and the derivation crashes.

This logic stems from the fact that Rooth-Hamblin focus alternative computation is *unselective*; that is, the semantic contribution of a focused constituent is not *indexed* to be only visible to one particular focus-sensitive operator. Therefore if another focus-sensitive operator intervenes, it can interrupt the association of the higher operator with the focused constituent below, as schematized in (42):[15]

(42) **The focus intervention schema (Beck, 2006):**

* Op_1 ... Op_2 ... XP_F
$\underset{\sim\sim\sim\sim\sim\sim\sim\sim}{\leftarrow}$

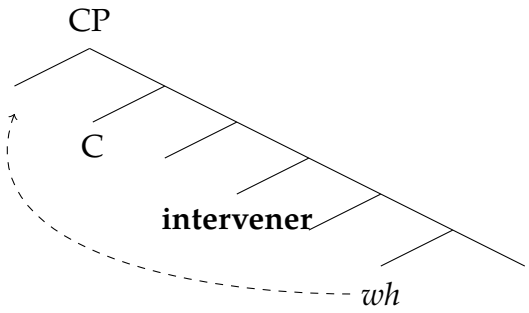
One instantiation of this illicit configuration—which affects the interpretation of multiple *wh*-questions—is schematized in (43b). The problem here is one of *Minimality*: the alternatives projected from the *wh*-word must be interpreted by the associated complementizer. However, focus-sensitive operators also interpret alternatives in their scope (Rooth, 1985, 1992). When a focus-sensitive operator (represented as **intervener**) intervenes in between the in-situ *wh*-word and the interpreting complementizer, the alternatives projected

[15]This schema is called the *General Minimality Effect* in Beck (2006, p. 17).

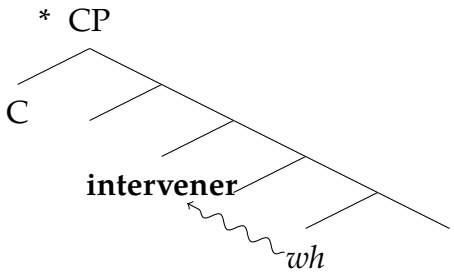
by the the *wh*-word will be interpreted by the intervener instead of by C, thus disrupting the question interpretation.[16,17]

(43) **Only the Rooth-Hamblin alternatives method is subject to intervention:**

a. Covert movement:



b. Rooth-Hamblin alternatives:



The covert movement strategy of interpreting *wh*-phrases, on the other hand, is immune from intervention effects: intervention only affects *wh*-phrases that project focus alternatives but not traces of *wh*-movement (43a).

The Beck (2006) schema for intervention effects between an in-situ *wh*-phrase and C is summarized in (44). Given this schema for intervention effects, we predict such effects to arise in superiority-violating questions when an intervener is introduced between the in-situ *wh*-word and C. We expect not to find intervention effects for superiority-obeying questions, since all *wh*-phrases in such questions move to C by LF. These structures are illustrated in (45) below. This is consistent with the findings of Pesetsky (2000).[18]

(44) **Intervention schema with in-situ *wh*-phrases (Beck, 2006):**

* LF: [C ... **intervener** ... *wh*]

[16]It is worth noting that for intervention effects to occur as theorized by Beck (2006) in structures such as (43b), the alternatives used by focus-sensitive operators (à la Rooth) and the alternatives used for question interpretation (à la Hamblin) must be the same formal objects. This equivalence of focus alternatives and *wh*-interpreting alternatives is therefore an important theoretical claim of Beck's (2006) system. This formal equivalence reflects the long-observed similarities between *wh* and focus realization cross-linguistically, including in syntax and prosody (Horvath 1986; Culicover 1992; Simpson 2000; Arregi 2002; Szendrői 2003; Simpson and Bhattacharya 2003; Truckenbrodt 2013 and many others). However, see for example Mayr (to appear) for arguments against this approach.

[17]Note that there may also be another problem when interpreting configuration (43b). Standard focus-sensitive operators utilize both the focussemantic value and the ordinary semantic value for their interpretation (Rooth, 1985, 1992), but the ordinary semantic value for the complement of the intervener in (43b) will be undefined (see further discussion in section 1.5).

[18]Note that the more general schema in (42) predicts intervention effects in only in questions but also in Association with Focus constructions. Beck (2006) discusses this prediction but fails to find intervention effects in these configurations. However, see Erlewine and Kotek (2014) for a discussion and an argument that such effects do in fact exist, when covert focus movement is controlled for.

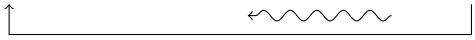
(45) **The interaction of superiority and interveners at LF (cf (39)):**

a. English superiority-obeying questions: no intervention effects

✓ [$_{CP}$ wh_1 wh_2 [C [$_{TP}$ ... **intervener** ... t_1 ... t_2]]]

b. English sup-violating questions, all German questions: intervention effects

* [$_{CP}$ wh_2 [C [$_{TP}$ ... **intervener** ... wh_1 ... t_2]]]



1.4.3 Beck's (2006) theory of intervention effects

In this section I present Beck's (2006) formal theory of intervention effects. The details are presented here for completeness, but the reader should be able to ignore this section and still understand the arguments made in this dissertation.

Informally, the description of an intervention effects is as was given above: a linguistic structure is ungrammatical if a focus-sensitive operator (an **intervener**) occurs between an LF-in-situ *wh*-phrase and the complementizer that must interpret it:

(46) **Intervention schema with in-situ *wh*-phrases (Beck, 2006):**

* LF: [C ... **intervener** ... *wh*]

Beck (2006, section 3.2) proposes a formal semantic mechanism to predict this observed behavior. The proposal borrows from Rooth (1992); Kratzer (1991), and Wold (1996). Within this mechanism, each logical form α has an ordinary semantic value $[\![\alpha]\!]^g$ and a focus-semantic value $[\![\alpha]\!]^{g,h}$. The usual assignment function is g, and h is used for interpretation of "distinguished variables." In the syntactic structure for (47a), the squiggle operator $\sim$ is added, and *ALT* represents a set of alternatives provided by the context.

(47) **A simple sentence with focus:**

a. **Only** John left.

b. [[only *ALT*] [$\sim$*ALT* [John$_{F1}$ left]]]

A two-place semantics for *only* is given in (48). Here, *only* takes two arguments: the first is the set of alternatives *ALT*, and the second is the prejacent (that is, the remainder of the sentence, including the squiggle operator):

(48) **A two-place semantics for *only*:**
$[\![\text{only}]\!](\alpha)(\beta)(\text{w}) = 1$ iff for all p such that $p(w)$=1 and $p \in \alpha$, $p = \beta$

The alternatives in *ALT* are computed from the focus-semantic value of the prejacent by replacing the F-marked constituent with other elements provided by the context. For (47) the alternatives might contain propositions such as {*John* left, *Mary* left, *Bill* left, ...}. The sentence is then true if the only true alternative is the one represented by the ordinary semantic value of the prejacent. That is, if it is true that John left and no one else left.

Beck defines the way that *ALT* comes to have the alternatives in it in (49): The ordinary value of [$\sim$*ALT* Y] is undefined unless *ALT* only contains propositions that are possible alternatives to the prejacent. The focus-semantic value of the proposition is reset to its ordinary value:

(49) **The meaning of a focussed sentence:**
$[\![\sim ALT\ \text{Y}]\!]^{g,h} = [\![\sim ALT\ \text{Y}]\!]^{g}$

(50) $$[\![\sim ALT\ \text{Y}]\!]^{g} = \begin{cases} [\![\text{Y}]\!]^{g} \text{ if } \text{g}(ALT) \subseteq \{[\![\text{Y}]\!]^{g,h'} : h' \in \text{H and } h' \text{ is total}\} \\ \text{undefined otherwise} \end{cases}$$

Each focused constituent carries an index. The focus-semantic value of that constituent is set to be whatever the distinguished variable assignment function h assigns for that index. Otherwise, it is set to be the same as the ordinary semantics of the unfocused constituent, (51).

(51) **The semantics of a focused constituent:**
$$[\![\text{XP}_{\text{F1}}]\!]^{g,h} = \begin{cases} h(1) \text{ if } 1 \in \text{Dom}(h) \\ [\![\text{XP}_{\text{F1}}]\!]^{g} \text{ otherwise} \end{cases}$$

The derivation of (47a) is as in (52).

(52) **The derivation of (47a):**

a. $[\![\text{ John}_{\text{F1}} \text{ left }]\!]^g = \lambda w.$ John left in w

b. $[\![\text{ John}_{\text{F1}} \text{ left }]\!]^{g,h} = \lambda w.h(1)$ left in w

c. $[\![\sim ALT [\text{ John}_{\text{F1}} \text{ left }]]\!]^g = \begin{cases} \lambda w.\text{John left in w} \\ \quad \text{if for all } h' \in \text{H} \\ \quad h' \text{ is total} \rightarrow \lambda w.h'(1) \text{ left in } w \in g(ALT) \\ \text{undefined otherwise.} \end{cases}$

d. $[\![[\text{ only } [\sim ALT [\text{ John}_{\text{F1}} \text{ left }]]]\!]^g = \begin{cases} [\![\text{only}]\!](\lambda w.\text{John left in w}) \\ \quad \text{if for all } h' \in \text{H} \\ \quad h' \text{ is total} \rightarrow \lambda w.h'(1) \text{ left in } w \in g(ALT) \\ \text{undefined otherwise.} \end{cases}$

$= \begin{cases} (1 \text{ iff for all } p \text{ such that p(w)=1 and p} \in ALT, \text{ p = John left in w}) \\ \quad \text{if for all } h' \in \text{H}, h' \text{ is total} \rightarrow \lambda w.h'(1) \text{ left in } w \in g(ALT) \\ \text{undefined otherwise.} \end{cases}$

$= \begin{cases} (1 \text{ iff for all } p \text{ such that p(w)=1 and p} \in ALT, \text{ p = John left in w}) \\ \quad \text{if } g(ALT)\{\lambda w.x \text{ left in } w : x \in D\} \\ \text{undefined otherwise.} \end{cases}$

Next we can turn to the derivation of a question. Beck assumes that *wh*-phrases have a focus-semantic value, but no ordinary semantic value:

(53) **The semantics of *who*:**

Ordinary semantics: $[\![who_1]\!] =$ undefined

Focus-semantics: $[\![who_1]\!]^{g,h} = \begin{cases} h(1) \text{ if } 1 \in \text{Dom}(h) \\ \text{undefined otherwise} \end{cases}$

Beck also assumes the following interpretability principle (see also Beck and Kim (2006)):

(54) **Principle of Interpretability (Beck, 2006, p. 16):**
An LF must have an ordinary semantic value.

Since a *wh*-word only has a focus-semantic value, a sentence cannot contain a *wh*-phrase unless it also contains a question operator, C, which discards the (undefined) ordinary semantic value generated by the *wh*-word and uses just the focus semantic value.[19]

(55) **The question operator and its meaning:**

a. $[\![\text{C}_i \text{ Y}]\!]^{g,h} = [\![\text{C}_i \text{ Y}]\!]^{g}$

b. $[\![\text{C}_i \text{ Y}]\!]^{g} = \lambda p.\exists x [p = [\![\text{Y}]\!]^{g,h[x/i]}]$

Intervention effects occur if a focus-sensitive operator—associated with a $\sim$ operator—is encountered before the question operator C, as in the LF in (56):[20]

(56) **The LF of a question with an intervention effect:**

a. Only John$_F$1 saw *who*?

b. [$_{\text{CP}}$ C$_i$ [$_{\text{IP3}}$ only [$_{\text{IP2}}$ $\sim$*ALT* [$_{\text{IP1}}$ John$_j$ saw *who*$_i$]]]]

In this structure, the squiggle operator is the first operator c-commanding the *wh*-phrase, and therefore it will interpret the focus instead of C. The squiggle operator refers to the ordinary semantic value of its sister, in addition to the focus-semantic value. As a result, the ordinary semantic value at the level of IP$_2$ will be undefined, because it contains a *wh*-phrase which, by definition, does not have an ordinary semantic value. At this point, the focus-semantic value of IP$_2$ is set to its ordinary semantic value, which again is undefined. Once this step takes place, there is no way for the derivation to recover. Even if a question operator C is introduced later, e.g. above IP$_3$ in (56b), discarding the undefined ordinary semantic value that has been inherited by IP$_3$ won't fix the problem, because the focus-semantic value that C will operate on is also undefined. The result, then is an uninterpretable structure, which leads to ungrammaticality which we diagnose as an intervention effect.

In more general terms, this system dictates that the first focus-sensitive operator c-commanding a *wh*-phrase must be a question operator, C. All other focus-sensitive operators in natural language operate on both the ordinary semantic value as well as the focus-semantic value of their sister, and as a result will lead to an uninterpretable structure if they apply to a *wh*-phrase, which does not have an ordinary semantic value.

[19]The reader will note that I am using different notation than Beck does. Beck uses the symbol Q to refer to the question operator; I will instead reserve this symbol for Q-particles in the sense of Cable (2010) (see section 1.5). I reserve C for the interrogative complementizer, which is a version of Beck's question operator. I use *ALT* to indicate sets of alternatives.

[20]Note that, following Beaver and Clark (2008), the squiggle operator itself is not necessary for the logic of the argument. All that matters is that a focus-sensitive operator is the first operator c-commanding an in-situ *wh* instead of a question operator.

1.5 Q-particles and Cable's theory of pied-piping

1.5.1 The syntax of Q-particles

Q-particles have been argued to be central to the analysis of *wh*-in-situ languages as well as *wh*-fronting languages (Hagstrom, 1998; Miyagawa, 2001; Kishimoto, 2005; Cable, 2007, 2010). Here I will adopt Cable's 2007; 2010 theory of Q-particles, where movement of *wh*-elements and pied-piping are recast as instances of Q-movement. *Wh*-in-situ languages and *wh*-fronting languages share a very similar structure: in all languages, *wh*-words are rendered interpretable through the help of a Q-particle, which must move to the interrogative complementizer, C, in time for interpretation. The Q-particle can attach directly to a *wh*-word or to a larger structure that contains a *wh*-word—a *wh-phrase*.

The presence of Q-particles driving interrogative movement and pied-piping is apparent in Tlingit (Na-Dene; Alaska, British Columbia, Yukon), the object of Cable's study. In (57), we have several examples of questions in Tlingit. Questions may involve the fronting of a bare *wh*-word, (57a), or pied-piping of additional material of different sizes, (57b–d). Each fronted phrase contains a *sá* particle at its right edge. Cable argues that this is a Question-particle, which projects a further phrasal layer, a QP. In a multiple question, each *wh*-phrase occurs with its own Q-particle, (57e). The QPs in the question are all attracted to the CP layer by the interrogative probe, which probes for Q-features.

(57) ***Wh*-movement and pied-piping in Tlingit (Cable, 2010):**

a. [Daa **sá**] i éesh al'óon?
what **Q** your father he.hunts.it
'What is your father hunting?'

b. [Daakw keitl **sá**] asháa?
which dog **Q** it.barks
'Which dog is barking?'

c. [Goodéi **sá**] kkwagóot?
where.to **Q** I.will.go
'Where will I go to?'

d. [Goodéi wugootx **sá**] has oowajée i shagóonich?
where.to he.went **Q** they.think your parents.ERG
'Where do your parents think that he went?'

e. [Aadóo **sá**]$_1$ [daa **sá**]$_2$ [$_{TP}$ t_1 yéi oowajée [t_2 du jee yéi teeyí]]?
who **Q** what **Q** they.think their hand.at it.is.there
'Who thinks they have what?'

The possible merger sites of the Q-particle are subject to cross-linguistic variation. As we can see above, in Tlingit it is possible to front large constituents, including verbal and clausal material, which is impossible in languages like English and German. Cable refers to the latter languages as 'limited pied-piping' languages. In these languages, the placement of Q is regulated via a locality-sensitive Agree operation between the Q-particle and the *wh*-word.

(58) **Limited pied-piping languages (Cable, 2010, p. 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.[21] Thus limited pied-piping languages are those where Q/*wh*-Agreement must occur.

This explains the limited distribution of pied-piping in English, illustrated in (59):

(59) **Complements of lexical heads cannot pied-pipe Cable (2010, p. 151):**

a. I wonder [[$_{DP}$ *whose* [$_{NP}$ pictures]] John bought]?

b. * I wonder [[$_{NP}$ pictures of *whom*] John bought]?

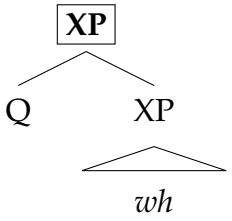
c. * I wonder [[$_{AP}$ proud of *whom*] John was]?

d. * I wonder [[$_{VP}$ eaten *what*] John has]?

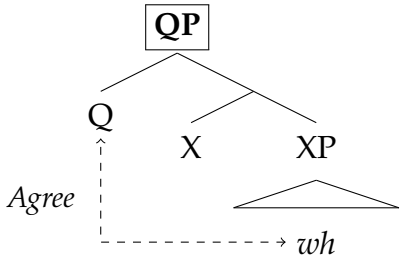
Wh-in-situ languages and *wh*-fronting languages differ in the way Q-particles project after they have been merged into the derivation. In *wh*-in-situ languages, Q *adjoins* to XP and XP projects, (60a). In *Wh*-movement languages, on the other hand, Q merges with XP, and projects a QP layer, (60b). For Cable, this choice of adjunction vs. projection is made at the level of the individual language and is then used for all cases of QP-construction in the derivation of all questions in that language. This behavior of Q-particles is assumed without any argument.

(60) **Possible QP structures in Cable (2010):**

(a) *wh*-in-situ languages:



(b) *wh*-fronting languages:

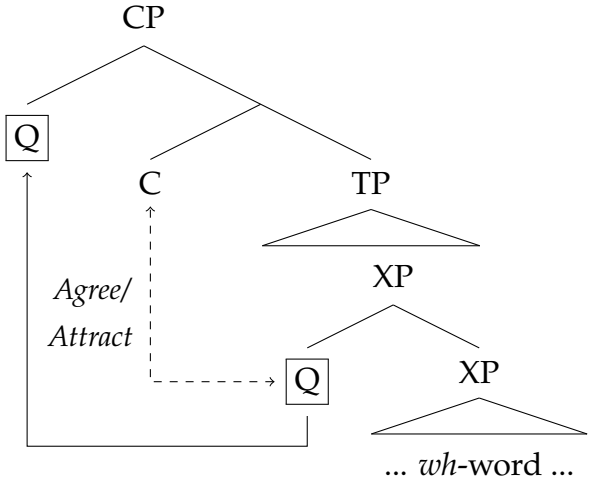


[21] Lexical categories here include NP, AP and VP.

(61) **Q-adjunction and Q-projection: a language-level parameter**
In a given language, only one of the two structures (60a) and (60b) is possible.

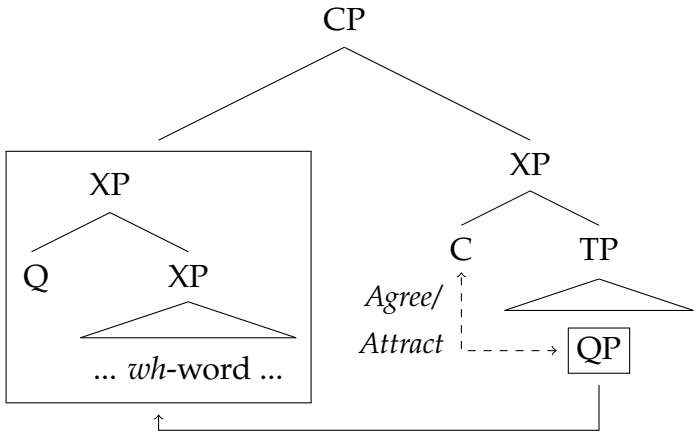
The difference in observed *wh*-movement in *wh*-in-situ languages and *wh*-fronting languages is explained in terms of Q-movement. In *wh*-in-situ languages, Q does not project any further structure after it is merged into the derivation. Consequently, we derive a language in which Q alone moves to C, (62)—a *wh*-in-situ language.

(62) **Q-movement in *wh*-in-situ languages: Q-adjunction (Sinhala, Japanese...)**



In *wh*-fronting languages, Q projects a QP layer following its merger with XP. Consequently, the whole QP—Q along with its sister—is attracted to C following interrogative probing, (63). The result is movement of a structure containing a *wh*-word and potential additional structure, commonly referred to as pied-piping.

(63) **Q-movement in *wh*-fronting languages: Q-projection (English, German...)**



Q-theory provides an explanation for pied-piping that does not rely on feature-percolation: The target of interrogative probing and movement is always a QP. QP necessarily contains a *wh*-word and may contain some additional material. In limited pied-piping languages, the size of QP is restricted by a syntactic Agree operation that forces a local relationship between *wh* and Q, (58).

Superiority-obeying questions in English are derived from structures where a QP is projected around each *wh*-word in the question. By the end of the derivation, all QPs move to Spec,CP in a structure-preserving order (obeying the "Attract Closest" principle). QPs that do not move to the CP layer undergo existential closure at the TP layer and become *wh*-indefinites. Once at the CP edge, the question is interpreted using a semantics equivalent to the Karttunen (1977) semantics for questions.

To derive superiority-violating questions, the higher *wh*-word in the question is not merged with a Q-particle. Only one QP is constructed, by merging Q with the lower *wh*-word. Since interrogative probing targets the Q-feature, not a *wh*-feature, the higher *wh*-phrase is invisible to the probe and remains in-situ. The QP containing the lower *wh*-phrase is found by the probe and attracted to Spec,CP. The in-situ *wh* is subsequently interpreted by C, using Rooth-Hamblin alternatives computation. The resulting structures are sketched in (64a–b):

(64) **Structure of superiority-obeying and superiority-violating questions:**

a. $[_{CP}\ [_{QP_1}\ Q\ [\ wh_1\ ]]\ [_{QP_2}\ Q\ [\ wh_2\ ]]\ \ [\ C\ [_{TP}\ ...\ t_1\ ...\ t_2\ ]]]$ superiority-obeying

b. $[_{CP}\ [_{QP_2}\ Q\ [\ wh_2\ ]]\ \ [\ C\ [_{TP}\ ...\ [\ wh_1\ ]\ ...\ t_2\ ]]]$ superiority-violating

Finally, we assume the following pronunciation rule to derive the word-order observed in English questions (based on Pesetsky 2000):

(65) **Pronunciation rule (English):**
When there are multiple QPs in Spec,CP, pronounce the highest QP at the head of its movement chain, and all of the others at the tail of their respective chains.

1.5.2 Intervention effects and the semantics of Q-particles

Following Beck (2006), Cable (2010) adopts an analysis of intervention effects where intervention effects occur when an intervener—a focus-sensitive item—is introduced between a *wh*-in-situ and the complementizer that interprets it. What is crucial for this analysis is that the semantic interpretation of the *wh*-word is short-circuited due to the semantic content of the intervener: *wh*-words are semantically deficient in a characteristic way, having only a focus-semantic value, their normal-semantic value being undefined.

(66) **The semantics of *what*:**
Ordinary semantics: $[\![what]\!]$ = undefined
focus-semantics: $[\![what]\!]^f = \{x_{\langle s,e\rangle} : x \notin \text{human}\}$

(67) **The semantics of *who*:**
Ordinary semantics: $[\![who]\!]$ = undefined
focus-semantics: $[\![who]\!]^f = \{x_{\langle s,e\rangle} : x \in \text{human}\}$

To arrive at an interpretable structure, every *wh*-word must be c-commanded by a question operator—either a Q-particle or an interrogative complementizer C—without any other c-commanding focus-sensitive operator along the way. The question operators Q and C are the only focus-sensitive operators whose meanings do not also take as input the ordinary semantic value of their sister. All other focus-sensitive operators require as input both the ordinary semantic value and the focus-semantic value of their sister, and they reset the value of focused elements inside their sister to their ordinary semantic value. However, *wh*-words have no ordinary semantic value—it is undefined. This undefinedness is inherited by the larger structure, resulting in an ungrammatical sentence. The configuration in (68) will thus trigger an ungrammaticality which we can diagnose as an intervention effect. The squiggle operator is used to indicate a focus-sensitive operator.

(68) **Configuration of an intervention effect:**
* [Q/C [... $\underset{\leftsquigarrow}{\sim Op}$ ... *wh*-word ...]] (cf. Beck, 2006; Cable, 2010)

We are now in a position to explain intervention effects, such as in the pattern in (69):

(69) **D-linked superiority-violating questions are subject to intervention:**
a. *Which* boy did**n't** ____ read *which* book? ✓ sup.-obeying, intervener
b. * *Which* book did**n't** *which* boy read ____? * sup.-violating, intervener

As noted above, by the end of the derivation of all questions, all QPs must move to Spec,CP for interpretation in an order-preserving manner. In a superiority-obeying question, the resulting structure contains no element below the intervener that could be subject to intervention effects. Superiority-violating questions, on the other hand, are derived from structures in which at least one *wh*-word remains in-situ, inside TP. As a consequence, if an intervener occurs above the *wh*-in-situ, we yield the configuration in (68) and predict an intervention effect. The schema in (70) represents the structure under which superiority and intervention effects arise in Q-theory.

(70) **The interaction of superiority and interveners at LF:**

a. superiority-obeying questions: no intervention effects

✓ $[_{CP}\ [_{QP_1}\ Q\ [\ wh_1\ ]]\ [_{QP_2}\ Q\ [\ wh_2\ ]]\ \ [\ C\ [_{TP}\ ...\ \textbf{intervener}\ ...\ t_1\ ...\ t_2\ ]]]$

b. superiority-violating questions: intervention effects

* $[_{CP}\ [_{QP_2}\ Q\ [\ wh_2\ ]]\ \ [\ C\ [_{TP}\ ...\ \textbf{intervener}\ ...\ [\ wh_1\ ]\ ...\ t_2\ ]]]$

The Q-particle Q_i denotes a choice function, when defined (71a). Following Beck (2006), when Q_i composes with its sister it takes as its argument the focus-semantic value of its sister. Once the meaning of QP has been computed, the focus-semantic value of XP is reset to an ordinary semantic value that is used by the rest of the computation, (71b). Higher focus-sensitive operators cannot intervene, since the focus-alternatives introduced by the *wh*-word have already been taken care of.[22] QPs therefore shield *wh*-words from potential interveners.

(71) **The semantics of Q (Cable, 2010):**

a. $[\![Q_i]\!] = g(i) \in D_{cf}$

b. $[\![Q_i\ XP]\!] = [\![Q_i]\!]([\![X]\!]^F)$

Simplex *wh*-questions that contain just one QP are interpreted using the interrogative complementizer in (72). C contributes exactly one existential quantifier to the meaning of the question, which binds the choice-function variable introduced by Q.

[22] Note that since focus-alternatives are used inside QP, between Q and *wh*, we do expect intervention effects *inside* QPs. See Chapter 3.

(72) **The semantics of simplex C (Cable, 2010):**
$[\![\text{C XP}]\!]^g = \lambda p\ [\ \exists f.\ p = [\![\text{XP}]\!]^{g(i/f)}\ ]$

To interpret superiority-obeying questions with two *wh*-words, Cable (2010) introduces an additional complementizer, C_2, which can yield a multiple question meaning and at the same time bind both of the Q-particles in the question.[23] It does this by binding the choice function variables introduced by the two Q-particles. Under the assumption that there are at least as many choice functions over a certain set as there are elements in that set, the resulting meaning of the question is equivalent to the standard interrogative semantics assigned to *wh*-questions in a Hamblin (1973)/Karttunen (1977) framework.

(73) **C_2 in the semantics of superiority-obeying questions (Cable, 2010):**
$[\![\text{C}_{2\ i\ j}\ \text{XP}]\!]^g = \lambda p\ [\ \exists f.\ \exists h.\ p = [\![\text{XP}]\!]^{g(i/f)(j/h)}\ ]$

To derive a suitable question-meaning for a superiority-violating question with a *wh*-word in-situ, Cable assumes a C+ head that can give a *wh*-in-situ an appropriate interrogative meaning without attracting it to its specifier: this is an operator that will yield a multiple-question meaning but that can only bind one Q-particle: the other *wh*-word in the question must not be merged with a Q-particle and hence must be left in-situ. The *wh*-in-situ is interpreted using the mechanism of Rooth-Hamblin alternatives; this is compatible with Beck's (2006) view that intervention effects follow from focus-sensitive items that intervene between the *wh*-in-situ and the head with which it Agrees: in order for the alternatives of the *wh*-word to reach C+ and be interpreted, they must not be reset by any other focus-sensitive operator along the way.

(74) **C+ in the semantics of superiority-violating questions (Cable, 2010):**
$[\![\text{C+}_{\ i}\ \text{XP}]\!]^g = \lambda p\ [\ \exists f.\ \exists h.\ p = h\ (\ [\![\text{XP}]\!]^{F\ g(i/f)}\ )\ ]$

By assuming the existence of C+ alongside C_2 in the lexicon of English, we can explain the correlation between superiority and intervention effects in D-linked questions.[24] German, on the other hand, is assumed to have a C head and C+ head but not a C_2 head, thereby predicting that it will exhibit intervention effects not only in superiority-violating questions but also in superiority-obeying questions, because it must use the C+ head to interpret all its multiple questions.

[23] Similar heads would have to be added in order to deal with questions with three QPs, four QPs, etc.

[24] Cable proposes additional heads to interpret D-linked phrases as opposed to simplex *wh*-phrases. See Cable (2010) for details.

To account for the fact that English allows for superiority violations in D-linked questions only, Cable (2010) assumes different C heads for D-linked and non-D-linked questions. Only the head that interprets D-linked questions has a C+variant; the head that interprets non-D-linked questions only has a C_2 variant. This ensures that in a non-D-linked question, all QPs must move to C for interpretation. Because movement obeys the "Attract Closest" principle, we predict that only superiority-obeying questions are possible. Superiority-violating questions, which would require at least one *wh*-word to remain in-situ, could not be interpreted because English lacks the appropriate head that would be able to bind a non-D-linked *wh*-word that occurs in-situ. The reader is referred to Cable (2010, section 4.4.2.1) for further details and discussion.

1.6 Arguments for covert movement of in-situ *wh*-phrases

Existing literature provides us with some evidence for covert *wh*-movement of in-situ *wh*-phrases. The arguments come from the licensing of Antecedent Contained Deletion (ACD) and the licensing of parasitic gaps. As we will see, they reach a consensus about the status of the in-situ *wh*-phrase in superiority-obeying questions, but not regarding the status of *wh*-phrase in superiority-violating questions. I return to this point in Chapter 2.

1.6.1 Covert *wh*-movement and ACD licensing

One argument for covert movement comes from *antecedent-contained deletion* (ACD) constructions like (75) (Bouton, 1970; Sag, 1976; May, 1985; Larson and May, 1990):

(75) **Antecedent Contained Deletion:**
John [$_{VP}$ read [$_{DP}$ every book that Mary did [$_{VP}$ $\triangle$]]].

Example in (75) is interpreted by speakers as in (76), where the missing VP is interpreted as the expression *read t*:

(76) **Interpretation of ellipsis in (75):**
John [$_{VP}$ read [$_{DP}$ every book that Mary did [$_{VP}$ ~~read *t*~~]]].

For VP-ellipsis to be licensed, a pronounced antecedent VP must exist that is identical to the missing VP. The fact that the elided VP in (76) is resolved to the VP *read t* teaches us that the linguistic context must contain an antecedent of the form *read t*. However, if

the analysis of (75) does not involve covert movement, then there is no instance of the VP *read t* in the structure to serve as the antecedent for the ellipsis. In fact, the only VP in the structure appears to be *read every book that Mary did*, which itself contains the ellipsis site. This apparent contradiction is resolved if we assume covert movement of the object, hosting the relative clause, to a VP-external position. This movement leaves behind a trace, creating a VP of the form *read t*, supplying the appropriate antecedent for the elided VP.

(77) **Resolution of ACD using covert movement:**
[$_{DP}$ every book that Mary did [$_{VP}$ ~~read *t*~~]] [John [$_{VP}$ read *t*]].
↑ ⌊ ⌋

If covert *wh*-movement happens in a similar way to overt movement, it should be able to resolve ACD that occurs inside a (phonologically) in-situ *wh*-phrase. We have already seen instances substantiating this prediction in Chapter 5. Here I reproduce the argument from Pesetsky (2000), that *wh*-phrases in superiority-obeying questions but not in superiority-violating questions can host ACD. Hence, it is argued that only *wh*-phrases in superiority-obeying questions, but not in superiority-violating questions, undergo covert *wh*-movement. This fact will become important in Chapter 2.

(78) **ACD licensed by *wh*-in-situ in a superiority-obeying question:**

a. *Which* girl invited [*which* student that John did [$_{VP}$ △]]?

b. I need to know *who* can speak [*which* languages that Ken Hale can [$_{VP}$ △]]?

These examples show that ACD can be hosted inside an in-situ *wh*-phrase in superiority-obeying questions. To create a test sentence to check whether the same is possible with in-situ *wh*-phrases in superiority-violating questions, a more complex structure is required. This can be obtained by attaching a modifier that contains ACD to an otherwise grammatical superiority-violating question. The resulting examples are quite complex, but nonetheless appear to give rise to crisp judgments.

Before arriving at the crucial test case, we begin by constructing a similarly more complex superiority-obeying question, (79a). This example contains three relevant DP positions: the subject of *order*, the object of *order*, and the object of *congratulate*. The gap indicates the base-position of the overtly moved *wh*-phrase. The intended interpretation of (79a) is given in (79b).

(79) **ACD licensed by *wh*-in-situ in a superiority-obeying question with 3 DPs:**

a. I need to know *which* girl ____ ordered [*which* boy that Mary (also) did △] to congratulate Sarah.

b. Paraphrase: I need to know for which girl x and for which boy y such that Mary ordered y to congratulate Sarah], x also ordered y to congratulate Sarah. [i.e., I need to know the girl-boy pairs such that both the girl and Mary ordered the boy to congratulate Sarah.]

Next we compare (79) with a superiority-violating counterpart, (80). Again, the same three DPs are being manipulated, and the gap indicates the base-position of the overtly moved *wh*-phrase. The intended interpretation of (80a) is given in (80b). However, despite the similarity to the superiority-obeying baseline in (79) and despite the fact that this is a semantically felicitous question, (80) is judged by speakers as markedly worse than (79): it appears that ACD cannot be licensed by the in-situ *wh*-phrase in a superiority-violating question.

(80) **ACD not licensed by *wh*-in-situ in a superiority-violating question:**

a. * I need to know *which* girl Sue ordered [*which* boy that Mary (also) did △] to congratulate ____.

b. Paraphrase: I need to know for which girl x and [which boy y such that Mary ordered y to congratulate x], Sue also ordered y to congratulate x. [i.e., I need to know the girl-boy pairs such that both Sue and Mary ordered the boy to congratulate the girl.]

This contrast between (79) and (80) is explained if the in-situ *wh*-phrase in a superiority-obeying question undergoes covert movement, as will be argued for at length in this dissertation, but the in-situ *wh*-phrase in a superiority-violating question is truly LF-in-situ.[25] Because the in-situ *wh* in a superiority-obeying question undergoes covert movement, it occupies a position at LF that allows for the construction of an appropriate antecedent for the ellipsis. A parallel derivation is not available to the superiority-violating question: the in-situ *wh* is in fact in-situ at LF; it is therefore contained inside the elided material, and as a result it is impossible to find a constituent that is parallel to the elided constituent and could serve as the antecedent for the ellipsis.

[25] See Pesetsky (2000, pp. 31–33) for a discussion and dismissal of several possible alternative explanations for the difference between (79) and (80).

I note that this contrast should also be supported by additional baseline examples not provided by Pesetsky (2000), but which appear to support the contrast. In particular, it is important to verify that the ungrammaticality of the configuration in (80) is due to the presence of the in-situ *wh*-phrase and not to some extraneous factor—for example, the fact that the *wh*-phrase in this example is extracted across an object relative clause. That is, we expect that a minimally different example containing a DP which we expect to be able to QR at LF to again be grammatical. Here I illustrate this with a definite DP.

Example (81a) provides a baseline that does not contain ACD. Example (81b) then replaces the predicate in this example with the predicate *ordered*, which is identical to the matrix predicate in this example, and the example remains grammatical.[26] Example (81c) replaces the predicate *ordered* with an ellipsis marker, and the example still remains grammatical. Finally, example (81d) is identical to (80a), where the definite description heading the relative clause, *the boy*, is replaced with a *wh*-phrase, *which boy*. This step leads to ungrammaticality, thus showing that the source of the ungrammaticality of (80) is indeed the fact that ACD cannot be licensed by the in-situ *wh*-phrase in that question.[27]

(81) **ACD licensed in question with definite article, but not with *wh*-in-situ:**

a. ✓ I need to know *which* girl Sue ordered [the boy that Mary was dancing with *t*] to congratulate ____.

b. ✓ I need to know *which* girl Sue ordered [the boy that Mary_{F} (also) ordered $\triangle$] to congratulate ____.

c. ✓ I need to know *which* girl Sue ordered [the boy that Mary_{F} (also) did $\triangle$] to congratulate ____.

d. * I need to know *which* girl Sue ordered [*which* boy that Mary_{F} (also) did $\triangle$] to congratulate ____.

Finally, one might ask whether, adopting Fox and Nissenbaum's (1999) theory of ACD resolution under which ACD resolution always involves late merger (extraposition) of the relative clause, the contrast between (79) and (80) could be accounted for by an appeal to the impossibility of rightward movement of an element that has a gap in it (*to congratulate t*). To test this, below I compare examples with and without extraposition of the relative

[26] This example is judged as slightly degraded because of the repetition of the predicate in the matrix and embedded clauses. The predicate must be down-stressed in this situation; when this happens, it has been argued the structure has very similar behavior and licensing conditions as ACD (see Tancredi (1992) a.o.)

[27] These examples are naturally read with focus on Mary inside the relative clause. This seems necessary for the sentence to be grammatical.

clause. Example (82) is based on a suggestion by Danny Fox (p.c.); example (82a) is similar in its structure to (80), while (82b) contains an extraposed relative clause.

(82) **Extraposition does not improve violating question with ACD:**

a. ** I need to know *which* book Sue ordered [*which* boy that Mary (also) did △] to read ____.

b. * I need to know *which* book Sue ordered *which* boy to read ____ [that Mary also did △].

We find is that (82b) is improved over (82a), but both examples are judged as ungrammatical. I propose that (82b) removes a center-embedded confound found in examples (82a) and (80), but it illustrates that ACD hosted by the in-situ *wh*-phrase in a superiority-violating question remains impossible even when this confound is eliminated.

1.6.2 Covert *wh*-movement and parasitic gaps

A well-known property of parasitic gaps is that they are gaps that occur inside islands, which are licensed by $\overline{\text{A}}$-movement that takes place outside the island (Ross, 1967; Engdahl, 1983; Nissenbaum, 2000a,b; Culicover and Postal, 2001, a.o.). Such $\overline{\text{A}}$-movement operations include *wh*-movement (83a), topicalization (83b), relativization (83c), and heavy NP shift (83d) (data from Nissenbaum (2000b)).

(83) **Parasitic gaps licensed by $\overline{\text{A}}$-movement:**

a. *Which* article did you file ____ [without reading *pg*]?

b. John, I talked to ____ [in order to impress *pg*].

c. Mary's the person who we called ____ up [after meeting with *pg*].

d. John filed ____ [without reading *pg*] a recent article about Amazonian frogs.

Parasitic gaps are not possible when no $\overline{\text{A}}$-movement has occurred in the structure, as shown in (84).

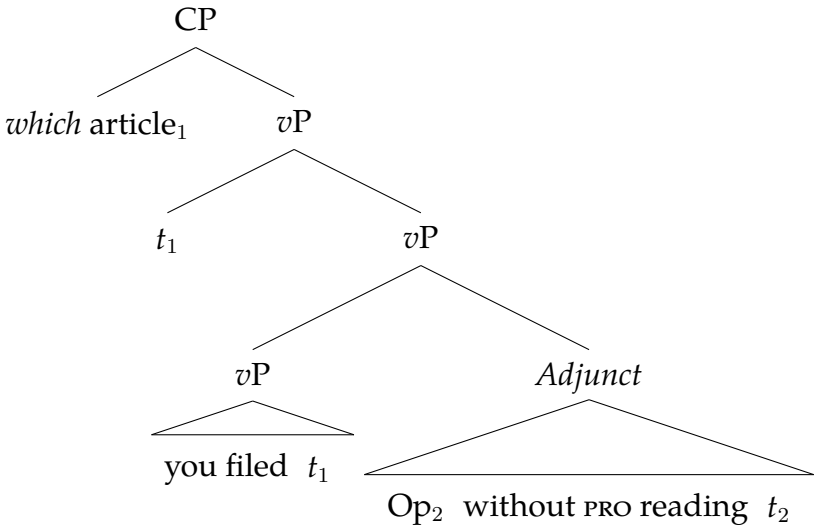
(84) **Parasitic gaps not possible without $\overline{\text{A}}$-movement:**

a. * You filed that article [without actually reading *pg*].
cf. You filed that article [without actually reading it].

b. * You talked talked to John [in order to impress *pg*].
cf. You talked talked to John [in order to impress pg].

Nissenbaum (2000a) assumes, with previous work (Taraldsen, 1981; Chomsky, 1982, 1986; Engdahl, 1983, a.o.), that (a) parasitic adjunct and its licensing *v*P are sisters, not in a chain; and (b) parasitic adjuncts involve the movement of a null operator (syntactically similar to relative clauses) to an outer specifier position of *v*P. The parasitic adjunct and its *v*P sister then compose through a special predicate modification.[28] The syntactic structure of (83a) is given in (85).

(85) **The syntax of parasitic gaps:**



Nissenbaum argues that when a structural configuration as in (85)—that is, when a DP occurs in a Spec,*v*P position that is structurally higher than a (clausal) modifier adjoined to the *v*P—it not only can't, but in fact must be associated with a parasitic gap in that adjunct. Given this description, we may ask whether there is evidence that *wh*-in-situ licenses parasitic gaps. In particular, we might expect *wh*-in-situ that undergoes covert movement, including the in-situ *wh* in a superiority-obeying multiple question in English, to license such gaps.

Engdahl (1983) has argued that covert movement does not license parasitic gaps. Compare (86a–b).

(86) **Parasitic gap apparently not licensed by covert movement in multiple question:**

a. *Which* article did you file ____ [without reading *pg*]?

b. * *Who* ____ filed *which* article [without reading *pg*]?

[28] For Nissenbaum, this forms part of an argument that successive-cyclic movement targets every *v*P along the way to its final position. See Nissenbaum (2000a, p. 48 et seq. for discussion).

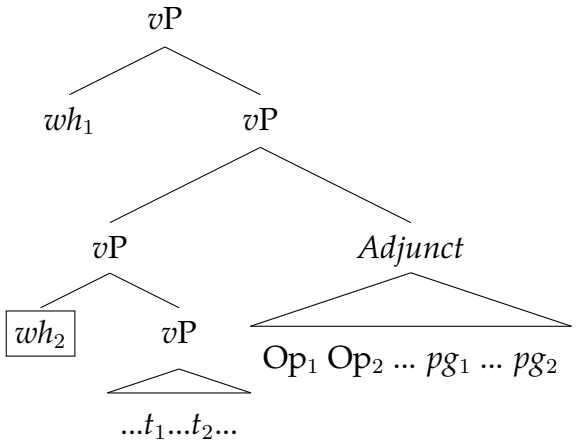
Nissenbaum (2000a) argues that the fact that covert movement does not normally license parasitic gaps is explained by Richards's (1997) tucking-in, and the standard assumption that overt movement happens before covert movement:

(87) **The non-extension condition:**
Movement may not extend the tree if an alternative exists (it must tuck in below the outermost segment whenever possible).

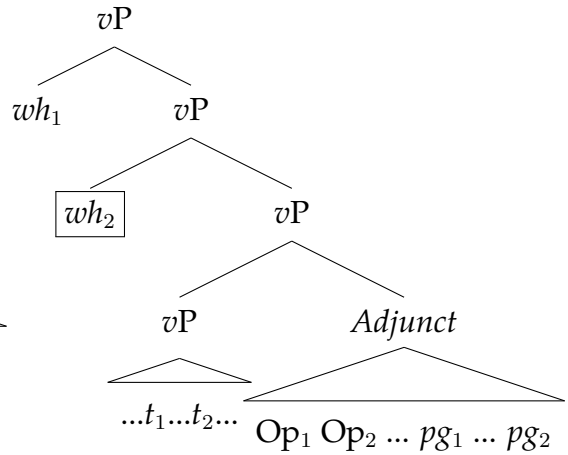
There are two ways to created a structure with tucking-in, parallel to observed overt movement in Bulgarian, as in (88a–b).

(88) **Two possible ways to tuck in:**

(a) *Below* the parasitic adjunct:



(b) *Above* the parasitic adjunct:



In the case of (88a), the covertly moved *wh* tucks in *below* the adjunct, as therefore we expect that only the overtly moved *wh* can license a parasitic gap, (89):

(89) **Parasitic gaps licensed by overtly moved *wh* in multiple question:**
?*Which* senator$_1$ did you persuade ____ to borrow *which* car$_2$ [after talking to pg_1 for an hour]?

In the case of (88b), on the other hand, the covertly moved *wh* tucks in *above* the adjunct and thus creates a structural configuration in which it is possible to find parasitic gaps licensed by *wh*-in-situ:

(90) **Parasitic gaps licensed in multiple question under parallelism:**
?*Which* senator$_1$ did you persuade ____ to borrow *which* car$_2$ [after getting [an opponent of pg_1 to put a bomb in pg_2]]?
*cf. *Which senator$_1$ did you persuade ____ to borrow which car$_2$ [after putting a bomb in pg_2]?*

Note that there is no way for the in-situ *wh* alone to license a parasitic gap (cf. (86b)):

(91) **Parasitic gaps not licensed by in-situ *wh* alone:**
**Which* senator$_1$ did you persuade ____ to borrow *which* car$_2$ [after putting a bomb in pg_2]]?

Furthermore, the parasitic gaps must appear in the same order as the surface order of the *wh*-phrases in the question, (92a), and they must occur inside the same island, not in separate ones, (92b).

(92) **Parasitic gaps not licensed in multiple question when parallelism not met:**

a. * *Which* car$_1$ did you lend ____ to *which* senator$_2$ [after getting [an opponent of pg_2 to put a bomb in pg_1]]?

b. * *Which* senator$_1$ did you persuade ____ to borrow *which* car$_2$ [after talk to pg_1] [without fixing pg_2 first]?

We have seen, then, that in-situ *wh*-phrases in a superiority-obeying question are able to license a parasitic gap, when they occur in the same adjunct as a corresponding gap for the overtly moved *wh*. Next, we note that the same also holds for the in-situ *wh* in a superiority-violating question: a parasitic gap is licensed under parallelism with a gap for the overtly moved *wh*, (93a). A parasitic gap is not licensed by an in-situ *wh* alone (93b), and not if the order of gaps does not correspond to the surface order of the two *wh*-phrases.

(93) **Parasitic gaps licensed in superiority-violating multiple question:**

a. ? *Which* kid$_1$ did you give *which* candy bar$_2$ to ____ [without first speaking with pg_1 about the ingredients in pg_2]?

b. * *Which* kid$_1$ did you give *which* candy bar$_2$ to ____ [without looking at the ingredients in pg_2]?

c. * *Which* kid$_1$ did you give *which* candy bar$_2$ to ____ [without mentioning the ingredients in pg_2 to a parent of pg_1]?

Thus evidence from the licensing of parasitic gaps leads us to conclude that in-situ *wh*-phrases can license parasitic gaps (under parallelism with the overtly moved *wh*-phrase) in both superiority-obeying questions *and* superiority-violating questions. This finding is in conflict with Pesetsky's (2000) finding that in-situ *wh*-phrases cannot license ACD, as we have seen in section 1.6.1. I leave this question open at the moment.

1.7 The structure of this dissertation

The remainder of the dissertation is structured as follows:

In Chapter 2, I present my proposal for the syntax and semantics of *wh*-questions. The analysis combines Cable's (2007; 2010) Q-based theory of *wh*-movement and pied-piping with a simple semantics, building on established ingredients in the literature, which are combined in a novel way. I model the pair-list reading of the question as denoting a family of questions, and derive the pair-list and single-pair readings of the question from minimally different LFs. This theory naturally fits with existing analyses of the presuppositions of questions and with Beck's (2006) theory of focus intervention effects and its extension in Cable's work.

The proposal in chapter 2 predicts that *wh*-phrases that move covertly will pied-pipe material with it, much like their overtly moving counterparts. In Chapter 3, I investigate the presence and size of covert pied-piping in multiple *wh*-questions. This chapter, based on joint work with Michael Yoshitaka Erlewine, argues that in-situ *wh*-phrases in superiority-obeying questions obligatorily move at LF, and that they pied-pipe the *largest* constituent that would be possible for overt movement in a parallel simplex question. Evidence for this behavior comes from the interaction of pied-piping constituents with focus intervention effects and with Antecedent Contained Deletion. I argue that this finding sheds light on the different roles of LF and PF in the theory of grammar, and on their different preferences with regard to movement.

In Chapter 4, I take a closer look at the interaction between covert movement and intervention effects in multiple English questions. I show that, contrary to what has previously been assumed in the literature, it is possible to systematically induce intervention effects in superiority-obeying questions, and it is additionally possible to escape intervention in superiority-violating questions in some contexts. This provides additional support for the view that intervention effects happen whenever a surface *wh*-word is c-commanded by an intervener and is unable to (overtly or covertly) move above the intervener at LF. The intervener disrupts the relation between the *wh* and its associated Q-particle, leading to ungrammaticality. I argue that considerations such as the status of the question as obeying or violating superiority is immaterial to this phenomenon.

I further investigate the LF position of in-situ *wh*-phrases in Chapters 5 and 6. I argue for a *partial* covert movement step of in-situ *wh*-phrases in the derivation of superio-

rity-obeying English questions, based on the online processing and offline judgments of multiple *wh*-questions:

In Chapter 5, I present a series of sentence processing experiments investigating English superiority-obeying *wh*-questions. I argue that participants' processing signature is consistent with a *partial* covert movement step of the in-situ *wh*-phrase, and is inconsistent with accounts that predict that the *wh* is truly LF-in-situ and also with accounts that predict that the *wh* covertly moves to C at LF. I argue for a particular view of covert *wh*-movement where movement targets the lowest position at which the *wh*-phrase is interpretable. I show that this position can be manipulated using the presence of focus-interveners in the structure, with consequences for participants' reading times. The results of this chapter argue for restrictions on interrogative syntax and the possible LFs that serve as input to the semantics of Chapter 2, which are further explored and spelled out in Chapter 6.

In Chapter 6, I investigate questions in which an in-situ *wh*-phrase is trapped inside an island. The distribution of intervention effects shows that covert movement occurs inside the island, but the *wh*-phrase cannot escape the island. I argue that this partial covert movement of in-situ *wh*-phrases in English should be modeled as *covert scrambling*, and that it is equivalent to a movement step that can be observed overtly in German. I argue that, unlike in previous theories of questions and intervention effects, this view allows for the modeling of English and German multiple questions as parallel in all respects except whether the language has overt or covert scrambling, hence providing an explanation for how the complex behavior of multiple questions and intervention effects is acquired by native speakers. Apparent differences between the behavior of English and German with regard to intervention effects are also naturally explained under this view.

Finally, Chapter 7 provides a summary of the main findings and arguments made in this dissertation, and discusses some open questions and directions for future work.

The reader will note that in addition to the conclusion chapter, at the end of each chapter I provide a one-page summary of the main arguments and findings of that chapter.

Chapter 2

The syntax and semantics of *wh*-questions

In this chapter I present my formal proposal for the syntax and semantics of *wh*-questions. In section 2.1, I briefly summarize the data that my proposal will aim to explain. My proposal adopts the syntax of Cable's (2010) theory of Q-particles but combines it with a novel semantic analysis. In section 2.2 I present the assumptions I make about the syntax of *wh*-questions. In section 2.3 I then present a semantics to interpret the structures I propose in section 2.2. I show how my proposal derives the semantics of simplex questions, and the pair-list readings of superiority-obeying and violating questions and how the presuppositions of the simplex and multiple questions can be explained. Section 2.4 surveys the predictions of the theory for different positions of Q-particles in a question, 2.4.1, explains how Beck's (2006) theory of intervention effects fits with the current proposal, 2.4.2, and discusses differences between English and German questions, 2.4.3. Section 2.5 summarizes the advantages of the view developed here.

2.1 The desiderata

I begin this chapter by surveying the facts that this chapter aims to derive, based on the summary and data presented in the previous chapter. As we have seen, D-linked English questions allow for both superiority-obeying questions and superiority-violating questions. We have seen evidence that superiority-obeying questions do not exhibit intervention effects, and that the in-situ *wh* in such question is additionally able to host Antecedent

Contained Deletion. These facts are explained if in-situ *wh*-phrases in superiority-obeying questions are able to covertly move to C at LF: this would allow the *wh* to occupy an LF position above any intervener inside TP, and it would allow for the creation of an appropriate antecedent for the ellipsis introduced via ACD.

In contrast, superiority-violating questions are subject to intervention whenever an intervener c-commands an in-situ *wh*-phrase in the question. Furthermore, in-situ *wh*-phrases in superiority-violating questions are unable to host ACD. These facts are explained if the in-situ *wh* in a superiority-violating question does not move at all at LF, and is instead truly LF-in-situ: in that case, the *wh* would not be able to move above an intervener at LF, predicting ungrammaticality unless the intervener itself can be scoped out of the question or reconstructed below the *wh*,[1] and it is impossible to construct an appropriate antecedent for the ellipsis introduced via ACD. The relevant data regarding intervention effects is repeated in (1) below.

(1) **Only superiority-violating questions are subject to intervention effects:**

a. Superiority-obeying, no intervener:
✓ *Which* student did Fred introduce ____ to *which* professor?

b. Superiority-violating, no intervener:
✓ *Which* professor did Fred introduce *which* student to ____?

c. Superiority-obeying, intervener:
✓ *Which* student did **only** Fred introduce ____ to *which* professor?

d. Superiority-violating, intervener:
* *Which* professor did **only** Fred introduce *which* student to ____?

In German, we have seen that not only superiority-violating questions but also superiority-obeying questions are subject to intervention effects, whenever an intervener c-commands an in-situ *wh*. This is explained if in German, only one *wh*-phrase is able to move in the derivation of the question. This phrase overtly fronts, and no covert movement is possible. Thus, to escape intervention, the *wh*-phrase must overtly scramble above the intervener.

(2) **Intervention effects in superiority-obeying question in German:**

a. * *Wen* hat **niemand** *wo* gesehen?
whom has nobody where seen
'Where did nobody see whom?'

[1] I show that this is the case in Chapter 4.

b. *Wen* hat Luise *wo* gesehen?
whom has Luise where seen
'Where did Luise see whom?'

c. *Wen* hat *wo* **niemand** gesehen?
whom has where nobody seen
'Where did nobody see whom?'

Finally, we have furthermore seen that superiority-obeying and superiority-violating multiple questions can have single-pair and pair-list readings. I propose to model the pair-list reading of the question as a family of questions, keyed on the higher *wh*-phrase Dayal (2002). The denotations of the pair-list readings of superiority-obeying and superiority-violating questions are given in (3)–(4), respectively, for a domain with three students, *John, Mary, Bill* and three books, *Moby Dick, War and Peace, Oliver Twist*.

(3) **A family of questions denotation for a superiority-obeying question:**
Which student read *which* book?

$$\left\{ \left\{ \begin{array}{c} \text{John read MD} \\ \text{John read WP} \\ \text{John read OT} \end{array} \right\}, \left\{ \begin{array}{c} \text{Mary read MD} \\ \text{Mary read WP} \\ \text{Mary read OT} \end{array} \right\}, \left\{ \begin{array}{c} \text{Bill read MD} \\ \text{Bill read WP} \\ \text{Bill read OT} \end{array} \right\} \right\}$$

(4) **A family of questions denotation yields a pair-list reading:**
Which book did *which* student read?

$$\left\{ \left\{ \begin{array}{c} \text{John read MD} \\ \text{Mary read MD} \\ \text{Bill read MD} \end{array} \right\}, \left\{ \begin{array}{c} \text{John read WP} \\ \text{Mary read WP} \\ \text{Bill read WP} \end{array} \right\}, \left\{ \begin{array}{c} \text{John read OT} \\ \text{Mary read OT} \\ \text{Bill read OT} \end{array} \right\} \right\}$$

I will model the single-pair reading of the question as a set of propositions that are the possible answers to the question (Hamblin, 1973; Karttunen, 1977), as in (5), which together with the presupposition that an answer must have a unique maximally informative true answer will ensure a single-pair answer (Dayal, 1996). This presupposition will be discussed in greater detail in section 2.3.3.[2]

(5) **A single-pair reading is modeled as a set of propositions:**

$$\left\{ \begin{array}{l} \text{John read MD, John read WP, John read OT, Mary read MD,} \\ \text{Mary read WP, Mary read OT, Bill read MD, Bill read WP, Bill read OT} \end{array} \right\}$$

[2]I discuss the single-pair reading of superiority-violating questions in section 6.5.

2.2 The syntax of *wh*-questions

2.2.1 A Q-based approach to interrogative movement

My proposal will be spelled out within the framework of Cable's (2010) Q-based theory of *wh*-movement and pied-piping (see detailed summary in section 1.5). I assume, with Cable, that interrogative movement in natural language should be modeled as Q/QP-movement. *Wh*-words and *wh*-phrases may not undergo independent *wh*-movement, but instead may only be targeted for interrogative movement when they are contained inside a QP, which is targeted for Agree/Attract operations by the interrogative probe. I furthermore assume, with Cable, that the merger position of the Q-particle in 'limited pied-piping' languages is restricted, so that the size of QPs in languages like English and German is effectively limited to nominals but not larger structures that contain functional material such as VPs, TPs, CPs, or embeddings thereof.[3] Finally, I assume that by the end of the derivation, all Q/QPs in the derivation must move to Spec,CP.[4]

Since English and German are *wh*-fronting languages, the projection parameter of the Q-based system is set so that Q-particles always project a QP layer when they merge with a *wh*-containing phrase. Following Cable, I assume that Q agrees with *wh* whenever a QP is projected. In what follows, I will use QPs and *wh*-phrases interchangeably, to refer to a fronted interrogative constituent. Finally, I assume, with Cable, that it is possible to leave *wh*-phrases in-situ by not merging them with a Q-particle. In English and German, C has an EPP feature, requiring that one QP be pronounced in its specifier. This requirement can only be met if there is at least one QP in the derivation of a question in these languages. Note furthermore that in English it is possible to have additional QPs that covertly move to C at LF, but this option is not available in German, as discussed above. I will return to this point below, after introducing the semantics of my proposal.

[3]More specifically, Q must not be separated from *wh* by lexical material. Cable argues that English is a Limited Pied-Piping Language, defined as follows:

(i) **Limited Pied-Piping Language (Cable, 2010):**
A language where a *wh*-word cannot be dominated in a pied-piped phrase by either an island or lexical category.

Other languages, including English in some restricted cases (see Chapter 3) may allow for larger pied-piping. Tlingit, for example, the object of Cable's study, allows for pied-piping of entire islands.

[4]We will later see that this follows from the semantics of QPs.

The syntax that I assume below is crucially different from Cable's (2010) proposal in one way. I assume that in addition to projecting Q-particles, it is possible to base-generate non-projecting Q-particles in the CP layer.[5] As we will see below, this will allow for the derivation of the single-pair and pair-list readings of the question in a principled way.

2.2.2 The interrogative probing system

The derivations of superiority-obeying and violating word orders in multiple questions that I will present below will rely on two principles: Attract Closest (Chomsky, 1995) and tucking-in (Richards, 1997). The definition of Attract Closest is given below.

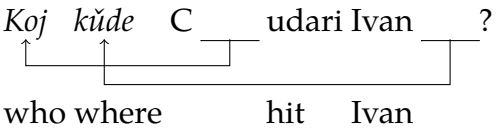
(6) **Attract Closest (Chomsky, 1995, chapter 4, pp. 280, 296):**
α can raise to target K only if there is no legitimate operation Move β targeting K, where β is closer to K.

(7) **Closeness (Pesetsky and Torrego, 2001):**
Y is closer to K than X if K c-commands Y and Y c-commands X.

The notion of tucking-in follows from Attract Closest and an additional principle such as "Shortest Move" (Chomsky, 1955). Tucking-in requires crossing paths in multiple *wh*-questions instead of nested paths: this would allow for the shortest movement step of each *wh*-phrase in the question from its base-generated position to C. This explains the strict ordering of *wh*-phrases in Bulgarian, a multiple *wh*-fronting language, where *wh*-phrases appear in the same order in specifiers of CP that they were based generated in, (8).[6]

(8) **Tucking in (Bulgarian, Richards 1997):**

a. Crossing paths:

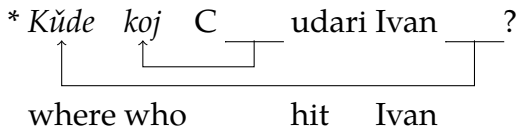


'Who hit Ivan where?'

[5] An alternative which I will not explore here is that the non-projecting Q-particle is base-generated near a *wh*-word and moves from there.

[6] As Richards notes, a tucking-in derivation is "counter-cyclic" in that it does not extend the tree. This violates Extension Condition (Chomsky, 1993). See Richards (1997) for discussion of this issue.

b. Nested paths:



I follow Richards (1997); Pesetsky (2000); a.o. in assuming that tucking-in also applies to *wh*-movement in English. In particular, below I will assume that the first instance of interrogative movement to a CP specifier will correspond to the element that is overtly moved in the question, and all other elements that move to inner specifiers of CP will be pronounced in their base positions, hence instantiating cases of covert movement:

(9) **Pronunciation rule (English, German):**
Pronounce the highest QP in Spec,CP at the head of its movement chain, all other QPs at the tail of their chains.

Based on this probing system and the assumptions in the previous section, the derivation of a superiority-obeying question in English may involve only one QP, or it may involve multiple QPs which are attracted to C in an order-preserving manner. For the remainder of this chapter, I will present derivations that involve multiple QPs, but also discuss what would happen if only one QP is present. In German, on the other hand, I will follow Cable in arguing that only one QP may be present in the derivation of a question. We will see the consequence of this assumption in section 2.4.3.[7]

2.2.3 A sketch of the proposal

With these assumptions in place, I next describe the derivations I propose for superiority-obeying and superiority-violating multiple questions. I concentrate here on syntactic (probe-driven) movement. In section 2.3 I will show each derivation is compositionally derived and interpreted. I will argue for an additional step of semantic (type-driven) movement at the end of each derivation discussed here. This step will affect the resulting reading of the question, but I ignore it here and focus instead on the interrogative syntax.

[7] In section 2.4.3 I propose an additional restriction on Q-projection in *wh*-fronting languages: in languages with overt scrambling, the possibility of covert phrasal movement may be restricted. This assumption will play a crucial role in the discussion in Chapter 6, where I will argue that it provides a more explanatory generalization of the difference between the behavior of English and German with regard to intervention effects.

Our main goal in this chapter will be to develop derivations for the single-pair and pair-list readings of superiority-obeying and superiority-violating questions in English and in German,[8] in such a way that is able to combine with existing theories of intervention effects to predict the behavior of multiple questions with regard to intervention: In English, superiority-obeying questions are immune from intervention effects while superiority-violating questions are subject to such effects; in German, both superiority-obeying and superiority-violating questions are subject to intervention effects. The description of intervention effects that I intend here is that intervention effects arise if an intervener occurs above an in-situ *wh*-phrase at LF.

I assume, with Pesetsky (2000); Beck (2006); Cable (2010); Kotek (2014b) that the in-situ *wh*-phrase in a superiority-obeying question is able to undergo covert movement at LF, but the in-situ *wh*-phrase in a superiority-violating question is truly LF-in-situ. Further evidence in support of this state of affairs, in particular the covert movement of the in-situ *wh* in superiority-obeying questions, will be presented in each one of the following chapters of this dissertation, 4-6.

The main difference between the derivations of superiority-obeying questions and superiority-violating questions in English comes from the number of QPs that is possible in the question. In a superiority-obeying question, every *wh*-word is able to merge with a Q-particle and project a QP. When interrogative probing occurs, the highest QP will be found first, and will be attracted to the outermost specifier of CP; lower QPs will be found in subsequent probing iterations, and will tuck into inner specifiers (Richards, 1997). The resulting derivation will have all QPs in the question hosted in Spec,CP in the same order in which they were base-generated. Such a question is therefore predicted to be immune from intervention effects since interveners occupy positions in TP, while all QPs are in Spec,CP at LF. The structure I propose is illustrated in (10a).[9]

A superiority-violating question is derived from a structure in which the base-generated *higher wh*-word does not merge with a Q-particle at all and thus remains LF-in-situ. The base-generated *lower wh*-word is merged with a Q-particle that projects a QP. The interrogative probe will agree with QP and move it to Spec,CP. The in-situ *wh*-word will

[8] In section 6.5.1 I discuss Wiltschko's (1997) observation that in German, superiority-violating questions can only have a pair-list reading but not a single-pair reading, and propose a way to accommodate it into the proposal developed here. At the moment, however, I abstract away from this detail.

[9] Alternatively, when no intervener is present, in-situ *wh*-words in a superiority-obeying questions may remain in-situ at LF. These *wh*-words may be interpreted either using the projecting Q-particle merged with the overtly moved QP, or using an additional non-projecting Q-particle that is base-generated in the CP layer.

subsequently be interpreted either by the projecting Q (to derive a single-pair reading) or by an additional Q which is base-generated in the CP layer (for a pair-list reading). I illustrate the structure of a pair-list reading of the superiority-violating question in (10b).[10]

(10) **Structure of superiority-obeying and superiority-violating questions:**

a. $[_{CP}\ [_{QP_1}\ Q\ [\ wh_1\ ]]\ [_{QP_2}\ Q\ [\ wh_2\ ]]\ \ [\ C\ [_{TP}\ ...\ t_1\ ...\ t_2\ ]]]$ superiority-obeying

b. $[_{CP}\ [_{QP_2}\ Q\ [\ wh_2\ ]]\ \ Q_1\ \ [\ C\ [_{TP}\ ...\ [\ wh_1\ ]\ ...\ t_2\ ]]]$ superiority-violating

Note that under the definition of Attract Closest and of Closeness in (6)–(7) above and the derivation I propose in (10b), superiority violations in English questions are only apparent. The derivation of a superiority-violating question does not involve a lower interrogative phrase "skipping" over a higher one. In fact, only one QP occurs in the question and therefore there is only one target for the interrogative probe. A similar logic is proposed in Cable (2007, 2010) to explain superiority-violations, borrowing from Pesetsky (2000). We are thus able to avoid a derivation in which a *lower wh*-phrase is moved over a c-commanding *higher* one, which would violate Attract Closest.

To derive German multiple questions, I follow Pesetsky (2000); Cable (2010) in assuming that only one QP may be hosted in Spec,CP in German. This QP will undergo overt movement. Any other *wh*-words in the question may not merge with Q, and thus remain LF-in-situ. The derivation of both superiority-obeying and superiority-violating questions will have a structure as in (10b).

2.3 The semantics of *wh*-questions

Having described the syntax of English and German question, in this section I turn to the semantics of multiple *wh*-questions. I begin by introducing the basic ingredients of the proposal—namely, the meaning I propose for the interrogative components of the derivation, *wh*-words, Q-particle, and the Complementizer. I then show how this proposal derives the meaning of a simplex question, the pair-list reading of superiority-obeying and

[10] Here and throughout, I mark the base-generated higher Q-particle and *wh*-word with the index 1, and the lower Q-particle and *wh*-word with the index 2. Recall that solid arrows indicate overt movement, dashed arrows indicate covert movement, and curly arrows to indicate an area in which in-situ composition is used. These arrows are used here as a notational convenience only.

superiority-violating questions, and the single-pair reading of these questions. I additionally discuss the presuppositions of the questions and propose to adopt Fox's (2012) *Ans* operator as a filter on the resulting meanings of the questions I derive here.

2.3.1 The ingredients

In this section I develop a system of compositional interpretation for questions, comprising of three interrogative ingredients—*wh*-words, Q-particles, and the Complementizer.

I propose, following Beck (2006); Beck and Kim (2006), that *wh*-words denote Hamblin sets, corresponding to the answer to the short question denoted by the *wh*-word. Here, I use the implementation in Beck and Kim (2006). Crucially, *wh*-words have a focus-semantic value, but no ordinary semantic value. The ordinary and focus-semantic value of *what* are given in (11a–b).

(11) **The semantics of *what*:**
Ordinary semantic value: $[\![\textit{what}]\!]^o$ is undefined
Focus-semantic value: $[\![\textit{what}]\!]^f = \{x_e : x \in \text{non-human}\}$

Like any other F-marked element in the derivation, the *wh*-word is interpreted using Alternative Semantics, the standard approach to focus semantics originally proposed by Rooth (1985, 1992). F-marked constituents introduce a set of alternative denotations to the syntactic object's ordinary denotation. Elements that are not F-marked will have a focus-semantic value consisting of the singleton set of their ordinary semantic value. These elements point-wise compose with one another, using the recursive definition in (12).

(12) **A recursive definition for the computation of focus-semantic values:**
Terminal nodes (TN):

$$[\![\alpha_\tau]\!]^f = \begin{cases} \{[\![\alpha_\tau]\!]\} & \text{if } \alpha \text{ not F-marked} \\ \text{a subset of } D_\tau & \text{if } \alpha \text{ F-marked} \end{cases}$$

Functional application (FA):

$$\left[\!\!\left[\begin{array}{c} \alpha_\tau \\ \diagup\ \diagdown \\ \beta_{\langle\sigma,\tau\rangle} \quad \gamma_\sigma \end{array} \right]\!\!\right]^f = \begin{cases} \left\{ b(g) \mid b \in [\![\beta]\!]^f, g \in [\![\gamma]\!]^f \right\} & \text{if } \alpha \text{ not F-marked} \\ \text{a contextually-determined subset of } D_\tau & \text{if } \alpha \text{ F-marked} \end{cases}$$

I adopt the interpretability condition of Beck (2006); Beck and Kim (2006):

(13) **Principle of Interpretability:**
An LF must have an ordinary semantic interpretation.

Since the *wh*-word itself only has a focus-semantic value but no ordinary semantic value, any structure that contains a *wh* will also have an undefined ordinary semantic value. I propose that such a structure must be interpreted using a Q-particle, which is able to assign its argument an ordinary semantic value.

The semantics I propose for the Q-particle is given in (14). Q takes an intensionalized set of propositions, set of sets of propositions, etc., and returns the same set as the ordinary-semantic value of the structure. The focus-semantic value of the resulting structure is assumed to be the singleton set of the ordinary semantic value.

(14) **The semantics of the Q-particle:**

a. $[\![\text{Q } \alpha_\sigma]\!]^o = [\![\alpha_\sigma]\!]^f$

b. $[\![\text{Q } \alpha_\sigma]\!]^f = \{[\![\text{Q } \alpha_\sigma]\!]^o\}$ $\qquad \sigma \in \{\langle s,t\rangle, \langle st,t\rangle, \langle\langle st,t\rangle,t\rangle, ...\}$

Note that this definition of Q has two consequences, which will become important below. First, this definition ensures that Q-particles (with or without an associated QP) must be interpreted in Spec,CP. Q cannot occur elsewhere, as this would not yield a convergent meaning for the structure.[11] Second, although Q merges with a nominal—this is what drives interrogative movement and pied-piping—this results in a type-mismatch inside QP. As a result, Q must move out of QP and adjoin to the spine in the CP layer at some point in the derivation. In this chapter I will assume that this happens after QP has reached Spec,CP. I explore alternative timing for Q-movement out of QP in Chapter 6.

The definition in (14) is similar in spirit to the question-level operators in Shimoyama (2001); Beck and Kim (2006). However, by assigning this semantics to the Q-particle and allowing it to be type-flexible, we will be able to derive the semantics of simplex and multiple questions in a principled way, without needing to define multiple Complementizers to deal with questions with with varying configurations and numbers of moved vs. LF-in-situ *wh*-phrases, as in Cable's original semantics for Q-theory.[12]

[11] As we will observe in section 2.3.3 below, the position of the Q-particle will depend on the position of an *Ans* operator which I assume occurs in the performative layer above CP.

As noted above, Q-particles are able to merge with a *wh*-containing-phrase and project a QP, or alternatively be base-generated in Spec,CP. This additional Q will be used to derive pair-list readings of questions in which one or more *wh*-words are left in-situ. I assume that these non-projecting Q-particles can only be merged into the structure if they are able to Agree with an in-situ *wh*-element. This restricts non-projecting Q-particles from being vacuously merged into the structure, and from interpreting non-*wh*-elements.

(15) **Projecting and non-projecting Q-particles:**
A Q-particle may merge with a *wh*-containing phrase and project a QP, or it may be base-generated in the CP layer and interpret an in-situ *wh*-element.

Finally, recall that the interrogative Complementizer plays an important role in the syntax of a question, by hosting the interrogative probe and driving the interrogative movement we observe in *wh*-movement languages such as English and German. The complementizer is additionally able to host fronted *wh*-elements in its specifiers. However, I propose that C plays no role in the semantics of questions, and instead passes up the tree the denotation of its sister. Thus, in (16), C is modeled as a type-flexible identity function:

(16) **The semantics of the Complementizer:**
$[\![\text{C}]\!] = \lambda P_{\tau}.\ P$

Note that the proposal for the syntax and semantics of questions I develop here is compatible with Beck's (2006) theory of intervention effects and its reformulation in Cable (2010). Q is related to *wh* using focus-alternatives. Thus, the region between *wh* and Q is *intervenable*; that is, the insertion of a focus-sensitive operator in this region leads to ungrammaticality. The configuration of an intervention effect is given in (17):

(17) **Configuration of an intervention effect:**
* [Q_i ... **intervener** ... wh_i ...]

[12] A question arises regarding how to prevent Q from applying to non-*wh* F-marked material, e.g.:

(i) Who saw THIS?
≠ Who saw what?

I will not spell out a full system to deal with this here, but I assume that such F-marked material will be dealt with by its associated focus constituent, which must occupy a position in the clausal spine, below the interrogative layer.

This proposal allows for a more parsimonious generalization about the configurations that lead to intervention effects than given in Beck (2006) and Cable (2010)—namely, intervention is a disruption in the relation between Q and *wh*. The only difference between superiority-obeying questions and superiority-violating is in the domains in which we expect them to exhibit intervention effects: in superiority-obeying questions, QPs can be projected on top of each *wh*-word. Therefore, intervention will only be observed in a limited part of the question, inside QP but not outside it, because QP can move above potential offending interveners (18a).[13] In superiority-violating questions, on the other hand, wh_1 is not inside a QP. Therefore, it must maintain a relation with a Q-particle in the CP layer through focus-alternatives. Therefore, the entire domain between the base position of *wh* and the position of Q in Spec,CP is subject to intervention effects, in addition to intervention effects inside the moved QP in the structure, (18a–b).

(18) **Sensitivity to intervention effects happens in two cases:**

a. [$_{QP}$ Q ...INTERVENABLE... *wh* ...] C ... ____

b. Q ... C ... INTERVENABLE... *wh* ...

2.3.2 The derivation of a simplex question

With the ingredients of the proposal in place, let us consider the derivation of a simplex question, *Which book did John read t?*. In this derivation, I propose that Q merges with *wh* and projects a QP, which is then attracted by the interrogative probe to Spec,CP. The LF I propose for the question is given in (20).[14] Note that I represent λ-binders as nodes in the tree and I indicate the element that they are abstracting over with indices for readability. The binder and index alike are used here as a notational convenience only. I assume here that the meaning of a singular *which*-NP is identical to the meaning of the NP. As with other *wh*-elements, the *which*-phrase does not have an ordinary semantic value.[15]

(19) **The meaning of a *which*-NP phrase:**

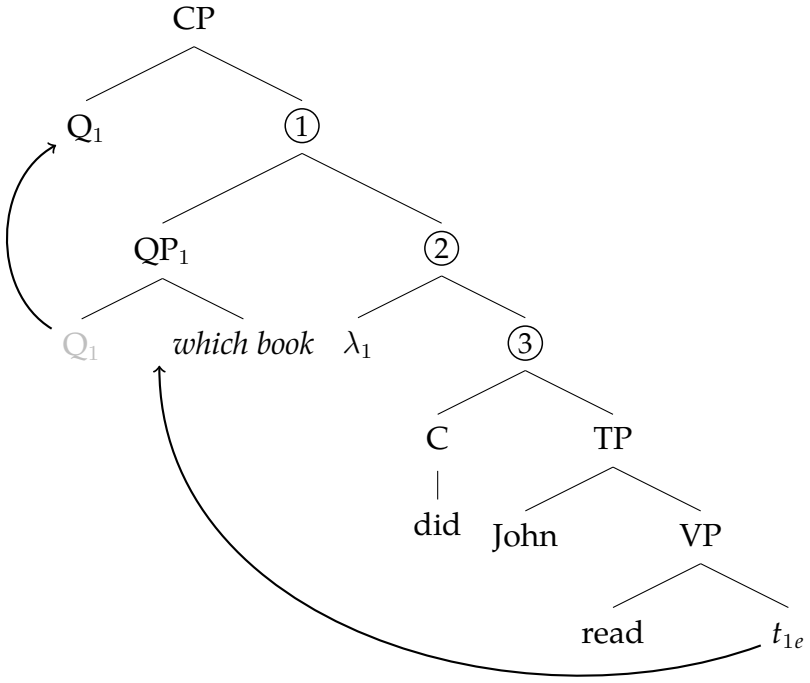
$[\![\text{which NP}]\!]^f = [\![\text{NP}]\!]^o$

[13] In Chapters 4 and 6 we will see that, in fact, when QP cannot move above an intervener, we observe intervention effects in superiority-obeying questions, above the landing site of QP.

[14] To simplify the derivation, I ignore irrelevant parts of the structure, including the *v*P layer, and I do not represent the movement of the subject from its *v*P-internal position to Spec,TP.

[15] Under this view, Q and *which* can be thought of as complementary functions: *which* takes an ordinary semantic value and returns a focus-semantic value, while Q takes a focus-semantic value and returns an ordinary semantic value.

(20) **The LF of a simplex question:**



The derivation of (20) is given in (21) below. At the TP level, we compute an assignment dependent proposition, whose free variable is abstracted over at node ② (recall that C simply passes up the tree the value of its sister). At node ①, we point-wise compose this set with the meaning of the *wh*-phrase using the functional application rule in (12). At this point, node ① only has a focus-semantic value but no ordinary semantic value, because the *wh*-word *what* has an undefined ordinary semantic value. Finally, at the CP level the Q-particle takes the focus-semantic value of its sister and returns it as the ordinary semantic value of the question. The meaning of the question is thus a set of propositions that are possible answers to the question, a Hamblin-Karttunen set.[16]

(21) **The derivation of a simplex question:**

a. $[\![\text{TP}]\!]^o = \lambda w.$ John read x in w

b. $[\![③]\!]^o = [\![\text{TP}]\!] = \lambda w.$ John read x in w

c. $[\![②]\!]^o = \lambda x.\ \lambda w.$ John read x in w

d. $[\![\text{QP}_1]\!]^o$ is undefined
$[\![\text{QP}_1]\!]^f = \{x_e : x \in \text{book}\}$

[16]For completeness, in (21) and in all other derivations below, I show not only the sets that we derive as the denotation of the question, but also their characteristic functions.

e. $[\![\textcircled{1}]\!]^o$ is undefined
$[\![\textcircled{1}]\!]^f = \{\lambda w.$ John read x in $w : x \in book\}$

f. $[\![\text{CP}]\!]^o = [\![\textcircled{1}]\!]^f = \{\lambda w.$ John read x in $w : x \in book\}$
$= \lambda q_{\langle s,t\rangle} \,.\, \exists x \in book\, [q = \lambda w.$ you read x in $w]$

I note that the tree in (20) represents two steps of interrogative movement. The first step is the movement of QP_1 to Spec,CP. This movement is syntactic probe-driven successive-cyclic movement that must take place once the interrogative probe on C agrees with QP. The second movement step is a semantic type-driven movement of Q from its position inside QP to a position adjoined to the spine. Note that this movement does not leave a trace and does not introduce a λ-binder.

This step of Q-movement from a position in Spec,CP to the spine raises several questions. First, we may wonder why Q was merged at a position near *wh* and projected a QP, instead of in Spec,CP, since it is required to occupy a position there at LF. Such a state of affairs is required in English (and in other overt *wh*-movement languages) by the EPP property of interrogative C: Q must merge with *wh* and project a QP because the EPP requires there to be at least one interrogative phrase in Spec,CP; a standalone Q does not satisfy this requirement, because it is null.[17]

Next, we may wonder what regulates the target position of Q-movement. I propose that economy principles dictate that Q-movement must be the shortest that would derive a particular meaning. We will see below that Q must occur in different positions in order to derive the single-pair and the pair-list reading of a multiple question. In a simplex question, Q will move just above its original position in QP and no further.

[17] At this point, an alternative option is to propose a different semantics for the Q-particle, as in (i):

(i) **An alternative semantics for the Q-particle:**
$[\![\text{Q } \alpha]\!]^o = \lambda p_{\langle e,st\rangle}.\ \lambda q_{\langle s,t\rangle} \,.\, \exists x \in [\![\alpha]\!]^f \,.\, q = p(x)$
$= \lambda p \,\{\, p(x) : x \in [\![\alpha]\!]^f \,\}$

As the reader can verify, this semantics will yield the desired meaning of the question without requiring the additional Q-movement step I assume in the LF in (20). A generalized, type flexible, version of (i) will additionally yield the desired meaning for superiority-obeying questions, where all the *wh*-words occur inside QPs. However, (i) will be unable to derive the meaning of a superiority-violating question, which will contain a non-projecting Q that must move alone to C, without further assumptions (although I believe it may be possible to reach a converging derivation without much additional work). Even worse, I see no clear way to derive the single-pair reading of a multiple question using (i). Therefore, at least for the derivation of a single-pair reading of a question, and perhaps also for the derivation of a superiority-violating question, we must postulate the meaning of Q I assume in the text above. As a consequence, I have chosen to only use this meaning for Q in all of the derivations I present here. I leave for future work the question whether the two entries for Q I show in (14) and in (i) can be unified, or if there is a principled type-shifting rule that can take us from one entry to the other.

2.3.3 On the presuppositions of the question

It has been argued that questions with singular *which*-phrases presuppose that there is a unique maximally informative answer to the question. Dayal (1996) proposes that an *Ans* operator which takes the question denotation as its argument derives the uniqueness presupposition. This operator returns the maximally informative member in the set, and is undefined if such a member does not exist. This will yield the desired meaning and presupposition of (20)–(21):

(22) **The *Ans* operator as Max_{inf} (Dayal, 1996):**[18]
$[\![Ans]\!]\,(P) = \text{Max}_{inf}(P)$
$\text{Max}_{inf}(P)(w) = \iota p \in P$, s.t. $w \in p$ and $\forall q \in P\ (w \in q \rightarrow p \subseteq q)$

An example for an answer set yielded by (21) is given in (23), assuming four books in the context: *Moby Dick, War and Peace, The Brothers Karamazov*, and *Oliver Twist*. Let us assume that in the actual world, John read Moby Dick, indicated by a box:

(23) **A set of possible answers to (21):**
$\left\{\boxed{\text{John read MD}}, \text{John read WP}, \text{John read BK}, \text{John read OT}\right\}$

The *Ans* operator will take the set in (23) as input. Here there is a single proposition that is true in the set, and the answer operator will return this proposition. Notice that the propositions in (23) are logically independent from one another. Therefore, if more than one proposition were true, *Ans* will be unable to return a unique maximally informative true answer, and the result will therefore be undefined.[19] This is the desired result.

Next we turn to the derivation of multiple *wh*-questions. Multiple *wh*-questions are ambiguous between a single-pair reading and a pair-list reading:[20]

(24) **The single-pair and pair-list readings of a multiple question:**
Which student read *which* book?

a. Single pair: Specifies just one pair as the answer to the question, e.g.:
John read Moby Dick.

[18] Dayal does not use the term Max_{inf}, but the definition she provides is equivalent to Max_{inf}, as proposed in Fox and Hackl (2006) and subsequent work.

[19] Note that complex propositions such as "John read MD and WP" are not in this set because our question, *Which book did John read?* contains singular agreement on the *which*-phrase.

[20] As noted above, I will return to a more detailed discussion of this claim in section 6.5.

b. Pair-list: Specifies for each member of the higher *wh* a corresponding answer from the lower *wh*. If $\{John, Mary, Bill\} \in [\![\text{student}]\!]$, a possible answer is: *John read Moby Dick, Mary read War and Peace, Bill read The Brothers Karamazov*.

The single-pair reading of the question can be analyzed similarly to the meaning of a simplex question. Suppose the propositions in the context are as in (25) below, where the proposition that is true in the actual world is indicated by a box.

(25) **A set of possible answers to *Which student read which book?*:**

$$\left\{ \begin{array}{l} \boxed{\text{John read MD}}\text{, John read WP, John read BK, John read OT,} \\ \text{Mary read MD, Mary read WP, Mary read BK, Mary read OT,} \\ \text{Bill read MD, Bill read WP, Bill read BK, Bill read OT} \end{array} \right\}$$

The *Ans* operator will take the set in (25) as input. As in the case of the simplex question, *Ans* will act as a filter and seek to return the maximally informative true member in the set. (25) contains such a proposition; *Ans* will therefore successfully apply to (25) and return the proposition "John read Moby Dick" as the answer to the question—a single pair. Notice that as with (23), the propositions in (25) are logically independent from one another. Therefore, if more than one proposition is true, *Ans* would be unable to return a unique maximally informative true answer, and the result will therefore be undefined.

Turning next to the pair-list reading of multiple question, I follow Roberts (1996); Hagstrom (1998); Krifka (2001); Büring (2003); Willis (2008); Fox (2012); Nicolae (2013) a.o. in adopting a "family of questions" meaning for the pair-list reading of the question. That is, if a simplex question and similarly a single-pair reading of a multiple question denote a set of propositions that are the possible answers to the question, the pair-list reading of a multiple question denotes a set of questions. For a superiority-obeying question, e.g. *Which student read which book?*, this amounts to quantifying over every student in the domain and asking for each one, which book they read. For a situation with three students, we create the following set of questions:

(26) **A set of questions based on the denotation of the higher *wh* in (24):**

$\{\{\lambda w.\ x \text{ read } y \text{ in } w : y \in [\![\text{book}]\!]\} :\ x \in [\![\text{student}]\!]\}$

$$\left\{ \begin{array}{l} \text{Which book did John read?} \\ \text{Which book did Mary read?} \\ \text{Which book did Bill read?} \end{array} \right\}$$

Assuming that there are four books (Moby Dick, War and Peace, The Brothers Karamazov, Oliver Twist), each question in (26) will contain four propositions, with a structure as in (27). This is a set of questions keyed on *students*:

(27) **A family of questions denotation based on (26):**

$$\left\{ \left\{ \begin{array}{c} \text{John read MD} \\ \text{John read WP} \\ \text{John read BK} \\ \text{John read OT} \end{array} \right\}, \left\{ \begin{array}{c} \text{Mary read MD} \\ \text{Mary read WP} \\ \text{Mary read BK} \\ \text{Mary read OT} \end{array} \right\}, \left\{ \begin{array}{c} \text{Bill read MD} \\ \text{Bill read WP} \\ \text{Bill read BK} \\ \text{Bill read OT} \end{array} \right\} \right\}$$

For a superiority-violating question, e.g. *Which book did which student read?*, following the same logic that yielded (27) above, we need to derive a family of questions denotation ordered by the values of the books in the context as the pair-list reading of the question. Assuming four students: John, Mary, Bill and Suzy, and three books: Moby Dick, War and Peace, and The Brothers Karamazov in the context, we derive the following family of questions as in (28). This is a set of questions keyed on *books*:

(28) **A family of questions denotation for a superiority-violating question:**
Which book did *which* student read?

$$\left\{ \left\{ \begin{array}{c} \text{John read MD} \\ \text{Mary read MD} \\ \text{Bill read MD} \\ \text{Suzy read MD} \end{array} \right\}, \left\{ \begin{array}{c} \text{John read WP} \\ \text{Mary read WP} \\ \text{Bill read WP} \\ \text{Suzy read WP} \end{array} \right\}, \left\{ \begin{array}{c} \text{John read BK} \\ \text{Mary read BK} \\ \text{Bill read BK} \\ \text{Suzy read BK} \end{array} \right\} \right\}$$

Notice that in (27)–(28), the sets of propositions are ordered according to ("keyed on") the higher *wh*-phrase in each question. This higher *wh*-phrase is then the one to which the exhaustivity presupposition of the pair-list reading of the question applies, while the lower *wh* is the one to which uniqueness applies. The definition of these presuppositions is repeated here. (See also section 1.2.)

(29) **The presuppositions of a multiple question (Dayal, 2002):**

a. Domain exhaustivity: every member of the set quantified over by the overtly moved *wh* is paired with a member of the set quantified over by the in-situ *wh*.

b. Point-wise uniqueness (*functionhood*): every member of the set quantified over by the overtly moved *wh* is paired with no more than one member of the set quantified over by the in-situ *wh*.

Notice that Dayal's (1996) *Ans* operator in (22) is unable to apply to families of questions as in (27)–(28), because they are sets of sets instead of sets of propositions. *Ans* will seek the maximally informative proposition in this set, but fail to find one because the set contains no propositions. In (30) I define a recursive *Ans* operator, that is able to apply to sets of propositions, or to sets of such sets, etc. See alternative proposals in Dayal (2002); Fox (2012); Nicolae (2013). This proposal amounts to a recursive application of the requirement that each question—that is, each set of propositions in a family of questions denotation—have a unique maximally informative true answer. This guarantees exhaustivity over the first element in the pair, and point-wise uniqueness for the second element:

(30) **A recursive definition for *Ans*:**
$[\![Ans]\!]\left(P_{\langle st,t\rangle}\right) = \lambda w.\text{Max}_{inf}(P)(w)$
$[\![Ans]\!]\left(K_{\langle \sigma,t\rangle}\right) = \lambda w.\forall P_\sigma \in K\left([\![Ans]\!]\,(P)(w)\right) \qquad \sigma \in \{\langle st,t\rangle, \langle\langle st,t\rangle,t\rangle, ...\}$
where $\text{Max}_{inf}(P)(w) = \iota p \in P$, s.t. $w \in p$ and $\forall q \in P\,(w \in q \rightarrow p \subseteq q)$

The *Ans* operator in (30) takes a question denotation and returns the maximally informative true member in the set. If the input to *Ans* is a set of propositions (of type $\langle st,t\rangle$), *Ans* behaves is the operator in (22): it requires there to be a true proposition in the question denotation which is maximally informative. That is, there must be a single true answer to the question. This will derive the correct presupposition for both a simplex question and for a single-pair multiple question. If, on the other hand, the input to *Ans* is a family of questions, *Ans* applies recursively to each question in the family of questions and requires there to be a maximally informative true answer to each question. Assuming again the same domain of students and books as in (25), the family of questions denotation for the pair-list reading of the superiority-obeying question is given in (31). As before, I mark the answers that are true in the contexts with boxes.

(31) **A family of questions denotation for *Which student read which book?*:**

$$\left\{ \left\{ \begin{array}{l} \boxed{\text{John read MD}} \\ \text{John read WP} \\ \text{John read BK} \\ \text{John read OT} \end{array} \right\}, \left\{ \begin{array}{l} \text{Mary read MD} \\ \boxed{\text{Mary read WP}} \\ \text{Mary read BK} \\ \text{Mary read OT} \end{array} \right\}, \left\{ \begin{array}{l} \text{Bill read MD} \\ \text{Bill read WP} \\ \boxed{\text{Bill read BK}} \\ \text{Bill read OT} \end{array} \right\} \right\}$$

If (31) (of type $\langle\langle st,t\rangle,t\rangle$) is the input to *Ans*, the operator will recursively apply to each question (of type $\langle st,t\rangle$) in the set, using the second line of the definition. For each question, the first line in the definition of *Ans* can now apply and return the true maximally

informative answer to the question. We thus exhaustify over the set of questions, ordered by the higher wh_1, essentially asking the question: *for each student, what did s/he read?*. We now require uniqueness—that there be a unique true answer to each question. The question is thus only defined if there is exactly one boxed answer to each question, but note it is allowed for there to be a book which no one read—that is, the set of books, corresponding to the lower wh_2 is not exhaustified here.

This recursive definition of *Ans* is thus able to explain the presuppositions of both the single-pair and the pair-list readings of multiple questions. I note that we may in addition wish to add an operator to our semantic lexicon that is able to act as a filter on question meanings. This operator will take the meaning of the question as input, check that this question is well-defined—that is, that it has a maximally informative true answer (or the equivalent of this requirement for a family of questions)—and return the same set as output. This set can then be used by operators in the performative layer, as needed. Such an operator, which I will call *answerable* here, can be defined using *Ans*:[21,22]

(32) **A recursively defined filter on question meanings using *Ans*:**

$$[\![Answerable]\!]\left(P_{\langle st,t\rangle}\right) = \exists q : [\![Ans]\!](P) = q.\ P$$

$$[\![Answerable]\!]\left(K_{\langle \sigma,t\rangle}\right) = \forall P_{\sigma} \in K\left(\exists q : [\![Ans]\!](P) = q\right).\ K$$

$$\sigma \in \{\langle st,t\rangle, \langle\langle st,t\rangle,t\rangle, ...\}$$

Next I show how my proposal compositionally derives the correct LFs for the two readings of a multiple question.

[21] See also Nicolae's (2013, p. 175) Iᴅ operator.

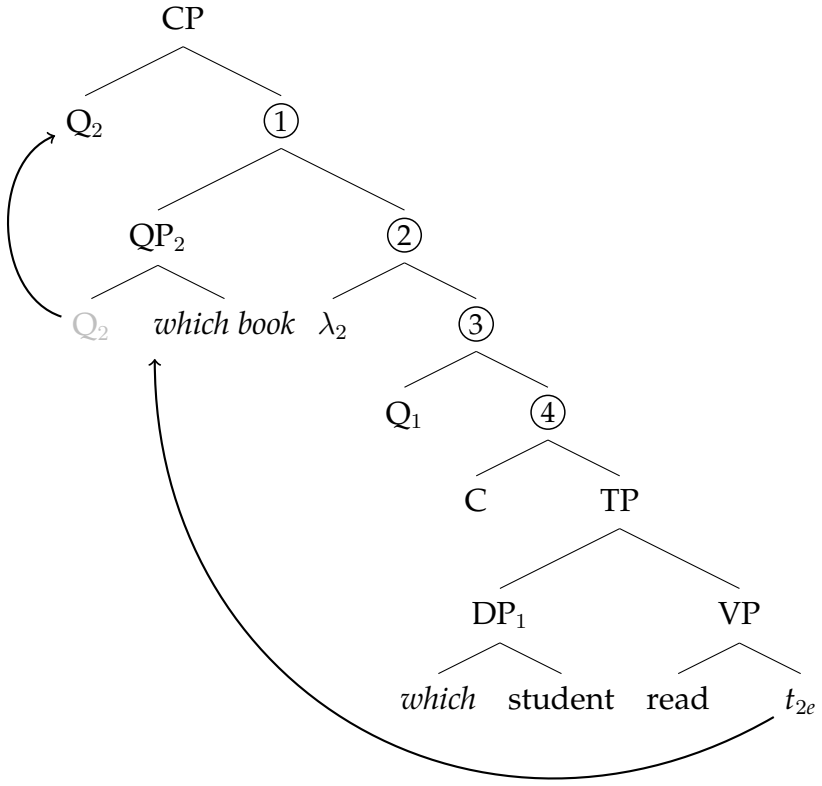
[22] Here I the notation $\lambda alpha.\beta : \gamma$, following Heim. β denotes a definedness condition on α, and γ denotes the output of the function.

2.3.4 The pair-list reading of superiority-violating questions

I begin with the derivation of the pair-list reading of a superiority-violating question, e.g. *Which book did which student read?*. As we will see, there is only one possible LF that can derive the required word order and meaning of this question, but there are two different ways of deriving the parallel superiority-obeying question, which I return to next.

To derive the superiority-violating word-order and meaning, only one QP may be constructed in the derivation, containing the lower *which book*. The (base-generated) higher *which student* must not occur inside a QP but instead must remain in-situ. This makes QP_2 the first (and here, only) target for interrogative probing. I assume that the probe finds QP_2 and moves it to the Spec,CP, and that, in addition, a non-projecting Q-particle, Q_1, is merged into the CP layer in order to interpret the in-situ wh_1. The proposed LF for this question is given in (33):[23]

(33) **The LF of a superiority-violating question:**



[23]Here and throughout: I label *wh*-phrases that did not merge with a Q-particle as DP, and *wh*-phrases that did merge with a Q-particle as QP.

Note that it is impossible to derive the desired structure if both *wh*-phrases are contained inside QP. In that case, the logic of Attract Closest and tucking-in would dictate that QP_1 occupy an outer Spec,CP and that QP_2 would occupy an inner Spec,CP, yielding a derivation that we will see below results in a superiority-obeying word order and meaning. Therefore, here it is necessary that only the lower *wh* be contained in a QP.

The derivation of the meaning of this question is given in (34). Note that since TP contains an element that only has a focus-semantic value but no ordinary semantic value—DP_1 which contains the *wh*-phrase *which student*, TP too only has a focus-semantic value but no ordinary semantic value. C passes up the value of TP, and we use Q_1 to turn it into an ordinary semantic value. This meaning is assignment dependent, since it contains a free variable which is abstracted over at node ②. At node ① we point-wise compose the set of propositions computed at ② with QP_2, which contains a *wh*-phrase and hence does not have an ordinary semantic value. Q_2 takes this set of questions and returns it as the meaning of CP. We yield the desired family of questions denotation, which can be paraphrased as follows: "for every individual in the domain of books, answer the question: which student read that book?"

(34) **The derivation of a superiority-violating question:**

a. $[\![\mathrm{DP}_1]\!]^o$ is undefined
$[\![\mathrm{DP}_1]\!]^f = \{x_e : x \in \mathit{student}\}$

b. $[\![\mathrm{TP}]\!]^o$ is undefined
$[\![\mathrm{TP}]\!]^f = \{\lambda w.\ x \text{ read } y \text{ in } w : x \in \mathit{student}\}$

c. $[\![④]\!]^o = [\![\mathrm{TP}]\!]^o$ is undefined
$[\![④]\!]^f = [\![\mathrm{TP}]\!]^f = \{\lambda w.\ x \text{ read } y \text{ in } w : x \in \mathit{student}\}$

d. $[\![③]\!]^o = [\![③]\!]^f = \{\lambda w.\ x \text{ read } y \text{ in } w : x \in \mathit{student}\}$
$= \lambda q_{\langle s,t\rangle}.\ \exists x \in \mathit{student}\ [q = (\lambda w.\ x \text{ read } y \text{ in } w)]$

e. $[\![②]\!]^o = \lambda y.\ \lambda q_{\langle s,t\rangle}.\ \exists x \in \mathit{student}\ [q = (\lambda w.\ x \text{ read } y \text{ in } w)]$

f. $[\![\mathrm{QP}_2]\!]^o$ is undefined
$[\![\mathrm{QP}_2]\!]^f = \{y_e : y \in \mathit{book}\}$

g. $[\![①]\!]^o$ is undefined
$[\![①]\!]^f = \{\{\lambda w.\ x \text{ read } y \text{ in } w : x \in \mathit{student}\} :\ y \in \mathit{book}\}$

h. $[\![\mathrm{CP}]\!]^o = [\![①]\!]^f = \{\{\lambda w.\ x \text{ read } y \text{ in } w : x \in \mathit{student}\} :\ y \in \mathit{book}\}$
$= \lambda Q_{\langle st,t\rangle}\ .\ \exists y \in \mathit{book}\ [Q = \lambda q_{\langle s,t\rangle}.\ \exists x \in \mathit{student}\ [q = (\lambda w.\ x \text{ read } y \text{ in } w)]]$

In set terms, the resulting meaning of the derivations we have seen in this section can be described as a family of questions denotation, keyed on the higher *wh*-element, *which book*. For a domain with three students, *John, Mary, Bill* and three books, *Moby Dick, War and Peace, Oliver Twist*, we arrive at the following set containing three questions, each about who read each book in the context, (35), as desired.

(35) **A family of questions denotation yields a pair-list reading:**
Which book did *which* student read?

$$\left\{ \left\{ \begin{array}{c} \text{John read MD} \\ \text{Mary read MD} \\ \text{Bill read MD} \end{array} \right\}, \left\{ \begin{array}{c} \text{John read WP} \\ \text{Mary read WP} \\ \text{Bill read WP} \end{array} \right\}, \left\{ \begin{array}{c} \text{John read OT} \\ \text{Mary read OT} \\ \text{Bill read OT} \end{array} \right\} \right\}$$

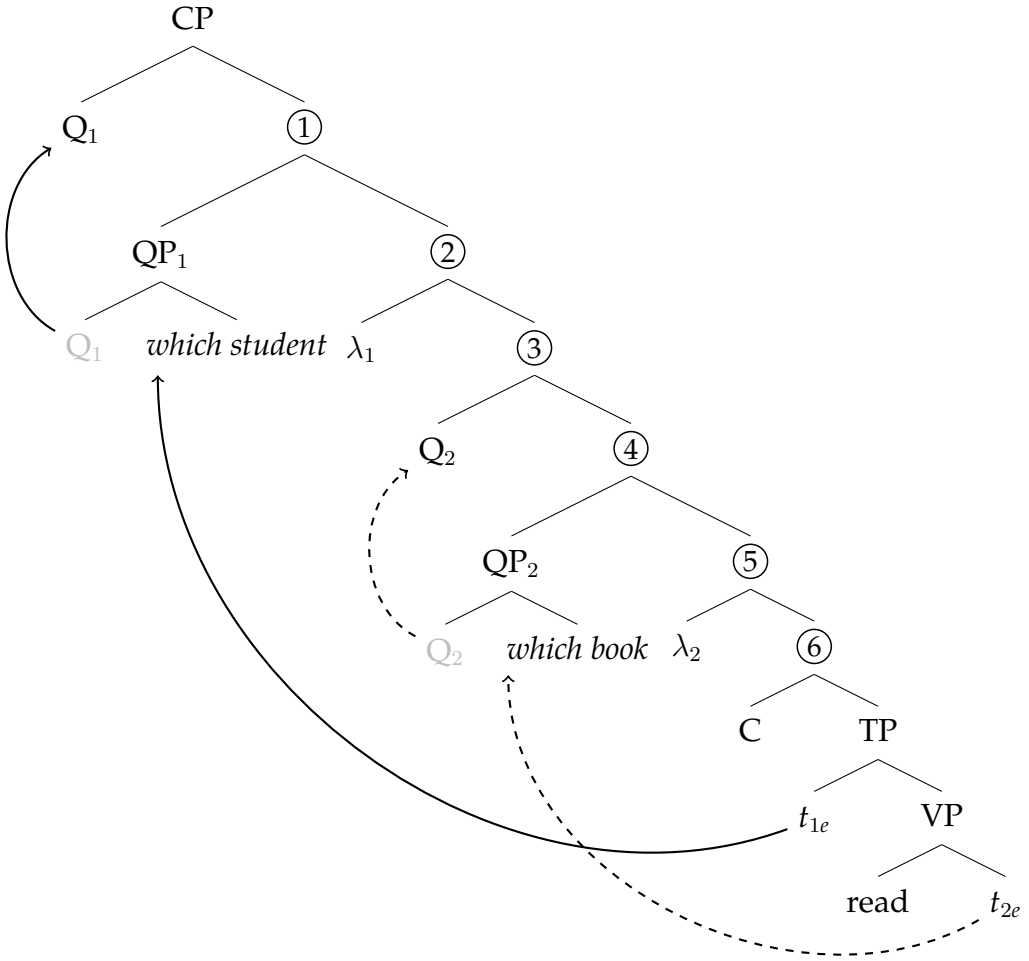
Finally, note that there is one other logical possibility for the derivation of a superiority-violating question not discussed here: we could choose not to merge the non-projecting Q_1 into the derivation at all and instead use a derivation with a single Q-particle—the projecting Q_2. In section 2.3.6 I will show that such a derivation will yield the single-pair reading of the question, and will additionally discuss it in section 2.4.1.

2.3.5 The pair-list reading of superiority-obeying questions

In this section I discuss the derivation of the pair-list reading of superiority-obeying questions. There are two ways to derive the pair-list reading of the question within the system proposed here. One option involves the projection of two QPs, corresponding to the two *wh*-phrases in the question. Alternatively, it is possible to project one QP on the higher *wh*-phrase, while the lower *wh*-word remains in-situ and is interpreted using a non-projecting Q in the CP layer. In the absence of an intervener, both of these derivations will yield the same result, as I will show below. I discuss intervention effects in section 2.4.2.

I begin by considering a derivation in which all the *wh*-words in the structure are contained inside QPs. The tree in (36) illustrates the LF of the question *Which student read which book?*. Here, we construct two QPs, corresponding to the two *wh*-phrases in the question. Both QPs are agreed with by the interrogative probe, and they are attracted in the same order that they are found in the question, with the lower QP_2 tucking in below QP_1 (Richards, 1997). Q then moves out of its respective QP and adjoins to the CP spine immediately above its sister.

(36) **The LF of a superiority-obeying multiple question with multiple QPs:**



The derivation of (36) is given in (37). This derivation proceeds similarly to the derivation of the simplex question in (21), with one difference: at node ③, we have a structure containing one QP, similar to the structure of the simplex question at the end of its derivation. However, unlike the simplex question, the denotation of node ③ is assignment dependent, containing a free variable that is abstracted over at the next node up. Next,

we repeat the process of point-wise composing the resulting set of propositions with the meaning of the *wh*-phrase *which student*, and applying Q_1 to this meaning. The result of this process is a family of questions denotation, which with the aid of a notion of the *Ans* operator I presented in section 2.3.3 can be thought of as having the import of the following paraphrase: "for every individual in the domain of students, answer the question: which book did that individual read?" This is the desired meaning of a superiority-obeying question.

(37) **The derivation of a superiority-obeying multiple question with multiple QPs:**

a. $[\![\text{TP}]\!]^o = \lambda w.\ x \text{ read } y \text{ in } w$[24]

b. $[\![⑥]\!]^o = [\![\text{TP}]\!]^o = \lambda w.\ x \text{ read } y \text{ in } w$

c. $[\![⑤]\!]^o = \lambda y.\ \lambda w.\ x \text{ read } y \text{ in } w$

d. $[\![\text{QP}_2]\!]^o$ is undefined
$[\![\text{QP}_2]\!]^f = \{y_e : y \in book\}$

e. $[\![④]\!]^o$ is undefined
$[\![④]\!]^f = \{\lambda w.\ x \text{ read } y \text{ in } w : y \in book\}$

f. $[\![③]\!]^o = [\![④]\!]^f = \{\lambda w.\ x \text{ read } y \text{ in } w : y \in book\}$
$= \lambda q_{\langle s,t\rangle}.\ \exists y \in book\ [q = (\lambda w.\ x \text{ read } y \text{ in } w)]$

g. $[\![②]\!]^o = \lambda x.\ \lambda q_{\langle s,t\rangle}.\ \exists y \in book\ [q = (\lambda w.\ x \text{ read } y \text{ in } w)]$

h. $[\![\text{QP}_1]\!]^o$ is undefined
$[\![\text{QP}_1]\!]^f = \{x_e : x \in student\}$

i. $[\![①]\!]^o$ is undefined
$[\![①]\!]^f = \{\{\lambda w.\ x \text{ read } y \text{ in } w : y \in book\} :\ x \in student\}$

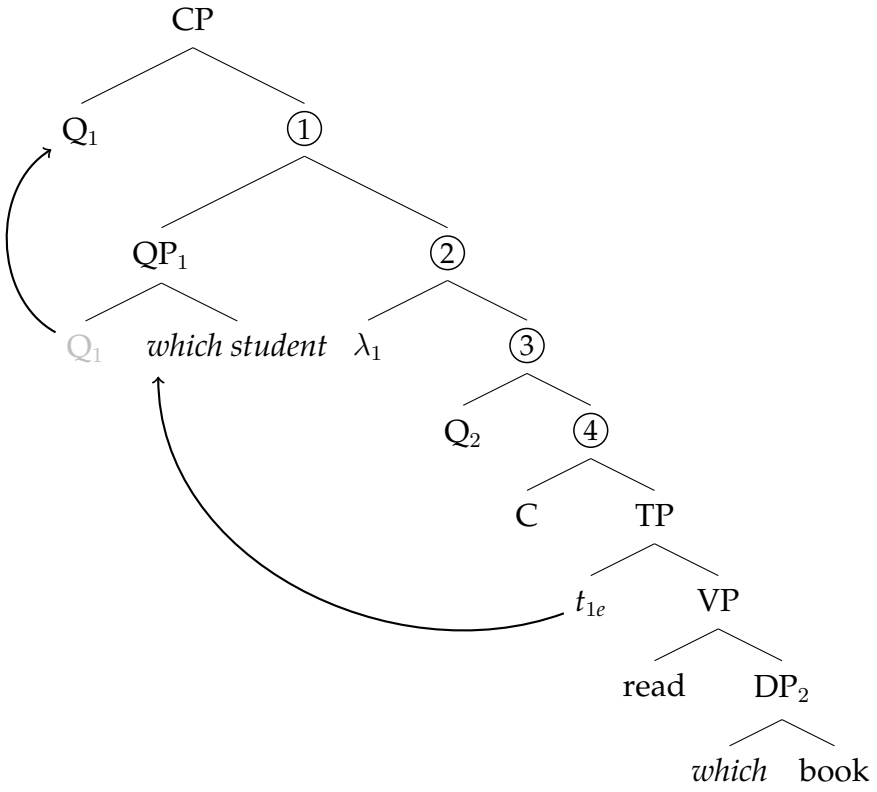
j. $[\![\text{CP}]\!]^o = [\![①]\!]^f = \{\{\lambda w.\ x \text{ read } y \text{ in } w : y \in book\} :\ x \in student\}$
$= \lambda Q_{\langle st,t\rangle}\ .\ \exists x \in student\ [Q = \lambda q_{\langle s,t\rangle}.\ \exists y \in book\ [q = (\lambda w.\ x \text{ read } y \text{ in } w)]]$

We thus derive the desired meaning of the pair-list reading of the question. Combined with the pronunciation rule in (9), we guarantee that the higher *wh*-phrase is pronounced in Spec,CP and that the lower *wh*-phrase is pronounced in its base position, yielding the correct word-order of the question.

[24] To simplify the notation, I represent assignment dependent elements in the denotation using unbound variables.

Next let us consider a derivation in which the lower *wh*-phrase, *which book*, remains in-situ at LF and is interpreted using a non-projecting Q-particle that occurs in Spec,CP. The LF for such a structure is given in (38). Here, only the higher, overtly fronted *wh*-phrase is merged with a projecting Q-particle. This QP is agreed with by the interrogative probe and is moved to C. The lower *wh*-phrase remains in-situ at LF, and is interpreted using a dedicated non-projecting particle, Q_2.

(38) **The LF of a superiority-obeying multiple question with one QP:**



The derivation of this LF is given in (39). As the reader may verify, the resulting meaning is identical to the one yielded by the LF containing two QPs, as shown in (37).

(39) **The derivation of a superiority-obeying question with one QP:**

a. $[\![\text{DP}_2]\!]^o$ is undefined
$[\![\text{DP}_2]\!]^f = \{y_e : y \in \textit{book}\}$

b. $[\![\text{TP}]\!]^o$ is undefined
$[\![\text{TP}]\!]^f = \{\lambda w.\ x \text{ read } y \text{ in } w : y \in \textit{book}\}$

c. $[\![④]\!]^o = [\![\text{TP}]\!]^o$ is undefined
$[\![④]\!]^f = [\![\text{TP}]\!]^f = \{\lambda w.\ x \text{ read } y \text{ in } w : y \in \textit{book}\}$

d. $[\![③]\!]^o = [\![④]\!]^f = \{\lambda w.\ x \text{ read } y \text{ in } w : y \in book\}$
$= \lambda q_{\langle s,t\rangle}.\ \exists y \in book\ [q = (\lambda w.\ x \text{ read } y \text{ in } w)]$

e. $[\![②]\!]^o = \lambda x.\ \lambda q_{\langle s,t\rangle}.\ \exists y \in book\ [q = (\lambda w.\ x \text{ read } y \text{ in } w)]$

f. $[\![\text{QP}_1]\!]^o$ is undefined
$[\![\text{QP}_1]\!]^f = \{x_e : x \in student\}$

g. $[\![①]\!]^o$ is undefined
$[\![①]\!]^f = \{\{\lambda w.\ x \text{ read } y \text{ in } w : y \in book\} :\ x \in student\}$

h. $[\![\text{CP}]\!]^o = [\![①]\!]^f = \{\{\lambda w.\ x \text{ read } y \text{ in } w : y \in book\} :\ x \in student\}$
$= \lambda Q_{\langle st,t\rangle}\ .\ \exists x \in student\ [Q = \lambda q_{\langle s,t\rangle}.\ \exists y \in book\ [q = (\lambda w.\ x \text{ read } y \text{ in } w)]]$

In set terms, the resulting meaning of the derivations we have seen in this section can be described as a family of questions denotation, keyed on the higher *wh*-element. For a domain with three students, *John, Mary, Bill* and three books, *Moby Dick, War and Peace, Oliver Twist*, we arrive at the following set, (40), as desired.

(40) **A family of questions denotation for a superiority-obeying question:**
Which student read *which* book?

$$\left\{ \left\{ \begin{array}{l} \text{John read MD} \\ \text{John read WP} \\ \text{John read OT} \end{array} \right\}, \left\{ \begin{array}{l} \text{Mary read MD} \\ \text{Mary read WP} \\ \text{Mary read OT} \end{array} \right\}, \left\{ \begin{array}{l} \text{Bill read MD} \\ \text{Bill read WP} \\ \text{Bill read OT} \end{array} \right\} \right\}$$

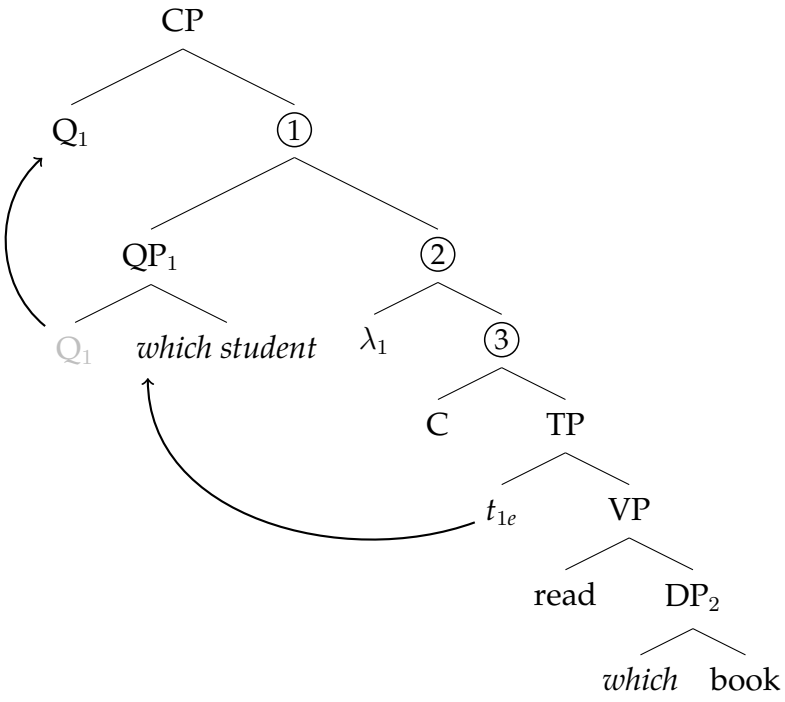
Finally, note that as in the case of the superiority-violating structure in section 2.3.4, here too there are possible additional derivations, in which the non-projecting Q_2 is not merged into the derivation at all, or where the non-projecting Q is merged in a higher position in Spec,CP. In section 2.3.6 I will show that such a derivation yields the single-pair reading of the question.

2.3.6 The single-pair readings of multiple questions

Let us now return to the derivation of single-pair readings of multiple questions. Following the discussion of the presuppositions of the question above, we notice that the single-pair reading of a multiple question is derived if we obtain a *flat* structure instead of a family of questions denotation for the question. That is, if instead of dealing with a family of questions denotation—a set of questions—we deal with a simple question denotation—a set of propositions—the application of the *Ans* operator will yield the prediction that only one member of the set can be true, a single-pair answer.

Notice that such a structure can be obtained if all the Q-particles in the question occur above all the *wh*-phrases in the derivation. In that case, the structure below the Q-particles, denoted by node ① in the tree below, will contain multiple elements projecting focus-semantic values—namely, the *wh*-phrases in the structure, and they will point-wise compose with one another to yield a set of propositions. Q will turn this set into the ordinary meaning of the question. One such structure for a superiority-obeying question is illustrated below. Here there is only one Q-particle in the question, originating in the fronted QP and then adjoined to the CP spine.

(41) **The LF of a superiority-obeying multiple question with one QP:**



The derivation of this reading is given in (42). Crucially, at node ①, there are two elements projecting focus-alternatives—the two *wh*-phrases in QP_1 and DP_2. These elements point-wise compose with the rest of the derivation using the special point-wise Functional Application rule presented in (12). We thus have a set of propositions as the meaning of ①. This node then serves as input for Q_1, which will in turn return this set as the ordinary semantic value of the question.

(42) **The derivation of the single-pair reading of a sup.-obeying multiple question:**

a. $[\![DP_2]\!]^o$ is undefined
$[\![DP_2]\!]^f = \{y_e : y \in book\}$

b. $[\![TP]\!]^o$ is undefined
$[\![TP]\!]^f = \{\lambda w.\ x \text{ read } y \text{ in } w : y \in book\}$

c. $[\![③]\!]^o = [\![TP]\!]^o$ is undefined
$[\![③]\!]^f = [\![TP]\!]^f = \{\lambda w.\ x \text{ read } y \text{ in } w : y \in book\}$

d. $[\![②]\!]^o$ is undefined
$[\![②]\!]^f = \lambda x.\ \{\lambda w.\ x \text{ read } y \text{ in } w : y \in book\}$
$= \lambda x.\ \lambda q_{\langle s,t\rangle}.\ \exists y \in book\ [q = (\lambda w.\ x \text{ read } y \text{ in } w)]$

e. $[\![QP_1]\!]^o$ is undefined
$[\![QP_1]\!]^f = \{x_e : x \in student\}$

f. $[\![①]\!]^o$ is undefined
$[\![①]\!]^f = \{\lambda w.\ x \text{ read } y \text{ in } w : x \in student, y \in book\}$

g. $[\![CP]\!]^o = [\![①]\!]^f = \{\lambda w.\ x \text{ read } y \text{ in } w : x \in student, y \in book\}$
$= \lambda q_{\langle s,t\rangle}.\ \exists x \in student\ \exists y \in book\ [q = (\lambda w.\ x \text{ read } y \text{ in } w]$

In set terms, the resulting meaning is a set of propositions, corresponding to the possible answers to the question. Combined with an *Ans* operator which ensures that the set contains a unique maximally informative true member, we thus yield a single-pair answer to the question.

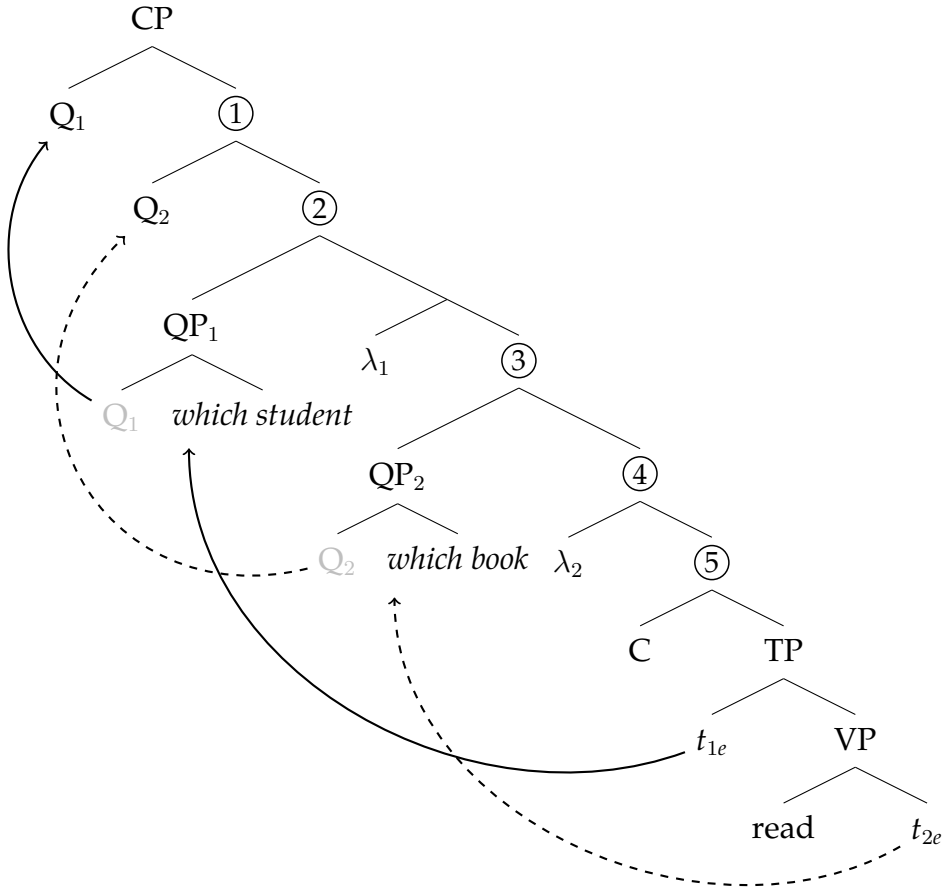
(43) **A single-pair reading is modeled as a set of propositions:**

$$\left\{ \begin{array}{l} \text{John read MD, John read WP, John read OT, Mary read MD,} \\ \text{Mary read WP, Mary read OT, Bill read MD, Bill read WP, Bill read OT} \end{array} \right\}$$

In addition to the LF and derivation presented here, it is possible to derive a single-pair reading of the superiority-obeying question from an LF that contains two QPs. The LF for

the single-pair reading I present below is very similar to the LF for the pair-list reading of the question presented in 2.3.5, except for the position of Q_2 in Spec,CP, which must be above QP_1 (but could be above or below Q_1).

(44) **The LF of the single-pair reading of a superiority-obeying multiple question:**



The derivation of this question is illustrated in (45). Notice that the derivation proceeds similarly to the derivation in (42) up to node ①. As in (42), at node ②, there are two elements projecting focus-alternatives—the two *wh*-phrases in QP_1 and QP_2. These elements point-wise compose with the rest of the derivation using the special point-wise Functional Application rule presented in (12). Q_2 will return this set of propositions as the ordinary meaning of ①. This node then serves as input for Q_1, which in turn will yield the final meaning of the question. As proposed in (14), the focus-semantic value of node ① is the singleton set of its ordinary semantic value.[25] Q_1 will return this as the ordinary semantic value of the question.

[25]See Beck and Kim (2006) for a similar assumption for their C.

(45) **The derivation of the single-pair reading of a sup.-obeying multiple question:**

a. $[\![\text{TP}]\!]^o = \lambda w.\ x \text{ read } y \text{ in } w$

b. $[\![\textcircled{5}]\!]^o = [\![\text{TP}]\!] = \lambda w.\ x \text{ read } y \text{ in } w$

c. $[\![\textcircled{4}]\!]^o = \lambda y.\ \lambda w.\ x \text{ read } y \text{ in } w$

d. $[\![\text{QP}_2]\!]^o$ is undefined
$[\![\text{QP}_2]\!]^f = \{y_e : y \in book\}$

e. $[\![\textcircled{3}]\!]^o$ is undefined
$[\![\textcircled{3}]\!]^f = \{\lambda w.\ x \text{ read } y \text{ in } w : y \in book\}$

f. $[\![\text{QP}_1]\!]^o$ is undefined
$[\![\text{QP}_1]\!]^f = \{x_e : x \in student\}$

g. $[\![\textcircled{2}]\!]^o$ is undefined
$[\![\textcircled{2}]\!]^f = \{\lambda w.\ x \text{ read } y \text{ in } w : x \in student, y \in book\}$

h. $[\![\textcircled{1}]\!]^o = [\![\textcircled{2}]\!]^f = \{\lambda w.\ x \text{ read } y \text{ in } w : x \in student, y \in book\}$
$= \lambda q_{\langle s,t\rangle}.\ \exists x \in student\ \exists y \in book\ [q = (\lambda w.\ x \text{ read } y \text{ in } w]$

i. $[\![\text{CP}]\!]^o = [\![\textcircled{1}]\!]^f = \{\{\lambda w.\ x \text{ read } y \text{ in } w : x \in student,\ y \in book\}\}$
$= \{\ \lambda q_{\langle s,t\rangle}.\ \exists x \in student\ \exists y \in book\ [q = (\lambda w.\ x \text{ read } y \text{ in } w]\ \}$

Although at first glance the meaning we derive in (45i) does not appear to yield the correct meaning of the question, upon closer inspection we conclude that this does, in fact, predict a single-pair reading of the question. At the CP node, we derive a singleton set of questions, which will be fed into the *Ans* operator in (30). An example of such a set is shown in (46):

(46) **A set of answers to (44) derived by (45):**

$$\left\{ \left\{ \begin{array}{l} \text{John read MD, John read WP, John read BK, John read OT,} \\ \text{Mary read MD, Mary read WP, Mary read BK, Mary read OT,} \\ \text{Bill read MD, Bill read WP, Bill read BK, Bill read OT} \end{array} \right\} \right\}$$

This set (of type $\langle\langle st, t\rangle, t\rangle$) is the input to *Ans*, (30). The operator will recursively apply to the only question in this set (of type $\langle st, t\rangle$), and require there to be a unique maximally informative answer to that question. Since the inner set in (46) contains logically independent propositions, this requirement is met if and only if there is a single true proposition that serves as the answer to the question—that is, we derive a single pair reading.

Finally, let us turn to the derivation of the a single-pair reading of a superiority-violating question. Note that we are able to derive the single-pair reading using the same logic as for the derivation of this reading for the superiority-obeying question in (45). Here, we require a derivation that is identical in all steps to the one for the pair-list reading of the superiority-violating question presented in section 2.3.4, with the exception that a non-projecting Q-particle, which was used to derive the pair-list reading of the question, is not merged at all. This LF is sketched in (47). Alternatively, additional non-projecting Q-particles can be merged into the derivation above QP_2, to yield a nested structure as in (46). Since the application of such a Q-particle is vacuous, I propose that it cannot be merged at all. However, as we have seen, additional Q-particles present in this derivation will yield a single-pair reading, as desired.

(47) **An LF for a single-pair reading of a superiority-violating question:**
$[_{CP}\ Q_2\ [_{QP_2}\ Q_2\ [\ wh_2\ ]]\ [\ C\ ...\ [\ wh_1\ ]\ ...\ t_2$

(48) **An LF for a with vacuous additional Qs also yields a single-pair reading:**
$[_{CP}\ Q_1\ Q_2\ [_{QP_2}\ Q_2\ [\ wh_2\ ]]\ [\ C\ ...\ [\ wh_1\ ]\ ...\ t_2$

2.4 Some consequences of the proposal

2.4.1 Q-ordering and readings of the question

In section 2.3 I showed how my proposal can derive the readings of simplex and multiple questions. In this section I provide a summary of the readings that are predicted.

The syntax I propose in section 2.2 allows for more than one possible derivation for a superiority-obeying question. In such derivations, all Q-particles are able to project QPs. Following the logic of Attract Closest and tucking in, we predict that the QPs will both occupy Spec,CP positions, and occur in the same order in which they were base-generated. Furthermore, by the end of the derivation, the Q-particles in these QPs must move out of QP and adjoin to the spine, to resolve a type-mismatch. The position to which these Q-particles adjoin will predict whether the question will have a single-pair reading or a pair-list reading. If each Q-particle undergoes a small movement step just above its associated QP, we derive a pair-list reading, as described in section 2.3.5, (49a). If both Q-particles occur above all *wh*-phrases in the question, we derive a single-pair reading. Note that the order in which the Q-particles occur does not make a difference—both orders derive the same single-pair reading, (49b–c).[26]

(49) **Various ways to derive superiority-obeying structures with multiple QPs:**

a. $[_{CP}\ Q_1\ [_{QP_1}\ Q_1\ [\ wh_1\ ]]\ Q_2\ [\ [_{QP_2}\ Q_2\ [\ wh_2\ ]]\ [\ C\ ...\ t_1\ ...\ t_2$

→ Pair-list reading keyed on wh_1

b. $[_{CP}\ Q_1\ Q_2\ [_{QP_1}\ Q_1\ [\ wh_1\ ]]\ [\ [_{QP_2}\ Q_2\ [\ wh_2\ ]]\ [\ C\ ...\ t_1\ ...\ t_2$

→ Single-pair reading

c. $[_{CP}\ Q_2\ Q_1\ [_{QP_1}\ Q_1\ [\ wh_1\ ]]\ [\ [_{QP_2}\ Q_2\ [\ wh_2\ ]]\ [\ C\ ...\ t_1\ ...\ t_2$

→ Single-pair reading

One additional derivation mentioned briefly in section 2.3.6 contains a single Q-particle. If this is the case, the resulting structure will yield a single-pair reading. Notice that in the absence of an intervener, the LF in (50) and the ones in (49b–c) are all candidates for the derivation of the single-pair reading.[27] As we will see below, (50) becomes unavailable if there is an intervener present, but this result is unproblematic because, as we can see here, it is possible to derive the single-pair and pair-list readings of the question from the LFs in (49).

(50) **A single Q-particle in a question yields a single-pair reading:**

$[_{CP}\ Q_1\ [_{QP_1}\ Q_1\ [\ wh_1\ ]]\ [\ C\ ...\ t_1\ ...\ [\ wh_2\ ]$

In Chapters 5-6 I will argue that superiority-obeying questions may involve only *partial movement* of the lower QP, to positions other than interrogative C. This partial movement step will be followed by movement of the Q-particle alone to C. Note that in such derivations, too, QP_1 will c-command Q_2/QP_2. As a result, the set of possible derivations we obtain will be the same as described in (49). This proposed change to the theory and its implications will be discussed at length in section 6.4.

Next consider the possible derivations for superiority-violating questions. Here, I argued that the higher wh_1 cannot be merged with a Q-particle and must instead remain in-situ at LF. A Q-particle merges with the lower wh_2 and projects QP_2. QP_2 is attracted by

[26] For reasons of derivational economy, we may prefer the derivation of the single-pair reading that requires the smallest possible movement steps—that is, (49b) may be preferred over (49c).

[27] Economy considerations might cause us to prefer the derivation in (50), which contains just one QP and thus less movement, over the derivations in (49b–c), which contain an additional Q-particle and require more movement for the derivation of the same reading.

the interrogative probe to Spec,CP to satisfy C's EPP feature, and subsequently Q_2 moves out of QP_2 and adjoins to the spine. This derives the word-order of a superiority-violating question. If the lone Q-particle in the derivation is then responsible for interpreting all of the *wh*-elements in the question, the resulting structure yields a single-pair reading.

(51) **A single Q-particle in a question yields a single-pair reading:**
$[_{CP}\ Q_2\ [_{QP_2}\ t_{Q2}\ [\ wh_2\ ]]\ [\ C\ ...\ [\ wh_1\ ]\ ...\ t_2$

In addition to this derivation, it is possible to base-generate an additional non-projecting Q-particle, Q_1, in the CP layer. If Q_1 occurs in an inner CP specifier, the derivation will yield a pair-list reading of the question, (52a). If Q_1 occurs above QP, the result is a single-pair reading of the question.

(52) **Various ways to derive superiority-violating structures:**

a. $[_{CP}\ Q_2\ [_{QP_2}\ t_{Q2}\ [\ wh_2\ ]]\ Q_1\ [\ C\ ...\ [\ wh_1\ ]\ ...\ t_2$

→ Pair-list reading keyed on wh_2;

b. $[_{CP}\ Q_1\ Q_2\ [_{QP_2}\ Q_2\ [\ wh_2\ ]]\ [\ C\ ...\ [\ wh_1\ ]\ ...\ t_2$

→ Single-list reading

Finally, note that LFs that contain no Q-particles at all are ruled out by the principle of interpretability, which requires each derivation to have an ordinary semantic value. Derivations that only contain non-projecting Q-particles in the CP layer are not possible in English and German because these languages have an EPP feature, requiring something to be pronounced in the specifier of the interrogative C. Hence, each derivation must contain at least one projecting Q-particle, which merges with *wh*-phrase and moves to Spec,CP.

2.4.2 How intervention fits in

Let us now turn our attention back to the phenomenon of intervention effects. The general pattern we wish to explain is repeated in (53)—superiority-obeying questions are immune from intervention effects, but superiority-violating questions are subject to such effects.

(53) **Intervention effects affect superiority-violating questions:**

a. *Which* boy did**n't** ____ read *which* book? ✓sup.-obeying, intervener

b. * *Which* book did**n't** *which* boy read ____? * sup.-violating, intervener

The structures I propose in this chapter for simplex and multiple *wh*-questions are compatible with Beck's (2006) theory of intervention effects and its reformulation in Cable (2010) (see sections 1.4-1.5). Q is related to *wh* via focus-alternatives. Thus, the region between *wh* and Q is predicted to be *intervenable*—that is, the insertion of a focus-sensitive intervener into this region leads to ungrammaticality, because only the Q-particle is able to correctly deal with the semantics of the *wh*-phrase and yield a convergent derivation. The configuration of an intervention effect is given in the schema in (54):

(54) **Configuration of an intervention effect:**
* [Q_i ... **intervener** ... wh_i ...]

Given the derivations I proposed for multiple questions, repeated from (49)–(52), we predict intervention effects to occur only in regions where focus-alternatives are computed. Those regions are shown using squiggly arrows below (the arrows indicating the final Q-movement step are omitted in these derivations, for readability). Note that there are more such regions in superiority-violating questions than in superiority-obeying question.[28]

(55) **Focus-alternatives in superiority-obeying and superiority-violating questions:**

a. [$_{CP}$ Q_1 [$_{QP_1}$ Q_1 [wh_1]] Q_2 [[$_{QP_2}$ Q_2 [wh_2]] [**C** [$_{\mathbf{TP}}$ ... t_1 ... t_2 *sup.-obeying*

b. [$_{CP}$ Q_2 [$_{QP_2}$ Q_2 [wh_2]] Q_1 [**C** [$_{\mathbf{TP}}$ ... [wh_1] ... t_2 *sup.-violating*

In the schemas above, QP_1 and QP_2 in a superiority-obeying structure both occupy Spec,CP positions. As a results, they occur *higher* than potential interveners inside TP. Interveners may only affect the question if they are pied-piped with QP—that is, we only expect to observe intervention inside pied-piping constituents in such questions.[29] In superiority-violating questions, wh_1 occurs in its base-generated position inside TP. Hence, interveners occurring above this *wh* are expected to disrupt the projection of alternatives between *wh* and Q, causing an intervention effect. We also expect to find intervention effects inside QP_2, if an intervener separates wh_2 from Q_2 inside the moved constituent.

[28] Here I show for each question-type the derivation with the *smallest* region where focus-alternatives are computed. As I have shown in section 2.4.1, there are possible derivation that require all *wh*-elements in the question to be interpreted by Q-particles that occupy positions near the outermost Q-particle in the schemas above (that is, near Q_1 in (54a) and near Q_2 in (54b). These derivations predict a greater intervenable region than I discuss above.

[29] Unless covert movement of QP_2 is restricted, see Chapters 4, 6.

Note that this proposal does not predict a two-way correlation between superiority and intervention effects, such that superiority-violating questions are always subject to intervention and superiority-obeying questions are always immune from such effects, contra Pesetsky (2000); Cable (2010) and other recent literature. Instead, we predict a one-way correlation: intervention happens whenever a focus-sensitive operator occurs between *wh* and Q. Within the current proposal, we therefore expect to find intervention effects in all superiority-violating questions, since the derivation of such questions always involves leaving a base-generated high *wh*-phrase in-situ at LF.[30] However, we additionally expect to find intervention effects inside QPs, and between *wh* and the edge of the pied-piped constituent. Such intervention effects are expected to occur in superiority-obeying questions in addition to superiority-violating questions. This prediction has been shown to be borne out for overt pied-piping in German and English Sauerland and Heck (2003); Cable (2010, respectively). In Chapter 3 I will show that this is also borne out for covert pied-piping in superiority-obeying questions in English (see also Kotek and Erlewine (to appear)).

In Chapter 4 I show that if QP-movement in superiority-obeying questions in restricted, so that QP cannot target C but instead must stop at a lower position, we observe intervention effects above the landing site of QP. In such cases, I will argue that Q moves alone from the landing site of QP to C, similarly to the derivations that we have seen for superiority-violating questions, hence predicting the pattern of intervention effects we will observe.

The emerging generalization is as described in the schema in (54)—intervention involves the disruption of the projection of alternatives between *wh* and Q. The reason that previous work on this phenomenon has argued that intervention only affects superiority-violating questions in English is that the derivation of such questions necessarily involves an LF-in-situ *wh*. The entire domain between this *wh* and Q, which occupies a position in the interrogative CP layer, is subject to intervention. On the other hand, in superiority-obeying questions *wh*-phrases can occur inside QPs, and it is normally possible to move the entire QP to C, above potential interveners. Intervention only happens in special circumstances—inside QPs, and if QP movement is restricted in some way, so that at some point in the derivation Q is forced to strand its associated QP behind and move alone to C. I will return to this point in Chapter 6.

[30] Except if it is possible to move the in-situ *wh* above the intervener through some other movement operation, unrelated to interrogative movement. I show such cases in Chapter 4.

2.4.3 The difference between English and German questions

Next we turn our attention to the derivation of German questions. I propose that simplex questions are derived via the same mechanism as English questions. However, recall that German multiple questions behaved differently than English multiple questions with regard to intervention effects. In particular, German exhibits intervention effects both in superiority-obeying question and superiority-violating questions, when an intervener occurs above a (surface) in-situ *wh*-phrase. The data below shows that superiority-obeying questions are subject to intervention if an intervener occurs above the in-situ *wh* (56b), and that intervention is avoided if the *wh* is overtly scrambled above the intervener (56c):

(56) **Intervention effects in superiority-obeying question in German:**

a. *Wen* hat Luise *wo* gesehen?
whom has Luise where seen
'Where did Luise see whom?'

b. * *Wen* hat **niemand** *wo* gesehen?
whom has nobody where seen
'Where did nobody see whom?'

c. *Wen* hat *wo* **niemand** gesehen?
whom has where nobody seen
'Where did nobody see whom?'

That is, we observe the behavior typical in English superiority-violating question in all German questions. In previous work, this has been explained by a stipulation that in German, only one QP can be hosted in Spec,CP, while in English it is possible to host more than one QP in Spec,CP (Pesetsky 2000, also adopted in Beck 2006). Cable (2007, 2010) translates this stipulation into Q-theory by assuming that only one QP can be constructed in German, and that it must then overtly move to Spec,CP. Any other *wh*-phrases are not merged with a Q-particle, and remain in-situ, predicting that the entire region between the in-situ *wh* and Q (or C, for Cable), in the CP layer, is subject to intervention effects.

I propose instead that the reason German does not allow covert QP movement, whereas English does have this option, is that it is possible to use overt scrambling in German but not in English, and furthermore that German is a scope-rigid language but English is not. Therefore, to obtain a different scope relation in German, it is necessary to use overt scrambling, whose effects are transparent on the surface structure. In English, the possibility of

overt scrambling is unavailable, and instead covert movement is able to derive different scope relations. In Chapter 6 I will present a more detailed discussion of this claim. I will argue that English and German are more similar than current theories would lead us to believe: German allows *overt scrambling*, while English allows *covert scrambling* instead. I argue that this proposal has favorable consequences with regard to language acquisition and to cross-linguistic variation. The data motivating this will be presented in Chapters 5-6 of the dissertation.

The derivations for both superiority-obeying questions and superiority-violating questions in German will resemble the derivation of superiority-violating questions in English. Below I illustrate the proposed derivations for the single-pair and pair-list readings of multiple questions in German. In all cases, there is an LF-in-situ *wh*-word occurring in its base-generated position. This *wh*-word projects focus-alternatives that must be interpreted by Q. Hence, no intervener can occupy a position between *wh* and Q. If an intervener occurs in the question, *wh* must scramble above it to avoid intervention.

(57) **Superiority-obeying structures in German:**

a. $[_{CP}\ Q_1\ [_{QP_1}\ Q_1\ [\ wh_1\ ]]\ Q_2\ [\ \mathbf{C}\ ...\ t_1\ ...\ [\ wh_2\ ]$

→ Pair-list reading keyed on wh_1;

b. $[_{CP}\ Q_1\ [_{QP_1}\ Q_1\ [\ wh_1\ ]]\ [\ \mathbf{C}\ ...\ t_1\ ...\ [\ wh_2\ ]$

→ Single-list reading (possible: an additional Q_2 next to Q_1)

(58) **Superiority-violating structures in German:**

a. $[_{CP}\ Q_2\ [_{QP_2}\ Q_2\ [\ wh_2\ ]]\ Q_1\ [\ \mathbf{C}\ ...\ [\ wh_1\ ]\ ...\ t_2$

→ Pair-list reading keyed on wh_2;

b. $[_{CP}\ Q_2\ [_{QP_2}\ Q_2\ [\ wh_2\ ]]\ [\ \mathbf{C}\ ...\ [\ wh_1\ ]\ ...\ t_2$

→ Single-list reading (possible: an additional Q_1 next to Q_2)

Given these schemas, we see that there is an intervenable region in both superiority-obeying and superiority-violating multiple *wh*-questions in German. We thus expect to find more cases of intervention in German than in English—in particular, we expect to find intervention effects not only in superiority-violating questions but in superiority-obeying questions as well. This is indeed the attested pattern.

2.5 Features and advantages of the current proposal

In this chapter I proposed a new syntax and semantics for *wh*-questions. The proposal built on ingredients from the existing literature, but these ingredients were combined in a novel way. This allowed previously disconnected analyses of related phenomena in the literature on questions to receive a unified account.

I adopted Cable's (2010) syntactic theory of *wh*-movement, which models this movement as Q-driven and provides a principled account of pied-piping. I proposed one change—that in addition to the presence of projecting Q-particles in the derivation of English and German, it is possible to merge non-projecting Q-particles directly to the CP layer, and that these non-projecting Q-particles are able to agree with and interpret LF-in-situ *wh*-words.

I chose not to adopt Cable's (2010) semantics for Q-theory and instead developed a new semantic proposal. The analysis comprises of three interrogative elements, *wh*-words, Q-particles, and C. Each is assigned a simple semantic meaning: *wh*-words are analyzed as Hamblin sets (Hamblin, 1973, a.o.); Q-particles lift the focus-semantic value of their sister into the ordinary semantic value of the structure (cf. Shimoyama, 2001; Beck and Kim, 2006), and C does not play any role in the semantic derivation.

I showed that the proposal put forth here is able to correctly model the meaning of simplex questions. In addition, the proposal is able to derive the single-pair and pair-list readings of multiple questions in a principled way, an issue that is often not addressed in theories of interrogative semantics. I model multiple questions as families of questions, and proposed an *Ans* operator, based on Dayal (1996), that is able to recursively apply to families of questions and derive the presuppositions of simplex and multiple questions (cf. Dayal, 1996, 2002; Fox, 2012; Nicolae, 2013).

This proposal is able to model both superiority-obeying questions and superiority-violating questions with one or more in-situ *wh*-phrases and/or moved *wh*-phrases without the need for multiple heads to deal with the different combinatorial configurations of *wh*-phrases that are possible in such questions, as is the case in Cable's (2010) original proposal (and similarly in Dayal, 1996). This proposal is furthermore able to derive both the single-pair and pair-list reading of the question in a principled way and from minimally different LFs. This is not attempted in Cable's (2010) original semantics for Q-theory—the semantics proposed there only predicts a single-pair reading of the question, but the different readings of the question are not discussed at all.

Finally, I showed that this proposal combines with Beck's (2006) theory of intervention effects to correctly predict the distribution of intervention effects in English and German multiple questions. This is an advantage over other recent theories of multiple questions that assign them a family of questions denotation, e.g. Fox (2012); Nicolae (2013), and over Cheng and Demirdache's (2010) theory of multiple questions which uses a choice function mechanism to derive a pair-list reading of such questions. These proposals are not compatible with any existing theory of intervention, and furthermore they cannot derive superiority violations without some modification to the theory.

I discussed ways to explain the difference between English and German with regard to their sensitivity to intervention effects. Previous explanations of this difference stipulate a difference in English and German's ability to host multiple interrogative phrases in Spec,CP, or a difference in how many QPs can be projected in the derivation of a question (Pesetsky, 2000; Beck, 2006; Cable, 2007, 2010). I proposed instead that the difference should be attributed to English and German's differing abilities to use overt scrambling: German has at its disposal overt scrambling, and it is furthermore scope-rigid. Consequently, any scope-taking operation must take place overtly, e.g. via scrambling. This precludes covert QP-movement in German, and requires overt scrambling of a *wh* over an intervener to avoid an intervention effect. English, on the other hand, lacks overt scrambling, but instead it is able to use covert movement to change scope relations in a sentence, including covert QP-movement above interveners.

The discussion of the behavior of English and German multiple questions with regard to intervention raises an important question: how is such a complex system acquired by children exposed to English vs. German input? Although the surface appearance of English and German questions is quite similar, they exhibit differences with regard to intervention effects. Previous explanations of this difference rely on subtle but important differences in the structure of the interrogative system of the two languages, involving mostly silent material such as the availability of covert movement and one vs. multiple possible specifiers of CP (Pesetsky, 2000; Beck, 2006; Cable, 2007, 2010). These changes make English and German non-trivially different from one another. It seems plausible that the data that would be required to acquire these two different systems is not frequently available to children, and hence we must ask how these two different types of adult grammars are formed.

In Chapters 5–6, I will present data which will motivate the claim, argued for in more detail in Chapter 6, that in fact English is more similar to German than previously believed. The radical claim which I will defend in Chapter 6 is that the only kind of interrogative system that exists is the German kind. German allows *overt* scrambling of otherwise in-situ *wh*-phrases to higher positions to avoid intervention. In fact, it has been shown that a short scrambling, or *object shift*, step always occurs in superiority-obeying questions. I argue that English allows a *covert* version of this operation. More specifically, I will argue that the derivation of English superiority-obeying questions always involves a *covert scrambling* step, which can be made longer, just as in German, to avoid intervention effects. Superiority-violating questions in both languages involves a truly LF-in-situ *wh*-phrase. To acquire the English vs. German system, then, the child must determine whether they are acquiring an *overt* scrambling language or a *covert* scrambling language. Such data is ubiquitous and easily discernible, accounting for how the English and German systems are acquired.

2.6 An alternative system

Before concluding this chapter, I would like to briefly remark on a different choice that could have been made when developing the proposal laid out above. As the reader will recall, the proposal I develop includes three interrogative elements, *wh*-words, Q-particles, and the complementizers. All three contribute to the syntax of the question, but only two of these elements make a contribution to the semantics of the question. I have chosen to make these elements *wh* and Q.

An alternative theory is one in which it is the complementizer that makes a contribution to the semantics, and Q is only implicated in the syntax of *wh*-movement and pied-piping, but not in deriving the meaning of the question. Instead of generating non-projecting Q-particles in the CP layer, then, we would allow for CP recursion in order to derive higher order families of questions, as in Fox (2012); Nicolae (2013). This alternative proposal will thus have the following components:

(59) **An alternative C-based semantics for Q-theory:**

a. **The semantics of *what*:**
Ordinary semantic value: $[\![what]\!]^o$ is undefined
Focus-semantic value: $[\![what]\!]^f = \{x_e : x \in \text{non-human}\}$

b. **The semantics of the Complementizer:**
$[\![\text{C } \alpha_\sigma]\!]^o = [\![\alpha_\sigma]\!]^f$
$[\![\text{C } \alpha_\sigma]\!]^f = \{\ [\![\text{C } \alpha_\sigma]\!]^o\ \}$ $\sigma \in \{\langle s,t\rangle, \langle st,t\rangle, \langle\langle st,t\rangle,t\rangle, ...\}$

c. **The semantics of the Q-particle:**
$[\![\text{Q}]\!] = \lambda P_\tau.\ P$

This alternative system has several features that should be taken seriously. First, it puts the burden of question interpretation on C instead of Q, aligning with more traditional approaches to question semantics which usually assume C is responsible for this step. It furthermore allows us to more easily combine the semantic portion of the proposal with other syntactic theories of pied-piping, instead of Cable's theory which I have used here. This alternative system also does not have the type-mismatch problem of the original proposal, created because the syntax of Q requires it to combine with nominals (in English), but its semantics requires it to operate on sets of propositions (or sets of such sets, etc.). As we saw, this type-mismatch required us to assume an obligatory movement step of Q out of QP that occurs in the CP layer, to yield an interpretable structure. In the alternative system, no type-mismatch issue arises, and Q can stay inside QP.

Although I believe that this alternative proposal is able to derive the meanings of simplex and multiple questions I have presented in this chapter, I do not adopt it in the remainder of the dissertation. As we will see in Chapters 3-4, the proposal I adopt here allows for a uniform characterization of intervention effects in questions and inside pied-piping constituents, which is lost in the alternative version of the proposal. Moreover, in Chapters 5-6 we will see evidence that the covert movement step of surface in-situ *wh*-elements in superiority-obeying questions does not normally reach C, but instead behaves like QR or scrambling in its extent. As I will show, the Q-based semantics will allow for a description of these facts within the theory proposed in this chapter, but I believe that such an explanation is not straightforward in a C-based semantic system. For these reasons, I will not explore this alternative C-based semantics any further here, and will leave to future work the possibility that it might replace the Q-based semantics that I propose here.

2.7 Chapter summary

This chapter presented a new proposal for the syntax and semantics of *wh*-questions.

Section 2.2 combines the syntax of Cable's (2010) theory of Q-particles with a novel semantic analysis. One change to Cable's syntax was adopted: in addition to **projecting Q-particles**, English and German have **non-projecting Q-particles** which may adjoin to the clausal spine in the CP layer and agree with and interpret in-situ *wh*-words.

The system comprising of three interrogative elements, ***wh*-words, Q-particles, and C**, with meanings as follows, §2.3.1:

- **The semantics of *what*:**
  Ordinary semantic value: $[\![what]\!]^o$ is undefined
  Focus-semantic value: $[\![what]\!]^f = \{x_e : x \in \text{non-human}\}$
- **The semantics of the Q-particle:**
  $[\![\text{Q } \alpha_\sigma]\!]^o = [\![\alpha_\sigma]\!]^f$
  $[\![\text{Q } \alpha_\sigma]\!]^f = \{\ [\![\text{Q } \alpha_\sigma]\!]^o\ \}$ $\qquad \sigma \in \{\langle s,t\rangle, \langle st,t\rangle, \langle\langle st,t\rangle,t\rangle, ...\}$
- **The semantics of the Complementizer:**
  $[\![\text{C}]\!] = \lambda P_\tau.\ P$

This system is able to derive the meaning of simplex questions, §2.3.2, the pair-list readings of multiple questions, modeled as families of questions, §2.3.4-2.3.5, and the single-pair reading of a multiple question, §2.3.6. The derivations crucially rely on the position the Q-particle occupies in Spec,CP, as discussed in §2.4.1.

An *Ans* operator (Dayal, 1996; Fox, 2012; Nicolae, 2013) is adopted in order to derive the presuppositions of the question, §2.3.3.

This proposal is able to combine with Beck's (2006) theory of intervention effects to correctly predict when intervention effects happen, §2.4.2.

The proposal is also able to derive the difference between English and German multiple questions, with regard to their sensitivity to intervention effects, §2.4.3. Instead of stipulating a difference in English and German's ability to project QPs or host them in the CP specifiers, the proposal attributes English and Germans' differing behavior with regard to intervention effects to a difference in the availability of overt scrambling in the two languages.

Chapter 3

Covert movement and LF-pied-piping[1]

In the previous chapter I presented a theory of interrogative syntax-semantics under which superiority-obeying questions can optionally involve covert *wh*-movement of the (phonologically) in-situ *wh*-phrase.[2]

(1) **Two possible derivations of superiority-obeying questions:**

a. $[_{CP}\ Q_1\ [_{QP_1}\ Q_1\ [\ wh_1\ ]]\ Q_2\ [_{QP_2}\ Q_2\ [\ wh_2\ ]]\ [\ \mathbf{C}\ ...\ t_1\ ...\ t_2$

b. $[_{CP}\ Q_1\ [_{QP_1}\ Q_1\ [\ wh_1\ ]]\ Q_2\ [\ \mathbf{C}\ ...\ t_1\ ...\ [\ wh_2\ ]$

When an intervener is present in the derivation, however, only (1a) is possible, in order to avoid an intervention effect. I argued that intervention effects are the result of a disruption of the transmission of focus-alternatives between *wh* and Q. Making (1b) unavailable whenever an intervener occurs above the in-situ *wh*, as this would lead to the illicit configuration in (2).

(2) **Configuration of an intervention effect:**

* [Q_i ... **intervener** ... wh_i ...]

The question, then is what positions Q and *wh* occupy at LF. As we have seen, the availability of (1a) predicts that we should be able to covertly move the in-situ *wh* above

[1] This chapter is the product of joint research with Michael Yoshitaka Erlewine. What follows, with some modifications to the background, and discussion, is our joint paper *Covert pied-piping in English multiple wh-questions* (Kotek and Erlewine, to appear in *Linguistic Inquiry*).

[2] Here I show derivations for the pair-list reading. Derivations for the single-pair reading always predict a larger region of in-situ composition, indicated here with a squiggly arrow, than the pair-list reading.

any interveners in the question, predicting a lack of intervention effects in superiority-obeying questions. However, note that if an intervener occurs *inside* QP, we again predict an intervention effect. The goal of this chapter is to test this prediction, that intervention effects should occur inside pied-piped constituents.

Building on previous work by Sauerland and Heck (2003), Cable (2007, 2010) shows that intervention effects can occur inside overtly pied-piped QPs. I will argue below that the logic of intervention (Beck, 2006, schema above) can be extended to diagnose the presence and size of *silent* QPs, containing in-situ *wh*-words and undergoing covert movement. The diagnostic will investigate the status of the (phonologically) in-situ *wh*-phrase in superiority-obeying English *wh*-questions such as those in (3).

(3) ***No* causes intervention effect in superiority-obeying multiple question:**

a. ✓ *Which* student read a book from *which* library?

b. * *Which* student read **no** book from *which* library?

I will argue that the ungrammaticality of example (3b) is the result of an intervention effect inside a *covertly* pied-piped QP. That is, the surface-in-situ *wh*-word *which* covertly moves at LF and pied-pipes a constituent containing the intervener *no*—that is, the QP in this case must contain the entire DP headed by *no*, and not only the *wh*-phrase *which library*. The contrast in (3) and other examples presented in section 3.2 is predicted by the semantics of pied-piping constituents proposed here, following Cable (2007, 2010), together with Beck's (2006) theory of intervention effects.

The pattern that will emerge will provide evidence for the view that the constituent pied-piped with *wh* corresponds to the *largest* among the corresponding overt pied-piping possibilities for a parallel simplex *wh*-question. This is so even when this choice will inevitably lead to an intervention effect which would be avoided if a smaller QP—of a size that is in principle possible, indeed even preferred in the case of overt pied-piping—were constructed. This, I argue, reveals the true nature of pied-piping: unlike overt pied-piping, which is subject to restrictions from both LF and PF, covert pied-piping is guided only by LF. The investigation of covert pied-piping, then, reveals the true preference of LF and Core Syntax with regard to pied-piping: LF chooses the largest possible constituent as its preferred candidate for movement. In overt pied-piping, however, this choice can be overridden by certain PF constraints—in particular, the preference of the *wh*-phrase to be near the edge of the pied-piped constituent (Heck, 2008, 2009).

3.1 Background: Intervention effects in overt pied-piping

In this section I briefly remind the reader of Beck's (2006) theory of focus intervention effects for English questions and discuss its extension to intervention inside pied-piping constituents (Cable, 2007, 2010). I will motivate the use of intervention effects as a diagnostic tool for regions in the derivation of a question in which covert movement has occurred and regions in which Rooth-Hamblin alternatives are computed.

3.1.1 Beck's theory of focus intervention effects

Recall that Pesetsky (2000) observes a correlation between superiority and intervention in English multiple questions with D-linked *wh*-phrases: such questions generally allow both superiority-obeying and superiority-violating word orders, but the superiority-violating ones are subject to intervention effects caused by elements like *only* and negation.

(4) **D-linked superiority-violating questions possible but subject to intervention:**

a.	*Which* boy ____ read *which* book?	✓ sup.-obeying, no intervener
b.	*Which* book did *which* boy read ____?	✓ sup.-violating, no intervener
c.	*Which* boy did**n't** ____ read *which* book?	✓ sup.-obeying, intervener
d.	* *Which* book did**n't** *which* boy read ____?	* sup.-violating, intervener

To explain the relation between superiority and intervention effects, Pesetsky (2000) argues that superiority-obeying questions and superiority-violating questions are derived from different structures. Of particular importance is the location of the (phonologically) in-situ *wh*-phrase: the in-situ *wh*-phrase covertly moves to C at LF in a superiority-obeying question, but remains in its base-generated position in a superiority-violating question.

This dissertation adopts Pesetsky's view, and its reanalysis within Cable's (2010) Q-theory, and has developed a principled semantics for the resulting readings of the questions and for their behavior with respect to intervention effects (following Beck 2006; Cable 2010). Beck (2006) proposes that when an in-situ *wh*-phrase remains LF-in-situ, it is interpreted via Rooth-Hamblin alternative computation (Hamblin, 1973; Kratzer and Shimoyama, 2002, a.o.). The Rooth-Hamblin alternative computation strategy of interpreting *wh*-phrases is subject to *intervention effects* caused by focus-sensitive ***interveners***.[3] *Wh-*

[3] In this dissertation I will not comment on what defines the set of interveners, but instead use several of the known interveners in English, including *no, every, only, few* and sentential negation. I note that there is a question regarding the sense in which these interveners are focus-sensitive, which I will not solve here.

phrases interpreted using covert movement are not subject to intervention effects. In Chapter 2 I proposed the following schema to describe the LF configuration that gives rise to intervention effects:

(5) **Configuration of an intervention effect:**

* [Q_i ... **intervener** ... wh_i ...]

The relationship between superiority and intervention effects I have proposed in this dissertation is summarized in (6a–b).[4]

(6) **The interaction of superiority and interveners at LF:**

a. Superiority-obeying questions: no intervention effects

✓[$_{CP}$ QP_1 QP_2 [C [$_{TP}$ ... **intervener** ... t_1 ... t_2]]]

b. Superiority-violating questions: intervention effects

* [$_{CP}$ QP_2 Q_1 [C [$_{TP}$ ... **intervener** ... wh_1 ... t_2]]]

Using this logic, intervention effects can diagnose whether or not covert QP-movement has occurred in the derivation of a question: the presence of an intervention effect teaches us that a (phonologically) in-situ *wh*-phrase is interpreted through Rooth-Hamblin alternative computation, and the lack of an intervention effect teaches us that the QP has covertly moved above the scope of the intervener.[5]

3.1.2 Intervention effects in overt pied-piping

Cable (2007, 2010) shows that intervention effects occur in superiority-obeying English questions inside pied-piping constituents, (7). This work builds on a study by Sauerland and Heck (2003) who show a similar effect in German, (8).

(7) **Intervention effect in English pied-piping (Cable, 2007):**

a. ? [A picture of *which* president] does Jim own ___?

b. * [**No** pictures of *which* president] does Jim own ___?

[4]For simplicity, I do not show the movement step of Q out of the higher QP inside Spec,CP.

[5]This diagnostic was first proposed in Kotek (2014a). See Erlewine and Kotek (2014); Kotek (2014a) for more on the use of focus intervention effects to diagnose regions of Rooth-Hamblin alternative computation, in *wh*-questions with islands and in Association with Focus constructions, respectively.

c. * [**Few** pictures of *which* president] does Jim own ___?

d. * [**Only** PICTURES of *which* president] does Jim own ___?

(8) **Intervention effect in German pied-piping (Sauerland and Heck, 2003):**
Fritz möchte wissen [[ein/***kein** *wie* schnelles Motorrad] du fahren darfst].
Fritz wants know a/**no** how fast motorbike you drive may
'Fritz wants to know how fast a/***no** motorbike you are allowed to drive.'

Cable (2007, 2010) argues that the presence of intervention effects inside pied-piping constituents is explained if *wh*-words inside such constituents are interpreted via Rooth-Hamblin alternative computation between *wh* and the edge of the pied-piping. Cable's theory is designed to explain the presence and size of pied-piping in *wh*-questions in different languages. In this theory, *wh*-movement is recast as QP-movement: in the construction of a *wh*-question, a Q-particle (silent in English but overt in some languages) merges with a particular *wh*-containing constituent. The resulting QP is targeted by the interrogative C for Agree and Attract operations. Movement of a QP containing more than just the *wh*-word leads to what has previously been described as pied-piping.

The size of pied-piping is then determined by the position to which Q adjoins. In (9a), Q adjoins to the *wh*-containing DP "a picture of *which* president"; in (9b), Q adjoins to the PP "of *which* president"; in (9c), Q adjoins to the *which*-phrase DP "*which* president." The positions to which Q can adjoin are restricted in some languages by a local Agree operation between *wh* and Q. In English, Q cannot adjoin to constituents larger than in (9a).

(9) **Different sizes of pied-piping correspond to different positions of Q-adjunction:**
Base structure: Jim owns (Q) a picture (Q) of (Q) *which* president

a. ? [$_{QP}$ Q A picture of *which* president] does Jim own ___?

b. [$_{QP}$ Q Of *which* president] does Jim own a picture ___?

c. [$_{QP}$ Q *Which* president] does Jim own a picture of ___?

In the derivation of a question like (9), then, two processes occur: first, QP moves to the specifier of the interrogative complementizer, and second, inside QP, the *wh*-word itself is interpreted via Rooth-Hamblin alternative computation between *wh* and Q.

(10) **Interpreting (9a) through both movement and alternative computation:**
[$_{QP}$ Q A picture of *which* president] does Jim own ___?
Rooth-Hamblin alternatives *QP-movement*

Building on Beck (2006), Cable argues that this alternative computation inside QP is subject to intervention effects. Therefore, if a focus-sensitive operator occurs between *wh* and Q, it will interrupt the projection of alternatives from *wh* to Q and lead to the same problem that is caused if an intervener occurs between an LF-in-situ *wh* and C (or a non-projecting Q that occurs in the CP layer, in the system I have proposed here).[6] Cable argues that this explains the ungrammaticality of examples (7b–d): an intervener—e.g. **no**, **few** or **only**—occurs between *wh* and the edge of the pied-piping constituent, where Q is merged, and blocks the transmission of Rooth-Hamblin alternatives between *wh* and Q.

(11) **No intervention when intervener not inside the pied-piping constituent:**

a. * [$_{QP}$ Q **No** pictures of *which* president] does Jim own ___? (=7b)

b. ✓ [$_{QP}$ Q Of *which* president] does Jim own **no** pictures ___?

c. ✓ [$_{QP}$ Q *Which* president] does Jim own **no** pictures of ___?

Further evidence to show that the relevant structural configuration for these contrasts is the one proposed here—i.e., that an intervener *between* the *wh* and the edge of the pied-piping (Q) is the source of ungrammaticality in (7b–d)—is provided below. Placing an intervener inside QP but below the *wh*-word does not trigger intervention, (12). In addition, the intervention effect in (7b) can be avoided by pied-piping a smaller constituent which does not include the potential intervener (11).

(12) **No intervention when intervener inside pied-piping constituent but below *wh*:**
✓ [*Which* picture containing **no** presidents] does Jim own ___?

Following the arguments shown in the previous chapters of the dissertation that the (phonologically) in-situ *wh*-phrase in a superiority-obeying question can covertly move to

[6] Several alternatives to Beck's (2006) theory of intervention effects have been proposed in the recent literature. This footnote discusses two which identify interveners as *anti-topic* items—items that cannot be topicalized or backgrounded. See footnote 10 for another alternative approach, Mayr (to appear).

Grohmann (2006) proposes a theory of intervention effects in German where intervention is caused when an anti-topic item occurs between two *wh*-phrases in the CP periphery. Note that this theory does not clearly extend to English, as discussed by Grohmann himself (see Grohmann 2006 pp. 13, 24), and that furthermore the theory predicts no intervention effects inside pied-piped constituents, because intervention is caused when interveners move to a topic position in the CP periphery, but not when they move inside DPs.

Tomioka (2007b) proposes a prosody-based account of intervention effects in Japanese and Korean single *wh*-questions, according to which intervention occurs when an anti-topic item occurs to the left of a *wh*-word in a question, with these interveners including items such as NPIs and disjunctions. This theory does not clearly extend to English, because it crucially relies on prosodic properties of Japanese and Korean questions, which English does not share. As pointed out in Kotek and Erlewine (to appear), it is possible that Tomioka (2007b) makes incorrect predictions for Japanese questions with configurations such as the ones discussed here. See Kotek and Erlewine (to appear) for details.

C at LF (and that it must do so, if an intervener is present), we may ask: how much material is pied-piped with QP? I will use the presence or absence of intervention effects inside potentially covertly pied-piped constituents as a diagnostic for regions where covert movement has occurred and regions where Rooth-Hamblin alternatives are used. I elaborate on this logic in section 3.2, where I present a novel pattern of intervention effects in English superiority-obeying questions.

3.2 Diagnosing covert pied-piping

In this section I will argue based on the pattern of intervention effects in English superiority-obeying multiple *wh*-questions that covert pied-piping exists, and furthermore that covert pied-piping of larger constituents is preferred over that of smaller constituents.

3.2.1 The diagnostic

My main focus will be on questions such as (13) below, where I assume that the (phonologically) in-situ *wh*-phrase covertly moves at LF.

(13) **Superiority-obeying multiple question: the lower *wh* covertly moves at LF:**
Which student *...which...* C ___ read a book from *which* library?

Given that in superiority-obeying questions the in-situ *wh*-phrase covertly moves at LF, we are interested in knowing if covert *wh*-movement pied-pipes material along with the *wh*-word, and if so—how much. At least three different sizes of covertly pied-piped constituents could be available in (14), corresponding to the possible sizes of overt pied-piping in examples such as (9) above.[7]

(14) **Options for covert pied-piping at LF, based on the options for overt pied-piping:**
Which student read a book from *which* library?

a. [$_{QP}$ Q *Which* student]$_1$ [$_{QP}$ Q a book from *which* library]$_2$ C t_1 read t_2

b. [$_{QP}$ Q *Which* student]$_1$ [$_{QP}$ Q from *which* library]$_2$ C t_1 read a book t_2

c. [$_{QP}$ Q *Which* student]$_1$ [$_{QP}$ Q *which* library]$_2$ C t_1 read a book from t_2

[7] See discussion in section 3.1.2 and Cable (2010) for arguments that Q can't be merged with VP and larger constituents in English.

The movement of the lower QPs in (14) is covert, and thus all three of the LF representations in (14) correspond to the same PF string: "which student read a book from which library?". Unlike with overt pied-piping, the choice of covert pied-piping size is not detectable in the resulting linearization.

I instead propose the use of intervention effects as a diagnostic for the existence and size of covert pied-piping. The different sizes of covert pied-piping in (14)—corresponding to different QP sizes—*predict different regions that should be subject to intervention effects*.

The logic of this diagnostic is as follows. As we saw in section 3.1.2, in cases of overt pied-piping, the region inside the pied-piping constituent (QP) and above the *wh*-word is *intervenable*; that is, the insertion of a focus-sensitive operator in this region leads to ungrammaticality (15) below). In the Cable (2007, 2010) theory, *wh*-phrases are interpreted by their Q-particle through Rooth-Hamblin alternative computation, thus explaining why the region between the *wh* and Q is intervenable under the Beck (2006) logic of intervention. Following Cable, I assume that covertly-moved QPs are also interpreted using this same semantic mechanism. Therefore, if covert pied-piping does occur, we predict a small region near and above the surface-in-situ *wh*-word to be intervenable (16).

(15) **Intervention in overt pied-piping (Cable, 2007, cf Sauerland and Heck 2003):**
[$_{QP}$ Q ...INTERVENABLE... *wh* ...] C ...

(16) **Intervention in covert pied-piping:**
... C ... [$_{QP}$ Q ...INTERVENABLE... *wh* ...]

The different covert pied-piping options in (14) predict different regions to be intervenable, represented by the gray shading in (17). (In (17) and subsequent examples, the lower QP is represented in-situ, to reflect the linearization at PF.) If the largest QP is chosen, (17a), the entire region between *a* and *wh* is intervenable. If the smaller QP in (17b) is chosen, only the preposition *from* is inside the intervenable region. If the smallest QP in (17c) is chosen, there is little or no intervenable region between Q and *wh*.

(17) **Different covert pied-piping options predict different intervenable regions:**
Which student read a book from *which* library?

a. [$_{QP}$ Q *Which* student] read [$_{QP}$ Q a book from *which* library].

b. [$_{QP}$ Q *Which* student] read a book [$_{QP}$ Q from *which* library].

c. [$_{QP}$ Q *Which* student] read a book from [$_{QP}$ Q *which* library].

3.2.2 The diagnosis

In what follows, I will use the size of the intervenable region as a diagnostic for the presence of covert pied-piping and its size. I use the interveners **no**, **only**, and **very few**, placed inside regions suspected of being intervenable. If the presence of an intervener in the resulting examples causes an intervention effect, the conclusion will be that the intervener occurs inside an intervenable region.

Since it has been argued that intervention effects only affect the pair-list reading of a question (Beck, 1996a; Pesetsky, 2000; Kotek, 2014a, see also discussion in section 6.5.2), I present each example in a context designed to bring out the pair-list reading of the multiple question and satisfy its presuppositions (Dayal, 2002). I begin with our baseline example, (13), repeated below in (18) with a context supporting its pair-list interpretation. The question is reported to be grammatical and felicitous in this context.

(18) **Baseline: multiple question with pair-list reading**

a. Context: Over the break, every student read a book from a local library and submitted a book report. Each report gave the title of the book and which library it was borrowed from. You have read all the book reports. So tell me, what I want to know is:

b. ✓ *Which* student read a book from *which* library?

Next, consider an example in which the determiner *a* is replaced with the determiner ***no***, which we saw to be an intervener in cases of overt pied-piping in section 3.1.2, (19). Again, the question is preceded by a context designed to favor the pair-list reading of the question and satisfy its presuppositions. If *no* occurs inside an intervenable region, we expect this manipulation to lead to an intervention effect. The result, as reported by native speakers of English, is that the question is ungrammatical despite appearing in a context that should make it felicitous. That is, we observe an intervention effect.[8]

[8]Cable (2007) reports examples similar to (19) to be grammatical, cf. his example (81) on page 139. However, Cable does not report whether the question can be interpreted as having a pair-list reading or only a single-pair reading. As I have noted above, the single-pair reading of the question is indeed predicted to be possible, accounting for the judgment reported by Cable.

(19) **Intervention effect caused by the presence of *no* in the question:**

a. Context: Over the break, the students were assigned to go read one book each from every library in the area and submit a book report. No student completed the entire assignment; every student went to all but one of the libraries. You have read all the book reports. So tell me, what I want to know is:

b. * *Which* student read no book from *which* library?

The contrast between (19) and its baseline (18) tells us that the intervener *no* is in an intervenable region.[9] Recall that different sizes of covert pied-piping predict different intervenable regions. In particular, *no* is an intervenable region if the largest pied-piping option was chosen: *no book from which library* (20a). If, however, a smaller pied-piping constituent is targeted for movement—*from which library* (20b) or *which library* (20c)—we expect *no* to be outside the intervenable region and therefore not cause an intervention effect. Therefore, the intervention contrast observed in (19) is predicted by pied-piping of the largest option as in (20a) but not (20b–c).

(20) **Different covert pied-piping options predict different intervenable regions; only (20a) predicts (19):**

Which student read no book from *which* library?

a. [$_{QP}$ Q *Which* student] read [$_{QP}$ Q **no** book from *which* library]?

b. [$_{QP}$ Q *Which* student] read **no** book [$_{QP}$ Q from *which* library]?

c. [$_{QP}$ Q *Which* student] read **no** book from [$_{QP}$ Q *which* library]?

Note that this effect is not a general effect attributable to the presence of a negative quantifier in the question. The example below, in which the quantifier *less than three* is used, is judged by speakers to be felicitous and grammatical in the context.[10]

[9]For some speakers, the determiner *no* in object position is generally slightly degraded. Nonetheless, native speakers report a strong contrast with the example in (19) with the relevant reading, beyond what may be expected from simply having *no* in object position. Furthermore, this contrast is not limited to *no*—further examples will show that other items in this position can also act as interveners. Therefore, this example constitutes one in a series of intervention effects in this configuration, rather than an outlier.

[10]Mayr (to appear) offers an alternative characterization to Beck's (2006) intervention effects, proposing that intervention occurs when a non-additive element has a *wh*-phrase in its scope. I believe that this theory may, in principle, predict intervention effects inside DPs. However, his theory predicts that all non-additive quantifiers, including *less than n* should act as interveners. Data from Mayr suggest that this is indeed the case in German, but the native speakers I have consulted find a clear contrast between the example with *no* and the example with *less than three* in English. This finding thus constitutes a challenge to the generality of Mayr's theory and its extension to English.

(21) **No intervention effect with *less than three*:**

a. Context: Over the break, the students were assigned to go read three book each from every library in the area and submit a book report. No student completed the entire assignment; every student had one particular library from which they failed to read three books. You have read all the book reports. So tell me, what I want to know is:

b. ✓ *Which* student read less than three books from *which* library?

Furthermore, note that an intervention effect can be observed not only with *no* but also with *only* and with *very few*, as shown in (22)–(23) below. I note that the judgment with *very few* appears to be less sharp than with *no* and *only*.[11]

(22) **Intervention effect caused by the presence of *only* in the question:**

a. Context: At the flea market, a number of collectors are selling pictures and autographs of past presidents. For most presidents, they have successfully sold both pictures and autographs, but according to the records, every collector has one president for which they did not sell any autographs. You have read through all the records. So tell me, what I want to know is:

b. * *Which* collector sold only PICTURES of *which* president?

(23) **Intervention effect caused by the presence of *very few* in the question:**

a. Context: We at McDonald's are testing three new toppings for burgers: cranberries, jicama, and natto. As a pilot, these toppings were offered at several branches around the world for one week only. At each branch, only two toppings sold thousands while the other sold about a hundred. Culinary tastes vary across the world, so there was no clear overall winner. You have looked at all the sales records. So tell me, what I want to know is:

b. ?? *Which* branch sold very few burgers with *which* topping?

[11]Much work on proportional determiners such as *few* argues that these determiners have three truth-conditionally distinct readings, including the cardinal reading, the proportional reading and the so-called reverse-proportional reading. The computation of two of these readings—the proportional and the reverse-proportional—has been argued to involve focus, but the cardinal reading of *few* NP can be derived through a simple comparison of the cardinality of NP with a contextual standard. See Herburger (2000); Büring (1996b); Kotek et al. (2012) for discussion of the readings and their derivations. The example in the context we give is designed to be a felicitous use of *very few* only under the focus-sensitive proportional reading. However, it is possible that interference from a cardinal reading is making the judgment more difficult than in the other cases considered here.

With these results in mind, the main contrasts that must be explained are the minimal pairs in (24)–(25) below. I argue that these contrasts are the result of intervention effects, caused by placing the interveners *no* and *only* between *wh* and the edge of a covertly pied-piped constituent that is at least as large as the DP headed by *no* and *only*. I acknowledge that the judgements behind the contrasts I present here are subtle. This is in part due to the complexity of even the baseline questions, as well as the relatively complex contexts that accompany these questions, in order to ensure that they are interpreted with the relevant (pair-list) reading. Despite this, these contrasts have remained robust across a variety of elicitation and verification sessions.

(24) **Minimal pair: *no* causes intervention effect in multiple question**

a. ✓ *Which* student read a book from *which* library? (=18)

b. * *Which* student read **no** book from *which* library? (=19)

(25) **Minimal pair: *only* causes intervention effect in multiple question**

a. ✓ *Which* collector sold two pictures of *which* president?

b. * *Which* collector sold **only** PICTURES of *which* president? (=22)

Note that the ungrammaticality of (24b) is not due to a general negative island effect between the in-situ *wh*-word and C (Ross, 1984; Rizzi, 1990; Szabolcsi and Zwarts, 1993; Beck, 1995; Rullmann, 1995; Kuno and Takami, 1997; Fox and Hackl, 2006, a.o.). It has been observed that certain *wh*-phrases are unable to move across intervening negative elements. For example, in example (26), we see that movement of the manner *wh*-word *how* is ungrammatical over both sentential negation and the negative determiner *no*.

(26) **Negative islands affecting *how*-movement (Szabolcsi and Zwarts, 1993):**

a. * How did**n't** you think that I behaved ___?

b. * How did **no one** think that I behaved ___?

If the ungrammaticality of (24b) were due to a negative island, then we would expect that any negation between the in-situ *wh*-phrase and C would trigger a similar negative island effect. This is not the case. In example (27) below, we see that sentential negation (shown to trigger negative islands in (26a) above) does not trigger ungrammaticality, in contrast to (24b). Therefore the ungrammaticality of (24b) cannot be due to a so-called negative island effect.[12]

(27) **Sentential negation does not cause a negative island effect (cf 24b):**
✓ *Which* student did**n't** read a book from *which* library?

Similarly, the contrasts in (24)–(25) cannot be due to a general Beck (2006) intervention effect between the in-situ *wh*-phrase and C. High interveners in superiority-obeying questions do not cause intervention effects, including other negative interveners such as *no one* and *never*. As a result, it cannot be the case that the surface in-situ *wh* in these examples is interpreted in-situ at LF, projecting alternatives all the way up to C. If that were the case, we would predict the examples with higher interveners in (28) to be ungrammatical, contrary to fact. Interpreting these *wh*-phrases in-situ at LF would not be able to explain the contrast between the grammatical (28a–b) on the one hand and the ungrammatical (24b) and (25b) on the other hand.[13]

(28) **No intervention effect with higher intervener:**
a. ✓ *Which* student did**n't** read a book from *which* library? (=27)
b. ✓ *Which* collector **only** APPRAISES pictures of *which* president?

Additionally, no intervention effect is observed when a focus-sensitive operator occurs inside the potentially pied-piped region but *below* the intervener, as in (29).

(29) **No intervention effect with intervener below *wh*:**
a. ✓ *Which* student read *which* book containing **no** princesses?
b. ✓ *Which* student read *which* book discussing **only** princesses?

Finally, no intervention effect arises when *no* heads a coargument to the *wh*-phrase in a double-object construction. As in (19) above, the negative head *no* occurs above the in-situ *wh*-word. However, unlike in (19), intervention does not occur in this structure.

(30) **No intervention effect with *no* in a coargument:**
a. Context: Professors White and Black are co-teaching a syntax class. Over the break, each student in the class was expected to write three book reports. Each book report had to be submitted to both professors for grading. Each student wrote three book reports, but oddly enough, each student submitted her three

[12]Note that this sentence is interpreted by native speakers with wide scope for the indefinite: $\exists >$ not. This is consistent with our findings above, that a large, DP-sized constituent is the QP that is covertly pied-piped.

[13]Also recall that, for the pair-list readings targeted here, the surface in-situ *wh*-phrase cannot be interpreted in-situ through a choice-function mechanism such as Reinhart (1997).

book reports to only one of the two professors. You have looked at the grading book. So tell me, what I want to know is:

b. ✓ *Which* student submitted **no** book report to *which* professor?

The important difference between these two structures is in the pied-piping options available to them, and in particular that *no book report to which professor* in (30) is not a possible QP and therefore not a possible target for covert pied-piping. The cases of intervention we observe in examples such as (19), then, are precisely those where the intervener is contained within a constituent which is a pied-piping candidate for the *wh*-phrase.

Combining all our findings, we observe intervention effects in questions in which the intervener occurs in a small region above the *wh* as in (24b) and (25b), but not in questions that contain a high intervener such as (28) and (30). Therefore, we know that the interveners in (24b) and (25b) are inside intervenable regions but the ones in (28) and (30) are not. Consequently, it cannot be the case that the *wh* in the superiority-obeying questions that we are examining remains in-situ and is interpreted via Rooth-Hamblin alternative computation between its base-generated position and C. Instead, the pattern of intervention effects that we find is consistent with the presence of covert pied-piping: intervention occurs only when the intervener is placed inside QP and above *wh*, as in (31). This is predicted if the derivation of superiority-obeying questions involves covert movement of the lower *wh* to C at LF, with pied-piping of a constituent inside of which Rooth-Hamblin alternatives are computed between *wh* and Q.

(31) ***No* causes intervention effect because it is in intervenable region inside QP:**

a. ✓ *Which* student read [$_{QP}$ Q a book from *which* library]? (=18)

b. * *Which* student read [$_{QP}$ Q **no** book from *which* library]? (=24b)

Cable's (2010) theory predicts that VPs and larger sized constituents cannot form QPs in English. Thus interveners at the VP level and higher will not be in an intervenable region, explaining the lack of intervention by higher interveners as in (32a). Similarly, since intervention only affects the region between the *wh*-word and Q, this approach also explains the lack of intervention in (32b).

(32) **No intervention effect when intervener is outside intervenable region:**

a. ✓ *Which* student did**n't** read [$_{QP}$ Q a book from *which* library]? (=27)

b. ✓ *Which* student read [$_{QP}$ Q *which* book containing **no** princesses]? (=29a)

Finally, the evidence from intervention presented here makes it possible to further pinpoint the size of covert pied-piping. Assuming that the options for covert pied-piping parallel the options for overt pied-piping in a singular *wh*-question, we imagine the covert pied-piping options in (20), repeated below. Note that only (20a) predicts the intervention effect that we have observed. If (20b–c) were possible candidates for covert pied-piping, we would predict no intervention effect in (31b). Hence, we must conclude both that covert pied-piping exists and that it necessarily chooses the *largest* option among those available for overt pied-piping.

(20) **Different covert pied-piping options predict different intervenable regions:**
Which student read no book from *which* library?

a. [$_{QP}$ Q *Which* student] read [$_{QP}$ Q **no** book from *which* library].

b. [$_{QP}$ Q *Which* student] read **no** book [$_{QP}$ Q from *which* library].

c. [$_{QP}$ Q *Which* student] read **no** book from [$_{QP}$ Q *which* library].

3.2.3 Covert pied-piping and and Antecedent Contained Deletion[14]

In the previous section I presented evidence for the existence of covert pied-piping in English multiple *wh*-questions. I have argued that covert pied-piping, unlike its overt counterpart, must choose the largest possible candidate for movement that would be possible in a corresponding simplex question. I argued that smaller constituents are not viable candidates for covert QP-movement, as they would lead to the prediction that no intervention effects should occur in covert pied-piping. This state of affairs leads to a prediction with regard to the resolution Antecedent Contained Deletion (ACD). An example of ACD is given in (33) below.[15]

(33) **Antecedent Contained Deletion:**
John [$_{VP}$ read [$_{DP}$ every book that Mary did [$_{VP}$ $\triangle$]]].

Example in (33) is interpreted by speakers as in (34), where the missing VP is interpreted as the expression *read t*:

[14]This section is not part of Kotek and Erlewine (to appear). I thank Irene Heim and Danny Fox for suggesting the idea discussed here.

[15]See also a brief discussion in section 1.6.1. ACD will be discussed at greater length in Chapter 5, in particular in section 5.1.2.

(34) **Interpretation of ellipsis in (33):**
John [$_{VP}$ read [$_{DP}$ every book that Mary did [$_{VP}$ ~~read *t*~~]]].

For VP-ellipsis to be licensed, a pronounced antecedent VP must exist that is identical to the missing VP. The fact that the elided VP in (34) is resolved to the VP *read t* teaches us that the linguistic context must contain an antecedent of the form *read t*. However, if the analysis of (33) does not involve covert movement, then there is no instance of the VP *read t* in the structure to serve as the antecedent for the ellipsis. In fact, the only VP in the structure appears to be *read every book that Mary did*, which itself contains the ellipsis site. This apparent contradiction is resolved if we assume covert movement of the object, hosting the relative clause, to a VP-external position. This movement leaves behind a trace, creating a VP of the form *read t*, supplying the appropriate antecedent for the elided VP.

(35) **Resolution of ACD using covert movement:**
John [$_{DP}$ every book that Mary did [$_{VP}$ ~~read *t*~~]] [$_{VP}$ read *t*]].

Note furthermore that in sentences with different possible antecedents for the ellipsis, different movement steps must be assumed in order to create an appropriate antecedent. In (36), ACD can be resolved to the smaller VP_2, *read t*, or to the larger VP_1, *wanted to read t*. Movement of the object relative clause must accordingly target VP_2 or VP_1, respectively, to create an appropriate antecedent for the ellipsis.

(36) **ACD may be ambiguous, target different VPs:**
John [$_{VP1}$ wanted to [$_{VP2}$ read [$_{DP}$ every book that Mary did [$_{VP3}$ △]]].
a. John wanted to [$_{DP}$ every book that Mary did [$_{VP}$ ~~read *t*~~]] [$_{VP}$ read *t*]].
b. John [$_{DP}$ every book that Mary did [$_{VP}$ ~~wanted to read *t*~~]] [$_{VP}$ wanted to read *t*]].

A similar example can be constructed with an object relative clause as we have been considering in this chapter. Consider example (37) below, where ACD is hosted by the DP [a future president of *which* country...].[16] All things being equal we would expect two possible resolutions of this ellipsis, the first with [$_{QP}$ *which* country...] moving above *gave money*, (37a), and the second with [$_{QP}$ a future president of *which* country...] moving above *gave money*, (37b).

[16] I thank David Pesetsky (p.c.) for his help in constructing this example.

(37) **ACD hosted inside large DP is potentially ambiguous:**
Which woman gave money to a future president of *which* country that Barbara Bush (also) did △?

a. *Which* woman [$_{QP}$ *which* country that Barbara Bush (also) did [$_{VP}$ ~~gave money to a future president of *t*~~]] [$_{VP}$ gave money to a future president of *t*]?
→ The woman and Barbara Bush gave money to future presidents of (possibly different) countries

b. *Which* woman [$_{QP}$ a future president of *which* country that Barbara Bush (also) did [$_{VP}$ ~~gave money *t*~~]] [$_{VP}$ gave money *t*]]?
→ The woman and Barbara Bush gave money to the same future president

However, if our conclusions from the previous section are correct, (37a) should be ruled out because covert pied-piping must target the larger constituent, as in (37b). This prediction appears to be correct: native speakers report that example (37) implies that Barbara Bush and the other woman gave money to the same future president, as predicted from the LF in (37b), and that it is not possible to understand the sentence as allowing Barbara Bush and the other woman to have given money to different presidents, as predicted by the LF in (37a). Note that as predicted by this logic, the minimally different example below is judged as infelicitous, as it implies that Barbara Bush and the other woman gave birth to the same future president, contradicting our world knowledge.

(38) **Minimally different example is infelicitous:**
?? *Which* woman gave birth to a future president of *which* country that Barbara Bush (also) did △?

3.3 Pied-piping and the interfaces

In the previous section I presented evidence for the existence of covert pied-piping from the pattern of intervention effects in superiority-obeying English multiple *wh*-questions. I showed that the pattern is predicted only if we assume a *local* region of focus alternative computation: intervention occurs only in a small region above the surface in-situ *wh*-phrase. This pattern does not support a theory where these surface in-situ *wh*-phrases are generally sensitive to negative islands; nor does it support a theory where such *wh*-phrases are interpreted in-situ and project Rooth-Hamblin alternatives from their base-generated position to C. Instead, this pattern is predicted by Cable's (2010) theory of pied-

piping. This theory predicts both the size of pied-piping that should be possible, and that inside the covertly pied-piped QP we should find a region that is subject to intervention effects, under Beck's (2006) theory of intervention effects. Moreover, unlike overt pied-piping, covert pied-piping must choose the largest possible candidate for movement and smaller constituents are not viable candidates. This finding was additionally supported by data from the pattern of ACD resolution in sentences with covert QPs.

This section addresses the discrepancy between the sizes of overt vs. covert pied-piping. Although overt pied-piping can target constituents of varying sizes, with a preference for smaller movement, we have seen that in order to explain the pattern of intervention effects in covert pied-piping, only the largest option among those available to overt pied-piping must be considered. I will argue that this discrepancy is the result of different interface constraints that affect overt vs. covert movement.

3.3.1 The leftness constraint on overt movement

As is well known, overt pied-piping can target constituents of varying sizes, as shown in (39). Furthermore, we have seen in example (11)—repeated below as (40)—that targeting a smaller constituent for pied-piping can rescue a question from an intervention effect.

(39) **Options for overt pied-piping:**

a. [$_{QP}$ Q A picture of *which* president] does Jim own ___?

b. [$_{QP}$ Q Of *which* president] does Jim own a picture ___?

c. [$_{QP}$ Q *Which* president] does Jim own a picture of ___?

(40) **No intervention if the intervener is not inside the pied-piping constituent:**

a. * [$_{QP}$ Q **No** pictures of *which* president] does Jim own ___?

b. ✓ [$_{QP}$ Q Of *which* president] does Jim own **no** pictures ___?

c. ✓ [$_{QP}$ Q *Which* president] does Jim own **no** pictures of ___?

In contrast to this state of affairs in overt pied-piping, to correctly predict the pattern of intervention effects observed in covert pied-piping it must be the case that only the largest QP available in (39), observed in (39a), is targeted for movement in the case of covert pied-piping. If smaller constituents could also be targeted for movement, we would predict no intervention effects at all in the superiority-obeying questions that we surveyed above. That is, in a multiple *wh*-question like (41), only (41a) is a valid QP that

can be attracted by C; the QPs in (41b–c) cannot be available targets for movement. (Here, ○ is used to indicate derivations that the grammar considers, and × indicates those that are not considered.)

(41) **Only the largest covert pied-piping correctly predicts the section 3 pattern:**
Which student read no book from *which* library?

a. ○ [$_{QP}$ Q *Which* student] read [$_{QP}$ Q **no** book from *which* library].

b. × [$_{QP}$ Q *Which* student] read **no** book [$_{QP}$ Q from *which* library].

c. × [$_{QP}$ Q *Which* student] read **no** book from [$_{QP}$ Q *which* library].

This discrepancy is particularly puzzling since most speakers report a preference for the smaller overt pied-piping options in (39b–c) over (39a). Thus, it appears that the least preferred among the overt pied-piping options is the only candidate for covert pied-piping, (41a). Moreover, as we have seen, the upper bound on the possible size of QP is consistent across overt and covert pied-piping: in both cases, QPs formed by merging Q with VP or with a larger structure are ruled out. Consequently, I suggest that possible QP sizes are the same across overt and covert pied-piping.

I propose that the discrepancy we observe in the pattern of intervention effects results from the different constraints that overt and covert pied-piping must satisfy. While overt pied-piping is subject to both LF and PF constraints, covert pied-piping is subject to LF constraints only. That is, overt pied-piping feeds both LF and PF, and therefore must satisfy constraints at both interfaces. Covert pied-piping only feeds LF and thus shows us the true preference with regard to pied-piping: LF prefers to pied-pipe as large a constituent as possible, but in overt movement, this preference can be overridden by the needs of PF.

In particular, it has been noticed by several researchers that overtly-moved *wh*-phrases prefer to be near the left edge of the clause (Horvath, 2007; Heck, 2008, 2009; Richards, 2010; Cable, 2012, 2013, a.o.). Richards (2010) proposes that this is a linearly-oriented preference PF interface constraint. He defines this constraint as a requirement on the prosody of *wh*-questions (42), and shows that it can be satisfied in different languages in different ways—either through overt movement or through manipulation of prosodic phrase boundaries in *wh*-in-situ languages.

(42) **Prosody condition on *wh*-questions (Richards, 2010):**
Given a *wh*-phrase α and a complementizer C where α takes scope, create a level of phrasing on which α and C are not separated by any phonological phrase boundaries.

In English, the interpreting complementizer is always to the left and *wh*-movement is invoked to satisfy (42). Therefore the result of this prosody condition is a requirement for *leftness*, as in (43):

(43) **The leftness preference of *wh*-phrases: a PF constraint**
Wh-phrases prefer to be closer to the left edge of the clause.

I argue that the effects of this constraint are observable in English overt pied-piping. For example, consider the options for overt pied-piping in (39), repeated below. While all three pied-piping options are strictly speaking grammatical, many speakers report a preference for (39b–c) over (39a). This preference correlates with the fact that the *wh*-word is significantly further away from the clause edge in (39a) than in (39b–c).

(39) **Options for overt pied-piping:**
a. [$_{QP}$ Q A picture of *which* president] does Jim own ___?
b. [$_{QP}$ Q Of *which* president] does Jim own a picture ___?
c. [$_{QP}$ Q *Which* president] does Jim own a picture of ___?

Example (39) makes clear that all theories of pied-piping must allows for some measure of optionality with regard to the satisfaction of Richards's (2010) prosody constraint (the *leftness* constraint). In Cable's (2010) work, the syntax allows several different options for the merger site of the Q morpheme. This grammatical mechanism must then interact in some way with the prosody constraint to predict that some positions for Q are preferred over others.

Further examples help clarify that it is the linear distance from the left edge of the clause that matters here, not the size of the pied-piping constituent or the depth of the embedding of the *wh*-word within. Consider the examples in (44) below. Although the syntactic and semantic content of the two examples is very similar, speakers report a difference in their acceptability. Example (44a), which contains a large pied-piping constituent with the *wh* deeply embedded is judged by speakers to be perfectly acceptable. This contrasts sharply with (44b), which is degraded. This contrast is attributed to the

fact that the *wh* is near the left edge of the pied-piping constituent in (44a) but not in (44b) (data from Cable, 2012).

(44) **Large pied-piping is grammatical if *wh* is at edge of moved constituent:**

a. ✓ [$_{QP}$ Q [[*Whose* brother]'s friend]'s father] did you see?

b. ?? [$_{QP}$ Q The father of [[*whose* brother]'s friend]] did you see?

Furthermore, even larger pied-piping in which the *wh* is even further embedded, as in (45), remains grammatical, so long as the *wh*-word is near the left edge of the pied-piping constituent. Thus, PF does not restrict large pied-piping *per se*, but rather only pied-piping in which *wh* is not near the edge of the moved constituent.

(45) **Pied-piping remains grammatical even with deep embedding of *wh* in large QP:**

a. ✓ [$_{QP}$ Q [[[*Whose* brother]'s friend]'s father]'s boss] did you see?

b. ✓ [$_{QP}$ Q [[[[*Whose* brother]'s friend]'s father]'s boss]'s secretary] did you see?

This general preference of *wh*-phrases to be at the left edge (43) also results in corollaries such as Heck's (2008; 2009) Edge Generalization:[17]

(46) **The Edge Generalization (Heck 2008: 88, Heck 2009: 89)**
If α pied-pipes β (and movement of α to the edge of β is grammatically possible), then α must be at the edge of β.

Heck's Edge Generalization explains cases of secondary *wh*-movement as in (47a). Here, a QP containing *wh* is pied-piped to the edge of a question, and following this movement, *wh* must move to the edge of the pied-piping constituent. The general possibility of such movement for degree heads is illustrated by (47c) (data from Cable, 2012).

(47) **Secondary *wh*-movement of degree *wh* predicted by Edge Generalization:**

a. ✓ [[*How* big] a car] did Bill buy?

b. * [A [*how* big] car] did Bill buy?

c. ✓ Bill would never buy [[that big] a car].

[17] I note that both Heck (2008; 2009) and Cable (2007; 2010) have developed syntactic accounts of the Edge Generalization, which explains it through interactions in the narrow syntax. For Heck, the Edge Generalization follows from Attract Closest, while for Cable it is attributed to the Phase Impenetrability Condition and the need for Q to agree with *wh*. Here I will not attempt to decide which approach to the Edge Generalization is correct.

Again, this requirement that *wh* appear near the edge of QP appears to be a PF requirement, not one of structure-building or interpretation. An LF for a question as in (48a), where we see that secondary *wh*-movement is not possible, is also interpretable. (48c) shows that in this case, secondary *wh*-movement is generally not possible (data from Cable, 2012). From this point of view, then, secondary *wh*-movement is motivated solely by PF, not by LF.

(48) **Secondary *wh*-movement blocked for possessive *wh* but question remains interpretable:**

a. ✓ [In [*whose* honor]] was this made?

b. * [[*Whose* honor] in] was this made?

c. * This was made [[Dave's honor] in].

3.3.2 Covert pied-piping and the interfaces

To summarize, we have seen a PF preference for having *wh* near the edge of an overtly pied-piped constituent. We have also seen that this is not an absolute requirement: larger pied-piping as in (39a) are accepted by most speakers, even if they are found to be less well-formed than smaller pied-piping options (39b–c). Furthermore, we have seen that the PF preference is not for *smaller* pied-piping as a general rule, but rather for realization of the *wh*-word as far left as possible. This was demonstrated by the large possessive pied-piping in (44)–(45).

I propose that the PF constraint in (43) is the source of differences in size between pied-piping for overt and covert movement. By hypothesis, covert movement only affects the LF interface, and therefore the choice of covertly moved QP size will not affect PF:[18]

[18]But note that overt secondary *wh*-movement does still apply to PF-in-situ *wh*-phrases:

(i) a. ✓ I know [*which* student bought [[*how* big] a car]].

b. * I know [*which* student bought [a [*how* big] car]].

This contrast shows that surface in-situ *wh*-words are still subject to the general leftness preference (43). The choice of QP size in (49), on the other hand, simply cannot affect the PF output, due to the general unavailability of multiple *wh*-fronting in English.

(49) **The choice of covertly-moved QP size does not affect the PF linearization:**
Which student read a book from *which* library?

a. [$_{QP}$ Q *Which* student] read [$_{QP}$ Q a book from *which* library].

b. [$_{QP}$ Q *Which* student] read a book [$_{QP}$ Q from *which* library].

c. [$_{QP}$ Q *Which* student] read a book from [$_{QP}$ Q *which* library].

The results of section 3.2 thus help disentangle the preferences of PF vs. LF with regard to pied-piping size. The intervention pattern we observe supports the conclusion that only the largest pied-piping is possible for covert movement, (50).

(50) **Large movement: The preference of Core Syntax and LF**
Prefer covert movement of the largest constituent among the choices available for overt movement.

Hence, we learn that the preference of LF and Core Syntax is for larger pied-piping. This preference can be overridden by the PF constraints that govern overt pied-piping such as (43), resulting in the complex patterns of pied-piping that we have seen here.

Formally, this preference for larger covert pied-piping could be thought of as derived from a top-down application of the constraint Attract Closest (Rizzi, 1990; Chomsky, 1993, 1995, 2000, see Chapter 1.3). That is, C probes from above for positions where Q could grammatically be merged to form a QP and attracts the first Q-compatible constituent that it finds.[19] In Cable's (2010) system, these possible positions are constrained as shown in (49), ruling out large pied-piping of VPs or larger material. Due to the top-down nature of probing (Chomsky, 2000), this would yield a preference of Core Syntax for larger QPs.

This kind of logic, where attraction operations must apply to a larger constituent which may itself contain a possible second target of movement is prevalent in the linguistic literature. For example, it is how Chomsky (1964) and Ross (1967) define the A-over-A principle, requiring that operations which may in principle apply to a larger target or to a smaller target contained within the larger target apply only to the larger target. I propose that in cases of overt movement, this operation is in competition with conditions on the prosody of *wh*-questions, as in Richards's (2010) work. Since these conditions only affect

[19] In this variant, then, it may be the case that QP is not at all constructed, but instead what matters is Q-compatibility, in Cable's (2010) system. Another option is that Q is counter-cyclically merged to produce a QP for C to Attract. Alternatively, under a left-to-right approach to structure building as in Phillips (1996, 2003), such a merger of Q would in fact not be counter-cyclic. Because Q is silent in English, these two variants are difficult to tell apart and I will not attempt to distinguish between them here.

movement that has consequences for the PF branch—that is, for overt movement—they are inactive for the purpose of deriving covert pied-piping. In that case, it is predicted that only Attract Closest is at play, and therefore that only the largest pied-piping option is available in the grammar.[20]

The end result of this discussion is somewhat different from the proposal in Cable (2010). In Cable (2010), all QPs derived from the grammatical merger of a Q-particle are predicted to be equally good. The grammaticality pattern observed here shows us that only the largest possible QP is considered for pied-piping by LF and Core Syntax. This choice can be overridden by the PF constraint preferring that *wh* be closer to the left edge of the clause, thus making smaller pied-piping options available for *overt* pied-piping only.

[20]One could also imagine another proposal similar in spirit, which involves a trans-derivational application of Attract Closest. That is, we could imagine the grammar considering the three derivations in (49) in parallel, differing only in the position where Q is merged. The derivation with the largest QP (49a) will result in the optimal satisfaction of Attract Closest-type constraints for the probing of QP by C. See Reinhart (2006) for more on trans-derivational constraints and motivations for them.

3.4 Chapter summary

This chapter addressed the question of whether covert movement triggers pied-piping.

The syntax-semantics of pied-piping constituents was used to diagnose the existence and size of *covert* pied-piping, §3.1.

A small region between the surface-in-situ *wh*-word and the edge of the pied-piping constituent in superiority-obeying multiple questions is *intervenable* —that is, the insertion of a focus-sensitive operator in this region causes an intervention effect.

- ***No* causes intervention effect in superiority-obeying multiple question, but negation that is too low and sentential negation do not:**
  - ✓ *Which* student read [$_{QP}$ Q a book from *which* library]?
  - * *Which* student read [$_{QP}$ Q **no** book from *which* library]?
  - ✓ *Which* student read [$_{QP}$ Q *which* book containing **no** princesses]?
  - ✓ *Which* student did**n't** read [$_{QP}$ Q a book from *which* library]?

Whereas in overt movement, different sized QPs can be chosen for pied-piping, in covert movement, only the largest possible QP is considered by the grammar, §3.2.

This explains the possible antecedents for ACD resolution when ACD is hosted in a covertly moved QP, §3.2.3.

It is argued that different interface constraints affect overt and covert movement: overt movement feeds both PF and LF, while covert movement feeds only LF.

The true preference of Core Syntax and LF is for pied-piping *larger* constituents. Certain surface-oriented PF constraints can override this choice in *overt* pied-piping, §3.3.

- **Large movement: The preference of Core Syntax and LF**
  Prefer covert movement of the largest constituent among the choices available for overt movement.
- **The leftness preference of *wh*-phrases: a PF constraint**
  Wh-phrases prefer to be closer to the left edge of the clause.

Chapter 4

The intervention generalization

In this chapter takes a closer look at the distribution of intervention effects in English multiple *wh*-questions. I show that the pattern of intervention effects in English questions is more complicated than previously thought. In particular, I show that the correlation between superiority and intervention assumed in the previous literature, as in (1) below, does not in fact hold.

(1) **D-linked superiority-violating questions are subject to intervention:**

a.	*Which* boy ____ read *which* book?	✓sup.-obeying, no intervener
b.	*Which* book did *which* boy read ____?	✓sup.-violating, no intervener
c.	*Which* boy did**n't** ____ read *which* book?	✓sup.-obeying, intervener
d.	* *Which* book did**n't** *which* boy read ____?	* sup.-violating, intervener

(2) **The correlation between superiority and intervention (incorrect!):**
Superiority-obeying questions are immune from intervention effects.
Superiority-violating questions are subject to intervention effects.

We have already seen one case of intervention effects in superiority-obeying questions in Chapter 3, where intervention effects occurred inside overtly and covertly pied-piped QPs in English and German.

In this chapter I show that whenever covert QP-movement in superiority-obeying questions is restricted, intervention effects occur *above* the landing site of this restricted movement. I show three ways of restricting movement, using Binding Theory, Negative Polarity Items, and the Principle of Lexical Association (which regulates the placement

of F-marking in sentences). Moreover, I show that intervention effects in superiority-violating questions can be avoided in the right structural configurations—that is, if the intervener can be scoped out of the question or reconstructed below the in-situ *wh*, or if the in-situ *wh* can independently receive wide scope through means that do not involve interrogative movement. The emerging pattern will allow for a refined structural description of intervention effects, and will reaffirm the relevant configuration implicated in intervention effects proposed in Chapter 2—that is, intervention effects occur when (a) covert movement of the *wh* above the intervener is impossible for some reason, and (b) the relation between Q and *wh* is disrupted by intervening material.

4.1 Background: the intervention effects diagnostic

Before turning to the data, I begin with a brief summary of the intervention-effects diagnostic for covert *wh*-movement. In Chapter 3 I proposed the use of intervention effects as a diagnostic for regions in the question in which movement is used and regions where Rooth-Hamblin focus alternatives are computed. This diagnostic exploits the intervention schema, repeated in (3).[1]

(3) **Configuration of an intervention effect (cf. Beck, 2006):**
* [Q ... **intervener** ... *wh* ...]

Recall that an intervention effect occurs whenever an *intervener*—for Beck, a focus-sensitive operator—c-commands an in-situ *wh*-word that is interpreted using Rooth-Hamblin alternatives at LF. The covert QP-movement strategy of interpreting *wh*-phrases, on the other hand, is immune to focus intervention effects: intervention only affects *wh*-elements that are interpreted through focus-alternatives but not traces of QP-movement.[2]

Taken together with the assumption that in-situ *wh*-phrases in superiority-obeying questions can covertly move above potential interveners at LF, we expect to find intervention effects in superiority-violating questions but not in superiority-obeying questions:

(4) **Intervention effects affects superiority-violating question:**
a. *Which* student **didn't** read *which* book? Superiority-obeying
b. * *Which* book **didn't** *which* student read? Superiority-violating

[1] For Beck, the schema involves C instead of Q. See discussion in section 2.4.2.

[2] Here I use the term *wh-phrase* interchangeably with QP, to refer to the interrogative phrase that is (or would be) fronted through interrogative movement.

This state of affairs is summarized in the schemas below:

(5) **The interaction of superiority and interveners at LF:**

a. Superiority-obeying questions: no intervention effects

✓ [$_{CP}$ QP_1 QP_2 [C [$_{TP}$ ... **intervener** ... t_1 ... t_2]]]

b. Superiority-violating questions: intervention effects

* [$_{CP}$ QP_2 Q_1 [C [$_{TP}$ ... **intervener** ... wh_1 ... t_2]]]

Note that as mentioned in Chapter 3, an intervention effect most clearly affects the pair-list reading of a question—at least some speakers find that questions as in (5b) do not become ungrammatical but rather have a surviving single-pair reading.[3] Following this logic, it is possible to use focus intervention effects as a diagnostic for whether or not covert QP-movement has occurred in the derivation of a question: the presence of an intervention effect, detectable by the loss of the pair-list reading of the question, will teach us that a surface in-situ *wh*-phrase must have been interpreted using Rooth-Hamblin alternatives, whereas the lack of an intervention effect will teach us that the *wh*-phrase must have covertly moved (as part of a QP) above the scope of the intervener.

Using this diagnostic, I will show cases where intervention effects are systematically brought about in superiority-obeying questions, and cases where intervention is not found in superiority-violating questions.

4.2 Forcing intervention in superiority-obeying questions

In this section I show that intervention effects systematically affect superiority-obeying questions in English whenever covert movement of the surface in-situ *wh* is restricted in some way. Below I discuss three such ways: (a) using the Principle of Lexical Association (PLA), affecting the possible LF-positions of F-marked constituents; (b) using Negative Polarity Items (NPIs), when an NPI must stay below its licensor; and (c) using Binding Principles which force certain nominals to be inside or out of certain binding domains. I show that when movement is restricted, the familiar intervention effect pattern reemerges: we observe intervention effects above the (putative) LF position of the *wh*.

[3] I discuss this surviving reading in section 6.5 of the dissertation. Following Beck (1996a), Pesetsky (2000) marks this judgment with $^{??}$. Here I will instead mark examples with ^{*PL}, to remind the reader of the fact that the pair-list reading of the question (and perhaps also the single-pair, at least for some speakers) is affected by intervention.

4.2.1 Restricting movement using the Principle of Lexical Association

Background: The Principle of Lexical Association

Operators like *only* are called focus-sensitive as their interpretation relies on another constituent in the clause being focused. The process by which a focus-sensitive operator identifies and composes with its associated bound focus—known as Association with Focus—has been an area of intense interest since Jackendoff (1972). Association with Focus uses the same mechanism to establish a relationship between the focus-sensitive operator and its associate as proposed by the in-situ approach to *wh*-in-situ: the projection of focus-alternatives between the F-marked constituent and the focus-sensitive operator (Rooth, 1985, a.o.) (see details in section 1.1.3). The semantics of focus-alternatives makes the prediction that the F-marked constituent, the associate of the focus operator, must be within the scope of the operator: the alternatives that are considered by the focus-sensitive operator are computed based on the complement of the operator. As a result, F-marked constituents outside of that scope do not contribute to the evaluation of the operator.

One set of evidence motivating the kind of structural restriction on Association with Focus sketched above is examples like (6)–(7) below. The *wh*-question (6a) is ungrammatical with the intended interpretation. The corresponding echo question in (6b), with the F-marked constituent in the scope of the operator, is grammatical. Similarly, the topicalization example in (7a) is ungrammatical, but the corresponding example with in-situ focus is grammatical, (7b) (F-marking marked with an underline).

(6) **F-marked constituent may not move out above *only*:**

a. * *Who*$_{\text{F}}$ do you **only** like ____?
Intended: Who x is such that you like only x?

b. ✓ You **only** like *who*$_{F}$?

(7) a. * Mary$_{F}$, John **only** likes ____.
Intended: 'As for Mary, John only likes her$_{\text{F}}$ (and no one else).'

b. ✓ John **only** likes Mary$_{F}$.

Tancredi (1990) proposes to explain these contrasts through the *Principle of Lexical Association* (PLA):

(8) **The Principle of Lexical Association (PLA) (Tancredi, 1990, p. 30):**
An operator like *only* must be associated with a lexical constituent in its c-command domain.

Tancredi (1990) originally proposed the PLA for overt movement of a focus-associate out of the scope of the focus-sensitive operator, such as in (6)–(7). These examples are ungrammatical because the F-marked constituent in (6a) and (7a) has moved out of the scope of the operator. Consequently, there is no focused constituent c-commanded by *only* in the surface syntax that *only* can associate with, violating the PLA.

Aoun and Li (1993) expand this discussion to cases of covert movement. They show evidence from the interaction between focus-sensitive operators and the possible scopes of quantifiers, to motivate the view that the PLA must hold at LF. Consider first a baseline case of scope ambiguity presented in (9). Aoun and Li (1993) assume that quantifiers take scope through a covert movement operation that moves quantifiers to their interpreted scope position. In (9), an inverse-scope readings ($\forall > \exists$) is available due to QR of *every boy in the room* to a position above *someone* at LF, (9c). As *want* is a control verb, lowering of *someone* is not a possible operation. Thus, with the scope of *someone* $>$ *want* fixed, there are three predicted readings of the sentence, all of which are in fact attested:[4]

(9) **Scope ambiguity explained using QR analysis:**
Someone wants to meet every boy in the room.

a. [someone] wants [[every boy] PRO meet *t*] $\exists > want > \forall$

b. [someone] [every boy] *t* wants [PRO meet *t*] $\exists > \forall > want$

c. [every boy] [someone] wants [PRO meet *t*] $\forall > \exists > want$

Next consider what happens when a focus-sensitive operator, here *only*, is introduced into the sentence and associates with part of the quantifier. Aoun and Li (1993) argue that in this case, the inverse-scope reading illustrated in (9c) becomes unavailable. This is due to *only* preventing *every boy in the room* from QRing to a position above *only*, because *only* must associate with an F-marked constituent inside that quantifier. Assuming a fixed scope of *someone* $>$ *want* $>$ *only*, this forces *every boy in the room* to also stay below *someone*, making the inverse-scope reading unavailable. This prediction is borne out:

[4]Example (9) is a variation on Aoun and Li's (1993) original example, taken from Erlewine (2014). See the discussion there for details and for detailed contexts showing that all three readings in (9) are attested.

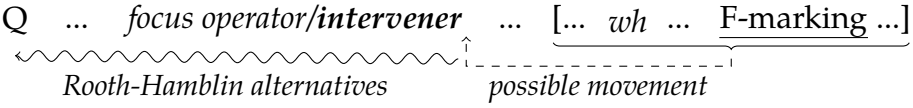
(10) **PLA restricts possible scope of QR (Aoun and Li, 1993):**
Someone wants to **only** meet [every $\underline{\text{boy}}_{\text{F}}$ in the room]. ✓$\exists > \forall$, *$\forall > \exists$

Example (10) has an attested surface-scope reading which (assuming that the alternative to "boy" is "girl") can be paraphrased as: "there is a certain person who wants to meet every boy in the room (but there is no one who wants to meet every girl in the room)." However, example (10) lacks an inverse-scope reading: "for every boy (but perhaps not for every girl) in the room, there is some (possibly different) person who wants to only meet that boy." The parallel reading for a sentence without *only* is possible, (9c). This has led Aoun and Li (1993) to argue that the PLA applies at LF, banning covert movement of an F-marked constituent out of the scope of the operator that must interpret it.

Restricting movement using the PLA

With this background in mind, we can now use the PLA to restrict covert *wh*-movement in a multiple question. That is, we predict a similar interaction between a focus-sensitive operator and F-marking inside the *wh*-phrase as we saw above with *every*. In particular, we expect movement in a configuration such as in (11) to only be able to target a position directly below the focus operator, and that Rooth-Hamblin alternatives must be computed above that region. Note furthermore that focus operators that are subject to the PLA—and in particular, *only*—are also known to be interveners. Hence, we expect to detect intervention effects in that region. Note that as long as the F-marking occurs inside the putative QP that would be constructed around the in-situ *wh*, we predict the same kind of behavior regardless of whether the F-marking is above or below the *wh*.[5]

(11) **Configuration which should restrict *wh*-movement using the PLA:**



[5]One might imagine two ways of interpreting a QP whose movement is blocked from reaching C. One option is that this restriction makes the presence of a QP impossible, and instead the surface in-situ *wh* is forced to be LF-in-situ, interpreted using a non-projecting Q-particle that is merged into the CP layer. Alternatively, we might imagine that QP-movement targets the highest position it can—directly below the focus operator in (11)—and then Q moves out of QP (as is necessary in the case of all QP-movement, because of a type-mismatch between Q and its sister) and continues alone to C. In Chapter 6 I will argue that the latter description is correct: we must allow QP-movement to positions other than C, with Q moving alone from QP's landing site to C. For present purposes, however, either interpretation of the data would suffice.

The relevant example is given in (12). Example (12a) provides a baseline and shows that in general, a multiple question can have both a pair-list reading and a single-pair reading. Example (12b) contains the focus-sensitive operator *only*, associating with a part of the *wh*-phrase. We thus expect that in this configuration, the *wh*-phrase cannot move above *only*, because *only* must associate with F-marking inside the *wh*-phrase. Note that *only* is also one of the classic interveners: when it occurs above a *wh*-phrase that is interpreted using Rooth-Hamblin alternatives, the result is an intervention effect. In the case of (12b), the reported judgment is the loss of the pair-list reading of the question; in the provided context, the question is ungrammatical.[6] We can diagnose this state of affairs as an intervention effect.

(12) **PLA restricts covert movement of *wh*-in-situ:**[7]

a. I can tell you [*which* student read *which* book].

b. Context: The students in the class were supposed to read one book *and* one article. However, everyone got confused and read one book *or* one article. I've been reading everyone's squibs. I've finished all the ones about books, so:
* I can tell you [*which* student **only** read *which* book$_F$].

I argue that (12b) exemplifies an intervention effect in a superiority-obeying question that occurs because we have restricted the possibility of covert movement in this question so that it necessarily targets a position below the intervener. Recall that normally, the in-situ *wh*-phrase in a multiple question is able to move above the intervener, avoiding an intervention effect, (12a). Notice furthermore that the same effect is obtained if F-marking occurs in other parts of the putative QP in the question, (13).[8]

(13) **F-marking on other parts of QP restricts covert *wh*-movement:**
$*^{PL}$ I can tell you [*which* student **only** read [$_{\text{QP}}$ *which* book about binding$_{\text{F}}$]].

Examples (12b) and (13) thus illustrate intervention effects in superiority-obeying questions. I note that this serves as a reminder that what intervention appears to block the pair-list reading of the question, but a single-pair reading remains available.

[6]Note that the expected pair-list reading here can be paraphrased: "I can tell you all the pairings of students and books, such that the student read that book (but I don't know about articles)."

[7]The data and judgments are based on Erlewine (2014). I have added the context here to favor the pair-list reading. This sharpens the judgment, as it eliminates interference from the single-pair reading.

[8]Recall from Chapter 3 that the QP here is predicted to be the DP *which book about binding* in (13). The reading that is blocked here can be paraphrased as "I can tell you all the pairings of students and books about binding, such that the student only read that book (but I don't know about other topics)."

4.2.2 Restricting movement using binding

In this section I use binding conditions A and B to restrict the possible movement of the (phonologically) in-situ *wh*-phrase. As in the cases we saw above, I show that when movement is restricted, we can observe intervention effects above the landing site of the movement in superiority-obeying questions.

Background: Reconstruction in A-movement chains

Binding theory studies the distribution of anaphoric elements such as pronouns and anaphors, with the goal of identifying the syntactic relationship that can or must hold between an anaphor and its antecedent. Here I will adopt the following definitions for Conditions A and B of binding theory:

(14) **Definition: Binding condition A**
An anaphor must have a binder that is in the anaphor's binding domain.

(15) **Definition: Binding condition B**
A pronoun must be free in its binding domain.

(16) **Definition: Binding domain**
The binding domain of a DP α is:
- if α is the subject of a tensed TP, the smallest TP containing α.
- otherwise, the smallest TP containing α and a DP which c-commands α.

Lebeaux (2009) argues that Condition A of binding theory applies at LF, whereas Conditions B and C apply at every stage of the derivation (including LF). The necessity of applying Condition A at LF can be seen in the following data set, originally discovered by May (1977, 1985), Aoun (1982), and Lebeaux (1995).

Consider example (17), containing two quantifiers: the overtly moved quantifier (2) and the in-situ universal quantifier ($\forall$). These two quantifier can have either a surface-scope or an inverse-scope reading, as indicated below (examples in this section are from Lebeaux, 2009, unless specified otherwise):

(17) **Sentence with two quantifiers is scopally ambiguous:**
Two women$_1$ seem t_1 to be expected t_1 to dance with *every senator*. (Ambiguous)
a. $\underline{2 > \forall}$: There are two women who dance with every senator.
b. $\underline{\forall > 2}$: Every senator has two (possibly different) women who dance with him.

Compare (17) to the minimally different (18). Example (18) is similar to (17) except that it contains the anaphor *each other*, which is bound by the existential quantifier *two women*. The resulting example is no longer ambiguous: it can only have an surface-scope interpretation, but not an inverse-scope interpretation.

(18) **Sentence with two quantifiers and anaphor becomes unambiguous:**
Two women$_1$ seem to each other t_1 to be expected t_1 to dance with *every senator*.
$^{\checkmark}2 > \forall$, $^{*}\forall > 2$ (Unambiguous)

We might think of this as a "trapping effect:" to get the inverse-scope reading, with *two women* below *every senator*, we assume a reconstruction operation that allows the existential quantifier to take scope in its base position, as in the LF in (19a). Since the existential and universal quantifiers are in the same clause, they can now scopally interact with one another, leading to the inverse-scope reading. The same derivation is not possible in (19b): if the existential quantifier takes scope in its base position, the anaphor *each other* is unbound. The fact that there is only one scope ordering for the quantifiers in (18) shows that the quantifier is trapped upstairs (it has to bind the anaphor) at LF. The two quantifiers in this sentence are not in the same clause and therefore cannot interact with each other.[9] Note that these examples show that the inverse scope we observe in (17) is not obtained through long-distance QR of the lower quantifier *every senator*. If that were the case, we would incorrectly predict the inverse-scope reading to be available in (18).

(19) **LFs for (17) and (18):**

a. t_1 seem t_1 to be expected *Two women*$_1$ to dance with *every senator*.

b. *Two women*$_1$ seem to each other t_1 to be expected t_1 to dance with *every senator*.

A similar effect can be obtained using bound pronouns: Example (20a) illustrates a baseline example containing two quantifiers, which are scopally ambiguous. Example (20b) shows that when a pronoun bound by the higher quantifier is introduced into the sentence, the resulting sentence is unambiguous. The explanation of the facts is as in the examples (17)–(18) above: the bound pronoun blocks the higher quantifier from A-reconstructing to a position when it is a clause-mate of the lower quantifier, which would allow us to derive the inverse-scope reading.

[9] For convenience, I illustrate the position at which the quantifier is interpreted with a full copy, and other positions that it moved through using traces.

(20) **Scope trapping effect with bound pronouns:**

a. *Two women*$_1$ seem to be attracted t_1 to *every man*.
$^{\checkmark}2 > \forall$, $^{\checkmark}\forall > 2$ (Ambiguous)

b. *Two women*$_1$ seem to their$_1$ mother t_1 to be attracted t_1 to *every man*.
$^{\checkmark}2 > \forall$, $^{*}\forall > 2$ (Unambiguous)

Restricting covert movement using binding theory

With this background in mind, we can now use binding to restrict covert *wh*-movement in a multiple question. In particular, if a *wh*-phrase contains a bindee, we expect that it will have to reconstruct below its binder at LF. Consequently, if an intervener is placed above this landing site of the *wh*-phrase, we expect to observe an intervention effect.

(21) **Configuration which should restrict *wh*-movement using binding:**

Q ... ***intervener***/*binder* ... [... *wh* ... bindee ...]

Rooth-Hamblin alternatives *possible movement*

Example (22) is one relevant test case. Example (22a) provides a baseline for a superiority-obeying question with an intervener, **no girl**. As with other such examples, the pair-list reading of the question is available despite the presence of the intervener. Example (22b) is minimally different from the baseline in that it contains a bound pronoun occurring inside the putative QP in this question, and being bound by *no girl*, the intervener. Although both the baseline (22a) and the test sentence (22b) are quite complex due to the embeddings and number of arguments in the sentence, speakers find that there is a contrast between the two examples.

(22) **Scope trapping with reconstruction restricts covert *wh*-movement:**

a. $^{\checkmark}$ *Which* boy believed that **no girl** seemed to *which of my friends* to be intelligent?

b. ^{*PL} *Which* boy believed that **no girl** seemed to *which of her friends* to be intelligent?

A similar test case is given in (23). Example (23a) provides a baseline for a superiority-obeying multiple question with an intervener, **no girl**. Examples (23b–c) contain an anaphor and a bound pronoun, respectively, occurring inside the putative QP in this question, and being bound by *no girl*, the intervener. These examples are judged by na-

tive speakers as degraded.[10,11]

(23) **Scope trapping effect causes an intervention effect:**

a. ✓ Which boy gave **no girl** *which picture of Kennedy*?

b. $*^{PL}$ Which boy gave **no girl** *which picture of herself*?

c. $*^{PL}$ Which boy gave **no girl** *which picture of her best friend*?

4.2.3 Restricting movement using NPIs

In this section I explore one further way of restricting covert movement of *wh*-phrases, using the licensing conditions governing Negative Polarity Items.

Background: The licensing conditions of NPIs

Negative Polarity Items (NPIs) are a class of items whose hallmark property is exclusion from positive environments. Such items are licensed in negative, downward entailing, and non-veridical environments (Baker, 1970; Linebarger, 1980; Ladusaw, 1980; Giannakidou, 1997; von Fintel, 1999, among many others). English *any* and *ever* (first identified in Klima's (1964) work on English negation) are well-known NPIs:

(24) ***Any* is a Negative Polarity Item:**

a. John didn't buy <u>any</u> books.

b. * John bought <u>any</u> books.
cf. John bought two books.

NPIs are licensed not just by negation but by other downward entailing operators, such as negative quantifiers, (25a), the restriction of a universal quantifier, (25b), and the restriction of an *if*-clause, (25c) (cf. Ladusaw, 1980, and much subsequent work).

[10] Some of my consultants were unsure whether (23b–c) can have a felicitous single-pair reading. I speculate that this is because of the relatively high complexity of these examples compared to the ones in the previous sections.

[11] At least some speakers prefer an interpretation of this question that appeal to a functional reading. If this is so, example (23) may not be a fair test case for those speakers. I will not fully explore here the nature of the pair-list reading that would be predicted in these cases, if the sentence did not exhibit an intervention effect. This reading seems to involve a list reading of a functional nature, which is not straightforwardly predicted to interact with Beck's (2006) theory of intervention effects. I leave this question open at this point, but for completeness I note that for this test case to be fully developed, an account of the blocked readings and their relation to Beck intervention effects is required.

(25) **NPIs are licensed in downward entailing contexts:**

a. {Few professors/*Many professors} invited any students.

b. Every student who saw anything contacted the police.

c. If you talk to any students, just let me know.

Uribe Etxebarria (1994) argues that the licensing conditions on NPIs must be satisfied at LF and not a S-Structure: NPIs can sometimes occur outside the scope of 'bleached predicates' that allow the NPI to reconstruct into their scope. Note, however, that it is not sufficient that an NPI occur in a downward entailing context. It is also necessary that other scope-bearing elements not separate the NPI from its licensor. Example (26) below illustrates this requirement: (26a) provides a baseline for a grammatical sentence containing an NPI. In example (26b), a quantifier is added to the sentence, which separates the NPI from its licensor. The result is ungrammaticality (example from Honcoop (1998)).

(26) **Scope bearing elements can't intervene between the NPI and its licensor:**

a. Nobody gave John anything.

b. * Nobody gave *most beggars/every beggar* anything.

Linebarger (1980, 1987) proposes the Immediate Scope Constraint to account for this behavior:

(27) **The Immediate Scope Constraint (Linebarger, 1987, p. 338):**
A negative polarity item is acceptable in a sentence S if in the LF of S the subformula representing the NPI is in the immediate scope of the negation operator.
An operator is in the immediate scope of NOT only if (i) it occurs in a proposition that is the entire scope of NOT, and (ii) within this proposition there are no logical elements intervening between it and NOT.

Guerzoni (2006) reformulates this constraint in terms of the familiar Beck intervention effect. She proposes that NPIs covertly move to their licensors at LF, but this movement can be constrained in ways that are known to constrain QR, for example using islands. In that case, the NPI is interpreted using an alternative mode of composition, which is subject to intervention effects from intervening quantifiers. [12] For a more recent discussion of this phenomenon, see Chierchia (2013).

[12]Guerzoni (2006) bases her theory on Pesetsky's (2000) work on English, distinguishing between *phrasal movement* and *feature movement* (in the sense of Chomsky 1995). Feature movement can be thought of as equivalent to Agree without movement, requiring an alternative mode of composition in order to interpret the in-situ element. Following Beck (2006), this mode of composition is the use of focus alternatives.

While Guerzoni shows that there is some overlap between the set of Beck interveners and the set of elements that are implicated in the Immediate Scope Constraint, she does not show comprehensive evidence that they are the same. An important question for our purposes, then, is whether a *wh*-phrase, or a QP, acts as an intervener in the sense of the Immediate Scope Constraint. Example (28) is an attempt to construct such an example. Example (28a) provides us with a baseline for a multiple question with a ditransitive predicate *give*. Example (28b) shows that an NPI is not licensed in this question in the absence of a licensor. Example (28c) contains such a licensor—here, negation—and the resulting question is judged as grammatical. It appears, then, that a *wh*-phrase is not by itself an intervener for the purposes of the Immediate Scope Constraint. This allows us to use the licensing conditions of NPIs to restrict the movement of *wh*-phrases.

(28) ***Wh*-phrases and the Immediate Scope Constraint:**

a. *Which* boy gave *which* girl some flowers?

b. * *Which* boy gave *which* girl <u>any</u> flowers?

c. *Which* boy **didn't** give *which* girl <u>any</u> flowers?

Restricting covert movement using NPI licensing

Given that it is possible to place NPIs inside multiple questions and to inspect their licensing conditions, we can attempt to use NPI licensing to restrict the covert movement of a QP. Here it is worth noting that several licensors of NPIs are traditional interveners. Hence, assuming that the licensing conditions on NPIs must hold at LF, we can affect the movement of a *wh*-phrase containing an NPI in the same way as we did with the PLA above: we can force a *wh* to stay (or to reconstruct to a position) below an intervener by having the following configuration in (29). Note that the ordering of the NPI with respect to the *wh* should not matter, as long as both occur inside the (putative) QP.

(29) **Configuration which should restrict *wh*-movement using NPIs:**

Q ... ***intervener***/*licensor* ... [... *wh* ... <u>NPI</u> ...]

Rooth-Hamblin alternatives *possible movement*

not licensed in a question when negation is not present, (31a), but it is licensed when c-commanded by negation, (31b).[13]

(30) **NPI licensed in question when negation is present:**

a. * *Which* boy read a book about any president?

b. ✓ *Which* boy **didn't** read a book about any president?

Example (31a–c) show that intervention effects indeed re-emerge in superiority-obeying question in the configuration in (29). In particular, we observe the loss of the pair-list reading when the NPI any occurs in the D position in QP, (31a) and when it occurs further down in QP, below the *wh*, (31b). We also see that this result is maintained with a lower negation in a further embedded clause, (31c).[14]

(31) **NPI restricts covert movement of *wh*-in-situ:**

a. *PL *Which* boy **didn't** read any book about *which* president?

b. *PL *Which* boy **didn't** read *which* book about any president?

c. *PL *Which* boy wants to **not** read any book about *which* president?

Similarly, a question with the minimizer *a single* also induces an intervention effect in the question. I note that, as with (31a), the judgment here is more subtle than with other examples. The problem, as far as my consultants are able to articulate it, is that there is no prosody that would make the question grammatical.

(32) **Minimizer-NPI restricts covert movement of *wh*-in-situ:**

a. *PL *Which* boy **didn't** read a single book about *which* president?

b. *PL *Which* boy wants to **not** read a single book about *which* president?

We have now seen three cases of intervention effects in superiority-obeying questions, all occurring when covert movement of the in-situ *wh*-phrase was restricted in some way: when there is an island present, using the Principle of Lexical Association, using Binding principles, and using NPIs. The fact that such effects can be systematically manufactured reinforces the conclusion that *movement* allows obviation of an otherwise expected intervention effect. Furthermore, when the *wh*-phrase is forced to be interpreted without movement, the pair-list reading of the question becomes sensitive to the presence of potential interveners in the question, but the single-pair reading is unaffected.

[13]This is necessary as it is well known that in some cases, NPIs can be licensed by a question, see e.g. Guerzoni (2003); Gajewski (2005) and citations therein.

[14]The judgments for (31a) appear less strong than in the other two cases. I have no explanation for this.

4.3 Avoiding intervention in superiority-violating questions

In this section I show that in some cases, intervention can be avoided in superiority-violating questions. This can happen in one of three cases:

(33) **Intervention is avoided when:**

a. When the intervener can be scoped *out of the question*.

b. When the intervener *lowers* to a position below the in-situ *wh*-phrase.

c. When the in-situ *wh*-phrase can scope above the intervener in some way.

This will, again, reinforce the conclusion that what matters for intervention effects is the structural configuration between the *wh* and the intervener at LF, and nothing else.

4.3.1 No intervention when intervener scopes out

The first prediction laid out above, that intervention effects are avoided when the intervener is above to scope out of the question, has been shown to be borne out. In particular, we expect to see this effect with quantifiers which normally act as interveners, such as **every** and **each**, which are able to take scope over the entire question, as in e.g. Chierchia (1993); Groenendijk and Stokhof (1984); Higginbotham (1993) (or alternatively over the question-act, as in Krifka 2001).[15]

We expect superiority-obeying questions with quantifiers to be ambiguous: both *wh*-phrases are able to covertly move above the quantifier at LF, so that the quantifier, a potential intervener, can take scope in-situ, below the *wh*s, or alternatively the quantifier can scope out of the question, above the *wh*s. This state of affairs in illustrated in (34a–b).

(34) **The possible scope of quantifiers in superiority-obeying questions:**

a. ✓ [$_{CP}$ QP_1 QP_2 C ... **quantifier** ... t_1 ... t_2]

b. ✓ **quantifier** [$_{CP}$ QP_1 QP_2 C ... t_{quant} ... t_1 ... t_2]

[15] I have chosen not to use these interveners in previous chapters because the intervention effect that they cause is manifested as the loss of a reading (where the quantifier scopes low, in its surface position) instead of a more simple ungrammaticality, as we observe e.g. with sentential negation or *only*. However, *each* and *every* behave like the other interveners I have considered before the purposes of the arguments I make in this dissertation. See more on the English data in Pesetsky (2000). For more on parallel effects in German, see Beck (2006); Mayr (to appear).

Superiority-violating quantifiers, on the other hand, are expected to be unambiguous: the in-situ *wh* cannot covertly move at LF and must instead be interpreted using Rooth-Hamblin alternatives. Consequently, if a quantifier occurs between the *wh* and C, the result is an intervention effect, (35a). However, the structure can be rescued if the quantifier itself scopes out of the question, as in (35b). Hence, we expect the superiority-violating question to be grammatical, but have unambiguously wide scope for the intervener.

(35) **The possible scope of quantifiers in superiority-obeying questions:**

a. * [$_{CP}$ QP_2 Q_1 C ... **quantifier** ... wh_1 ... t_2]

b. ✓ **quantifier** [$_{CP}$ QP_2 Q_1 C ... t_{quant} ... wh_1 ... t_2]

This is indeed the case. Example (36) shows that a superiority-obeying multiple question is ambiguous with respect to the scope of the quantifier. The superiority-violating question in (37), on the other hand, is unambiguous and can only have wide scope for the quantifier. (English data in this section from Pesetsky 2000.)

(36) **Superiority-obeying question with *every* is ambiguous:**
Which newspaper did **everyone** write to ____ about *which* book?

a. Wide-scope answering pattern:
Bill wrote to the New York Times about book X, Mary wrote to the Boston Globe about book Y, and Tom wrote to the Maquoketa Sentinel about book Z.

b. Narrow-scope answering pattern:
Everyone wrote to the New York Times about book X, everyone wrote to the Boston Globe about book Y, and everyone wrote to the Maquoketa Sentinel about book Z.

(37) **Superiority-violating question with *every* is unambiguous:**
Which book did **everyone** write to *which* newspaper about ____?
Only has answer pattern a, but not b.

Furthermore, if the quantifier is trapped and is unable to scope out of the question, the superiority-obeying question becomes unambiguous and only has narrow scope for the quantifier. Pesetsky (2000) shows this using quantifier float, which is argued to disallow QR of the quantifier out of the question. While example (38a) may be a request for an

answer that provides adult-kid-book triplets, (38b) is interpreted as a request for adult-book pairs, such that each kid in the group will persuade the adult to read the book:

(38) **Quantifier float restricts QR, sup.-obeying question becomes unambiguous:**

a. Tell me *which* adult **each kid** will try to persuade ____ to read *which* book.

b. Tell me *which* adult the kids will **each** try to persuade ____ to read *which* book.

In the same configuration, the inability of the quantifier to QR out of the question causes the superiority-violating question to exhibit an intervention effect:

(39) **Quantifier float restricts QR, intervention re-emerges in sup.-violating question:**

a. Tell me *which* book **each kid** will try to persuade *which* adult to read ____.

b. $*^{PL}$ Tell me *which* book the kids will **each** try to persuade *which* adult to read ____.

Similarly, an intervention effect with *only* is avoided if *only* and its associate are assigned wide scope with respect to the question. This is facilitated by some degree of focus on *only Mary*. Note that this example is minimally different from examples that have been shown to exhibit an intervention effect, e.g. (40b).[16]

(40) **No intervention effect when *only* receives wide scope in sup.-violating question:**

a. Sue asked *which* boy **only** Mary introduced *which* girl to ____.
[i.e., Mary is the only person such that Sue asked which boy this person introduced which girl to.]

b. $*^{PL}$ *Which* boy did **only** Mary introduce *which* girl to ____?

[16]Wide scope for *only* in (40b) would lead to what Pesetsky calls an "unaskable question": *A clause interpreted as a question may not request anything less than a full answer.* (Pesetsky, 2000, p. 64). For this reason, (i) is impossible with the indicated interpretation. Similarly, the multiple question in (40b) must be interpreted as a request for partial information if *only Mary* takes wide scope, rendering this interpretation degraded, if not impossible.

(i) *Which* girl did **only Mary** introduce to John?
Cannot be used to express the following request for information:
"I know that several people introduced girls to John. Tell me which girl Mary introduced to him, but don't tell me which girls other people introduced to him."

A similar effect has been reported in German, e.g. in Beck (1996a). Example (41) is a superiority-obeying multiple *wh*-question where the in-situ *wh*-phrase is separated from C by a universal quantifier, which acts as an intervener. Although this question is not ungrammatical, it is unambiguous: (41) may only be a request for a list of triplets, specifying for each boy who he observed at which time. The narrow scope answer pattern, specifying pairs of people and times such that every boy saw a certain person at a certain time, (41b), is blocked (German data from Mayr (to appear)).

(41) **Universal quantifier causes an intervention effect (German):**

Wen hat **jeder Junge** *wann* beobachtet?
who has every boy when observed

a. ✓ 'For every boy, who did he observe when?'

b. * 'Who is such that every boy observed him when?'

Note that when the in-situ *wh*-phrase is overtly scrambled over the quantifier, both answer patterns—the one with wide scope for the quantifier, (42a), and the one with narrow scope for the quantifier, (42b), become available:

(42) **No intervention when in-situ *wh* is scrambled over the quantifier (German):**

Wen hat *wann* **jeder Junge** beobachtet?
who has when every boy observed

a. ✓ 'For every boy, who did he observe when?'

b. ✓ 'Who is such that every boy observed him when?'

The facts observed above indicates in German, all in-situ *wh*-phrases are interpreted using the projection of Rooth-Hamblin alternatives between the *wh*-phrase and C. Therefore, the only possible LF for the question in 41) is one in which the quantifier takes wide scope over the question; an LF in which the quantifier remains in its surface position would create the intervention effect configuration. If the in-situ *wh* is overtly scrambled over the quantifier, the illicit configuration is avoided and the quantifier is able to be interpreted in its surface position.

4.3.2 No intervention when intervener reconstructs below *wh*

In the previous sections, we saw two kinds of cases in which intervention effects can be avoided in a multiple *wh*-question:

(a) When the in-situ *wh*-phrase covertly moves above the intervener (in superiority-obeying questions);

(b) When the intervener scopes out of the question (in superiority-violating questions).

Both cases create a configuration in which no offending operator separates the in-situ *wh*-phrase from Q. In addition to these cases, a third logical possibility for avoiding intervention is configurations in which the intervener *lowers* (reconstructs) below an in-situ *wh*. If such configurations can be constructed, we expect to again have an LF configuration in which nothing separates the in-situ *wh*-phrase from Q and hence the question is predicted to be grammatical despite the presence of an intervener in a surface position that normally leads to intervention. The configuration of interest is schematized in (43):

(43) **Avoiding intervention when the intervener reconstructs below in-situ *wh*:**

Here, a base-generated lower wh_2 is overtly fronted, and a higher wh_1 is interpreted in-situ using Rooth-Hamblin alternatives. An intervener, pronounced in a position above the in-situ wh_1, is reconstructed to a base position below this wh_1 at LF. We therefore predict that this intervener no longer blocks the projection of alternatives between wh_1 and Q, and the question should be grammatical. If this configuration can be obtained, we make a prediction about the scope of the intervener: the intervener should take narrow scope with respect to any element above its low LF position.

It is clear that this configuration can only be obtained with a subset of the known interveners in English. In particular, we do not expect to obtain this reading with sentential negation or with adverbials such as *always, often* or *never*. Furthermore, as it has been argued that negative DPs do not undergo A-reconstruction (see e.g. Lasnik, 1999; Iatridou and Sichel, 2011), this prediction also cannot be tested with interveners such as *no one*.

Below I will test this prediction with universal quantifiers. Notice that as shown in section 4.3.1, universal quantifiers are able to raise out of the question and receive wide

scope, a list-of-triples interpretation. However, here we will be interested in a different reading of the question: a list-of-pairs reading, with the quantifier taking narrow scope.

We begin with the baseline in (44), in which *all* is pronounced in an unraised position. This question has the reading that we are after: it is interpreted as a request for topic-professor pairs, such that the professor thought that all the students enjoyed that topic—that is, the list-of-pair reading.

(44) **Baseline: Superiority-violating question with a raising predicate and low *all*:**
Context: The first-year students took several classes this past semester, taught by different professors. Each professor thought that the students particularly enjoyed one topic that she taught. Tell me,
✓*Which* topic did it seem to *which* professor that **all** of the students enjoyed ___?

Next we show that in this environment, a raised universal can reconstruct and take narrow scope below another operator.

(45) ***All* can reconstruct to base position, inverse scope possible:**
Context: The first-year students took several classes this past semester, taught by different professors. As their TA, I know that:
[*All* of the students]$_1$ seemed to *some* professor t_1 to have enjoyed learning about multiple questions. ✓$\forall > \exists$, ✓$\exists > \forall$

Example (46) provides us with a test-case for the configuration in (43). The question is provided in a context that supports the list-of-pairs reading as in (44), with narrow scope for the quantifier. The question is judged as grammatical, despite the (surface) intervening quantifier:

(46) **Superiority-violating question with raised *all* can have reconstructed reading:**
Context: The first-year students took several classes this past semester, taught by different professors. Each professor thought that the students particularly enjoyed one topic that she taught. Tell me,
✓*Which* topic did **all** of the students seem to *which* professor to have enjoyed ___?

Here it may be difficult to ascertain whether the quantifier is interpreted in its base position, below *seem*, or in its pronounced position. Although we predict a scope difference, it appears to be quite subtle. However, the discussion in the previous section should

convince us that the quantifier has reconstructed, or else we must look for another explanation for the ungrammaticality of the list-of-pairs reading in that section. We may be further convinced that reconstruction plays a crucial role in example (46) when comparing it with the minimally different (47), where the quantifier has been floated, preventing it from reconstructing to its base position. In this case, the question is judged by speakers as degraded, and the list-of-pairs reading is lost.

(47) **Intervention effects reemerge with floated *all*:**
Context: The first-year students took several classes this past semester, taught by different professors. Each professor thought that the students particularly enjoyed one topic that she taught. Tell me,
^{*PL} *Which* topic did the students **all** seem to *which* professor to have enjoyed ___?

Similar results obtain with the universal quantifier *each*:

(48) **Pair-list reading possible when *each* reconstructs, not when it floats:**
Context: The first-year students took several classes this past semester, taught by different professors. Each professor thought that the students particularly enjoyed one topic that she taught. Tell me,
$^{\checkmark}$ *Which* topic did **each** student seem to *which* professor to have enjoyed ___?
^{*PL} *Which* topic did the students **each** seem to *which* professor to have enjoyed ___?

4.3.3 No intervention when in-situ *wh* has exceptionally wide scope

It is well known that Right-Node Raising (RNR, Ross 1967) constructions allow exceptional extraction of a *wh*-element across certain islands:

(49) **RNR allows for exceptional extraction of *wh*-elements out of islands:**
Which book$_1$ did [John meet the man who wrote ___], and [Mary meet the woman who published ___]?

Bachrach and Katzir (2009) argue that this is explained by a theory that relies on two assumptions: the first is that the shared material in the two conjuncts, the RN, remains *in-situ* and does not require any movement. This is motivated by evidence that RNR is both less local than movement usually, that it can target objects that do not undergo movement otherwise, and that it exhibits semantic effects that are surprising if there are

no syntactic differences between RNR and full coordination. The second assumption is that the RN exists in the derivation only once, and is *shared* across the two conjuncts through multidominance (McCawley, 1982; Wilder, 1999; Gračanin-Yuksek, 2007).

Bachrach and Katzir (2009) show that RNR can feed exceptional wide scope of a *wh* that is otherwise unavailable in questions:

(50) **RNR feeds *wh*-movement:**

a. * *Which* book did John meet the man who wrote ____ ?

b. ✓ *Which* book did [John meet the man who wrote ____], and [Mary meet the man who published ____]?

It is additionally possible to extract only part of a RN, leaving overt material on the right. The conjuncts in (51) contain relative clause islands, making it unlikely that the *wh*-phrase was extracted before RNR applied to the remnant. Instead, it appears that the availability of RNR facilitates the exceptional movement.

(51) **Movement can target just part of the *wh*-phrase:**
Which animal$_1$ did John say that Mary knew [a man who wrote ____], and [a woman who published ____] an encyclopedia article about t_1?

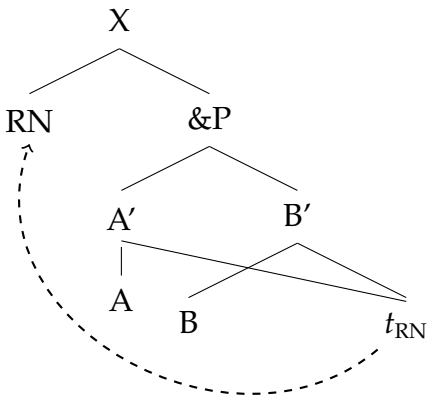
Note that island effects reappear if an island is added above the coordination:

(52) **Islands above the coordination cause ungrammaticality:**

* *Which* animal$_1$ does John know a reporter who made famous [a man who published ____], and [a woman who illustrated ____] a book about t_1?

Bachrach and Katzir (2009) propose an explanation of these facts based on the theory of multidominance. The RN is shared by two conjuncts, A' and B' in the schema below. Crucially, RN cannot be frozen for spell-out purposes until it is completely dominated, (54). This only happens at the & P level, and not before. As a consequence, islands that occur inside A' and B' are transparent and do not block movement of the RN. Only islands above & P affect the RN's movement.

(53)



(54) **Definition: Complete Dominance**
A node X completely dominates a node Y iff
(a) X is the only mother of Y, or
(b) X completely dominates every mother of Y.

The proposed derivation for example (49) is given in (55). Crucially, spell-out inside the conjuncts cannot freeze the RN (in this case, the *wh*-phrase, *which book*. Therefore, the RN is able to move above the conjunction.

(55) **Bachrach and Katzir's analysis of the exceptional *wh*-movement in RNR:**
Which book$_1$ did [John meet the man who wrote ___], and [Mary meet the woman who published ___] t_1?

Given this state of affairs, we predict a multiple question with an RNR construction should give an in-situ exceptionally wide scope, allowing it to escape intervention effects in superiority-violating questions. This indeed appears to be the case, as exemplified in examples (56)–(58). The (a) examples provide baselines for superiority-violating questions with interveners, negation and *only*, respectively. Both questions exhibit an intervention effect. In the (b) examples, the in-situ *wh* originates as the RN in a RNR construction, and an intervention effect is avoided.

(56) ***Wh*-phrase escapes intervention in superiority-violating question with RNR:**
a. ^{*PL} *Which* book did **only John** allow *which* student to read ___?
b. $^{\checkmark}$ *Which* book$_1$ did [**only John** allow ___], and [**only Mary** prohibit ___], *which* student to read t_1?

(57) a. ^{*PL} *Which* topic did he **never** claim *which* student would talk about ____?

b. ✓ *Which* topic$_1$ did [John **never** claim ____], and [Mary **never** promised ____], *which* student would talk about t_1?

(58) a. ^{*PL} *Which* student did **no one** give *which* book to ____?

b. ✓ *Which* student$_1$ did [**no one** give ____], and also [**no one** send ____], *which* book to t_1?

4.4 The intervention generalization

To conclude this chapter, let us briefly summarize the data we have seen so far regarding intervention effects in English multiple *wh*-questions. As we will see, this data will help us better characterize the phenomenon of intervention effects and give a descriptive generalization regarding its pattern.

Recall that we began this chapter by examining the correlation between superiority and intervention that has been assumed in the previous literature (Pesetsky, 2000; Beck, 2006; Cable, 2007, 2010; Kotek, 2014b):

(59) **The correlation between superiority and intervention (incorrect!):**
Superiority-obeying questions are immune from intervention effects.
Superiority-violating questions are subject to intervention effects.

I have shown that, in fact, the behavior of intervention effects is more complex:

In Chapter 3, I showed that intervention effects occur inside covertly pied-piped constituents (QPs) in English, between *wh* and the edge of the pied-piping constituent. In previous work, Sauerland and Heck (2003) and Cable (2010) have shown that intervention can similarly be observed in overt pied-piping in German and in English (respectively).

In Chapter 4, several new findings were discussed. First, it was shown that whenever covert movement is constrained in some way, intervention effects are detectable above the landing site of covert movement. This was shown using the Principle of Lexical Association, Binding condition A, and the licensing of Negative Polarity Items. One additional case of restricted movement using syntactic islands, showing similar results to the ones presented here, will be discussed at length in Chapter 6. Additionally, it was shown that intervention effects can be avoided in superiority-violating questions when an intervener

can be scoped out of the question, when it can be lowered or reconstructed below the in-situ *wh*-phrase, and when the in-situ *wh* can be given exceptionally wide scope in Right Node Raising constructions.

These findings support the following generalization:

(60) **Intervention effects in multiple questions (universal characterization):**
Intervention effects occur when a *wh*-word is interpreted *in-situ*, below an offending intervener, and is unable to (covertly or overtly) move above the intervener.

The corresponding schema, proposed in Chapter 2, is repeated below for convenience. As we have seen, this schema provides a unified account of intervention effects inside and out of pied-piping constituents.

(61) **Configuration of an intervention effect:**
* [Q_i ... **intervener** ... wh_i ...]

Here is it important to note that this dissertation has provided evidence that movement, and in particular, its absence or restrictions on it, are implicated in the phenomenon of intervention effects. This was shown most clearly in the present chapter, but will again emerge as the relevant generalization in Chapters 5-6.

Throughout this dissertation, I adopt Beck's (2006) theory of intervention effects, under which what causes intervention effects is a disruption in the transmission of Rooth-Hamblin alternatives between an LF-in-situ *wh*-word and the operator that must interpret them, which I have assumed is the Q-particle.[17] I note, for completeness, that this part of the theory has been adopted here without further argument. This was done for convenience and for concreteness. I have proposed a theory of multiple questions that relies on the transmission of alternatives, as proposed in Beck (2006); Cable (2007, 2010), whose disruption would therefore cause an intervention effect as laid out in proposals by these authors. I leave for future work the possibility of a different theory of in-situ composition of *wh*-words, which might account for intervention effects in a different way than assumed here. Whatever this theory might be, I have shown here that this alternative mode of in-situ composition must be sensitive to the presence of "interveners," and predict ungrammaticality whenever a *wh* is c-commanded by such an intervener at LF.

[17] Or the interrogative complementizer, in alternative theories.

4.5 Chapter summary

The current chapter concentrates on the relation between superiority and intervention effects in English questions.

Section §4.2 showed that intervention effects can be systematically observed in superiority-obeying questions, when covert movement is constrained in some way. This was shown using:

- The Principle of Lexical Association, §4.2.1;
- Binding condition A, §4.2.2;
- The licensing of Negative Polarity Items, §4.2.3.

Section §4.3 showed that intervention can be avoided in sup.-violating questions:

- When the intervener can be scoped out of the question, §4.3.1;
- When it can be lowered or reconstructed below the in-situ *wh*, §4.3.2;
- When *wh*-in-situ takes exceptionally wide scope via Right Node Raising, §4.3.3.

These findings led to the following generalization, formulated in section §4.4:

- **Intervention effects in multiple questions (universal characterization):**
  Intervention effects occur when a *wh*-word is interpreted *in-situ*, below an offending intervener, and is unable to (covertly or overtly) move above the intervener.

The corresponding schema below, which provides a unified account of intervention effects inside and out of pied-piping constituents:

- **Configuration of an intervention effect:**
  * [Q_i ... **intervener** ... wh_i ...]

Chapter 5

The processing of multiple *wh*-questions[1]

In this chapter I return to an issue raised in Chapter 2. In Chapter 2 I presented a theory of interrogative syntax-semantics that included an optional covert movement step of the surface in-situ *wh*-phrase in superiority-obeying English questions to Spec,CP, as part of an associated covertly moved QP. The possibility of covert QP-movement in superiority-obeying questions was necessary in order to yield the correct behavior of English *wh*-questions with regard to intervention effects: Superiority-obeying questions appear not to show sensitivity to intervention effects when an intervener c-commands an in-situ *wh*-word, unless covert movement is restricted in some way, as we saw in Chapter 4. In contrast, in superiority-violating questions (and in all German questions), in-situ *wh*-words are truly LF-in-situ and are hence subject to intervention effects whenever an intervener c-commands a *wh*-word. This behavior also correlated with the ability of an in-situ *wh*-word to host Antecedent Contained Deletion: this is possible in superiority-obeying questions and impossible in superiority-violating questions, as predicted if surface in-situ *wh*-words are able to covertly move to form an appropriate antecedent for the ellipsis in the former question type, but not the latter (see section 1.6.1 for details).

In the absence of an intervener, then, the theory allows the option of covert QP movement in superiority-obeying questions, but does not force it. In this chapter I further investigate the possible LF position(s) of surface in-situ *wh*-phrases in superiority-obeying questions, with the goal of discovering whether covert QP-movement happens in the absence of an intervener, or only when one is present. I present three self-paced reading

[1]This chapter is the product of joint research with Martin Hackl and is currently a manuscript under review under the title: *A new syntax for multiple wh-questions: Evidence from real time sentence processing* (Kotek and Hackl, 2013).

experiments designed to test whether the in-situ *wh*-word in such questions is in-situ at LF or has moved to C. I will argue that, in fact, neither answer is correct. The experiments show that the in-situ *wh*-word in English superiority-obeying questions undergoes a *short*, partial QP-movement step, comparable to the behavior of quantifiers like *every*, but that from that point on the QP *can* but *need not* move any further: it can be interpreted using an in-situ mode of composition. In the presence of interveners, on the other hand, the predictions of our theory are borne out: we see evidence of covert movement of the in-situ *wh*—with its associated QP—to a position above the intervener.[2]

5.1 Theoretical background

Before presenting the empirical evidence in support of *partial QP-movement*, I first present relevant background for this chapter. Section 5.1.1 surveys the two traditional approaches to *wh*-in-situ—covert movement to C, and in-situ composition—and discusses the predictions these approaches make regarding the source and extent of covert *wh*-movement in multiple questions. Section 5.1.2 discusses Antecedent Contained Deletion (ACD), which will be central to the experiments presented in section 5.2. Section 5.1.3 presents the methodology that will be used in the experiments, and section 5.1.4 spells out the predictions made by the two theories for real-time sentence processing.

5.1.1 Two approaches to interrogative syntax-semantics

The literature on the syntax-semantics of *wh*-questions provides two approaches to the interpretation of in-situ *wh*-phrases: *covert movement* and *in-situ interpretation*. Below is a brief description of the two approaches, largely repeated from Chapter 1.

The covert movement approach

Under the covert movement approach to questions, *wh*-phrases must be in the CP layer in order to be able to make their contribution to the meaning of the question. Consequently, no *wh*-phrase may remain in situ at LF; instead, all *wh*-phrases occur syntactically next to the complementizer, regardless of where they are pronounced.[3]

[2]Throughout this chapter I will use both terms "covert QP-movement" and "covert *wh*-movement" to refer to the covert movement of the *wh*-word and possible additional pied-piped material.

(1) **The covert movement approach to *wh*-in-situ:**[4]
Surface syntax: *Which* student did Fred introduce to *which* professor?
LF: *Which* student [*which* professor [C [Fred introduced ____ to ____]]]

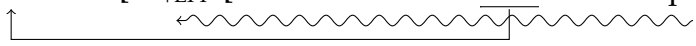
The covert movement approach thus predicts pervasive covert movement in multiple *wh*-questions. Movement is triggered for the semantic needs of the *wh*-words themselves, and targets the same syntactic position at LF: the interrogative C. This approach makes the prediction in (2).

(2) **A prediction of the covert movement approach:**
All *wh*-words in a question must (overtly or covertly) move to C for interpretation.

The in-situ approach

Under the in-situ approach to questions, no (overt or covert) movement is required in order to interpret a structure containing *wh*-elements. The meaning of a question like (3) can be calculated through a mechanism that passes the meanings of *wh*-words up the structure until they reach C, where they can be interpreted (Hamblin, 1973, a.o.). From this perspective, there is no reason to expect any instances of *wh*-movement that are caused by the semantic needs of the *wh*-words themselves. Even the fact that English questions require overt fronting of one *wh*-phrase is unexpected. To explain this fact, a purely syntactic mechanism must be invoked, unrelated to interrogative semantics, e.g. an 'EPP' feature requiring C to have an *wh*-phrase in its specifier (Chomsky, 1981).

(3) **The in-situ approach to *wh*-in-situ:**
Surface syntax: *Which* student did Fred introduce to *which* professor?
LF: *Which* student [C_{+EPP} [Fred introduced ____ to *which* professor]]



[3]Other theories argue that at least in some cases, it is not full *wh*-phrases but rather an operator that moves at LF (Aoun and Li, 1993; Hagstrom, 1998; Pesetsky, 2000; Watanabe, 2001; Kishimoto, 2005, a.o.). Since the target position of movement and the reasons for this movement are the same as in the approach introduced here, I classify these theories here as consistent with the covert movement approach. However, as we will see, even if these theories are classified as in-situ theories, they will be unable to derive the experimental results I present in section 5.2.

[4]Recall that straight arrows indicate overt movement, dashed arrows indicate covert movement, and curly arrows to indicate an area in which in-situ composition is used.

The in-situ approach to questions thus makes no predictions about the LF position of *wh*-phrases. Following standard assumptions in the theoretical literature that the simplest syntactic structure for a sentence is always preferred to a less simple one (cf. Chomsky, 1991, 1993, 1995, 2000; Epstein, 1992; Kitahara, 1997; Fox, 2000; Collins, 2001; Richards, 2001; Reinhart, 2006), it is predicted that *wh*-phrases occupy the position where they were merged into the syntactic structure. No covert movement occurs for the semantic interpretation of *wh*-phrases, (4), although movement for independent reasons remains possible.

(4) **A prediction of the in-situ approach:**
Wh-phrases in a question can be interpreted in-situ, without any movement.

5.1.2 Antecedent Contained Deletion

In this section I discuss Antecedent Contained Deletion (ACD), which will be central to the experimental methodology introduced in section 5.1.3 and the experiments presented in section 5.2 (see also sections 1.6.1 and 3.2.3 for additional relevant discussion). ACD is a phenomenon found in certain VP ellipsis contexts. Unlike a pronoun, which may take its reference from a contextually salient but unmentioned individual, for VP-ellipsis to be licensed a pronounced antecedent VP must exist that is identical to the missing VP (Hankamer and Sag, 1976).[5] This is straightforward in examples like (5), where the only pronounced VP in the sentence—read a book—can serve as an antecedent for the missing VP. In ACD cases like (6), however, the missing VP appears to be properly contained inside the only possible antecedent VP in the sentence. Matching the missing VP with the antecedent VP should be impossible since the missing VP is properly contained inside its antecedent and so cannot be identical to it.

(5) **VP-ellipsis and its resolution:**
a. John read a book and Mary did ⟨missing VP⟩, too.
b. John read a book and Mary did ⟨~~read a book~~⟩, too.

[5]How to define identity in the domain of ellipsis is a much debated question. For example, experiments have shown that voice mismatches are possible in some contexts but not others (e.g. Kehler, 2001; Arregui et al., 2006; Kertz, 2010; San Pietro et al., 2012, a.o.). It has also been argued that such mismatches are only possible in VP ellipsis but not in sluicing (Merchant, 2013). I will not attempt to contribute to the definition of identity here. I assume that traces count as identical for the purpose of ellipsis parallelism if they bound from parallel positions (e.g. Fox, 2002).

(6) **ACD and the containment problem:**

a. John read every book that Mary did ⟨missing VP⟩ .

b. John read every book that Mary did ⟨??⟩.

To solve the containment problem in (7a), a common analysis of ACD assumes covert movement of the object to a syntactic position in the higher TP_2, yielding the LF in (7b).[6] The resulting VP, containing only the Verb and the trace of covert movement, can then be used as an antecedent for the missing VP (cf. Williams, 1974, 1977; Sag, 1976; May, 1985; Larson and May, 1990; Johnson, 1996; Heim and Kratzer, 1998; Legate, 2002; Fox, 2003).

(7) **Resolution of ACD using covert movement:**

a. [$_{TP_1}$ John read [every book that Mary did ⟨missing VP⟩].

b. [$_{TP_2}$ [every book that Mary did ~~read *t*~~] [$_{TP_1}$ John read *t*]].

ACD can also occur in sentences with a *wh*-phrase complement of the verb. Example (8a) illustrates this for a sentence with an embedded multiple question, where the in-situ *wh*-phrase hosts an ACD site. The containment problem for this sentence is illustrated in (8b–c). To undo containment and allow for ACD resolution, the in-situ *wh*-phrase must undergo covert movement. Once covert movement has occurred, an appropriate antecedent can be found and used for the missing VP, (8d).

(8) **ACD in multiple *wh*-questions and its resolution:**

a. John knows [$_{TP_1}$ which student read [which book that Mary also did ⟨missing VP⟩]].

b. John knows [$_{TP_1}$ which student read [which book that Mary also did ~~⟨read [which book that Mary also did ⟨missing VP⟩⟩~~]]].

c. John knows [$_{TP_1}$ which student read [which book that Mary also did ~~⟨read [which book that Mary also did read [which book that Mary also did ⟨missing VP⟩⟩~~]]]].

d. John knows [$_{TP_1}$ which student [$_{TP_2}$ which book that Mary also did ~~⟨read *t*⟩~~] [read *t*]]

[6] More precisely, it is assumed that the object must move above the structure which will be used as the antecedent for the ellipsis. Here I use TP as a convenient notation, but this could be replaced with vP or some other label.

5.1.3 Self-paced reading and the Hackl et al. (2012) paradigm

In this section I present the methodology that will be used in the experiments in section 3. The goal of the experiments is to investigate the presence and extent to which in-situ *wh*-phrases undergo covert movement in multiple *wh*-questions. To this end, the experiments will use the paradigm developed in Hackl et al. (2012), which studies the real-time processing of sentences where covert movement has been argued to occur. In particular, this paradigm takes advantage of the inherently linear organization of real-time sentence processing: the human parser integrates material that occurs earlier in a sentence before it encounters material occurring later.

The paradigm relies on two underlying assumptions about the economy of structure building: (a) the linguistic parser always builds the simplest syntactic structure consistent with the linguistic input (cf. Bever, 1970; Frazier and Rayner, 1982; Phillips, 2003), and (b) structures without covert movement are simpler than structures with covert movement (cf. Fox, 1995, 2000; Tunstall, 1998; Frazier, 1999; Anderson, 2004).[7] Given these assumptions, it follows that the parser does not postulate covert movement in the parse of a sentence until the point at which the parser determines that it is necessary. From that point on, one might expect to find online consequences (detectable as a delay in Reading Times, RTs) of the *reanalysis* of the structure to a less preferred parse.

Note that these assumptions are consistent with a model of parsing under which linguistic structure is incrementally built by the parser in a top-down, left-to-right manner. *Reanalysis* requires the parser to revisit a portion of syntactic structure that has already been constructed, undo it, and re-build it in a way that is consistent with the new evidence that triggered the reanalysis. This step of revising already built structure is costly and has consequences in terms of a slow-down of processing times.

Hackl et al. (2012) test the covert movement theory of ACD by comparing the processing of sentences that contain non-quantificational objects (*the*, 9a–c) to sentences with quantificational objects (*every*, 9d–f)—where this factor is crossed with three different gap sizes inside an attached relative clause: (a) *no ellipsis* using a lexical <u>*verb*</u>, (b) *small ellipsis* marked by <u>*did*</u>, where the antecedent of the ACD site is the embedded VP headed by *treat*, and (c) *large ellipsis* marked by <u>*was*</u>, where the antecedent of the ACD site is the matrix VP headed by *reluctant*.

[7] For example, these can be formulated as the Minimal Attachment principle (see e.g. Frazier and Fodor, 1978, and references therein): *Attach each new item into the current phrase marker postulating only as many syntactic phrase nodes as is required by the grammar*.

(9) **The paradigm in Hackl et al. (2012):**

The doctor was [$_{VP1}$ reluctant to [$_{VP2}$ treat ...

a. **the** patient that the recently hired nurse *admitted* *(no ellipsis)*
b. **the** patient that the recently hired nurse *did* *(small ellipsis)*
c. **the** patient that the recently hired nurse *was* *(large ellipsis)*
d. **every** patient that the recently hired nurse *admitted* *(no ellipsis)*
e. **every** patient that the recently hired nurse *did* *(small ellipsis)*
f. **every** patient that the recently hired nurse *was* *(large ellipsis)*

... after looking over the test results.

ACD resolution involves at least three steps: (i) creating a structure in which antecedent containment is undone; (ii) identifying an appropriate antecedent for the ellipsis; and (iii) filling the antecedent into the gap and computation of the resulting meaning. Steps (ii) and (iii) are required for all cases of VP ellipsis. Step (i)—the reanalysis of the structure so as to undo antecedent containment—is only required in the case of ACD. Hackl et al. (2012) generate specific predictions for language processing in real time based on these properties and the assumptions that (a) step (i) of ACD resolution requires covert movement (cf. section 5.1.2), and (b) that quantificational objects (but not non-quantificational objects) require covert movement for their interpretation, and that this movement targets the lowest position in the structure where the object can be interpreted (cf. Fox, 1995, 2000; May, 1985; Heim and Kratzer, 1998).[8]

In the *definite* conditions in (9a–c), no covert movement is predicted to take place when the definite article is processed. The parser only assumes covert movement after it has been determined that the sentence contains an instance of ACD. This happens after encountering the auxiliaries *did* and *was* in (9b–c), which, together with the immediately following word, signal the presence of an ACD site and thus trigger reanalysis in order to resolve ACD. As discussed above, this reanalysis should incur some processing cost detectable in RTs following the ellipsis site, compared to the baseline with *no ellipsis* (9a). Furthermore, the difference in the locality of covert movement and, concomitantly, the size of the antecedent VP should also be reflected in RTs: the covert movement in (9c) must target a non-local position, above the matrix VP_1 headed by *reluctant*, in order to

[8]Following Heim and Kratzer (1998), we assume that Quantifier Raising (QR) happens for type reasons: a quantifier (type $\langle\langle e,t\rangle,t\rangle$) must either take a predicate of type $\langle e,t\rangle$ as its complement or else QR to a position of (extensional) propositional type t. Predicate Abstraction will turn the landing site into the necessary type $\langle e,t\rangle$ expression. QR to positions with non-propositional types is not considered.

make the matrix VP available for ACD resolution while the covert movement in (9b) targets a closer position above the embedded VP_2 headed by *treat*. On the assumption that non-local movement and the retrieval of a larger antecedent VP are more costly than local movement and the retrieval of a smaller antecedent VP, (9c) is expected to produce longer RTs than (9b).

For the *quantificational* conditions, different predictions are made. In all of (9d–f), the parser must assume covert movement as soon as it encounters the quantificational object headed by *every*. Furthermore, the movement is expected to be *local* and to target a position just above the embedded VP_2 headed by *treat*. Crucially, this position is high enough to preemptively undo antecedent containment in the case of *small ellipsis* (9e) but not in the case of the *large ellipsis* (9f): the movement triggered by *every* targets the same position that would be independently targeted for the resolution of the *small ellipsis*. Because this movement has already happened earlier in the parse, step (i) of ACD resolution can be avoided, and only steps (ii)–(iii) must apply when the ellipsis marker *did* is encountered. Crucially, this means that at the point of identifying the ACD site no *reanalysis* is predicted for this sentence. Hence, ACD resolution is expected to be easier compared to (9b) since part of the work necessary to resolve ACD has already happened prior to encountering the ACD marker *did* with *every*, but all three steps of ACD resolution must happen when *did* is encountered with *the*.[9]

In the case of the *large ellipsis* in (9f), by contrast, the covert movement step that was assumed following the processing of *every* is not sufficient to furnish a suitable antecedent VP: following this local movement, the missing VP is still contained inside its antecedent. Hence, when the auxiliary *was* is reached, the parser must again reanalyze the structure, covertly moving the object a second time, from its position above the embedded VP to a position higher than the matrix VP. This means that no facilitation of ACD resolution is expected in (9f) even though the host DP is quantificational in nature.

[9] At this point one might ask whether this logic would lead us to predict that the reading times of the region at and after the quantifier would be slower than the non-quantificational conditions, because quantifiers should cause a detectable reanalysis effect, and therefore a slowdown of reading times when they are encountered. This is possible, but no important predictions for our agenda rest on this point. If an effect is found, it may be attributed to surprisal or alternatively to a word-level lexical effect caused by the different in frequency of the quantifier vs. the definite article. On the other hand, if an effect is not found, we might conclude that the effect was either too small or too fast to detect in this way. Because this is the case, the Hackl et al. paradigm ensures that any effects of the determiner would be resolved in the spillover region between the determiner and the verb site, so that any effects attributed to the ellipsis resolution would not be affected by any earlier word-level effect.

Hackl et al. (2012) used sentences in a paradigm as in (9) in a self-paced reading study (Just et al., 1982): participants read sentences that appeared on the screen one word at a time using a moving window display. Residual Reading Times (RRTs) were analyzed for each word in the sentence. Given the methodology and experimental design, the predictions laid out above follow as long as readers must encounter the determiner before they reach the gap site. This is compatible with mainstream theories of processing that are currently available in the literature, including for example *serial* models of processing, (e.g. Ford et al., 1982; Frazier and Rayner, 1982; Pritchett, 1992) and *parallel* models of processing, (e.g. MacDonald et al., 1994; Tanenhaus and Trueswell, 1995).

Figure 1 shows RRTs two words after the ellipsis site in Hackl et al.'s experiment. These results indicate that the predictions described above are borne out: When the object is *definite*, ACD resolution is associated with longer RRTs compared to the baseline condition, *no ellipsis* (*Verb*). The increase in RRTs is linear across the three gap size levels (*the-verb* vs. *the-did* vs. *the-was*). When the object is *quantificational*, however, an interaction pattern emerges. No increase is observed between the *every-verb* condition and the *every-did* condition (*small ellipsis*), while a large increase is observed between the *every-did* condition and the *every-was* condition (*large ellipsis*). This is unexpected if the two factors (quantificational vs. non-quantificational object and ACD size) are not linked in some form, but it is the expected result under the assumption that covert movement is required to accommodate both a quantificational object and an ACD site, as the first step in resolving ACD.

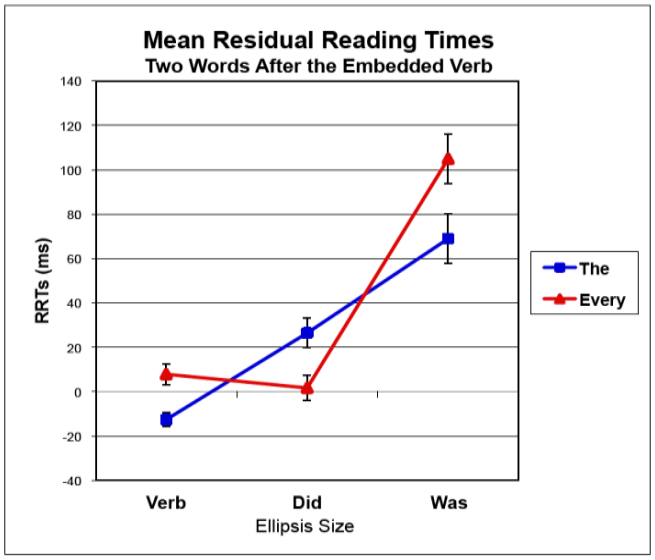


Figure 1: Results of Hackl et al. (2012)

There is a debate in the sentence processing literature about whether or not the size of the antecedent site affects the processing of the ellipsis site (cf. Murphy, 1985; Frazier and Clifton, 2000, 2001; Martin and McElree, 2008, 2009, 2011). The results discussed here do not rely on the answer to this question. Although the current thinking in the literature seems to suggest that a larger antecedent does not necessarily incur a larger cost in the

processing of ellipsis, it is possible to attribute the increased processing cost that Hackl et al. (2012) observe for the non-local ACD cases either to the longer covert movement step associated with the *large ellipsis* condition, or to the fact that the *large ellipsis* involves a more complex VP and hence more complex meaning than the *small ellipsis*.

5.1.4 Predictions of *wh*-in-situ theories for the Hackl et al. paradigm

The goal of the present paper is to provide experimental evidence to distinguish between the covert movement approach and the in-situ approach to interrogative syntax-semantics. As we have seen, the two approaches make different predictions regarding the availability of covert movement for in-situ *wh*-words in multiple questions, and in particular regarding (a) how much covert movement is predicted to be involved in the derivation of a multiple question, (b) what causes covert movement, and (c) what syntactic position is targeted by covert movement.

(10) **Predictions of the two approaches with regard to covert *wh*-movement:**

a. The covert movement approach:
All *wh*-phrases in a question must (overtly or covertly, as part of a QP) move to C for interpretation.

b. The in-situ approach:
Wh-phrases in a question can be interpreted in-situ, without any movement.

Within the Hackl et al. (2012) paradigm, the covert movement approach and the in-situ approach to the interpretation of in-situ *wh*-phrases make different predictions with regard to facilitation of ACD resolution in sentences in which an ACD gap site is hosted inside a *wh*-phrase, e.g. (11a–b):

(11) **ACD hosted by *wh*-phrase in the Hackl et al. paradigm:**

The conductor asked *which soloist* was [$_{VP1}$ willing to [$_{VP2}$ perform...

a. [$_{QP}$ **which** concerto that the brilliant protégé *did*] ... *(small ellipsis)*

b. [$_{QP}$ **which** concerto that the brilliant protégé *was*] ... *(large ellipsis)*

...and restructured the rehearsal accordingly.

In the covert movement approach, all *wh*-phrases must move *non-locally* to C for interpretation. Note that the QP that is predicted to be constructed to facilitate this covert movement includes not only the in-situ *wh*-word but its associated restrictor, including the relative clause hosting the ACD markers, *did and was*. As a result, we predict that both

small and *large* ellipsis should be relatively easy to process, because antecedent containment will have been undone by covert QP-movement before the parser reaches the gap site. When the parser encounters the gap site, all it needs to do is find an antecedent for the missing VP and nothing more.

In the in-situ approach, *wh*-phrases can be interpreted *in-situ* and hence the parser will not move the in-situ *wh* to C when it is encountered. Upon reaching the ellipsis site, the parser must reanalyze the structure and covertly move the *wh*-object to a position above the missing VP, in order to construct an appropriate antecedent for the ellipsis. Hence, a high processing cost should be associated with the resolution of the ACD site in both the *small ellipsis* condition and in the *large ellipsis* condition. The predictions of the two approaches are summarized in (12), and will be tested in Experiment 1 below.

(12) **Predictions of the two approaches with regard to ACD resolution:**

a. The covert movement approach:
The resolution of both small and large ellipsis is facilitated.

b. The in-situ approach:
The resolution of both small and large ellipsis is not facilitated.

5.2 Experimental evidence

In the following sections I present the results of three experiments that test the predictions of the covert movement approach and the in-situ approach to *wh*-in-situ. All three experiments use the paradigm in Hackl et al. (2012) as a tool for detecting covert movement in multiple *wh*-questions. To foreshadow the findings of this section, we will see that the experimental results are not predicted by either one of the two approaches sketched above. Instead, the results will motivate a new approach to in-situ *wh*-phrases in multiple questions, where an in--situ *wh* is able to undergo *partial movement* to positions other than the complementizer, and be interpreted from this landing site without further movement.

Previous processing work, as well as rating and corpus studies, show that questions with D-linked *wh*-phrases (Pesetsky, 1987) are easier to process than questions with bare *wh*-pronouns (Arnon et al., To appear; Clifton et al., 2006; Fanselow et al., 2008; Featherston, 2005a,b; Frazier and Clifton, 2002; Hofmeister et al., 2007). In order to make the experimental items as easy to process as possible, the items in Experiments 1–3 all use D-linked *wh*-phrases in a superiority-obeying word-order.

5.2.1 Experiment 1: *every* vs. *which*

This experiment tests the core predictions of the covert movement approach and in-situ approach to *wh*-in-situ. In particular, I compare the behavior of questions with an ACD gap hosted by a *wh*-phrase with the behavior of questions with an ACD gap hosted by the quantificational determiner *every*.

Design and materials

Experiment 1 presented participants with (embedded) *wh*-questions headed by a subject *wh*-phrase. Two factors were crossed: (a) *determiner*: whether the embedded question contained the quantificational determiner *every*, yielding a simplex *wh*-question, or a second *wh*-phrase, yielding a multiple *wh*-question; and (b) *ellipsis size*: whether the sentence contained a *small ellipsis* marked by *did*, where the antecedent of the ACD site is the embedded VP, VP_2, or *large ellipsis* marked by *was*, where the antecedent of the ACD site is the matrix VP, VP_1. A sample item is given in (13) below:[10]

(13) **Sample target item in Experiment 1:**

The conductor asked *which soloist* was [$_{VP1}$ willing to [$_{VP2}$ perform...

a. **every** concerto that the brilliant protégé *did* ... *(small ellipsis)*
b. **which** concerto that the brilliant protégé *did* ... *(small ellipsis)*
c. **every** concerto that the brilliant protégé *was* ... *(large ellipsis)*
d. **which** concerto that the brilliant protégé *was* ... *(large ellipsis)*

...and restructured the rehearsal accordingly.

There were 28 sentence templates following the sample paradigm in (13). Each sentence in a template employed either *every* or *which* as the determiner of the object DP. This DP hosted a relative clause with an ACD site marked with an auxiliary verb. The auxiliary *did* marked a *small ellipsis* corresponding to the embedded predicate, VP_2, and the auxiliary *was* marked a *large ellipsis* corresponding to the matrix predicate, VP_1. After the ellipsis site, the sentences had continuations beginning with a clausal conjunction or disjunction, which varied in length but were at least 5 words long, providing a spillover region for detecting possible processing difficulties associated with ACD resolution. See the Appendix for a full list of the materials.

[10] To simplify the discussion, in what follows I ignore the highest predicate embedding the question. I thus refer to the lower VP inside the embedded question as the "embedded VP" and to the larger VP inside the embedded question as the "matrix VP."

Because the experiments were conducted online, it was not possible to control the participants' screen size. Consequently, in order to ensure that the region of interest was read without interruptions that may artificially affect the data, all the sentences were presented on two lines, with the line break in target sentences always placed immediately following the verbal complex (that is, the first line of the sentence was the first line in (13), and the second line contained the text in lines a-d and the continuation following these lines).[11] Target items were counterbalanced across four lists using a Latin Square design and combined with 48 filler sentences of various types resulting in a total of 76 sentences. Non-target items included sentences that were similar to the target items in structure, in length and in containing quantifiers. 18 filler sentences resembled the target sentences in all aspects but contained a lexical verb instead of ellipsis (*did*, *was*). Filler sentences additionally contained line breaks in different positions, making it impossible for participants to anticipate where a line break might occur, or whether or not there will be ellipsis in the sentence. The remaining filler sentences were taken from an unrelated study.

Each experimental item was followed by a yes/no comprehension question. The questions asked about different aspects of the sentences, including about material inside the relative clause and about the predicates used in the sentences, to ensure that participants were processing all parts of the sentence at a deep level. The correct answers to half of the questions was *yes* and to the other half *no*.

Methods

Experiment 1 used the moving window self-paced reading methodology and was hosted on Ibex Farm.[12] Participants were presented with sentences that appeared on the screen one word at a time in a moving window display. Each trial begins with a series of dashes marking the length of the sentence. Participants press the spacebar to reveal the next word of the sentence. Each press of the spacebar reveals a new word while the previous word is again replaced with dashes. The amount of time a participant spends reading each word is recorded (RT). After the final word of each sentence, a yes/no comprehension question appears, asking about information contained in the sentence. Partici-

[11] Testing on a number of standard monitors showed this method to consistently avoid line breaks inside the region of interest, and was furthermore found to be the most natural among several other options in a pilot study.

[12] Ibex: Internet Based Experiments, created and maintained by Alex Drummond, accessible at `http://spellout.net/ibexfarm/`.

pants responded by pressing "1" for "Yes" or "2" for "No." No feedback was given about whether the answer to the question was correct or incorrect.

Before beginning the experiment, participants were given detailed instructions about the experiment and then read and accepted a consent statement. Participants were instructed to read the sentences at a natural rate to ensure understanding. They were also instructed to answer the comprehension questions as accurately as possible. There were three practice items before the experiment began. Each experiment took approximately 30 minutes to complete.

Subjects for the experiments were recruited through Amazon Mechanical Turk and they were paid $1.5 for their participation. The participants were asked about their native language but were told that payment was not contingent on their response. To further ensure that only native speakers of English participated in the experiments, IP addresses of participants were restricted to the US using Amazon Mechanical Turk's user interface. Participation was further restricted so that only Turk Workers with a overall approval rate of over 95% of all their submissions were allowed to participate in the experiments.

Predictions

The *every* conditions are expected to replicate the results of Hackl et al. (2012). That is, we expect to find a main effect of ellipsis size, such that *small ellipsis* is easier to process than *large ellipsis*: since *every* triggers covert movement to a position above the embedded VP_2 (headed by *perform* in (13)) as soon as the quantifier is encountered, we expect antecedent containment to be preemptively undone in the case of the *small ellipsis* (marked with *did*) (13a), leading to facilitation of ACD resolution in this case. However, since this movement does not target a position high enough to undo antecedent containment in the case of the *large ellipsis* (marked with *was*) (13c), we expect ACD resolution to be relatively more difficult in this case: once the auxiliary *was* is reached, the parser must perform a second reanalysis, covertly moving *every* from its QRed position above the embedded VP_2 to a position above the higher VP_1 (headed by *willing* in (13)), in order to allow for ACD resolution. These two conditions thus provide us with a baseline contrast against which to compare the *which* conditions in (13b,d).

For the *which* conditions, the two approaches to *wh*-in-situ make different predictions:

In the covert movement approach, all *wh*-phrases must move *non-locally* to C for interpretation. Both *small* and *large* ellipsis are predicted to be relatively easy to process because antecedent containment is undone by covert *wh*-movement before the parser

reaches the ellipsis site. When the parser encounters the ellipsis site—regardless of whether the ellipsis is *small* or *large*—all that is left to do is find an antecedent for the missing VP. We thus expect an interaction, such that the *which-did* and *which-was* conditions both pattern with the *every-did* condition and exhibit facilitation effects, compared to the remaining *every-was* condition where we predict participants to exhibit increased difficulties with ACD resolution.

According to the second approach, the in-situ *wh*-phrase can be interpreted in-situ. Hence, encountering the in-situ *wh*-phrase will not trigger reanalysis that could facilitate down-stream ACD resolution. Only upon reaching the ellipsis site itself will the need for reanalysis be apparent. Thus processing costs for ACD resolution are predicted to reflect both covert movement of the *wh*-object to a position above the missing VP as well as the retrieval of the appropriate antecedent for the elided VP and so should be relatively higher for both the *small* and *large* ellipsis conditions. Under this approach we thus expect to find a main effect of the object type, such that sentences with an object relative clause headed by *which* are more difficult to process than sentences with an object relative clause headed by *every*. This main effect may be accompanied by an interaction, such that the two which conditions pattern with *every-was* and are more difficult to process than *every-did*, or they may be even more difficult than the *every-was* condition.

(14) **Predictions with regard to ACD resolution in Experiment 1:**

a. The covert movement approach:
The resolution of both *small* and *large* ellipsis is facilitated.
Which-did and *which-was* pattern with *every-did* and are easier to process than *every-was*.

b. The in-situ approach:
The resolution of both *small* and *large* ellipsis is not facilitated.
Which-did and *which-was* are more difficult to process than *every-did*; they are at least as difficult to process as *every-was*.

Results

61 native speakers of English participated in this study. The following exclusion criteria were used to filter the results of this experiment and all subsequent ones: participants who held the spacebar continuously pressed instead of reading the sentences one word at a time as instructed, participants who participated in the study more than once, participants who submitted the entire survey in less than 10 minutes,[13] participants with

an average reaction time of over 700ms, and participants with low accuracy rates in response to comprehension questions (<75% on filler trials and <75% on target trials) were excluded from the study.[14] Twenty participants in Experiment 1 were excluded from the analysis for these reasons.[15] In addition, two target sentences and no filler sentences were excluded from the analysis because of low accuracy (<60% across participants).

Questions across the full experiment (targets and fillers) were answered correctly 87.5% of the time across participants; questions for experimental items were answered correctly on 83.3% of trials. The data was trimmed as follows: RTs from the first and last words of all items, RTs faster than 90ms or slower than 2000ms, and any RTs that were more than 2 standard deviations faster or slower than the average RTs for each subject (calculated per condition) were excluded from the analysis. Overall, less than 1% of the data were lost due to these criteria.[16] Figure 2 shows the mean residual reading times (RRTs)[17] for the two regions of interest for the four target conditions.

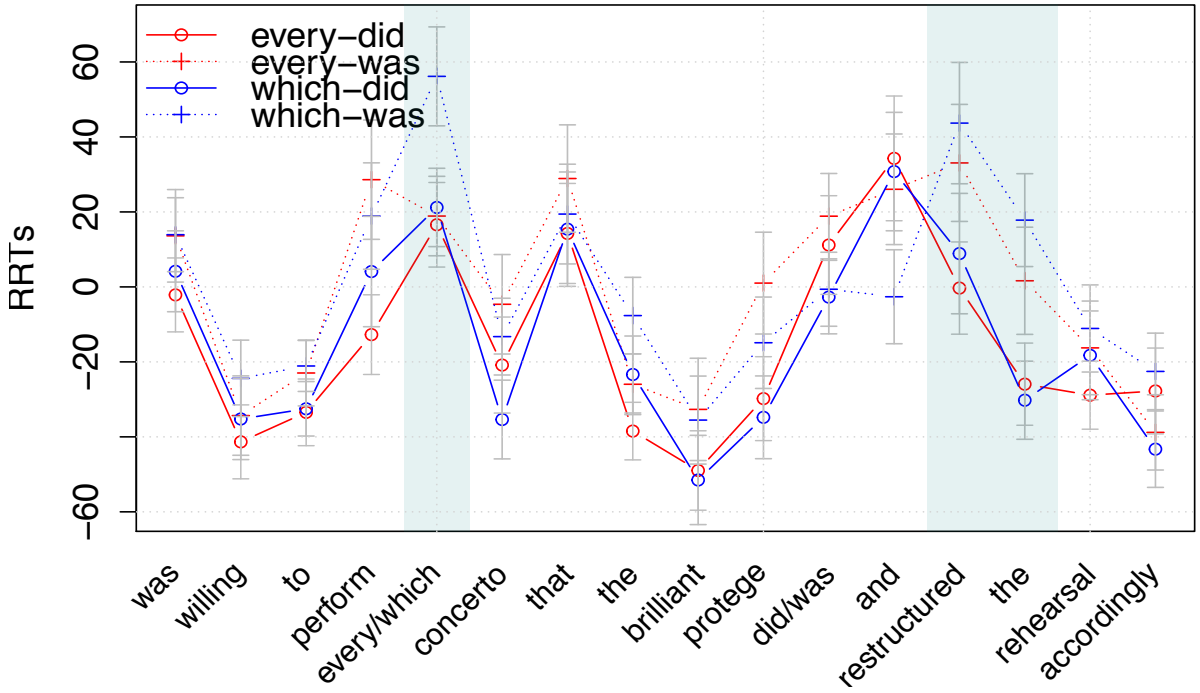


Figure 2: Residual reading times in target items in Experiment 1

[13] Average completion time for all of the experiments presented here was at least 25 minutes.

[15] Although this is exclusion rate is quite high, I believe that it is necessary in order to filter the relatively higher noise level in Amazon Mechanical Turk participants as compared to lab participants. I believe that this more parsimonious criterion helps ensure the validity of the results I report here.

[15] Particularly slow reading times in our experiments tended to reflect long breaks and distracted behavior of the participants, introducing extraneous noise into the results. Particularly fast reading times were similarly contributed by distracted participants.

[16] Here and in the other experiments, the results remain statistically unaltered if this step is not performed.

A linear mixed effects model was fit to the data using *R* and the *R* package *lme4* (Bates and Sarkar, 2007). The model predicted RRTs from the two factors of interest: *determiner* (*every* vs. *which*) and *ellipsis size* (*small ellipsis* marked by *did*, vs. *large ellipsis* marked by *was*).[18] The model contained random intercepts and slopes for both predictors for subjects and items (Baayen, 2004; Barr et al., 2013).

The results show a main effect of *determiner* at the slot at which the determiner appeared in the sentence (log likelihood tests comparing a model with and without the effect of *determiner*, $p<0.05$). This result is driven by the fact that reaction times in the *which* condition were slower than the reaction times in the *every* condition, across both ellipsis conditions.[19] The results additionally show a main effect of *ellipsis size* two words and three words after the auxiliary site (log likelihood tests, p's<0.05).[20] This result is driven by the fact that the resolution of *small ellipsis* is faster than the resolution of *large ellipsis* for both *every* and *which*. There were no differences between the two determiners at these slots, and there were no other significant effects in the results. The results of the model for the third word after the auxiliary site are summarized in Table 1.

Predictor	Coefficient	Standard Error	t value
Intercept	-31.591	18.851	-1.676
Determiner	3.586	16.018	0.224
Ellipsis size	39.8416	15.651	2.546
Determiner×*Ellipsis size*	2.665	20.628	0.129

Table 1: Results of Experiment 1

[17]RRTs were calculated based on a regression equation predicting reading time from word length using all words from all experimental items, except for the first word and the last word of the sentence.

[18]Similar results are obtained for logRTs in our data. I report the results for RRTs for convenience.

[19]Note, in particular, that the *which-was* condition appears to be slower than the other three conditions. However, the *determiner*×*ellipsis size* interaction is not significant (p=0.344), and furthermore *did* and *was* are not distinguishable at this slot.

[20]Note that the earliest we might expect an effect is on the word following the auxiliary verb (*did*/*was*) and not on the auxiliary itself. At this point in the sentence, readers encounter a conjunction or disjunction that can only be attached at the clausal level, indicating that the previous clause contained ellipsis. We observe the effect in the spillover region, one and two words downstream. This is common in selfpaced reading experiments, in experiments involving the Hackl et al. paradigm, e.g. Breakstone et al. (2011), and in many other studies (e.g. Clifton et al., 1999; Wagers and Phillips, 2009; Kazanina and Phillips, 2000; Xiang et al., 2011; Polinsky et al., 2012; Polinsky and Potsdam, Forthcoming, among others). Throughout this paper, all the experiment we will see exhibit the effect in this same region. It is important to note that the logic of this paradigm makes no predictions about where exactly an effect should be observed, as long as the effect happens inside the spillover region. This is an inherent weakness of the selfpaced reading methodology, but it is not constrained to our experiments alone. To interpret the effects seen here in the way that I do, they must happen only after the parser could have determined the presence of ACD, and they must happen within a region that is uniform across all conditions so that nothing else in that region could have generated the effects. The materials used here are constructed to ensure this.

Discussion

We observe two effects in Experiment 1. First, the main effect of *determiner* in the first region of interest may be attributed to the relatively higher complexity of a multiple question compared to that of a simplex question. When the parser encounters the in-situ *wh*-phrase in the *which* conditions, it realizes that the sentence will be paired with a more complex semantics than in the case of the simplex question with *every*. Regardless of the cause of this effect, it shows that our participants were processing the sentences at least at a depth sufficient for detecting the difference in determiner.

Second, we observe a main effect of *ellipsis size* in the second region of interest, following the auxiliary verb, such that sentences with a *small ellipsis* are read faster than sentences with a *large ellipsis*. This is the case for both determiners: *every* and *which*. To see this more clearly, observe Figure 3, which compares reading times for *every* and *which* two words after the auxiliary verb. As we can see, the *ellipsis size* manipulation affects the two determiners equally.

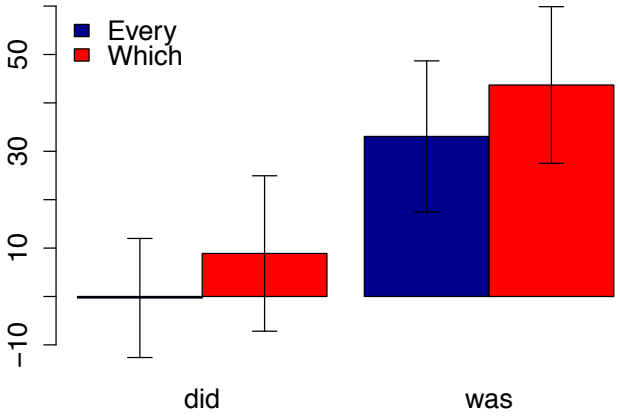


Figure 3: RRTs for 2nd word after AUX

This result is not predicted by either traditional approach to wh-in-situ. Recall that the covert movement approach predicts facilitation of both *small* and *large* ellipsis, because the in-situ *wh*-phrase must move to C for interpretation, as part of a QP, preemptively undoing antecedent containment in both ellipsis conditions. We would thus expect that RTs for both *which* conditions—involving both local and non-local ACD—to be lower than those for the *every* conditions. The in-situ approach, on the other hand, assumes that the in-situ *wh* can be interpreted without any movement at all, and hence predicts no facilitation by an upstream *which* for either the *small* or *large* ellipsis conditions.

Based on the results of Hackl et al. (2012), we may take the fact that there is no difference between *every-did* and *which-did* to indicate that local ACD resolution is facilitated in both cases. This is compatible with a view under which *wh*-phrases, like traditional quantifiers such as *every*, cannot stay in-situ at LF and instead must covertly move to the

nearest propositional node for interpretation.[21] Similar proposals have been previously made by several researchers for a variety of languages (cf. Baker 1970; Dornisch 2000 for Polish, Huang 1995; Kim 1991 for Korean, Rullmann and Beck 1998). However, instead of necessarily moving to C, I propose that once the in-situ *wh* has been integrated into the structure, it does not require any further movement: The movement step assumed by the parser is the smallest that can produce an interpretable structure.

An interpretable structure, for our purposes, must allow for an appropriate antecedent for ACD to be constructed. This means that additional movement—beyond the nearest node with propositional type in the structure—may be assumed after an auxiliary verb is encountered, which signals that such movement is necessary. This movement requires a *reanalysis* of the structure, with QP moving from its position at the nearest c-commanding node with propositional type in the structure to a higher position, causing a detectable slowdown in reading times. As we will see below, movement may also be required to be longer than the nearest propositional node in the structure if this landing site is below an offending intervener, which would otherwise cause an intervention effect. As will become crucial in Experiment 3, movement above an intervener is assumed to happen earlier in the parse than movement that is triggered by the needs of non-local ACD resolution.

Assuming that covert *wh*-movement should be modeled as QP-movement, the approach I propose is summarized in (15): the in-situ *wh* merges with a Q, and subsequently QP undergoes a *small* QR-like movement step. Following the necessary QP-movement step, Q moves out of QP and continues alone to C, leaving its *wh*-containing sister behind. Recall that this step of Q moving out of QP was a necessary part of the theory presented in Chapter 2, required for the semantic interpretation of the Q-particle. The proposal here, then amounts to arguing that this step happens earlier than previously assumed—namely, as early as possible, following the smallest possible movement step, instead of as late as possible, as I assumed before.[22]

[21] Following widely accepted theories of generalized quantifiers (Barwise and Cooper, 1981; Heim and Kratzer, 1998), I assume that object quantifiers are uninterpretable *in situ* and must move to a node that denotes a closed proposition (that is, a node of type *t*). This requirement follows from the generally assumed conditions on the interpretation of quantifiers: (a) they must bind a variable (the constraint against vacuous quantification), and (b) they must combine with an open formula created by abstracting over a closed proposition (see also the discussion of quantification in Kennedy (1997)).

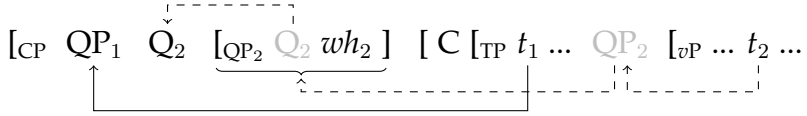
[22] Crucially, Q can only move out of QP *if movement has occurred*: the possibility of no QP-movement step is not entertained. Such an option would amount to destroying QP immediately after constructing it.

(15) **The *partial movement* approach:**
QPs undergo a *small* movement step to the first position where they yield an interpretable structure, followed by movement of Q alone to C.

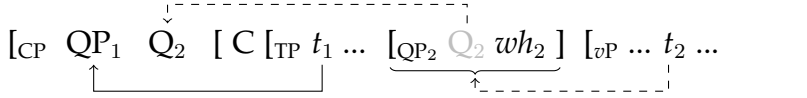
Thus, if the Chapter 2 theory assumed the largest possible QP-movement step and smallest possible Q-movement step, (16a),[23] we now have evidence from sentence processing for the opposite preference: we require a derivation with the *smallest* possible QP-movement step that would lead to an interpretable structure, and the *largest* possible Q-movement step (16b):[24]

(16) **Chapter 2 vs. Chapter 5: Differing size of QP vs. Q movement**[25]

a. Chapter 2: large QP-movement, small Q-movement:



b. Chapter 5: small QP-movement, large Q-movement:



To substantiate this approach and its predictions, below I present Experiments 2–3. Experiment 3 will test a prediction of the *partial movement* approach that if the partial movement step is forced to be long-distance via external interpretability considerations, we expect to detect an increased domain in which ACD resolution is facilitated. As we will see, this prediction is borne out. I will return to a detailed discussion of this prediction in section 5.2.3, but first I present Experiment 2, whose aim is to deal with an alternative interpretation of the results of Experiment 1. One possible alternative explanation for the results of Experiment 1 is that the experimental manipulation did not in fact succeed as intended. In particular, we must entertain and reject the possibility that participants failed to process the sentences at a deep level, and that instead of seeing any facilitation effects in our sentences we are only seeing a *complexity of antecedent effect*.

[23] Or, alternatively, no QP is constructed at all.

[24] Note that this does not need to lead us to reject the semantics in Chapter 2, but rather to refine the set of LFs that the syntax provides as input to the interpretative component.

[25] For simplicity, I do not illustrate the movement step of Q_1 out of QP_1, as it is not relevant to the current discussion. Because of the EPP requirement of English, one QP—QP_1, the one that undergoes overt movement—must move to C as a QP, and only then can Q move out of QP. If this step were to happen earlier, we would end up with an empty Spec,CP: since Q is null, we would be unable to satisfy the EPP feature.

Long distance dependencies, such as those required for the resolution of ellipsis, are constructed by integrating temporally and structurally distant linguistic material. As such, they require the support of working memory resources for their completion (Foraker and McElree, 2011). In order to establish a dependency, the parser must retrieve previously processed material from working memory at the gap position, and find an appropriate antecedent for the ellipsis. The distance between the gap site and the antecedent affects the retrieval process, resulting in longer reading times and decreased acceptability for longer dependencies (cf. Gibson, 1998; van Dyke and Lewis, 2003; Lewis et al., 2006; Warren and Gibson, 2002). Relatedly, we might expect semantically more complex antecedents (e.g. willing to perform) to be harder to retrieve from memory than simpler antecedents (e.g. perform).

One possible interpretation of Experiment 1, then, is that the Hackl et al. (2012) paradigm was not successfully replicated. Instead, participants were not reading the sentences carefully and were not affected by the *determiner* manipulation at all. A similar concern is that the experimental paradigm is not sensitive enough to detect differences between the processing of different quantifiers, perhaps because an embedding inside a question presents too much of a challenge to the participants. Hence, Experiment 1 only exhibits an effect of complexity of the antecedent, where the processing of long-distance ellipsis with a more complex antecedent is more costly than that of short-distance ellipsis with a simpler antecedent, and nothing more. To address this concern, first note that some comprehension questions directly targeted the relative clause, to ensure that it was processed at a deep level. Those questions did not suffer from lower accuracy rates than other comprehension questions. We furthermore detect a main effect of *determiner* once *which* and *every* are read, ensuring that participants did indeed pay attention to the determiners in the sentences.

However, to more directly address the concern that the Hackl et al. (2012) paradigm might not have worked as expected, Experiment 2a–b will attempt to replicate the Hackl et al. (2012) results—comparing the behavior of *every* and *the*—in the context of an embedded question, and then also compare the behavior of *which* and *the* in the same context. As we will see below, we find that ACD resolution with the quantificational determiner *every* is facilitated compared to ACD resolution in sentences with the non-quantificational definite article *the*, as predicted by the results of Hackl et al. (2012). We furthermore find that ACD resolution in sentences with *which* is similarly facilitated compared to ACD resolution in sentences with the definite article *the*. This result will eliminate the concern that the results of Experiment 1 do not show any facilitation effects with *which*.

5.2.2 Experiments 2a–b: *the* vs. *every* and *the* vs. *which*

The goal of Experiment 2 is to ensure that the paradigm of Experiment 1 is in principle sensitive enough to detect differences in the behavior of different determiners. Experiment 2a will attempt to replicate the Hackl et al. (2012) paradigm in a context as in Experiment 1, using an embedded question instead of a simple declarative sentence. Experiment 2b will then compare the behavior of multiple questions with *which* with the behavior of sentences with the non-quantificational definite article *the*. To allow for a direct comparison with Experiment 1, Experiment 2 uses the same materials as Experiment 1, with minor changes to accommodate the current experimental manipulation.

Design

Like Experiment 1, Experiment 2 presented participants with (embedded) *wh*-questions headed by a subject *wh*-phrase. Two factors were crossed: (a) *determiner*: whether the embedded question contained the quantificational determiner *every*, the *wh*-word *which*, or the definite article; and (b) *ellipsis size*: whether the sentence contained a *small ellipsis* marked by *did*, where the antecedent of the ACD site is the embedded VP_2, or *large ellipsis* marked by *was*, where the antecedent of the ACD site is the matrix VP_1. *Determiner* was treated as a between-subject factor: Experiment 2a compares *every* and *the*, and Experiment 2b compares *which* and *the*. The missing comparison, *which* and *every*, has already been done in Experiment 1. Sample items are given in (17)–(18):

(17) **Sample target item in Experiment 2a:**

The conductor asked *which soloist* was [$_{VP1}$ willing to [$_{VP2}$ perform...

a. **every** concerto that the brilliant protégé *did* ... *(small ellipsis)*
b. **the** concerto that the brilliant protégé *did* ... *(small ellipsis)*
c. **every** concerto that the brilliant protégé *was* ... *(large ellipsis)*
d. **the** concerto that the brilliant protégé *was* ... *(large ellipsis)*

...and restructured the rehearsal accordingly.

(18) **Sample target item in Experiment 2b:**

The conductor asked *which soloist* was [$_{VP1}$ willing to [$_{VP2}$ perform...

a. **which** concerto that the brilliant protégé *did* ... *(small ellipsis)*
b. **the** concerto that the brilliant protégé *did* ... *(small ellipsis)*
c. **which** concerto that the brilliant protégé *was* ... *(large ellipsis)*
d. **the** concerto that the brilliant protégé *was* ... *(large ellipsis)*

...and restructured the rehearsal accordingly.

The same 28 target sentences from Experiment 1 were used, along with the same 48 filler items. The only change introduced to the sentences was to the determiners, as indicated above. The comprehension questions to some items were also minimally changed to accommodate this manipulation. Experiment 2 used the same methods as described above for Experiment 1. See the Appendix for a full list of the materials.

Predictions

We expect Experiment 2a to replicate the results of Hackl et al. (2012). In particular, we expect to see an effect of *ellipsis size*, such that *small* ellipsis is easier to process than *large* ellipsis for both *the* and *every*. In addition, we expect to find a difference in the processing of ACD in sentences with a relative clause headed by *every* and sentences with a relative clause headed by *the*, such that the processing of ACD in sentences with *every* is facilitated compared to sentences with the.

In the *every* conditions (17a,c), the parser must assume covert movement as soon as it encounters *every*. This movement is expected to be local and to target a position above the embedded VP_2 headed by *perform* in (17), a position that is high enough to preemptively undo antecedent containment in the case of *small* ellipsis (17a) but not in the case of the *large* ellipsis (17c). Hence, the processing costs at the ellipsis site in the *small ellipsis* condition (18a) should be lessened since part of the work to resolve ACD, specifically reanalysis to undo antecedent containment, has already happened prior to encountering the ACD site. When the parser encounters *did* all it needs to do is find an antecedent for the missing VP and nothing more. In the case of the *large* ellipsis in (17c), the covert movement that was assumed following the processing of *every* is not sufficient: after local movement of the object DP the missing VP is still contained inside its antecedent. Hence, when the auxiliary *was* is reached, the parser must again reanalyze the structure, covertly moving the object a second time, from its position above the embedded VP_2 to a position higher than the matrix VP_1. Hence, a high processing cost should be associated with the resolution of the *large ellipsis* in (17c).

In the *definite* conditions in (17b,d), no covert movement is predicted to take place when the definite article is encountered. The parser only assumes a structure with covert movement of the object when it encounters the auxiliaries *did* and *was*, as the ACD marker is the earliest point at which the need for moving the object DP is detectable. The fact that processing the ACD site requires both reanalysis and retrieval of an antecedent is expected to result in relatively high processing costs following the ellipsis site. Moreover,

just like in the case of *every*, we expect that the processing costs for the *large ellipsis* condition should be higher than those associated with the *small ellipsis*, since retrieving a more complex antecedent VP is more difficult and requires longer distance covert movement than in the case of the small ellipsis.

We furthermore expect to find the same behavior pattern with *which* in Experiment 2b, (18): if *which* behaves like a quantifier in object position, we expect to find that *which*, like *every*, facilitates the resolution of small ellipsis with *did*, but not of large ellipsis with *was*, for the same reasons as described above for *every*. We expect the not to facilitate ACD resolution of any size, and hence we predict that sentences with the to be relatively more difficult to process than sentences with *which*.

Results

165 native speakers of English participated in this study: 84 subjects participated in Experiment 2a and 81 participated in Experiment 2b. 21 subjects were excluded from the analysis of Experiment 2a and 24 subjects were excluded from the analysis of Experiment 2b using the same exclusion criteria specified in Experiment 1. Three target sentences and one filler sentence were excluded from the analysis of Experiment 2a and three target sentences and two filler sentence were excluded from the analysis of Experiment 2b because of low accuracy (<60% across all participants).

Questions across the full experiment (targets and fillers) were answered correctly 86.7% of the time across participants in Experiment 2a and 85.8% of the time in Experiment 2b; questions for target items were answered correctly on 84.7% of trials in Experiment 2a and 83.8% of the time in Experiment 2b. The data was trimmed using the same criteria described for Experiment 1. Overall, less than 1% of the data was excluded from the analysis. Figure 4 below shows the mean RRTs for the region of interest for the four target conditions in Experiment 2a, comparing the processing of sentences with *the* and *every*.

A linear mixed effects model with random intercepts and slopes for *ellipsis size* for subjects and items was fit to the data.[26] The model predicted RRTs from the two factors of interest: *determiner* (*every* vs. *the*) and *ellipsis size* (*small ellipsis* marked by *did*, vs. *large ellipsis* marked by *was*). The results show a main effect of *ellipsis size* two and three words after the auxiliary verb site and a main effect of *determiner* two words after the auxiliary

[26] A more specified model that includes the effect of *determiner* yields a false convergence.

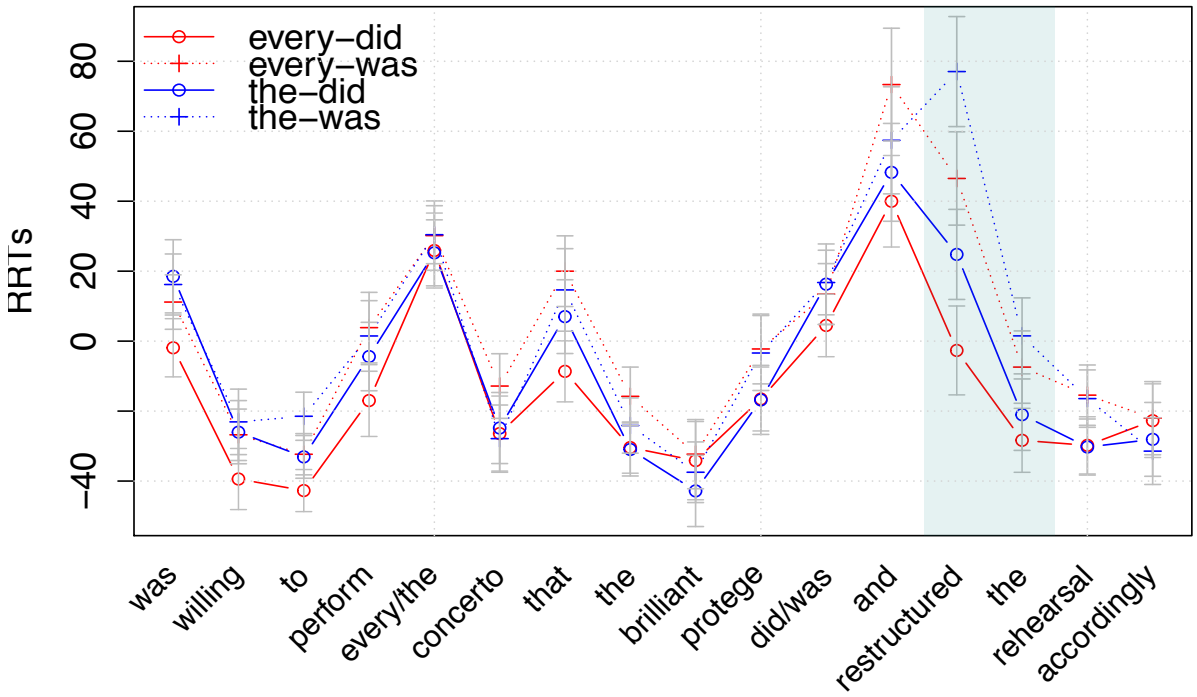


Figure 4: Residual reading times in target items in Experiment 2a

verb site (log likelihood tests comparing a model with and without the predictor of interest, p's$<$0.05). These results are driven by the fact that the resolution of *small ellipsis* is faster than the resolution of *large ellipsis* for both every and the, and furthermore that the resolution of ACD in sentences with a relative clause headed by *every* is faster than the resolution of ACD in sentences with a relative clause headed by *the*. There were no other significant effects in the data. The results of the model for the second word after the auxiliary site are summarized in Table 2.

Predictor	Coefficient	Standard Error	t value
Intercept	3.304	20.959	0.158
Determiner	21.780	16.517	1.319
Ellipsis size	39.008	19.510	1.999
Determiner×*Ellipsis size*	12.207	23.441	0.521

Table 2: Results of Experiment 2a

Next, we examine the results of Experiment 2b, comparing the determiners *the* and *which*. Figure 5 below shows the mean RRTs for the region of interest for the four target conditions. A linear mixed effects model with random intercepts and slopes for *ellipsis size* for subjects and items was fit to the data. The model predicted RRTs from the two

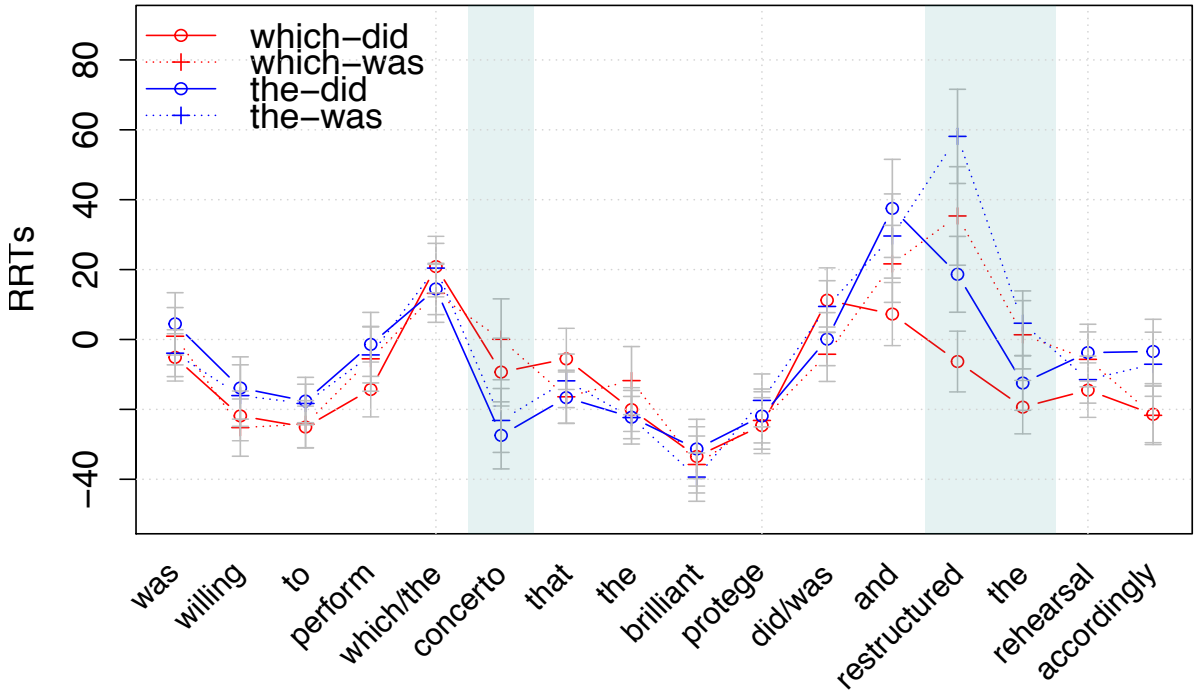


Figure 5: Residual reading times in target items in Experiment 2b

factors of interest: *determiner* (*which* vs. *the*) and *ellipsis size* (*small ellipsis* marked by *did*, vs. *large ellipsis* marked by *was*). The results show a main effect of *ellipsis size* two and three words after the auxiliary verb site and a main effect of *determiner* two words after the auxiliary verb site (log likelihood tests comparing a model with and without the predictor of interest, p's<0.05). These results are driven by the fact that the resolution of *small ellipsis* is faster than the resolution of *large ellipsis* for both *which* and *the*, and furthermore that the resolution of ACD in sentences with a relative clause headed by *which* is faster than the resolution of ACD in sentences with a relative clause headed by *the*. There were no other significant effects in the data. The results of the model for the second word after the auxiliary site are summarized in Table 3.

Predictor	Coefficient	Standard Error	t value
Intercept	16.572	15.716	1.054
Determiner	-22.748	14.213	-1.600
Ellipsis size	42.714	15.949	2.678
Determiner×*Ellipsis size*	-5.117	20.483	-0.250

Table 3: Results of Experiment 2b

Discussion

The results of Experiment 2a–b confirm that the Hackl et al. (2012) paradigm extends to the context of an embedded question. In addition to the main effect of *ellipsis size*, we find a main effect of *determiner*, such that sentences with *every* are processed faster than sentences with *the*, and sentences with *which* are also processed faster than sentences with *the*. That is, *every* and *which* pattern together and facilitate ACD resolution more than parallel sentences with *the*. To see this more clearly, consider Figure 6, which compares the reading times of *the*, *every* and *which* two words after the auxiliary verb site in Experiments 2a–b.

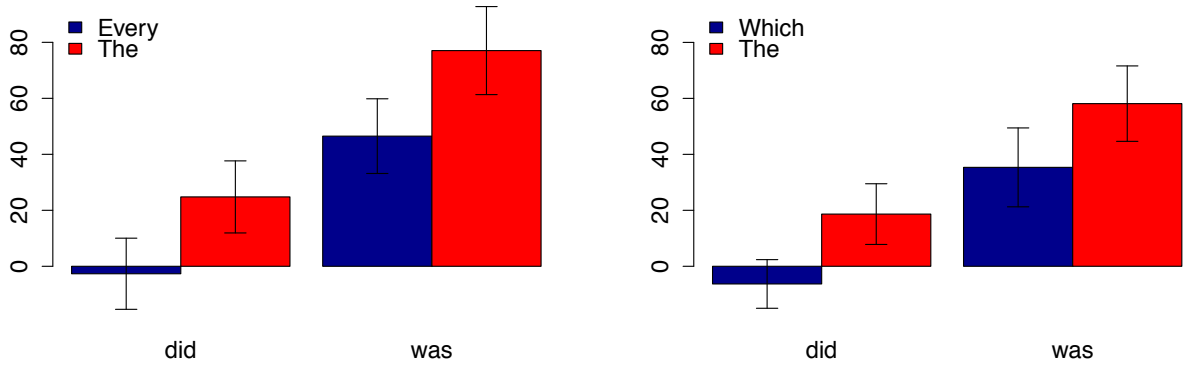


Figure 6: RRTs two words after AUX in Experiments 2a (left) and 2b (right)

For the results of Experiment 2a, I adopt Hackl et al.'s (2012) explanation that the parser must assume covert movement as soon as *every* is encountered, but no such covert movement is assumed with *the*.[27] As a result, covert movement must always be assumed to take place at the point of ACD resolution in the case of *the* but not in the case of *every*: when a *small ellipsis* (marked with *did*) is encountered, the parser must assume no additional covert movement with *every* since that has happened earlier in the parse. To explain the fact that non-local ACD resolution is less difficult with *every* as well I hypothesize that the second step of QR to a position above the matrix VP_1 is easier in the case of *every*, perhaps because the object needs to be moved less far than in the case of *the*.

The results of Experiment 2b are similarly explained if we assume that like quantifiers, *wh*-phrases—or the QPs that contain them—must QR to the nearest propositional node

[27]However, an important difference between these results and Hackl et al.'s (2012) results is that while Experiment 2 yields two main effects, Hackl et al. observed an interaction, such that *every-was* and *the-was* were not significantly different from each other. This played an important role in Hackl et al.'s argument that only local QR facilitates ACD resolution, which I was unable to replicate here. However, the results of Experiment 3 below will provide the missing evidence to make this claim here as well, and I will return to this point after introducing that experiment.

for interpretation as soon as they are encountered by the parser, but that no such movement is assumed in the case of the definite article *the*. As a result, covert movement must always be assumed to take place at the point of ACD resolution in the case of *the* but not in the case of *which*: when a *small ellipsis* (marked with *did*) is encountered, the parser must assume no additional covert movement with *every* since it has happened earlier in the parse. As in the case of *every* in Experiment 2a, we find that non-local ACD resolution is less difficult with *which* than with *the*. This is explained in the same way as for *every*: I hypothesize that the second QR step to a position above the matrix VP_1 is easier in the case of *which* because the object needs to be moved less far than in the case of *the*.

The results of Experiment 2 thus confirm that Experiment 1 is sensitive enough to detect potential differences between determiners with regard to their interaction with ACD, and that there is no reason to suspect that participants were not processing the experimental materials with sufficient depth. Here again, we find similar accuracy rates on target and filler sentences as in Experiment 1, and the overall reaction times in Experiment 2 are comparable to those found in Experiment 1 (see Figure 2).

The facilitation effect found with *every* compared to *the* and the fact that parallel behavior is observed with *which* support my interpretation of the results of Experiment 1: local ACD resolution with *which* is facilitated just as it is with *every*. The facilitation effect with *which* is not compatible with the *wh*-phrase having been processed in-situ when it was encountered by the parser, as we would then predict no effect of *determiner* in Experiment 2b. Instead, the results are consistent with the QP containing the in-situ *wh* being QRed *locally* to a position above the embedded VP_2, just like traditional quantificational determiners. From this moved position, Q moves out of QP and continues to C without the rest of QP. Under this approach, *which* is expected to facilitate ACD resolution to a similar extent as *every*, and this is indeed the result of Experiments 1 and 2b. Additional QP-movement is assumed only if necessary—after an ACD marker is encountered that signals the need for such movement. This movement requires a costly *reanalysis* of the structure, with QP occupying a higher position than originally assumed by the parser. These results led us to adopt a new approach to the interpretation of *wh*-in-situ:

(19) **The *partial movement* approach:**
QPs undergo a *small* movement step to the first position where they yield an interpretable structure, followed by movement of Q alone to C.

There is, however, an alternative interpretation of the results of Experiments 1–2: it is possible that Experiments 1–2 do not show lack of sufficient covert movement with *every* and *which* in the *large ellipsis* (*was*) condition, but instead only an effect of the complexity of the antecedent. If the difference between *the* on the one hand and *every* and *which* on the other hand is not the result of a difference in QR assumed for the interpretation of these determiners, but instead is contributed by some other source,[28] then we can no longer infer from the difference between the behavior of *every* (and *which*) and the that upstream covert movement has occurred with *every* (and *which*) but not with *the*. The main effect of *ellipsis size* could be explained as an effect of the complexity of the antecedent: integrating a smaller, simpler antecedent into the structure is easier than integrating a larger, more complex antecedent. The main effect of *determiner* would be a consequence of the as yet to be identified property of the that makes ACD resolution with it difficult.

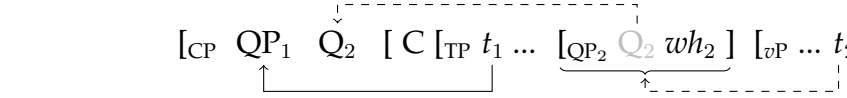
Experiment 3 will address this possible alternative interpretation of Experiments 1–2 by considering a prediction of the partial movement approach combined with the proposal I developed in Chapter 2: Although QPs may not need to move any further once they have been integrated into the structure, following an initial QR step, QPs may be forced to move higher because of the presence of a focus-sensitive intervener in the question. Recall that following Beck (2006), if a *wh*-element occurs below an intervener at LF, the result is an uninterpretable structure. This ungrammaticality is only avoided if the *wh* is able to covertly move above the intervener. Note that unlike in the case of non-local ACD, this movement is assumed to happen as soon as the *wh* is encountered by the parser. Hence we expect *large* ACD to be preemptively undone, facilitating its resolution.

(20) **Predictions of the partial movement approach:**
QPs move to the nearest propositional node for interpretation. Additional QP-movement may be forced by external interpretability considerations. Q will move out of QP only when it is in an interpretable position, and continue alone to C.

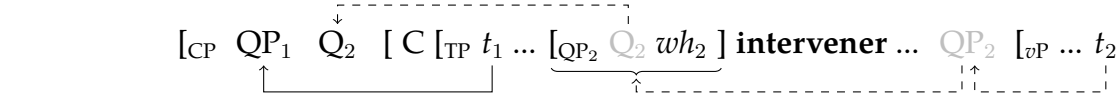
[28] For example, if—for whatever reasons—the processing of ACD hosted by *every* and *which* is easier than the processing of ACD hosted by *the*.

(21) **The size of covert QP-movement depends on interpretability considerations:**

a. No intervener: QP-movement to nearest *v*P, followed by Q-movement:



b. Intervener: QP-movement above intervener, followed by Q-movement:



5.2.3 Experiments 3a–b: *every* vs. *which* with interveners

As noted above, the *partial movement* approach to *wh*-in-situ predicts that, although QPs in object position can be interpreted in-situ following an initial movement step, other factors may force further QP-movement. If long-distance movement can be forced, we expect to find facilitation effects of ACD resolution in a larger portion of the sentence, up to the position targeted by covert movement. One phenomenon that has been argued to force covert movement of in-situ *wh*-phrases is *intervention effects*. Importantly, this phenomenon has not been argued to affect quantificational determiners like *every*, and so intervention effects allow us to make diverging predictions about the behavior of *every* and *which* and to experimentally test these predictions.

Below I give a brief sketch of the theory of intervention effects assumed here. I show how intervention effects can be used in the experimental paradigm to test the predictions of the *partial movement* approach, and then present Experiments 3a–b, which use intervention effects in the paradigm of Experiment 1 and corroborate the predictions of the partial movement approach to *wh*-in-situ.

The theory of intervention effects

As discussed in Chapter 1, the term *intervention effect* describes a situation in which a question is rendered ungrammatical because an in-situ *wh*-element is c-commanded at LF by an *intervener*, for instance a focus-sensitive operator such as *only* or negation.

Here I adopt Beck's (2006) approach to intervention effects, who following Pesetsky (2000), proposes that these effects are caused whenever a *wh*-phrase cannot covertly move above a potentially offending intervener and is instead forced to be interpreted in-situ. I assume, following the discussion in Chapter 2, that the intervener disrupts the transmission of focus-alternatives from the *wh* to its associated Q-particle, resulting in ungrammat-

icality, (22b). If, on the other hand, the *wh* is able to covertly move above the intervener, the question can be assigned a convergent semantics, (22a).

(22) **The configuration of an intervention effect (cf. Beck, 2006; Cable, 2010):**

a. ✓ Q ... *wh* ... **intervener** ... *t* ...

b. * Q ... **intervener** ... *wh* ...

Note that for Beck (2006), covert movement necessarily targets the interrogative complementizer, and intervention involves the disruption of alternatives transmitted between *wh* and C. That is, Beck adopts the traditional all-or-nothing view of covert movement. However, in principle all that is necessary for the *wh*-phrase to be interpretable in Beck's theory is for it to move above the intervener. This is compatible with a smaller movement step under the partial movement approach, as schematized in (22a).

In English, superiority-obeying questions are immune to intervention effects, but superiority-violating questions are ungrammatical whenever an intervener c-commands an in-situ *wh* (É Kiss, 1986; Pesetsky, 2000). This is illustrated in (23a–b), which employ the focus-sensitive operator ***only*** as an intervener.

(23) **Intervention effects only target superiority-violating questions:**

a. *Which* student did **only** Fred introduce ____ to *which* professor? Sup.-obeying

b. * *Which* professor did **only** Fred introduce *which* student to ____? Sup.-violating

Following Pesetsky (2000); Beck (2006); Cable (2007, 2010), in Chapter 2 I adopted an explanation of these facts under which in superiority-obeying questions, the in-situ *wh* is able to covertly move to C at LF. As a result, it occupies a position higher than the offending intervener at LF and hence the question is grammatical, (23a). In superiority-violating questions, on the other hand, the in-situ *wh* must stay in-situ at LF, and it is interpreted via focus-alternatives between its base position and a Q-particle that occupies a position in the CP layer. As a result, if an intervener occurs above the in-situ *wh*, the intervener will disrupt the transmission of alternatives between *wh* and Q, and the result is ungrammaticality, (23b).

The grammaticality of example (23a) is explained because a QP containing the surface in-situ *wh*-phrase *which professor* is able to covertly move above the intervener at LF. Note

that this movement of *which professor* targets a higher position than expected by the *partial movement* proposal advanced in the current chapter, if no intervener is present, (24). In example (24), *which professor* has covertly moved above the predicate *introduce* to satisfy the interpretability requirement which forces it to QR to a propositional node. In example (25b), *which professor* undergoes covert movement above the intervener (and perhaps as far as C) in order to avoid the illicit intervention effect configuration in (22b). If *which professor* were not covertly raised above the intervener, the result would be the ungrammatical (25a) (which is identical to (24) except for the presence of the intervener).[29]

(24) **LF of multiple question under the partial movement approach:**
Which student did Fred introduce ____ to *which* professor?
[[Q_1 *which* student]$_1$ Q_2 [C [$_{TP}$ ... t_1 ... [*which* professor]$_2$ [$_{VP}$ introduce ... t_2]]]]

(25) **LF of question with intervener under the partial movement approach:**
Which student did **only** Fred introduce ____ to *which* professor?

a. * [Q_1 [*which* student]$_1$ Q_2 [C [$_{TP}$...**intervener** t_1 [*which* professor]$_2$ [$_{VP}$ introduce...t_2]]]]

b. [Q_1 [*which* student]$_1$ Q_2 [C [$_{TP}$ ... [*which prof.*]$_2$ **intervener** t_1 t_2 [$_{VP}$ introduce ... t_2]]]]

We thus predict that the presence of an intervener in a question can force additional covert movement of QPs that could otherwise be interpreted without movement following their initial movement step. The movement must be at least as high as the intervener, but need not target C. Hence, we expect the presence and placement of an intervener in a question to affect ACD resolution in that question. The intervener marks the scope of the necessary covert movement in the question: the *wh* must move at least as high as the intervener in order to escape intervention. We thus expect to find facilitation of ACD resolution if the ellipsis is smaller than the movement required by the intervener. On the other hand, no additional movement step is predicted to occur in the case of *every*, because interveners do not interact with traditional quantifiers. Consequently, no additional facilitation of ACD resolution is expected when an intervener occurs in the context of *every*. Thus, we predict no effect of the presence and placement of an intervener in sentences with ACD hosted by *every*. Testing this prediction will be the goal of Experiments 3a–b.

[29]For simplicity, I do not draw arrows to represent the overt movement in these LFs, and I do not show the movement step of Q out of QP)

Experiment 3a–b will use the focus-sensitive intervener ***also***. Although previous work on English has not used this intervener, it is known to be focus-sensitive (Beaver and Clark, 2008, a.o.) and has been argued to act as an intervener in other languages (Kim, 2002; Beck, 2006, a.o.). I argue that it acts as an intervener in English as well, exhibiting the same grammaticality paradigm as known interveners such as ***only*** and ***even***, where a superiority-obeying question with ***also*** above the in-situ *wh*-phrase is grammatical, (27a), but a superiority-violating question with ***also*** above the in-situ *wh*-phrase is ungrammatical, (27b, cf. example (23)). Compare this with the baselines in (26), which are minimally different in that they do not contain an intervener. Here, both the superiority-obeying question (26a) and the superiority-violating question (26b) are grammatical.[30]

(26) **Baseline: sup.-obeying and sup-violating questions both grammatical:**

I know that the teacher punished some students last week. Do you know...

a. *which* punishment the teacher gave ____ to *which* student on Friday?

b. *which* student the teacher gave *which* punishment to ____ on Friday?

(27) ***Also* is an intervener in English:**

I know that the teacher punished some students on Thursday. Do you know...

a. *which* punishment the teacher ***also*** gave ____ to *which* student on Friday?

b. * *which* student the teacher ***also*** gave *which* punishment to ____ on Friday?

The choice of *also* as the intervener in Experiment 3 was driven by several considerations. Many interveners are quantificational elements such as *every NP, no NP, only NP*, etc. However, choosing such an intervener would require the introduction of yet another argument into the already complicated sentences of Experiments 1–2. This added complexity would make the sentences even more difficult to process and would complicate comparisons with Experiments 1–2. This leaves sentential operators that are able to modify the verbal complex in the sentences. When choosing an operator, it is important to consider the scope of the operator and the interpretational consequence its placement would impose on the sentence. Quantificational adverbs such as *always* and *often* were judged by native speakers to be awkward, and furthermore not to exhibit clear differences in meaning between a high and low placement of the adverb. Finally, sentential

[30]I note that judgments regarding intervention effects are notoriously tricky. I will return to a discussion of this fact in chapter 6. The question must be read with a supporting context, so that it receives a pair-list interpretation and not a single-pair interpretation. Many speakers additionally find the judgment crisper in an embedded context compared to a matrix question.

negation was rejected in order to avoid complications due to *neg*-raising, which would make the difference between a high and a low placement of negation less sharp.

Design

Experiment 3 is an expansion of Experiment 1, adding interveners to the questions. Three factors will be crossed: (a) *determiner*: whether the embedded question contained the quantificational determiner *every*, yielding a simplex *wh*-question, or a second *wh*-phrase, yielding a multiple *wh*-question; (b) *ellipsis size*: whether the sentence contained a *small ellipsis* marked by *did*, where the antecedent of the ACD site is the embedded VP_2, or *large ellipsis]* marked by *was*, where the antecedent of the ACD site is the matrix VP_1; and (c) *position of also*: whether the intervener *also* is *low* and occurs above the embedded VP_2, or *high* and occurs above the matrix VP_1.

To simplify the design and the analysis of the results, Experiment 3 is divided into two sub-experiments, each using just one determiner, *every* or *which*. Sample items for Experiments 3a–b are given in (28)–(29). See the Appendix for a full list of the materials used here and in the previous experiments.

(28) **Sample target item in Experiment 3a (*every*):**[31]

The conductor asked *which soloist* was ...

a. [$_{VP1}$ **also** willing to [$_{VP2}$ perform every concerto that the brilliant protégé *did* ... *(sm ellipsis)*
b. [$_{VP1}$ willing to [$_{VP2}$ **also** perform every concerto that the brilliant protégé *did* ... *(sm ellipsis)*
c. [$_{VP1}$ **also** willing to [$_{VP2}$ perform every concerto that the brilliant protégé *was* ... *(lg ellipsis)*
d. [$_{VP1}$ willing to [$_{VP2}$ **also** perform every concerto that the brilliant protégé *was* ... *(lg ellipsis)*

...and restructured the rehearsal accordingly.

(29) **Sample target item in Experiment 3b (*which*):**

The conductor asked *which soloist* was ...

a. [$_{VP1}$ **also** willing to [$_{VP2}$ perform which concerto that the brilliant protégé *did* ... *(sm ellipsis)*
b. [$_{VP1}$ willing to [$_{VP2}$ **also** perform which concerto that the brilliant protégé *did* ... *(sm ellipsis)*
c. [$_{VP1}$ **also** willing to [$_{VP2}$ perform which concerto that the brilliant protégé *was* ... *(lg ellipsis)*
d. [$_{VP1}$ willing to [$_{VP2}$ **also** perform which concerto that the brilliant protégé *was* ... *(lg ellipsis)*

...and restructured the rehearsal accordingly.

Experiment 3 contained the same 28 target sentences from Experiment 1, along with the same 48 filler items. The items were minimally changed to add the intervener *also* in the appropriate places. No changes were made to the comprehension questions.

Predictions

As sketched above, we expect interveners to interact with *which*-phrases and force movement of the in-situ *wh* to a position above the intervener. Following our assumptions about the parser, we expect it to perform the smallest movement possible, that is to target the first interpretable position above the intervener and no higher. Hence, in the *low also* condition, we expect QP-movement to target a position above *also* but below VP_1, while in the *high also* condition we expect long distance QP-movement above *also* and thus above VP_1. We do not expect interveners to interact with *every*, as conventional quantifiers do not interact with focus interveners, and hence we expect *every* to undergo a small QR step and not to move any further until the need for long-distance movement is apparent after reaching the ACD site marked by *was*.

We expect Experiment 3a to replicate the results of Experiment 1, since interveners should not affect the parsing of sentences with *every*. That is, we expect to find a main effect of *ellipsis size* and, crucially, no effect of the *placement of also*. The parser assumes covert movement as soon as it encounters *every* to a local position just above the embedded VP_2. This position is high enough to preemptively undo antecedent containment in the case of *small ellipsis* (28a–b) but not in the case of the *large ellipsis* (28c–d). Hence, no particular processing cost should be associated with the *reanalysis* step of ACD resolution at the ellipsis site in the *small ellipsis* conditions, because no additional movement is required at the gap site to resolve ACD in this sentence. All that the parser must do is identify an appropriate antecedent for the ellipsis, fill it into the gap and compute the resulting meaning. In the case of the *large ellipsis*, however, the covert movement that was assumed after *every* was encountered is not sufficient: following this movement, the missing VP is still contained inside its antecedent. Hence, when the auxiliary *was* is reached, the parser must reanalyze the structure, covertly moving the object from its position above the embedded VP_2 to a position higher than the matrix VP_1. Hence, a high processing cost

[31] I note that there are several choices for what element in (28)–(29) might be chosen by a reader to be the associate of *also*. One natural choice is *protégé*, which contrasts with the *soloist* occurring higher in the sentence. Other options native speakers have reported to us are possible choices are *concerto* and the verb *perform*. The actual choice made by readers is immaterial to the predictions for this experiment: all that matters is that *also* acts as a focus-sensitive operator, forcing movement above it in the case of *which* but not in the case of *every*.

should be associated with the resolution of the *large ellipsis* in (28c–d). Since the presence and position of *also* should not affect the movement of *every*, we predict no differences between the *low also* conditions (28b,d) and *high also* conditions (28a,c).

Different predictions are made in the case of Experiment 3b. Here, we expect the position of *also* to affect the amount of covert movement that the in-situ *wh*-phrase must undergo irrespective of the size of ACD.

In the *low also* conditions (29b,d), we expect the results to resemble those of Experiment 1 and Experiment 3a. The position of *also* above the embedded VP_2 will force local movement, targeting a position above *also* in the embedded VP_2 but below the matrix VP_1. This position is high enough to preemptively undo antecedent containment in the case of *small ellipsis* (29b) but not in the case of the *large ellipsis* (29d). Consequently, we expect ACD resolution to be facilitated in the case of *small ellipsis* but not in the case of the *large ellipsis*, resulting in larger RRTs for the *was* conditions compared to the *did* condition.

In the *high also* conditions (29a,c), the position of *also* is above the matrix VP_1. As always, the parser must assume covert movement as soon as it encounters *which*. Unlike in the case of *low also*, here the movement must be non-local and target a position above the matrix VP_1. This position is high enough to preemptively undo antecedent containment both in the case of *small ellipsis* (29a) and *large ellipsis* (29c). As a result, when the parser reaches the gap site—in both ellipsis conditions—no reanalysis is necessary in order to construct an appropriate antecedent for the ellipsis. All the parser must do is find an antecedent for the ellipsis in the already constructed structure, fill it into the gap and compute the resulting meaning, but nothing more. We thus expect ACD resolution to be facilitated in both the *small ellipsis* and the *large ellipsis* conditions.

In summary, in addition to a main effect of *ellipsis size* which we expect to find in both Experiments 3a–b, we expect no effect of the *position of also* in the case of Experiment 3a (with *every*), but we do expect an effect of the *position of also* in Experiment 3b (with *which*). In particular, a *high also* should force a longer covert QP-movement step than a *low also*, and this additional movement is expected to create a larger region in which the facilitation of ACD resolution is expected. Both experiments contain conditions that will serve to replicate the results of the previous experiments. Furthermore this experiment will present novel data on the online processing of questions with interveners.

Results

243 native speakers of English participated in this study: 123 subjects participated in Experiment 3a and 120 subjects participated in Experiment 3b.[32] 27 subjects were excluded from the analysis of Experiment 3a and 25 subjects were excluded from the analysis of Experiment 3b using the same exclusion criteria specified for Experiment 1. Two target sentences and three filler sentences were excluded from the analysis of both experiments because of low accuracy (<60% across all participants).

Questions across the full experiment (targets and fillers) were answered correctly 84.9% of the time across participants in Experiment 3a and 86% of the time across participants in Experiment 3b; questions for experimental items were answered correctly on 82.42% of trials in Experiment 3a and on 82.47% of the trials in Experiment 3b. The data was trimmed as described for Experiment 1 above. Overall, less than 1% of the data was excluded. Below I present first the results of Experiment 3a and then those of Experiment 3b. Figure 7 below shows the mean RRTs for the region of interest for the four target conditions in Experiment 3a. Recall that Experiment 3a contained *every* as the determiner heading the object relative clause in all target sentences.

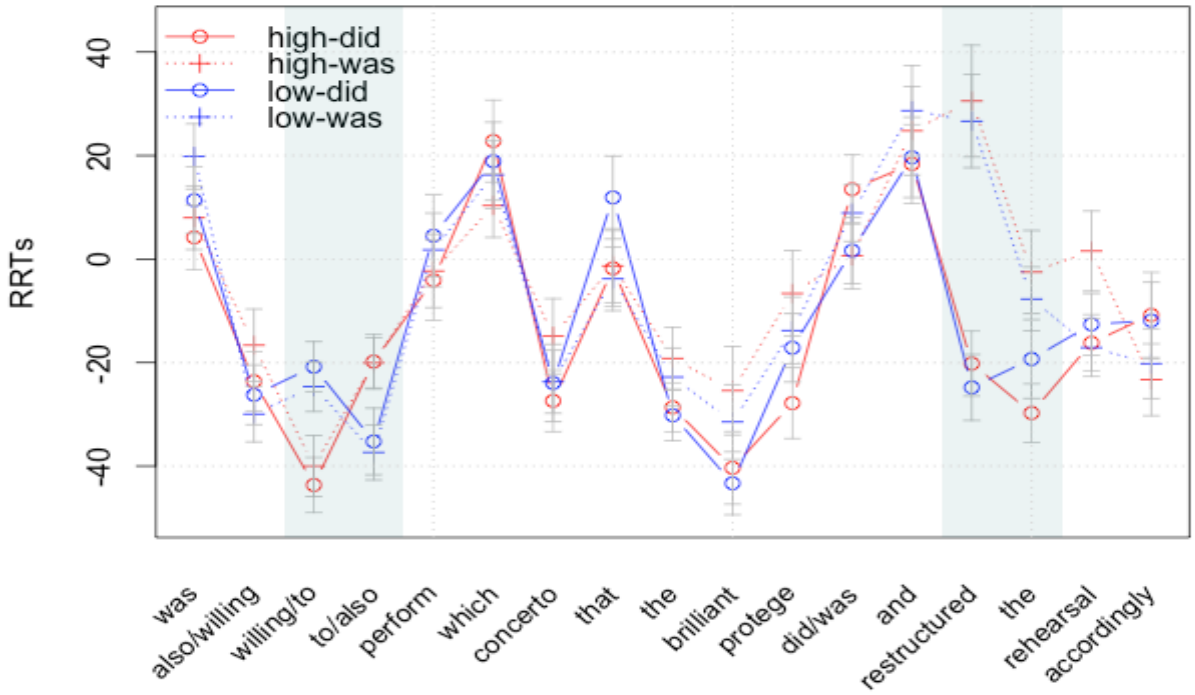


Figure 7: Residual reading times in target items in Experiment 3a

[32]The details for Experiments 3a–b represent the aggregate results from two separate replications of each experiment, requested by an anonymous reviewer of the journal paper version of the chapter.

A linear mixed effects model with random intercepts and slopes for subjects and random intercepts and slopes for the effect of *ellipsis size* for items was fit to the data.[33] The model predicted RRTs from the two factors of interest: *position of also* (*low*, above the embedded verb vs. *high*, above the matrix verb) and *ellipsis size* (*small ellipsis*, marked by *did*, vs. *large ellipsis*, marked by *was*). The results show a main effect of *position of also* at the third and fourth word in the region of interest (where *also* occurs in the sentences). The results additionally show a main effect of ellipsis size two and three words after the auxiliary site (log likelihood tests comparing a model with and without the predictor of interest, p's$<$0.05). These results are driven by the fact that the resolution of *small ellipsis* is faster than the resolution of *large ellipsis* for both the *low also* and *high also* conditions. There were no other significant effects in the data. The results of the model for the third word after the auxiliary site are summarized in Table 4.

Predictor	Coefficient	Standard Error	t value
Intercept	-28.342	11.909	-2.380
Position of also	7.449	8.282	0.900
Ellipsis size	25.073	10.653	2.354
Position of also$\times$*Ellipsis size*	-14.070	13.034	-1.079

Table 4: Results of Experiment 3a

Next, let us examine the results of Experiment 3b. Recall that in this experiment, the determiner heading the object relative clause in all four target conditions was *which*. Figure 8 shows the mean RRTs for the region of interest for the four target conditions.

A linear mixed effects model with random slopes and intercepts for subjects and items was fit to the data. The model predicted RRTs from the two factors of interest: *position of also* (*low*, above the embedded verb vs. *high*, above the matrix predicate) and *ellipsis size* (*small ellipsis*, marked by *did*, vs. *large ellipsis*, marked by *was*). The results show a main effect of *position of also* at the third and fourth word in the region of interest (where *also* occurs in the sentences). The results additionally show a main effect of *ellipsis size* two and three words after the auxiliary verb site and a main effect of the *position of also* three words after the auxiliary site (log likelihood tests, p's$<$0.05). The main effect of *ellipsis size* reflects the fact that the resolution of *small ellipsis* is faster than the resolution of *large ellipsis* for both *also* conditions, while the main effect of the *position of also* is caused because the processing of the *high also* conditions is faster than the processing of the *low*

[33] A more specified model with slopes for the effect of *also* for items did not converge.

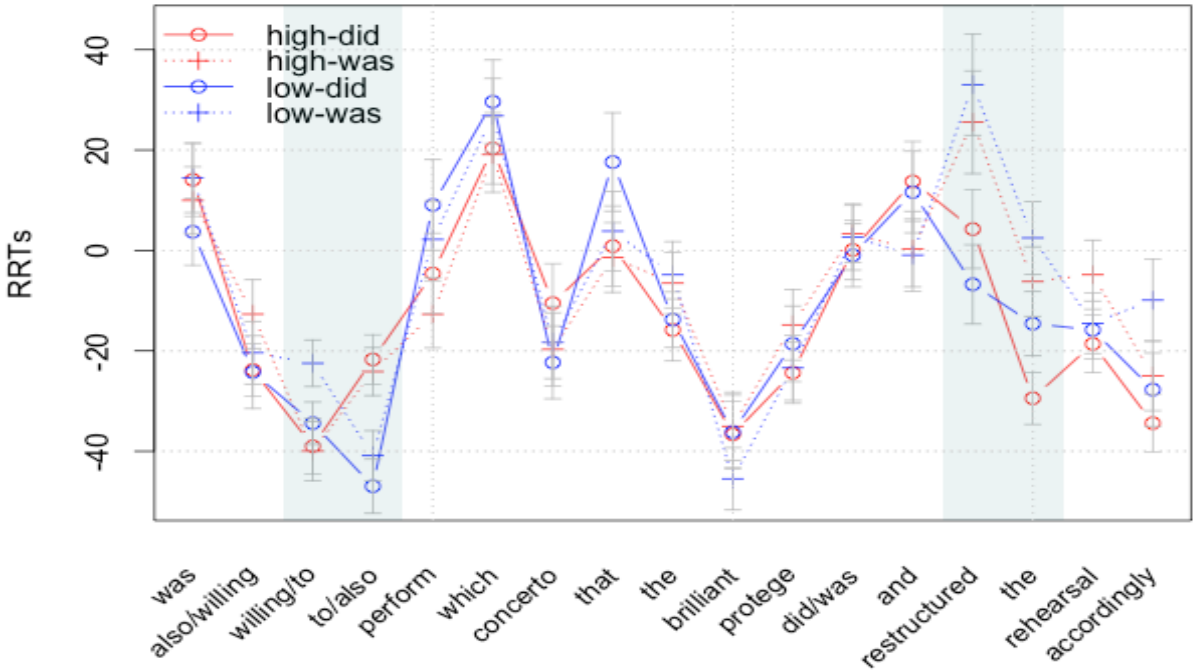


Figure 8: Residual reading times in target items in Experiment 3b

also conditions. There were no other significant effects in the data. The results of the model for the third word after the auxiliary site are summarized in Table 5 below.

Predictor	Coefficient	Standard Error	*t* value
Intercept	-29.634	9.056	-3.272
Position of also	17.017	7.584	2.244
Ellipsis size	21.984	9.215	2.386
Position of also×*Ellipsis size*	-6.791	11.810	-0.575

Table 5: Results of Experiment 3b

Discussion

Several effects can be observed in both Experiment 3a and Experiment 3b. First, we find a similar effect of the presence of *also* on participants' behavior when the word '*also*' was read. We can take this effect to indicate that our participants were paying attention to this experimental manipulation. Additionally, we find a main effect of *ellipsis size* in both experiments, occurring on the second and third words after the ellipsis site. This effect is more pronounced on the second word following the auxiliary verb, as can be seen in Figure 9. The graph on the left shows RRTs for sentences with an object relative clause hosted by *every* (Experiment 3a) and the graph on the right shows RRTs for sentences

with an object relative clause hosted by *which* (Experiment 3b). Note that here there is no difference between the two *also* conditions in the two experiments.

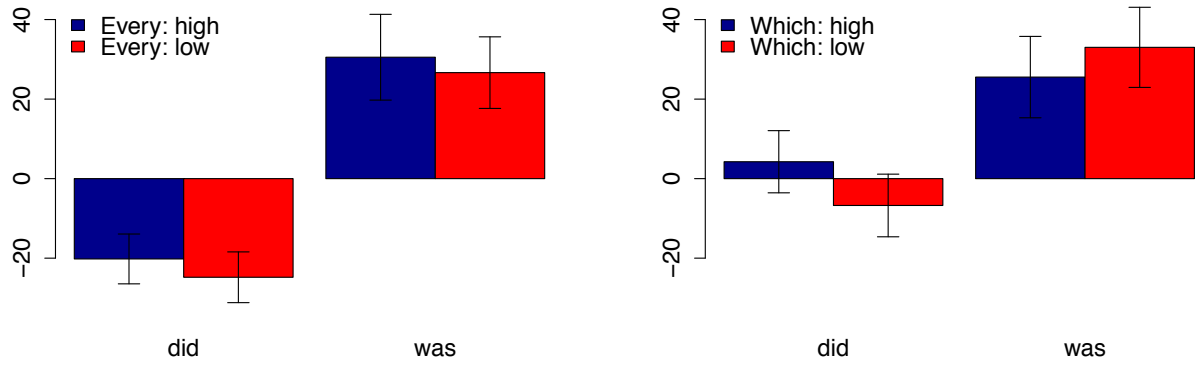


Figure 9: RRTs 2 words after AUX in Experiments 3a (*every*, left) and 3b (*which*, right)

In both Experiments 3a–b, we observe the main effect of *ellipsis size* not only on the second word following the auxiliary verb but also on the third word. More importantly, we find that on this word, the presence and position of *also* affects the resolution of ACD differently in the two experiments. Specifically, *also* does not have an effect in Experiment 3a, but in the case of Experiment 3b, we find a main effect of *position of also* in addition to the main effect of *ellipsis size*. To see this more closely, consider Figure 10, which compares the behavior of the four target conditions in Experiments 3a–b three words after the auxiliary verb. The graph on the left shows RRTs for sentences with an object relative clause hosted by *every* (Experiment 3a) and the graph on the right shows RRTs for sentences with an object relative clause hosted by *which* (Experiment 3b).

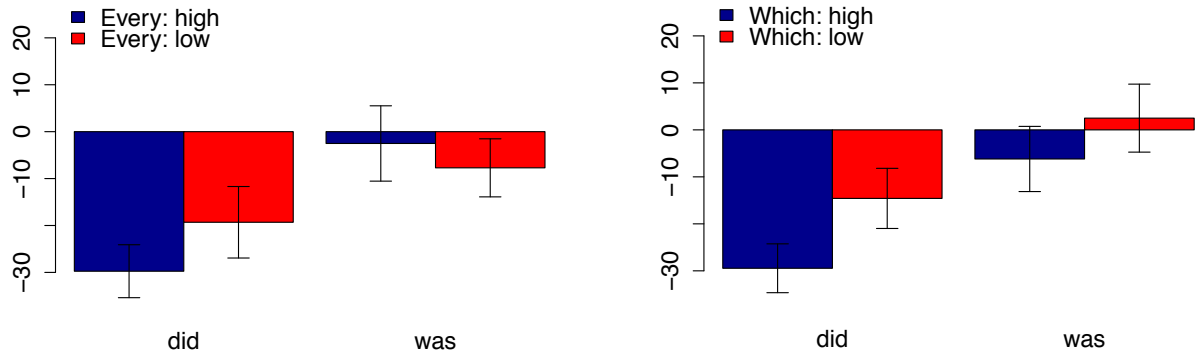


Figure 10: RRTs 3 words after AUX in Experiments 3a (*every*, left) and 3b (*which*, right)

The results of Experiment 3a exhibit parallel behavior for the two *also* conditions: the only effect here is that of the *ellipsis size*: *small ellipsis* (with *did*) is processed faster than *large ellipsis*(with *was*). In Experiment 3b, on the other hand, we find a main effect of

position of also in addition to a main effect of *ellipsis size*. In particular, we find that the *high also* condition is processed faster than the *low also* condition across both *ellipsis* conditions.

The main effect of *also* in Experiment 3b reflects a facilitation effect of non-local ACD resolution with *high also* (i.e. of the *was-high also* condition) so that it is processed at a similar speed to that of the *local* ACD with *low also* (i.e. of the *did-low also* condition). This is consistent with the partial movement approach: if interpretability requirements force long-distance covert *wh*-movement, we expect ACD to be facilitated in the entire movement domain. In Experiment 3b, the *high also* forces *wh*-movement above it and as a result, antecedent containment is preemptively undone not only for *small* ellipsis but also for *large* ellipsis. When the parser reaches the gap site in both conditions, all it has to do is find an appropriate antecedent for the ellipsis and nothing more. This should translate into a facilitation effect both for the *small* ellipsis (marked with *did*) and for the *large* ellipsis (marked with *was*) for sentences in the *high also* condition.

The effect of *ellipsis size* found in Experiments 3a–b represents the complexity of the antecedent effect, which is found here as well as in all the other experiments presented in this paper: although an intervener may force movement that preemptively undoes antecedent containment, resolving the ellipsis to a larger verbal complex is nonetheless more difficult than resolving it to a smaller, more local one. The main effect thus reflects the fact that composing a smaller more local VP (e.g., *perform*) into the structure is easier than composing a larger, more complex VP (e.g. *willing to perform*).

5.3 General discussion

5.3.1 Conclusions from the experimental findings

The results of Experiments 1–3 shed light on the interaction between properties of in-situ *wh*-phrases and the resolution of Antecedent Contained Deletion. More specifically, the findings suggest the following distribution at LF: in-situ *wh*-phrases are not interpreted in their base position, but they do not necessarily move to C for interpretation. Instead, they can be interpreted at any propositional node in the structure, just like traditional quantifiers. This was not predicted by the theory developed in Chapter 2, where—in the absence of an intervener—in-situ *wh*-words could remain in-situ, or could move to C, as part of a covertly moved QP. Unlike traditional quantifiers, however, in-situ *wh*-phrases

are subject to intervention effects. Thus, our proposal predicted that the presence of an element like *also*, which projects a domain of intervention, can force QPs to covertly move higher than a traditional quantifier in order to escape the intervention effect.

The evidence for the claim that in-situ *wh*-phrases undergo a *short* QR-like movement step as soon as they are integrated into the structure came from effects that in-situ *wh*-phrases have on ACD resolution in online sentence processing experiments in various environments. I assumed a model of parsing that relies on two assumptions about the economy of structure building: (a) the linguistic parser always builds the simplest syntactic structure consistent with the linguistic input, and (b) structures without covert movement are simpler than structures with covert movement. This is consistent with a model of parsing under which linguistic structure is incrementally built by the parser in a top-down, left-to-right manner. The simplest structure that is consistent with the linguistic evidence will be build, and the parser will not postulate covert movement in the parse of a sentence until the point at which the linguistic evidence shows that it is necessary. If this point happens after the parser has already committed itself to a structure that does not contain any movement, a *reanalysis* of the structure to a less preferred parse will be required. This reanalysis is a costly operation, triggering a slowdown of processing times.

Both ACD resolution and Quantifier Raising require covert movement, but the point in the parse at which movement must be assumed is different. Quantifier raising must be assumed as soon as the quantifier is encountered, because a quantifier in object position cannot be interpreted in its base position. The covert movement associated with ACD, on the other hand, happens only when the relative clause hosting the ACD gap is fully constructed, because only at this point does it become clear that the structure cannot be interpreted with the relative clause in its base position. This requires the parser to reanalyze an already existing structure, and to integrate the relative clause at a higher position than where it was built. The Hackl et al. (2012) paradigm exploits the fact that both Quantifier raising and ACD resolution use the same mechanism of covert movement, and the fact that (in some cases) this movement need only be assumed once in order to arrive at the desired structure. Hence, if the movement is triggered early in the parse, it will not be required downstream, and hence no difficulty should be detected at that point. If (sufficient) movement was not assumed early in the parse, we expect to observe a slowdown of Reading Times associated with the covert movement that must be postulated once the relative clause containing the ACD gap is formed.

Given these considerations, we may use different determiners in our sentences, which we expect to require different amounts of covert movement, as the heads of the relative clause. It is generally believed that the definite article *the* does not require any movement for its interpretation, and the quantificational determiner *every* requires a short QR step to the first node of propositional type in the structure. Under the proposal in Chapter 2, the in-situ *wh* in superiority-obeying questions may require no movement, or it may require long-distance QP-movement to interrogative C. The findings of Experiments 1–2 show that instead, in neutral environments, in-situ *wh*-phrases interact with ACD resolution in the same way that *every* does: relative to a baseline provided by the definite article *the*, ACD resolution is facilitated, suggesting that a QP is projected on top of the in-situ *wh*, and that this QP undergoes a short, partial movement step to the first node with propositional type in the structure, parallel to the QR step of *every*. That is, QP moves a short distance, but it does not reach C, contrary to the predictions of the theory. In intervention environments, in-situ *wh*-phrases can facilitate non-local ACD resolution, while *every* can't. This suggests that QP movement targets a position above the intervener, as predicted by the theory.

To see how facilitation of ACD resolution might arise as a consequence of the position of the in-situ *wh*-phrase at LF, observe that ACD resolution involves at least three steps: (a) creating a structure in which antecedent containment is undone; (b) identifying an appropriate antecedent for the ellipsis; and (c) filling the antecedent into the gap and computation of the resulting meaning. The latter two steps are required for all cases of VP ellipsis. The former movement step—the reanalysis of the structure so as to undo antecedent containment—is only required in the case of ACD. The facilitation effects of ACD resolution that we see in the experiments are the result of movement that preemptively undoes antecedent containment in the structure, so that under certain experimental manipulations step (a) of ACD resolution need not be performed when the presence of an auxiliary verb, marking the presence of ellipsis in the structure, is detected by the parser because sufficient movement had already been assumed earlier in the parse.

Experiments 1–2 show parallel behavior of *every* and *which*: both determiners facilitate the resolution of *small* ellipsis (with *did*) but not of *large* ellipsis (with *was*) (relative to a baseline provided by *the*): resolving a larger, more complex ellipsis that takes a non-local antecedent is more difficult than resolving a smaller, less complex one, that takes a local antecedent. The facilitation effect is explained if the parser must assume a small QR

step of the sentential object to the nearest propositional node in order to integrate both *every* and the QP that contains *which* into the structure. This early QR step preemptively undoes antecedent containment with *small* ellipsis: step (a) of ACD resolution can be avoided in this case, resulting in faster reading times. This step cannot be avoided for the *large* ellipsis, leading to higher processing costs. For *the*, no covert movement is assumed when it is encountered by the parser, because *the* can be composed as the sister of a verb in-situ. The parser assumes covert movement only when it reaches the gap site of ACD, resulting in slower reading times for both *small* and *large* ellipsis with *the*.[34]

The fact that in Experiment 3b the *high also* condition is processed at a faster rate than the parallel *low also* condition across both *ellipsis size* conditions again highlights the fact that step (a) of ACD resolution can be avoided whenever antecedent containment is preemptively undone: an intervener (here: *also*) can force long-distance *wh*-movement early in the parse of the sentence. In that case, when the gap site is reached no reanalysis is needed in order to find an appropriate antecedent for long distance ACD (as well as for the local ACD), resulting in faster reading times in those cases. We can understand these faster RTs as a facilitation effect: because sufficient movement was assumed earlier in the parse of sentences with a *high also*, step (a) of ACD resolution can be avoided and only steps (b)–(c)—which must be performed whenever there is any kind of ellipsis in a structure—must be calculated when the auxiliary verb, indicating the presence of an ellipsis site, is reached. On the other hand, in sentences with a *low also*, sufficient movement is done earlier in the parse only in the case of the *small ellipsis* but step (a) cannot be avoided when the parser reaches the auxiliary verb in the case of the *large ellipsis*.

As we have seen, the results of Experiments 1–3 are unpredicted by the traditional approaches to the interpretation of *wh*-in-situ, assumed in Chapter 2—namely, that the in-situ *wh* must either remain in-situ at LF, or else move to C. Both possibilities incorrectly predict invariability with regard to ACD resolution, such that ellipsis resolution should either be facilitated always (the *covert movement* approach) or never (the *in-situ* approach). However, the results show that the resolution of *small* ellipsis in Experiment 1—targeting

[34]These results are consistent with the results of Xiang et al. (2014), who compare the processing of in-situ *wh*-phrases to non-*wh* counterparts in Mandarin Chinese using a Speed-Accuracy Tradeoff experiment. As Mandarin is a *wh*-in-situ language, this study was able to compare simplex questions to minimally different sentences that did not contain a *wh*-phrase. Xiang et al. (2014) observe a processing cost involved with the interpretation of in-situ *wh*-phrases which they argue may be attributable to covert movement. However, note that Xiang et al. (2014) do not rule out the possibility of alternative mechanism for the interpretation of *wh*-phrases in their experiment, which do not involve movement. These mechanisms will not be able to explain the data presented here, as discussed above.

the smaller VP in the sentence—was facilitated, but the *large* ellipsis—targeting a higher VP—incurred a high processing cost. The fact that ellipsis whose resolution requires non-local movement of the in-situ *wh*-phrase was not facilitated in Experiment 1 shows that the *wh*-phrase does not move to C immediately upon integration into the structure. The fact that we see an increased effect of ACD facilitation with *which* compared to *the* in Experiment 2 confirms that *which* is not in situ at LF but instead patterning with *every* and undergoing a small movement step. This shows that the in-situ approach to *wh*-in-situ also cannot be correct.

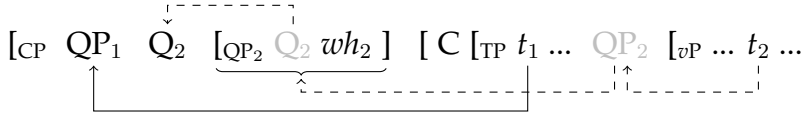
To resolve this apparent impasse I have proposed that the QP that is responsible for covert movement of the in-situ *wh* behaves like a quantifier that must minimally QR to the first propositional node in the structure, much like conventional quantifiers such as *every*. I furthermore proposed the *partial movement* approach:

(30) **The *partial movement* approach:**
QPs undergo a *small* movement step to the first position where they yield an interpretable structure, followed by movement of Q alone to C.

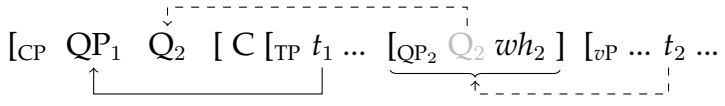
This approach can be seen as amendment to the is-situ approach to *wh*-in-situ: QP must move for basic structure-building reasons and interpretability, but it does not move any more than is needed for external interpretability reasons—for example, in order to resolve ACD or in order to avoid an intervention effect. Once QP is in an interpretable position, it make its contribution to the interrogative semantics without moving to C. Instead, Q will move out of QP and continue alone to C. That is, if Chapter 2 assumed a *maximal* QP-movement step, followed by a small movement step of Q out of QP—a step that is independently needed for the interpretation of the Q-particle—Chapter 5 presents the opposite view, under which QP undergoes the *minimal* step that would leave it in an interpretable position, followed by a large Q-movement step to C.

(31) **Chapter 2 vs. Chapter 5: Differing size of QP vs. Q movement**

a. Chapter 2: large QP-movement, small Q-movement:



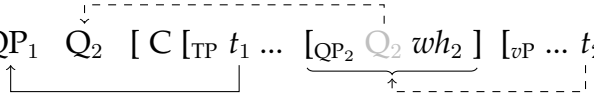
b. Chapter 5: small QP-movement, large Q-movement:



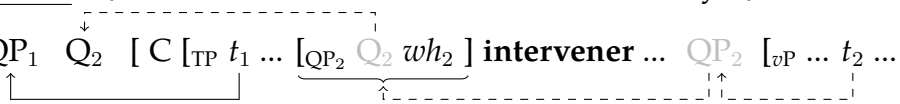
Experiment 3 corroborated an important prediction of the *partial movement* approach: that it should be possible to distinguish the behavior of *which* from that of *every*, and in particular that if *which* is forced to move even higher than expected for *every* as soon as it is encountered by the parser, we should find ACD facilitation effects in the entire domain of QP-movement:

(32) **The size of covert QP-movement depends on interpretability considerations:**

a. No intervener: QP-movement to nearest *v*P, followed by Q-movement:



b. Intervener: QP-movement above intervener, followed by Q-movement:



Experiment 3 tested this prediction by using intervention effects, which have been argued to require movement of *wh*-phrases above an intervener for interpretation, but do not affect the behavior of quantifiers such as *every*. I argued that *also* is an intervener in English and showed that, indeed, when *also* forces non-local movement of an in-situ *wh*-phrase, we see facilitation effects in ACD resolution of local, and crucially also of non-local ACD. The sensitivity of *which*, and the insensitivity of *every*, to the same manipulation show that *also* does not simply act as a scope marker for covert movement: such a proposal would incorrectly predict similar effects on *every* and *which*. Instead, we see *also* affecting only the *wh*-phrase but not the quantifier, consistent with the predictions of the intervention effect theory (Beck 2006) and the predictions of the *partial movement* approach.[35]

If the *partial movement* approach to *wh*-in-situ is on the right track, traditional approaches to interrogative syntax-semantics cannot be correct. *Wh*-phrases cannot be interpreted where they are pronounced, as in-situ approaches would have it, but they also need not move to C for their interpretation, as covert movement approaches claim. Instead, *wh*-phrases may remain in lower positions inside TP, and from there make their contribution to interrogative semantics without any further movement.

[35]Note that as a consequence, any theory of intervention effects that derives intervention without any covert movement faces difficulties in explaining the results of Experiment 3.

Finally, note that the results of Experiments 1–3 are consistent with the theory of ACD presented here, but it cannot be straightforwardly explained by theories of ACD that argue that it is overt extraposition of the relative clause that resolves ACD.[36] More generally, the findings discussed here cannot be explained by any theory that does not postulate that the same mechanism is used for the interpretation of quantifiers in object position and ACD. If different mechanisms are used—for example, covert movement in the case of quantifiers in object position but overt extraposition in the case of ACD—we cannot explain why the presence of different quantifiers upstream of the ACD gap can affect the resolution of ACD.

5.3.2 Partial movement and the syntax-semantics of Q-particles

Before concluding this chapter, let us step back and summarize how the empirical findings presented here affect the proposal for the syntax and semantics of *wh*-questions that I developed in Chapter 2.

I argued here that the experimental evidence motivates a view of in-situ *wh*-phrases in superiority-obeying questions where such *wh*-phrases are in fact not LF-in-situ but instead undergo a short QR-like partial movement step as soon as they are integrated into the structure. Within Q-theory (Cable, 2010), this means that as soon as the in-situ *wh* is reached by the parser, it must be merged with a Q-particle which projects a QP layer, and it is assumed to occupy a higher position than the base-generated position of *wh*.[37] This result could be thought to represent a preference for maximizing the number of QPs in the derivation:

(33) **The QP preference principle:**
Construct as many QPs as possible in a derivation, unless doing so would change the meaning of the question.

We thus have evidence that in the syntax of superiority-obeying questions:

(a) a QP is always constructed. This happens even though the semantics I have proposed in Chapter 2 allows the in-situ *wh* to be interpreted using a non-projecting Q-parti-

[36] Unless this extraposition invokes a step of Quantifier Raising, as assumed in Fox and Nissenbaum (1999).

[37] Note that since this is a superiority-obeying question, a higher *wh* has already been encountered. The parser has positive evidence that this lower *wh* will be pronounced in-situ.

cle (or alternatively through a derivation with just one Q-particle, merged with the overtly moved *wh*, to derive a single-pair reading of the question).

(b) QP-movement does not target C as part of the online construction of the parse. That is, the parser prefers small movement to a position other than C. In particular, we see that the default size of movement is no further than the first *v*P in the structure.

(c) The preference for small movement can be over-ridden if it would lead to an uninterpretable structure—for example, if it targets a position that is lower than an intervener at LF, or in order to construct an appropriate antecedent for the ellipsis in Antecedent Contained Deletion. In that case, a longer covert movement step is assumed.

Note furthermore that the QP that is constructed in the structures we examined in this chapter is quite large, covertly pied-piping additional material beside the *wh*-word itself, including the entire relative clause headed by the *wh* along with the ACD gap site. The semantics proposed in Chapter 2 could, in principle, be consistent with the construction of a smaller QP, containing for example just the *wh*-word and nothing else. The experimental results thus teach us that the syntax of *wh*-questions must be constrained so as to require the construction of the larger QP. This is consistent with the behavior of covert pied-piping we observed in Chapter 3.

In Chapter 6 I will provide additional evidence for partial movement in superiority-obeying questions, and show how these desiderata can be integrated in the formal theory I proposed in Chapter 2, modeling the covert movement we observed in this chapter as QP movement. However, although I develop such a proposal and discuss how it would fit into the proposal I made in Chapter 2, I will argue that there may be benefits to viewing this movement instead as instantiating *covert scrambling*, a more general operation that applies not just to in-situ *wh*-phrases but to other DPs as well. If this idea is on the right track, then the findings I have discussed in terms of QP-movement in this chapter should instead be recast in terms of covert *wh*-scrambling. I return to this point in Chapter 6.

5.4 Chapter summary

This chapter tested the predictions of the theory of Chapter 2 for online sentence processing of English multiple *wh*-questions. The goal was to investigate the LF-position of the in-situ *wh* in superiority-obeying questions.

Chapter 2 made available two LFs, corresponding to the two mainstream approaches to *wh*-in-situ in the current literature. Because these approaches assume different amounts of covert *wh*-movement in a question, they predict different effects of facilitation of ACD resolution in the Hackl et al. (2012) experimental paradigm,§5.1:

- **The *covert movement* approach** predicts facilitation both of *small* and *large* ellipsis, because there is non-local covert *wh*-movement to C.
- **The *in-situ* approach** predicts no facilitation of neither *small* nor *large* ellipsis, because *wh*-phrases are interpreted in their base positions without movement.

Experiment 1 compared in-situ *which* with *every* and showed that the *wh*-phrase behaves like a quantifier: it facilitates the resolution of *small* but not *large* ACD, §5.2.1.

Experiment 2 compared *which* and *every* with *the*. It replicated the results of Hackl et al. (2012) for *every* vs. *the*—where *the* does not facilitate any ACD resolution, but *every* does—and showed that *which* patterns with *every*, unlike *the*, §5.2.2.

Experiment 3 compared the interaction of *which* and *every* with the intervener *also*. It showed that *every* is not sensitive to the presence of *also* in the question, but *which* is: *also* can force long-distance covert *wh*-movement above it, creating a larger domain in which ACD facilitation effects are found, §5.2.3.

This led to argument in favor of **the *partial movement* approach** to *wh*-in-situ in English multiple *wh*-questions, §5.3:

- **The *partial movement* approach:**
  QPs undergo a *small* movement step to the first position where they yield an interpretable structure, followed by movement of Q alone to C.

Chapter 6

Modeling partial *wh*-movement

This chapter provides additional support for *partial wh-movement* in English multiple questions, argued for in Chapter 5. The data will come from the interaction of multiple *wh*-questions in which a surface in-situ *wh*-phrase occurs inside an island with intervention effects (Beck, 2006). After presenting the empirical evidence for partial movement, I will discuss the nature of this movement. I will argue that this partial movement is in fact a *covert scrambling* step, parallel to the one observed overtly in German. I discuss advantages of this view for the theory of grammar and for learnability. I additionally show how partial movement can be integrated into the proposal I developed in Chapter 2.

This chapter also briefly discusses the grammaticality status of questions that are subject to intervention effects. Previous literature has argued that at least for some speakers, some kind of reading survives intervention (Beck, 1996a). The question has been described by Pesetsky (2000) as having a surviving single-pair reading. I argue instead that it should be thought of as a kind of echo question.

6.1 Partial movement in questions with islands

This section examines the behavior of English multiple *wh*-questions in which the in-situ *wh*-phrase occurs inside an island, with regard to intervention effects. I show that intervention happens when an intervener is *above* the island but not when it is *inside* the island. I argue that this is predicted if the in-situ *wh*-phrase undergoes *partial covert movement* to the edge of the island, followed by in-situ interpretation above it, without further movement between the edge of the island to C. I argue that these findings are inconsistent with current theories of interrogative syntax-semantics, where in-situ *wh*-phrases must either move to C or else stay in-situ and be interpreted without any movement at LF.

6.1.1 Background: on the readings of questions with islands

It is important to note at the outset that I will not be taking as my starting point the often-cited claim by Dayal (2002) that questions such as (1), where the lower *wh* is inside an adjunct island, may only have a single-pair reading (1a) but not a pair-list reading (1b). Dayal (2002) develops a theory of the readings of multiple *wh*-questions that is based on this judgment, crucially requiring covert movement of the lower *wh*-phrase to the question Complementizer in order to yield a pair-list reading. The single-pair reading is derived using a choice-function mechanism (Reinhart, 1997).

(1) **Multiple question with island reportedly only allows single-pair reading:**
Which linguist will be offended if we invite *which* philosopher?

a. ✓ Single pair: Professor Smith will be offended if we invite Professor Black.

b. #/* Pair-list (Dayal (2002) judgment):
Professor Smith will be offended if we invite Professor Black, and
Professor King will be offended if we invite Professor Jones.

The judgment in (1) has recently been contested by Cheng and Demirdache (2010), citing Chris Tancredi (p.c.). Cheng and Demirdache (2010) offer the context in (2) with the judgment that a pair-list answer (2a) is felicitous here and moreover the single-pair answer is deviant because of the context, (2b).

(2) **Multiple question with island in fact allows pair-list reading:**
Context: Each of two philosophers will be offended if we invite one of two linguists. What I want to know is:
Which philosopher will be offended if we invite *which* linguist?

a. ✓ Pair-list: Quine will be offended if we invite Chomsky, and
Lewis will be offended if we invite Kayne.

b. #/* Single pair (infelicitous due to context):
Quine will be offended if we invite Chomsky.

In what follows I posit Cheng and Demirdache's (2010) conclusion that pair-list readings are available across islands—in addition to the single-pair reading.[1]

[1] I have also independently corroborated these judgments with English native speakers.

6.1.2 In-situ *wh*, islands and intervention effects

With the background on intervention in mind, let us return again to example (1), repeated below as the slightly modified (3).[2] As we saw above, this question has two felicitous readings: a single-pair and a pair-list reading (see section 1.2 for details.). In the following section it will become clear that an intervention effect seems to only affect the pair-list reading of the question. All of the native speakers who I have consulted report that they can access a single-pair reading of the questions presented here. As a consequence, here I restrict my attention only to the pair-list reading of the question. Questions are presented together with an intended pair-list answer, and with a supporting context. I return to this point in section 6.5.

(3) **Lower *wh* inside adjunct island: pair-list reading is available**
Context: The linguists at the conference are very picky about attending the conference dinner. However, each of them adores one philosopher and will certainly attend the dinner if that philosopher is invited. What I want to know is:
Q: *Which* linguist will come [if we invite *which* philosopher]?
A: Chomsky will come if we invite Quine,
Kayne will come if we invite Lewis,
Labov will come if we invite Russell, ...

Similarly, when the in-situ *wh*-phrase is inside a Complex NP (CNP) island, the resulting question can have both a single-pair reading and a pair-list reading.

(4) **Lower *wh* inside CNP island: pair-list reading is available**
Context: The linguists at the conference are very suspicious of rumors. However, each of them believed one of the rumors going around that we invited a particular famous philosopher to the conference party. What I want to know is:
Q: *Which* linguist believed the rumor [that we invited *which* philosopher]?
A: Chomsky believed the rumor that we invited Quine,
Kayne believed the rumor that we invited Lewis,
Labov believed the rumor that we invited Russell, ...

[2] In this example, I have replaced the predicate *be offended* with *come*, since native speakers report that it is easier to judge the question with the latter predicate than with the former. I use an *if*-adjunct in the text, but note that the facts remain the same if a *because*-adjunct is used instead.

We note that (3) and (4) both have felicitous pair-list readings, if a relevant context is available. Next, we introduce interveners into these questions, as in (5-6) below. We find that an intervention effect, diagnosed by the disappearance of the pair-list reading, occurs when an intervener (here: *only* or negation, in bold) is placed *above* the island, but not when it is *inside* the island.

(5) **Adjunct island: intervention *above* but not *inside* island**

a. Context: The linguists at the conference don't really want to attend the conference dinner. However, each of them adores one philosopher and has said that they will come just in case that phil. is invited. What I want to know is:
Q: *Which* linguist will **only** come [if we invite *which* philosopher]?
* A: Chomsky will only come if we invite Quine,
Kayne will only come if we invite Lewis,
Labov will only come if we invite Russell, ...

b. Context: The linguists at the conference are looking forward to the conference dinner. However, each of them dislikes all but one philosopher and will attend the dinner just in case that phil. alone is invited. What I want to know is:
Q: *Which* linguist will come [if we **only** invite *which* philosopher]?
✓ A: Chomsky will come if we only invite Quine,
Kayne will come if we only invite Lewis,
Labov will come if we only invite Russell, ...

(6) **CNP island: intervention *above* but not *inside* island**

a. Context: The linguists at the conference are very gullible and believe lots of rumors. However, each of them is suspicious of one rumor about a phil. that we supposedly invited to the conference party. What I want to know is:
Q: *Which* linguist **didn't** believe the rumor [that we invited *which* phil.]?
* A: Chomsky didn't believe the rumor that we invited Quine,
Kayne didn't believe the rumor that we invited Lewis,
Labov didn't believe the rumor that we invited Russell, ...

b. Context: The linguists at the conference are very suspicious of rumors. However, each of them believed the rumor that we failed to invite one philosopher to the conference party. What I want to know is:
Q: *Which* linguist believed the rumor [that we **didn't** invite *which* phil.]?
✓A: Chomsky believed the rumor that we didn't invite Quine,
Kayne believed the rumor that we didn't invite Lewis,
Labov believed the rumor that we didn't invite Russell, ...

The structural description of the configuration yielding intervention effects can be summarized as in (7):

(7) **Generalization about the interaction of intervention effects and islands:**
Intervention occurs when an intervener is found *above* an island, but not when an intervener is found *inside* an island.

Here I note that, following the discussion in Chapter 4, we predict that if the *wh*-phrase can be given exceptional wide scope through other means, so that it occupies a position above the intervener at LF, we expect the question to become grammatical again. Here we may attempt to assign the in-situ *wh* exceptional wide scope using extraposition. Following Williams' generalization and the extension of this logic in (Fox and Nissenbaum, 1999), we expect extraposition of the relative clause containing the in-situ *wh* in examples like (6) to assign the *wh* wider scope than when it is not extraposed.

(8) **Williams' generalization (Williams, 1974, ch. 4):**
When an adjunct β is extraposed from a "source NP" α, the scope of α is at least as high as the attachment site of β (the extraposition site).

The relevant example is given in (9) below. Example (9a), repeated from (6a), provides a baseline without extraposition.[3] (9b) shows that when the relative clause is extraposed above the temporal adjunct *yesterday*, assigning the relative clause exceptional wide scope, the sentence is reported to improve.

[3]Following Fox's work on scope economy, I assume that covert movement of the relative clause is blocked in sentence because it does not affect the semantic interpretation of the question. This economy principle is overridden in the case of overt extraposition, where movement has consequences for the pronunciation of the sentence.

(9) **Extraposition allows exceptional wide scope for in-situ *wh*:**

a. ^{*PL} *Which* philosopher **didn't** believe the rumor that we invited *which* linguist?

b. ? *Which* philosopher **didn't** believe the rumor yesterday [that we invited *which* linguist]?

Some speakers report similar contrasts to the ones observed in the case of questions with islands, (5)–(6), in questions with a lower *wh* that is in the complement clause of a non-bridge verb, such as *dream* or *shout*. Such verbs have been argued to be islands for extraction (Zwicky, 1971; Erteschik-Shir, 1973, a.o.), and therefore we correctly predict that interveners that occur above the island (10a) but not ones that occur inside it (10b) should cause an intervention effect, diagnosed by the lack a pair-list reading in (10a).

(10) **Non-bridge verbs are also an island for extraction:**[4]

a. ^{*PL} *Which* linguist **didn't** shout [that we invited *which* philosopher]?

b. *Which* linguist shouted [that we **didn't** invite *which* philosopher]?

Furthermore, configurations with three *wh*-phrases similar to those studies by Cheng and Demirdache (2010), where two *wh*-phrases are inside an island and one is outside, again exhibit intervention effects, diagnosed by the loss of the pair-list reading, when an intervener occurs above the island (11a) but not when it is inside it (11b). This is again predicted by the generalization in (7) and is consistent with the behavior of multiple questions that we have seen in (5), (6) and (10).

(11) **Questions with three *wh* exhibit intervention *above* but not *inside* the island:**

a. ^{*PL} *Which* ling. **didn't** believe the rumor [that *which* student invited *which* phil.]?

b. *Which* ling. believed the rumor [that *which* student **didn't** invite *which* p.]?

Note that if two *wh*-phrases occur outside the island with the intervener and one is inside the island, we predict a pair-list reading with a third triplet held constant. This prediction seems to be borne out:[5]

(12) **Questions with three *wh*: pair-list reading for *wh*s above the island**
Which linguist **didn't** tell *which* philosopher about the rumor [that *which* student had won a dissertation prize]?

[4]The judgments I report here are different than judgments for very similar examples found in Dayal (2002): Dayal reports judgments provided by an LI anonymous reviewer, according to which both (10a) and (10b) are ungrammatical. I have been unable to find speakers who confirm Dayal's reported judgments. Instead, speakers consistently report the judgments that I illustrate here.

[5]I thank David Pesetsky (p.c.) for bringing this point to my attention.

Finally, I note that German questions in configurations such as (5)–(6)—where the intervener occurs *inside* the island together with the *wh*—are ungrammatical. This is in line with previous evidence in the literature that the only way to escape intervention effects in German is to overtly scramble the in-situ *wh* above the intervener:

(13) **Intervener inside island causes intervention in German (Martin Hackl, p.c.):**

a. ✓ *Welcher* Philosoph wird sich aergern wenn wir *welchen* Linguisten einladen?
which philosopher will self be upset if we which linguist invite
'Which philosopher will be offended if we invite which linguist?'

b. * *Welcher* Philosoph wird sich aergern wenn niemand *welchen* Linguisten einlaedt?
which philosopher will self be upset if no one which linguist invite
'Which philosopher will be offended if no one invites which linguist?'

6.2 Interrogative syntax-semantics and partial movement

6.2.1 Implications for theories of interrogative syntax-semantics

The finding that an intervention effect occurs in questions in which the lower *wh*-phrase is inside an island if and only if an intervener is placed *above* the island but not *inside* it (as long as the intervener c-commands the *wh*-phrase within the island) has several important implications for theories of interrogative syntax-semantics.

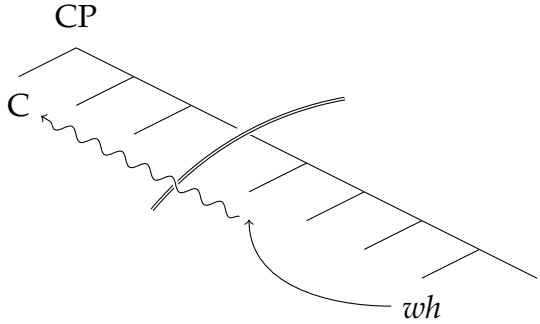
Recall that current theories of interrogative syntax-semantics assume assume that a *wh*-phrase must either covertly move to the C which assigns it a semantics, or else stay in-situ and use focus-alternatives between its base position and C. The examples in section 6.1.2, along with the empirical findings presented in Chapter 5, teach us that this architecture of interrogative syntax-semantics cannot be maintained.

The intervention effect occurring above the island in the (a) examples in (5)–(6), (10)–(11) shows that focus-alternatives were computed above the island. The fact that the (b) examples in (5)–(6), (10)–(11) are grammatical shows that it cannot be the case that alternatives were computed all the way from the *wh*-phrase's base-generated position. If that were the case, we would expect to find an intervention effect in the (b) examples of (5)–(6), (10)–(11), contrary to fact.

To account for the pattern of intervention effects, it must be the case that the *wh* covertly moves at least above the intervener inside the island in the (b) examples of (5)–(6), (10)–(11). That movement could not have targeted the matrix C, since we observe an

intervention effect in the (a) examples of (5)–(6), (10)–(11). In order to predict that intervention happens when an intervener occurs above the island but not when it is inside the island, we require a derivation in which *partial* movement of the *wh* takes place, followed by a second step in which Rooth-Hamblin alternatives are projected from *wh* to C. This type of derivation is schematized in (14):

(14)



Following Ross (1967); Chomsky (1977), and much subsequent work, we know that we cannot overtly extract a *wh*-phrase from inside an island in English. Bošković and Franks (2000); Polinsky and Potsdam (2013) show arguments for the sensitivity of covert movement to the presence of islands. Consequently, I propose that the position targeted by the movement of *wh* must remain inside the island, that is, it may reach as far as the the non-interrogative Spec,CP *inside* the island but no further. A similar argument has been made for Japanese, where it has been shown that *wh*-phrases cannot covertly move out of an island (Nishigauchi and Fujii, 2006).

This partial movement step is similar to the proposal in Cheng and Demirdache (2010), who provide evidence for such a derivation from (a) readings of questions with three *wh*-phrases where some *wh*-phrases are "trapped" inside an island and (b) the fact that such movement is overt in multiple *wh*-movement languages such as Romanian.[6]

The movement in (14), then, is overtly exemplified in multiple *wh*-questions in Romanian: a *wh*-phrase cannot move outside an island, (15a), and it also cannot stay in its base-generated position, (15b). Instead the *wh*-phrase moves inside the island, to its edge (15c).

[6]Cheng and Demirdache (2010) propose a choice-function semantics for the interpretation of the questions they consider, which I will not adopt here. See section 6.2.2 for a brief discussion.

(15) **Overt multiple fronting in Romanian questions** (Ratiu, 2005, 2007)

a. ***Wh* can't move out of the island:**

* [$_{CP1}$ *cine$_i$ ce$_k$* [$_{IP1}$ t_i o cunoaşte pe studenta
who what CL.3.FS know PREP student
[$_{CP2}$ *căreia* i s-a dedicat t_k ieri?
which.DAT CL.DAT.3SG EXPL.AUX dedicated yesterday

b. ***Wh* can't stay in-situ:**

* [$_{CP1}$ *cine$_i$* [$_{IP1}$ t_i o cunoaşte pe studenta
who CL.3.FS know PREP student
[$_{CP2}$ *căreia* i s-a dedicat *ce$_k$* ieri?
which.DAT CL.DAT.3SG EXPL.AUX dedicated what yesterday

c. ***Wh* moves to the edge of the island:**

✓[$_{CP1}$ *cine$_i$* [$_{IP1}$ t_i o cunoaşte pe studenta
who CL.3.FS know PREP student
[$_{CP2}$ *căreia* *ce$_k$* i s-a dedicat t_k ieri?
which.DAT what CL.DAT.3SG EXPL.AUX dedicated yesterday

'Who knows the student to whom was dedicated what yesterday?'[7]

6.2.2 Other approaches to the semantics of multiple *wh*-questions

We have seen that intervention effects appear to affect a question whenever covert movement of an in-situ *wh*-expression is limited in some way—for example, when it is in a superiority-violating question, or when it is trapped in an island.[8] Hence, it is necessary to adopt an interrogative semantics that derives the meaning of a question from a mechanism that is able to interact with intervention effects of the sort described above. Under current theories of intervention, this would require an analysis of multiple questions that utilizes focus-alternatives in some way.[9]

To account for the interaction of multiple questions with islands and interveners we have seen above, we require a theory that also allows partial covert movement to positions

[7] Ratiu notes that this question only has a single-pair reading and not a pair-list reading.

[8] We will see additional cases of restricted movement that conform to this generalization in Chapter 4.

[9] This would be consistent with Beck's (2006) theory, which I adopt here, and I believe that it is also consistent with Mayr's (to appear) theory of intervention effects. It is unclear how to account for the pair-list observation under Grohmann's (2006) theory, which locates the ungrammaticality of intervention effects in the position of the intervener in the question. It is also not clear how to predict this fact from Tomioka's (2007b) theory, which attributes the ungrammaticality to conflicting prosodic demands in the question. However, I note that Tomioka does not extend his theory to *wh*-movement languages. I leave for further investigation the question whether only the pair-list reading is affected in *wh*-in-situ languages.

other than the interrogative C. Therefore, any theory that can only derive the meaning of a question (or, the pair-list reading of the question) when all *wh*-phrases have moved to C is unable to predict an interaction with intervention effects. This makes the seminal proposal by Karttunen (1977) as well as more recent variants of this proposal such as those in Dayal (2002); Fox (2012) and Nicolae (2013) untenable without substantial modification.

Two alternative theories have been proposed to derive the meanings of multiple questions (in particular, the list readings of such questions) without obligatory movement to C. One such approach is proposed in Cheng and Demirdache (2010), who use choice functions to derive pair-list readings of multiple questions with partial *wh*-movement or no movement to C. However, this theory does not combine with any viable theory of intervention effects, as it does not use focus-alternatives in the derivation of a question in this theory, and to the best of my knowledge no current theory of intervention predicts sensitivity of choice function mechanisms to the presence of an intervener. I leave open the question of whether such an account can be developed.

A second approach to the derivation of multiple questions has been proposed in Cable (2010), building on a suggestion by Pesetsky (2000). This proposal has been surveyed in section 1.5. The LF structures proposed in this theory are similar to the ones I have proposed in Chapter 2, but the semantics that is associated with the structure is different than the analysis I have developed here. Instead, following work by Dayal (1996), Cable (2010) suggests that natural languages possess a number of distinct complex interrogative heads that are able to assign a meaning to multiple questions with various syntactic structures. In particular, Cable proposes an interrogative head that is able to interpret structures with one moved *wh*-phrase and one in-situ *wh*-phrase.[10] This head is argued to be used in superiority-violating constructions in English, and in all German multiple questions. Such a head (but not the one that is used when multiple QPs have been fronted) is sensitive to intervention effects.

One interpretation of the data presented in this paper is that the same interrogative head is also used in certain superiority-obeying questions in English, when one or more *wh*-phrases are trapped in an island. This would be a welcome outcome, as Cable (2010) integrates his approach to question semantics with Beck's (2006) theory of intervention effects, which might permit us to explain the intervention effect facts that we have seen

[10]Such a head could be generalized so that it could deal with additional in-situ *wh*-phrases, for example in questions with three *wh*-phrases.

above. However, in order to adopt this proposal, we would have to adopt a change to Cable's theory that would allow partial movement of the kind we have seen here. Such a state of affairs is predicted not to be possible, as Cable proposes that all QPs that are not hosted in the interrogative Spec,CP undergo existential closure and become *wh*-indefinites. To preempt this existential closure, we would to introduce a notion of 'exempt positions' into the theory, where QP will not undergo existential closure. Such position will include, in addition to the interrogative C, at least Spec,*v*P and the specifiers of declarative C.[11] We would furthermore need to allow some change in the theory whereby partially-moved QPs are subject to interveners that occur above them. Currently, any *wh*-phrase that occurs inside a QP is predicted by Cable to be immune to intervention effects. I will not pursue such amendments to Cable's theory here but instead continue to use the semantics for Q-theory that I have proposed in Chapter 2, which I have argued is simpler furthermore provides a wider empirical coverage than Cable's proposal.

6.3 Partial movement is covert scrambling

6.3.1 Covert *wh*-movement as covert scrambling

Having seen not only processing evidence for partial movement but also offline judgment data supporting this kind of movement in superiority-obeying English questions, I now turn my attention to a discussion of the nature of this partial movement. As the data in Chapters 5-6 shows, the covert movement of the in-situ *wh* in superiority-obeying questions is not an unbounded long-distance movement, as often assumed, but instead a short QR-like movement, which is only extended in extraordinary cases, for example in order to avoid a structure that would be uninterpretable to allow for ellipsis resolution.

In this section I explore the idea that this covert partial movement step in superiority-obeying English questions should be thought of as *covert scrambling* or QR of the in-situ *wh*. The movement of the in-situ *wh* is, then, not an interrogative movement that should be modeled as QP-movement, but instead it should be characterized as an instantiation of a more general QR operation that applies to other nominals as well. Proposals that QR is in fact covert scrambling—not just in the case of *wh*-movement but more generally

[11] To be fair, the amendment to Cable's theory that I present here does not straightforwardly predict a relation between *wh*-phrases and *wh*-indefinites. See Chapter 7 for some discussion of how this could be integrated into the system I propose here.

whenever quantifiers participate in covert scope-taking operations—have been made for English in the previous literature (Diesing, 1992; Beck, 1996b; Johnson and Tomioka, 1997; Takano, 1998; Johnson, 2000b; Akahane, 2007; Miyagawa, 2011).[12,13]

For Johnson and Tomioka (1997); Johnson (2000b), the analysis of QR as covert scrambling is proposed in order to explain scope relations in quantified sentences, and in particular quantifiers' interpretation with respect to sentential negation. For Diesing (1992), covert scrambling affects English bare plurals, which must occur higher than their base position, in order to receive a generic interpretation (cf. Kratzer 1995). Thus, bare plurals can facilitate Antecedent Contained Deletion, since they are in fact not in-situ but have undergone a short movement step. This is in contrast to the definite DP, which does not make a good host for ACD (see Chapter 5 for more discussion of this issue):

(16) **Bare plurals facilitate ACD (Diesing, 1992, p. 94):**
Oscar usually reads books that Olga does.
cf. Oscar read the book that Olga did.

Recall that the position targeted by QR is the nearest *v*P, where the scrambled object presumably adjoins to *v*P above the original position of the external argument (Diesing, 1992; Johnson, 2000b; Fox, 2000; Bruening, 2001).[14] This is also the position to which short scrambling typically moves an item in languages such as Dutch and German.

Example (17), from Richards (2004), shows overt short scrambling in German. As German is head-final, no DP can follow the verb. Unscrambled pronouns, following negation, must be interpreted as stressed (contrastively focussed) to be licit. Full DPs may be scrambled above negation or they may remain below negation.

[12]More precisely, Takano (1998) argues that English exhibits obligatory covert object shift. I believe that this is equivalent to short covert scrambling, as I have been referring to this movement here, and as argued by the other authors cited here.

[13]See Hornstein (1995); Pica and Snyder (1995); Kitahara (1996) for related discussion and a proposal to model QR in terms of A-movement. See arguments against this approach, specifically against Hornstein (1995) but, I believe, extending to these other proposals as well, in Kennedy (1997); Johnson (2000a).

[14]Note that although QR is normally clause bound, that is not always the case. The following is an observation by Moltmann and Szabolcsi (1994), discussed by Fox (2000):

(i) **QR is not always clause-bound**
a. *One girl* knows that *every boy* bought a present for Mary. *one* > *every*, **every* > *one*
b. *One girl* knows what *every boy* bought for Mary. *one* > *every*, *every* > *one*

See further discussion of long-distance scrambling/QR and arguments against long-distance scrambling in Miyagawa (2011).

(17) **Optional overt short scrambling in German (Richards, 2004):**

a. Peter hat (es/das Buch) nicht (das Buch/*es) gelesen (*es/*das Buch)
Peter has (it/the book) not (the book/*it) read (*it/*the book)
'Peter didn't read (it/the book)'

b. ... daß Peter (das Buch/es) nicht (das Buch/*es) las (*das Buch/*es)
... that Peter (the book/it) not (the book/*it) read (*the book/*it)
'...that Peter didn't read (it/the book)'

Hallman (1997) shows that although full DPs in German can optionally remain in-situ, *wh*-phrases always obligatorily undergo a short scrambling step. The data is given in (18). We see that a full DP ('das Buch', 'die Maria') can occur on either side of the adverbial 'gestern,' but a *wh*-phrase may only appear above the adverbial.[15]

(18) **Obligatory overt short *wh*-scrambling in German (Hallman, 1997):**

a. *Wer* hat denn (das Buch) gestern (das Buch) gelesen?
who has *denn* (the book) yesterday (the book) read
'Who read the book yesterday?'

b. *Wer* hat denn (*was*) gestern (**was*) gelesen?[16]
who has *denn* (what) yesterday (what) read
'Who read what yesterday?'

c. *Wer* hat denn (die Maria) gestern (die Maria) angerufen?
who has *denn* (the Maria) yesterday (the Maria) called
'Who called Maria yesterday?'

d. *Wer* hat denn (*wen*) gestern (**wen*) gelesen?
who has *denn* (who) yesterday (who) read
'Who read who yesterday?'

Moreover, this short scrambling step in (18) does not result in freezing of the in-situ *wh*. In fact, a longer scrambling step can be observed in questions with interveners: a *wh*-phrase cannot remain below an intervener at LF, and instead must overtly scramble over it to avoid an intervention effect:

[15] I thank Phil Brannigan (p.c.) for bringing this data to my attention.
[16] Note that the *wh* can be interpreted as a *wh*-indefinite here (Martin Hackl, p.c.).

(19) **Overt scrambling obligatory to avoid intervention (Beck, 1996b):**

a. * *Wen* hat **niemand** *wo* gesehen?
whom has nobody where seen

b. *Wen* hat *wo* **niemand** gesehen?
whom has where nobody seen
'Where did nobody see whom?'

Given these similarities between the overt behavior of German and the covert behavior of English, I propose that the nature of the movement we have observed thus far in this dissertation for English—obligatory short covert movement to the edge of the nearest *v*P, with a longer step to a position above interveners taking place when necessary for interpretability—is the same as observed overtly in German. As a result, I argue here that the more parsimonious analysis of English is one that models English as identical to German, with the single exception that movement is covert in English, but overt in German.

I note that the proposal that covert *wh*-movement in superiority-obeying English questions should be modeled as covert scrambling makes an interesting prediction with regard to intervention effects. As we have seen in this chapter, we observe an intervention effect whenever a *wh*-word occurs inside an island and intervener occurs outside it, in a different clause. Given the proposal here, however, we should find difficultly whenever an intervener occurs in a higher clause than the intervener, since QR/scrambling is often assumed to be clause-bound:

(20) **Predicted intervention configuration: intervener in higher clause than *wh***
$[_{CP}\ QP_1\ Q_2\ [\ C\ [_{TP}\ t_1$ ...**intervener**... $[_{CP}\ wh_2$ ... t_2 $[_{vP}$ ... t_2 ...

We have already seen evidence that this behavior extends to embeddings with non-bridge verbs in (10). This seems to be correct, although the judgments are not uniform across all my consultants. If my proposal is on the right track, the variability in judgments should correlate with the extent to which QR is clause-bound for different speakers.

(21) **Finite embeddings as islands for extraction:**

a. ?? *Which* ling. **didn't** believe/claim/say [that we invited *which* phil.]?

b. *Which* ling. believed/claimed/said [that we **didn't** invite *which* phil.]?

6.3.2 Consequences for the theory of grammar and for acquisition

Modeling covert *wh*-movement as covert scrambling has several benefits for the theory of grammar. From a theoretical standpoint, we are able to provide a more constrained theory of movement, where covert *wh*-movement, QR, and scrambling are modeled as one and the same operation. This is conceptually superior to a theory that posits three different types of movement operations, each with its own properties, but all covert and therefore perhaps not easily acquired.[17]

The QR-as-covert-scrambling proposal thus allows a clear division of labor between syntax and semantics. If scope is determined by QR, and QR is the covert counterpart of scrambling, languages differ along a single parameter: whether they have overt scrambling (German) or covert scrambling (QR in English). As a consequence, cross-linguistic variation is restricted to different parameter settings in syntax, while the semantic component can be kept uniform across all language types, presumably a desirable result in itself (see also discussion in Lechner 2013).

This proposal is more generally advantageous for a discussion of learnability and language acquisition: one puzzle regarding the behavior of multiple questions and intervention effects is how they come to be acquired by children. The stimuli, and positive evidence for these phenomena in general, are quite impoverished. The patterns we have seen are complex, involving at least two *wh*-phrases and an additional intervener, and they are rare. How, then do native speakers converge on their adult grammars? This is puzzling under previous theories of multiple questions, which propose quite different LF structures for English and German, despite their similar surface appearance.

Here a natural answer to the question can be provided. The grammars of English and German are the same with respect to the syntax-semantics of questions and intervention effects, with the exception that scrambling is overt in German but covert in English. QR, modeled in terms of scrambling, affects not only in-situ *wh*-phrases in multiple questions, but is ubiquitous and affects all quantifiers in the language. The child must therefore learn not whether there is covert *wh*-movement in her target languages and what syntactic position this movement targets, but instead whether the language has overt scrambling—for which there is ample evidence in the child's input. If a language does not exhibit overt scrambling, then it must have covert scrambling. A language with overt scrambling will

[17] See additional discussion and predictions for the behavior of short vs. long scrambling as A-movement vs. $\overline{\text{A}}$-movement, respectively, in Mahajan 1990.

be scope rigid, while a language without overt scrambling will allow for a covert version of this operation, resulting possible scope ambiguities.

Finally, the view of *wh*-movement and QR as covert scrambling can be accommodated in a single output model of the grammar (Bobaljik, 1995; Groat and O'Neil, 1996; Fox and Nissenbaum, 1999; Pesetsky, 2000), in which overt and covert movement operations are not distinguished by relative timing, but rather they apply in a single cycle and are distinguished only by whether the higher or the lower copy of the movement chain is pronounced. Hence, we do not require the familiar T model of grammar, under which 'covert' operations are operations that occur after the split in the grammar which takes a single input and leads to separate phonological (PF) and semantic (LF) representations.

6.3.3 A note on cross-linguistic variation

Above I argued that covert *wh*-movement in English should be modeled as covert scrambling, parallel to an overt scrambling step observed in similar German questions. This view has advantages for restricting the scope of cross-linguistic variation and the typology of natural languages, in reducing the difference between English and German to a single parameter. As is well known, cross-linguistic variation extends beyond *wh*-movement languages such as English and German. Here I briefly discuss how my view of covert movement fits with fully *wh*-in-situ languages and multiple *wh*-fronting languages.

Wh-in-situ languages are languages in which no overt movement is observed as part of the construction of *wh*-questions. At least two types of languages are predicted by Cable's (2010) theory—and by extension, by the proposal I have made in this dissertation—to exist. We expect to find languages in which projecting Q-particles merge with *wh*-phrases, much as they do in English, and are moved to Spec,CP for interpretation. Other languages may only use non-projecting Q-particles to interpret *wh*-words that are truly LF-in-situ. Cable (2010, ch. 3) discusses this predicted typology, and argues that Sinhala is a language of the former type, and that Japanese and Korean are languages of the latter type. I refer the reader to Cable for details regarding this claim. When covert QP-movement is unavailable in a language, we predict that intervention effects should only be ameliorated if an in-situ *wh*-word can be given wide scope over the intervener through other means. Languages like Japanese and Korean allow overt scrambling, and indeed are reported to behave like German in requiring scrambling of the *wh* above an intervener to avoid

intervention effects (cf. Beck, 2006; Beck and Kim, 2006; Tomioka, 2007b, a.o.).

Multiple *Wh*-fronting languages, such as Bulgarian, Romanian, and Russian, involve fronting of all the interrogative elements in the question. These languages, then must have a requirement for multiple specifiers of C to be filled, as proposed e.g. in Pesetsky (2000). This requirement does not stem from the semantic system put in place in this dissertation, but must instead be driven by the needs of the syntax. I note that in such languages, the availability of a scrambling operation is irrelevant, as following any short scrambling step in the derivation, all QPs must end up in Spec,CP positions. I will not explore these types of languages further in this dissertation.

6.3.4 On the modeling of scrambling

A final issue I would like to address in this section is how covert *wh*-scrambling should be modeled. As we have seen in Chapter 4 and in the current chapter, other movement operations beside QP-movement may apply to *wh*-phrases. These include A-movement, Right-Node Raising, Extraposition, and—if I am correct about the interpretation of the results of Chapter 5 and the current chapter—QR/scrambling. All of these operations appear not to only apply to the *wh*-word alone, but instead to involve pied-piping.

Therefore, German, and if I am correct, English too, must have at its disposal a general mechanism of scrambling that can apply not only to interrogative phrases but other nominals—pronouns, definite DPs, and quantifiers—with pied-piping. If so, scrambling should not receive a treatment in terms of interrogative QP-movement, as I have done in Chapter 5, but instead must receive whatever treatment one generally proposes for scrambling. As Cable (2010) himself notes, not only interrogative movement but other types of $\overline{\text{A}}$-movement operations as well exhibit pied-piping. For example, focus movement and relativization also allow pied-piping (data from Cable (2010), p. 200–201):

(22) **Pied-piping with focus movement:**

a. I've read John's book, but [DAVE's book], I haven't read.

b. * I've read John's book, but [DAVE's]$_1$, I haven't read [t_1 book]

(23) **Pied-piping with relative pronouns:**

a. The man [$_{\text{CP}}$ [$_{\text{DP}}$ *whose* father]$_1$ I met t_1]

b. * The man [$_{\text{CP}}$ [*whose*]$_1$ I met [t_1 father]]

Note, moreover, that different kinds of movements allow for different sizes of pied-piping. As originally noted by Ross (1967), relativization allows for large pied-piping:

(24) **Different sizes of pied-piping possible with relativization:**

a. Reports [*which*] the government prescribes the height of the lettering on the covers of are invariably boring.

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

d. Reports [the height of the lettering on the covers of *which*] the government prescribes should be abolished.

A correspondingly large pied-piping in questions is not possible:

(25) **Similarly large *wh*-pied-piping is not possible:**
*[The height of the lettering on the covers of *which* reports] did the government prescribe?

Free and headed relatives are similar to *wh*-questions in many ways, but as originally noted in Grosu (1989), free relatives contrast with headed relatives (and *wh*-questions) in their ability to pied-pipe (data from Horvath 2006):

(26) **Relatives with an overt head can pied-pipe additional material:**

a. The picture [*which*] you bought

b. The person [*whose* picture] you lost

c. The person [*whose* mother's picture] is hanging on the wall

(27) **Free relatives cannot pied-pipe additional material:**

a. I like [*what*] you bought.

b. I admire [*whose* picture] you lost.

c. * [*Whose* mother's picture] is hanging on the wall should be fired.

In Hungarian, relativization and focus-movement show different behavior with respect to pied-piping:

(28) **Relativization and focus movement pied-pipe different size material in Hungarian (Horvath, 2007, p. 11–12):**

a. * a filmszinésznő [[*néhány akiről írt könyvet*] láttam ____
the movie-actress some whom-about written book-ACC saw-1SG
a polcon] ...
the shelf-on...
'the movie-star a few books written about whom I saw on the shelf ...'

b. [*Néhány MARILYN MONROERÓL írt könyvet*] láttam ____
some M. M.-about written book-ACC saw-1SG
a polcon].
the shelf-on.
'It's a few books written about MARILYN MONROE that I saw on the shelf.'

Cable (2010, section 6.2) briefly discusses the possibility of modeling these different types of $\overline{\text{A}}$-bar movement with pied-piping within Q-theory as triggered by different types of Q heads such as Q_{FOC} and Q_{REL}, but he does not reach a definitive conclusion. In the following section I will present an analysis of covert scrambling modeled in terms of QP-movement, to illustrate how this movement could be integrated with the proposal I have developed in Chapter 2. As we will see, the details of the proposal will be quite complex, since it will derive all interrogative movement in terms of QP-movement. I present this analysis in order to demonstrate that such an analysis is possible and fits with the existing theory. However, if the discussion here is on the right track, scrambling should be modeled separately from QP-movement through an independent scrambling operation that determines the size of pied-piping independently than in interrogative QP-movement, allowing us to retain the theory proposed in Chapter 2 without changes.

6.4 Modeling partial movement with QPs

In this section I show how the notion of "partial movement" can be formally integrated into the interrogative syntax-semantics system that I developed in Chapter 2. As we will see, the assumptions that must be made in order to model partial *wh*-movement, or covert *wh*-scrambling, as QP-movement are quite complex. I will end this section by arguing that instead of adopting these assumptions, the proposal made in the previous section—that partial movement should be viewed as a form of covert scrambling—is preferable.

6.4.1 The syntax of partial movement

In Chapter 2 I developed a theory of interrogative syntax-semantics building on the syntax of *wh*-movement and pied-piping in Cable (2007, 2010). Following evidence from Pesetsky (2000) that the in-situ *wh* in superiority-obeying English questions can host an ACD gap and that superiority-obeying questions are immune from intervention effects, their derivation has been argued to involve covert movement of the in-situ *wh*-phrase to C. The in-situ *wh* in superiority-violating questions, on the other hand, cannot host an ACD gap and furthermore such questions are subject to intervention effects. Their derivation has thus been argued not to involve covert *wh*-movement.

In my Q-based proposal in Chapter 2, I argued that superiority-obeying can contain as many QPs as *wh*-phrases, and that these QPs are (normally) able to move to C, above potential interveners in the question. In superiority-violating questions, on the other hand, it was necessary not to merge the higher *wh* with a Q-particle, so that the lower *wh*, contained inside a QP, can be the first target of interrogative probing. This allows the lower QP to move to the outermost specifier of CP, deriving the superiority-violating word-order. The higher *wh* in the question, which was left in-situ, is interpreted by a Q-particle in the CP-layer using focus-alternatives. This predicts sensitivity to intervention effects above the in-situ *wh*.[18]

(29) **The structure of superiority-obeying and superiority-violating questions:**

a. $[_{CP}\ [_{QP_1}\ Q\ wh_1\ ]\ [_{QP_2}\ Q\ wh_2\ ]\ \ [\ C\ [_{TP}\ \ldots\ t_1\ \ldots\ t_2\ ]]]$ superiority-obeying

b. $[_{CP}\ [_{QP_2}\ Q\ wh_2\ ]\ \ Q_1\ \ [\ C\ [_{TP}\ \ldots\ wh_1\ \ldots\ t_2\ ]]]$ superiority-violating

[18] For simplicity, these schemas do not represent the obligatory movement step of Q out of QP, occurring in the CP layer.

The single-pair and pair-list readings of a multiple question are derived from minimally different LFs, varying only in the number and placement of Q-particles in the derivation. The LFs in (29) show the derivation of the pair-list reading. The single-pair reading can be derived by moving all the Q-particles above all of the *wh*-elements, or alternatively by having only one Q-particle—merged with the overtly fronted *wh*—in the derivation.

The analysis proposed here is thus on par with other recent proposals for the syntax of multiple questions (Pesetsky, 2000; Cable, 2010), and, I believe, fares better in terms of the semantics. However, the semantics I have proposed underdetermines the observed syntactic behavior of superiority-obeying English questions. In Chapter 5 and in the current chapter, we have seen evidence that the in-situ *wh* undergoes a QR-like movement step, which does not target C. In terms of Q-theory, we must assume that a QP is *always* constructed on top of the in-situ *wh*, even though, as sketched in Chapter 2, nothing would go wrong if one is not constructed (unless an intervener is present). We must furthermore assume that QP does not move to C, but instead undergoes a short movement step, followed by a long movement step of Q out of QP, which targets Spec,CP.

Thus, we see a tendency to maximize the number of QPs in a structure. In a superiority-obeying question, it is possible to have as many QPs as *wh*-phrases. In a superiority-violating question, it is necessary to have a higher in-situ *wh* that is not merged with a Q-particle in order to yield the correct word order and meaning of the question.

(30) **The QP preference principle:**
Construct as many QPs as possible in a derivation, unless doing so would change the meaning of the question.

We additionally see a preference for the *smallest* covert QP-movement step that would yield an interpretable structure (but note that *no movement* is not entertained here):

(31) **The laziness principle:**
Prefer the smallest QP step movement that would lead to an interpretable structure for the question.

6.4.2 The semantics of partial movement

In this section I present derivations for superiority-obeying and superiority-violating English questions, given the addition of partial movement to the theory. The proposed derivation for simplex questions, discussed in section 2.3.2, remains unchanged. I furthermore illustrate the derivation of a superiority-obeying question with an island, of the kind we have been discussing in this chapter.

Before getting started, let us remind ourselves of the ingredients of the semantics I propose for *wh*-questions. Note that the addition of partial movement to the theory does not affect the semantics of *wh*-questions. The meanings assigned to the three interrogative ingredients in a question are given below. *Wh*-words are analyzed as Hamblin-sets; the Q-particle lifts the focus-semantics of its sister to be the ordinary semantic value of the structure; and C does not contribute to the semantics of a question.

(32) **The semantics of interrogative particles:**

a. **The semantics of *what*:**
Ordinary semantic value: $[\![\textit{what}]\!]^o$ is undefined
Focus-semantic value: $[\![\textit{what}]\!]^f = \{x_e : x \in \text{non-human}\}$

b. **The semantics of the Q-particle:**

i. $[\![\text{Q}\ \alpha_\sigma]\!]^o = [\![\alpha_\sigma]\!]^f$

ii. $[\![\text{Q}\ \alpha_\sigma]\!]^f = \{[\![\text{Q}\ \alpha_\sigma]\!]^o\}$ $\qquad \sigma \in \{\langle s,t\rangle, \langle st,t\rangle, \langle\langle st,t\rangle,t\rangle, ...\}$

c. **The semantics of the Complementizer:**
$[\![\text{C}]\!] = \lambda P_\tau.\ P$

Partial movement results from a type-mismatch

At the outset of this section, I adopt the two principles introduced above, requiring the construction of as many QPs as possible in a question, and preferring the smallest QP-movement step that yield san interpretable structure. As we have seen, these assumptions are not predicted by the semantics I present here, but are required in order to explain the online and offline behavior of questions with regard to processing and intervention.

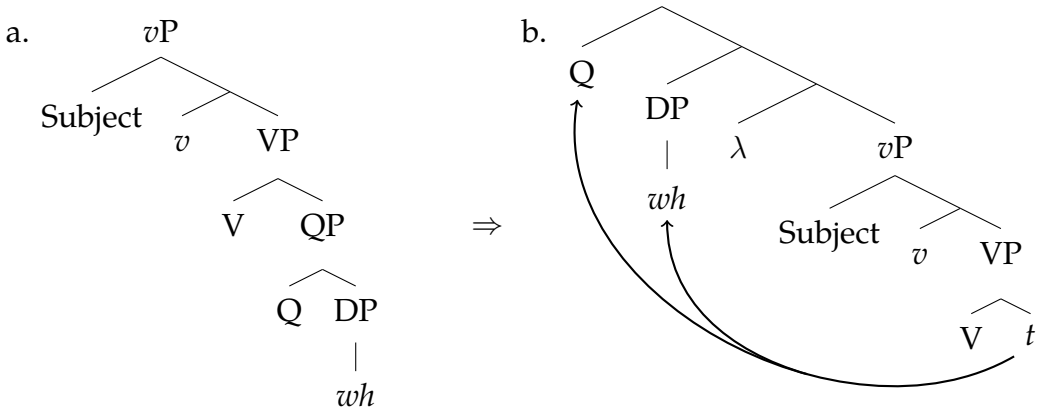
Above I proposed that the covert movement observed in superiority-obeying multiple questions resembles QR in targeting the nearest propositional type node in the structure. With that in mind, let us examine more closely the behavior of QPs in questions. Semantically, Q is an operator that applies to an element with an intensionalized propositional type that contains alternatives, and lifts it into the ordinary semantic value of the structure. Therefore, when Q merges with a nominal sister of (intensional) type $\langle s, e\rangle$ or $\langle s, \langle et, t\rangle\rangle$ to create a QP that will become the target of syntactic probing and movement operations, this operation necessarily results in a type mismatch. That is, Q plays two roles in the interrogative system developed here: syntactically, it drives interrogative movement when it projects a QP; semantically, it interprets the question by moving out of QP to the C layer and constructing a suitable input for the *Ans* operator.

In Chapter 2, I assumed that the type-mismatch was repaired by a simple movement of Q out of QP in Spec,CP. In this chapter, I explore the possibility of replacing this operation with a more complex operation, Q-Fission.[19] The purpose of this operation is to ensure that Q-movement can only happen as part of QP-movement and not in QP's base position.[20] This is necessary in order to explain the processing data we saw in Chapter 5. Q-Fission involves two steps: a short QR step of the DP sister of Q, and separate movement of Q above this structure, adjoining to the clausal spine. This is illustrated in the schema in (33):

[19]This is inspired by the morphological Fission operation, which takes a complex input and separates it into its components (Halle, 1997, a.o.). I thank Michael Yoshitaka Erlewine for suggesting this term.

[20]This would amount to the immediate destruction of QP, without evidence that QP was ever constructed.

(33) **Q-Fission:**



As noted above, I assume that Q-Fission can only apply when movement has occurred: a moved complex node can be taken out into a separate workspace in the process of movement, and separated into its two daughters. The daughters are then merged back into the tree separately, using a single λ-abstraction step. A Q-particle cannot detach from its sister in-situ. This is similar to the observation that floated quantifiers cannot be stranded in-situ, but instead only when movement has occurred (Sportiche, 1988):[21]

(34) **Quantifier float possible when movement has occurred (Harwood, 2011, p. 5):**

a. The buildings were all demolished.

b. * The buildings were demolished all.

While the data above might be explained as a ban on stranding *all* as the rightmost element in the sentence, data from German shows that this alone cannot explain the behavior of quantifier float (Martin Hackl, p.c.):[22]

(35) **Quantifier float possible when movement has occurred (German):**

a. Die Kinder haben alle gut Klavier gespielt.
the children have all well piano played
'The children all played the piano well.'

b. * Die Kinder haben gut alle Klavier gespielt.
the children have well all piano played

[21] It may be possible to use Fission in the analysis of floating quantifiers to explain this behavior, but I leave this issue for future work. See Bošković (2004, To appear); Harwood (2011) for a refinement of the descriptive generalization in Sportiche (1988). The details of this discussion need not concern us here.

[22] *Höflich* and *gut* represent low *v*P adverbs. *Gerne*, is a higher adverb, attaching at least as high as TP.

(36) a. Ich lade die Kinder gerne alle ein.
I invite the children happily all VERB-PRT
'I happily invite all of the children.'

b. Ich lade die Kinder alle höflich ein.
I invite the children all hopefully VERB-PRT
'I hopefully invite all of the children.'

c. * Ich lade die Kinder höflich alle ein.
I invite the children hopefully all VERB-PRT

Note that Q-Fission must not leave separate traces for the Q-movement and DP-movement steps, as this will result in a type mismatch and a crash of the derivation. However, here we see both Q and DP moving to the first node at which they can be integrated into the structure. This follows from the "laziness principle" introduced above, but more generally from the mechanism of QR, which, all things being equal, targets the closest position of the right type in the structure.[23] Further QP-movement step above this closest landing site will only take place if it is necessary, for example to avoid an intervention effect. This is similar to the overt scrambling step observed in German: if an intervener is present, *wh* must scramble above it in order to obtain an interpretable structure.

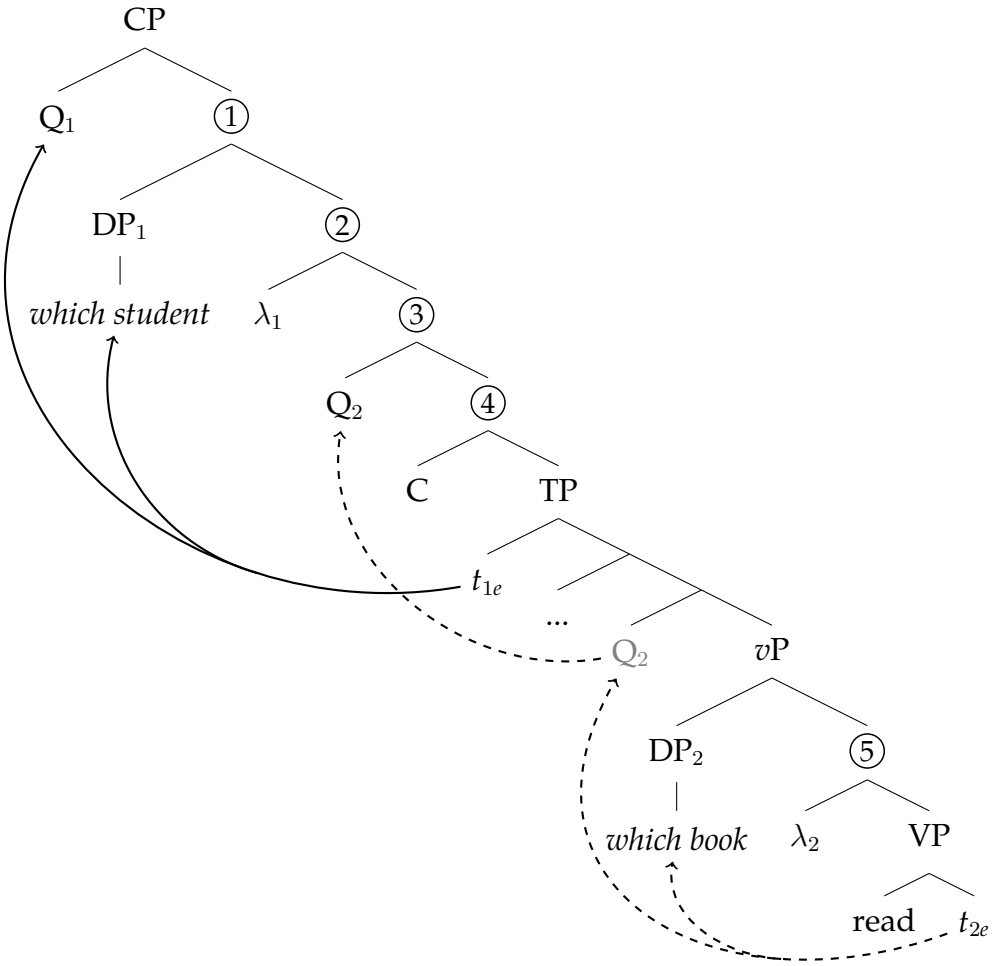
A final note is in order, before moving to the derivations. The schema in (33b) shows Q moving to a position just above *v*P. Although Q can compose with this structure without a type mismatch, notice that at this point, additional material cannot compose above this node: Q will return a set of propositions as the ordinary meaning of *v*P, and our semantics will not allow us to compose this set with additional material, unless a new functional application rule is introduced into the system. In order to avoid a crash in the derivation, Q will have to move to the interrogative CP layer, where a meaning of a set of propositions can serve as input to the *Ans* operator, yielding a convergent meaning for the structure.

[23] See Miyagawa (1995, et seq.), Bruening (2001), for an explanation of the motivation for QR in terms of a formal EPP feature or in terms of Edge Features in the sense of Chomsky (2008).

The derivation of superiority-obeying questions

I first show the derivation of the pair-list reading of superiority-obeying questions. In such questions, all the Q-particles project QPs. The tree in (37) illustrates the LF of the question *Which student read which book?*. Here, we construct two QPs, corresponding to the two *wh*-phrases in the question. The higher QP_1 is attracted by the probe to C, to satisfy C's EPP property. At this point it undergoes Fission, with Q_1 occurring above its sister in Spec,CP.[24] The lower QP_2 undergoes partial movement to the edge of *v*P, with Fission. Q_2 moves alone from this position to C, stranding its sister, and tucking in below QP_1.[25]

(37) **The LF of a superiority-obeying multiple question:**



[24]Note that the first interrogative movement step in any English and German question must target C. If Q-Fission happens at an earlier stage in the derivation and Q moves alone to Spec,CP, C's EPP requirement will not be satisfied, since Q is a null element.

[25]For simplicity, here and below I do not show the *v*P-internal base-generated position of the subject QP_1. A more complete derivation would show a familiar A-movement step of QP_1 from Spec,*v*P to Spec,TP, before

The derivation of (37) is given in (38). This derivation proceeds similarly to the derivation for the same question that I presented in Chapter 2, with one difference: the partial movement of QP_2 results in a larger portion of the structure, starting with node ⑤ and up to node ③, where focus-alternatives are computed point-wise and the structure does not have an ordinary semantic value. Q_2 turns this focus-semantic value into an ordinary semantic value. QP_1 composes with this structure and yields a family of questions denotation for the question, which can be paraphrased as follows: "for every individual in the domain of students, answer the question: which book did that individual read?"

(38) **The derivation of a superiority-obeying multiple question:**

a. $[\![vP]\!]^o = \lambda w.\ x$ read y in w

b. $[\![⑥]\!]^o = \lambda y.\ \lambda w.\ x$ read y in w

c. $[\![DP_2]\!]^o$ is undefined
$[\![DP_2]\!]^f = \{y_e : y \in book\}$

d. $[\![⑤]\!]^o$ is undefined
$[\![⑤]\!]^f = \{\lambda w.\ x$ read y in $w : y \in book\}$

e. $[\![TP]\!]^o$ is undefined
$[\![TP]\!]^f = \{\lambda w.\ x$ read y in $w : y \in book\}$

f. $[\![④]\!]^o = [\![TP]\!]^o = \{\lambda w.\ x$ read y in $w : y \in book\}$

g. $[\![③]\!]^o = [\![④]\!]^f = \{\lambda w.\ x$ read y in $w : y \in book\}$
$= \lambda q_{\langle s,t\rangle}.\ \exists y \in book\ [q = (\lambda w.\ x$ read y in $w)]$

h. $[\![②]\!]^o = \lambda x.\ \lambda q_{\langle s,t\rangle}.\ \exists y \in book\ [q = (\lambda w.\ x$ read y in $w)]$

i. $[\![DP_1]\!]^o$ is undefined
$[\![DP_1]\!]^f = \{x_e : x \in student\}$

j. $[\![①]\!]^o$ is undefined
$[\![①]\!]^f = \{\{\lambda w.\ x$ read y in $w : y \in book\} :\ x \in student\}$

k. $[\![CP]\!]^o = [\![①]\!]^f = \{\{\lambda w.\ x$ read y in $w : y \in book\} :\ x \in student\}$
$= \lambda Q_{\langle st,t\rangle}\ .\ \exists x \in student\ [Q = \lambda q_{\langle s,t\rangle}.\ \exists y \in book\ [q = (\lambda w.\ x$ read y in $w)]]$

Note that if Q_2 moves to a position above node ① (above or below Q_1 in the tree), we yield a single-pair reading for the question. See the discussion of how this comes about in section 2.3.6. In short, when all Q-particles occur above all the *wh*-elements in the question, those elements will all point-wise compose with one another to yield a flat set

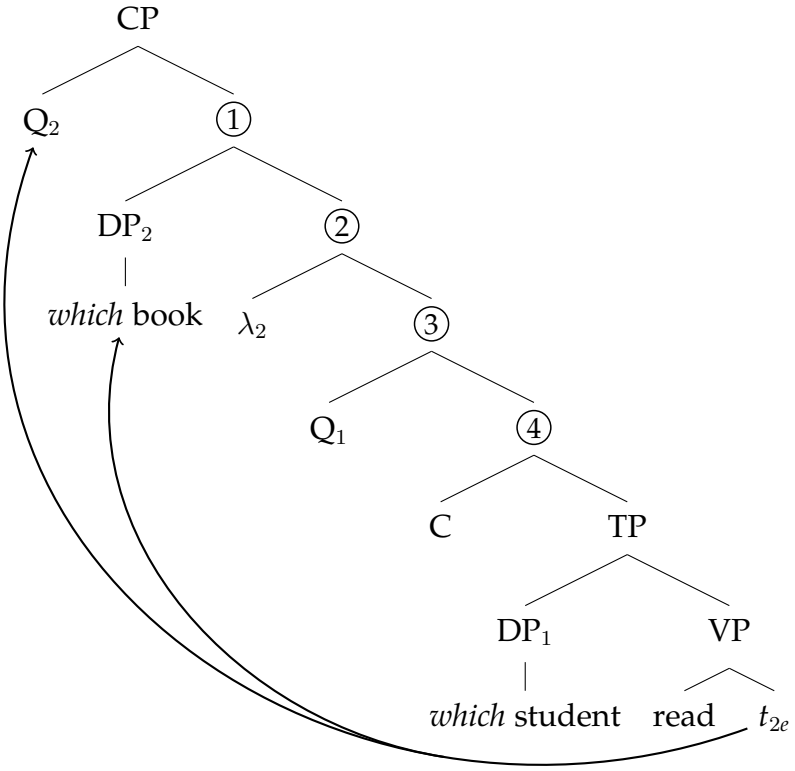
the $\overline{A}$-movement step to C. I also do not show successive-cyclic movement.

of propositions. Q will turn this set into the ordinary semantic value of the question. The presupposition of the question, that it must have a unique maximal answer, guarantees that only one proposition in this set can be true, yielding a single-pair reading.

The derivation of superiority-violating questions

We now turn to the derivation for a superiority-violating question, e.g. *Which book did which student read?*. Here, only one QP is constructed, on the lower wh_2. *Which student* is interpreted using a non-projecting Q-particle in the CP layer. The interrogative probe on C finds QP_2 and moves it (successive-cyclically) to Spec,CP, satisfying C's EPP requirement. In the final step of this successive cyclic movement, Q-Fission applies so that Q_2 occupies a position immediately above its sister, DP_2, in the CP layer. A non-projecting Q_1 is generated below DP_2 to yield a pair-list reading of the question. The proposed LF for this question is shown in (39):[26]

(39) **The LF of a superiority-violating question:**



[26] As in other derivations, I abstract away from the *v*P-internal subject position and movement to Spec,TP.

The derivation of the meaning of this question is given in (40). Note that TP contains DP_1, which only has a focus-semantic value, and therefore TP too only has a focus-semantic value but no ordinary semantic value. C passes up the value of TP, and Q_2 turns this value into an ordinary semantic value of node ③. This meaning is assignment dependent, since it contains a free variable which is abstracted over at node ②. At node ① we point-wise compose the set of propositions computed at ② with DP_2, which contains a *wh*-phrase and hence does not have an ordinary semantic value. Q_1 takes this set of questions and returns it as the meaning of CP. We yield a family of questions meaning, which can be paraphrased as follows: "for every individual in the domain of books, answer the question: which student read that book?"

(40) **The derivation of a superiority-violating question:**

a. $[\![DP_1]\!]^o$ is undefined
$[\![DP_1]\!]^f = \{x_e : x \in \textit{student}\}$

b. $[\![TP]\!]^o$ is undefined
$[\![TP]\!]^f = \{\lambda w.\ x \text{ read } y \text{ in } w : x \in \textit{student}\}$

c. $[\![④]\!]^o = [\![TP]\!]^o$ is undefined
$[\![④]\!]^f = [\![TP]\!]^f = \{\lambda w.\ x \text{ read } y \text{ in } w : x \in \textit{student}\}$

d. $[\![③]\!]^o = [\![③]\!]^f = \{\lambda w.\ x \text{ read } y \text{ in } w : x \in \textit{student}\}$
$= \lambda q_{\langle s,t\rangle}.\ \exists x \in \textit{student}\ [q = (\lambda w.\ x \text{ read } y \text{ in } w)]$

e. $[\![②]\!]^o = \lambda y.\ \lambda q_{\langle s,t\rangle}.\ \exists x \in \textit{student}\ [q = (\lambda w.\ x \text{ read } y \text{ in } w)]$

f. $[\![DP_2]\!]^o$ is undefined
$[\![DP_2]\!]^f = \{y_e : y \in \textit{book}\}$

g. $[\![①]\!]^o$ is undefined
$[\![①]\!]^f = \{\{\lambda w.\ x \text{ read } y \text{ in } w : x \in \textit{student}\} :\ y \in \textit{book}\}$

h. $[\![CP]\!]^o = [\![①]\!]^f = \{\{\lambda w.\ x \text{ read } y \text{ in } w : x \in \textit{student}\} :\ y \in \textit{book}\}$
$= \lambda Q_{\langle st,t\rangle}\ .\ \exists y \in \textit{book}\ [Q = \lambda q_{\langle s,t\rangle}.\ \exists x \in \textit{student}\ [q = (\lambda w.\ x \text{ read } y \text{ in } w)]]$

As with the superiority-obeying question above, we yield a single-pair reading of the question if Q_1 moves above DP_2. See the discussion above and in section 2.3.6 for details. See section 6.5.1 below for discussion of whether such a move should be allowed.

The derivation of questions with islands

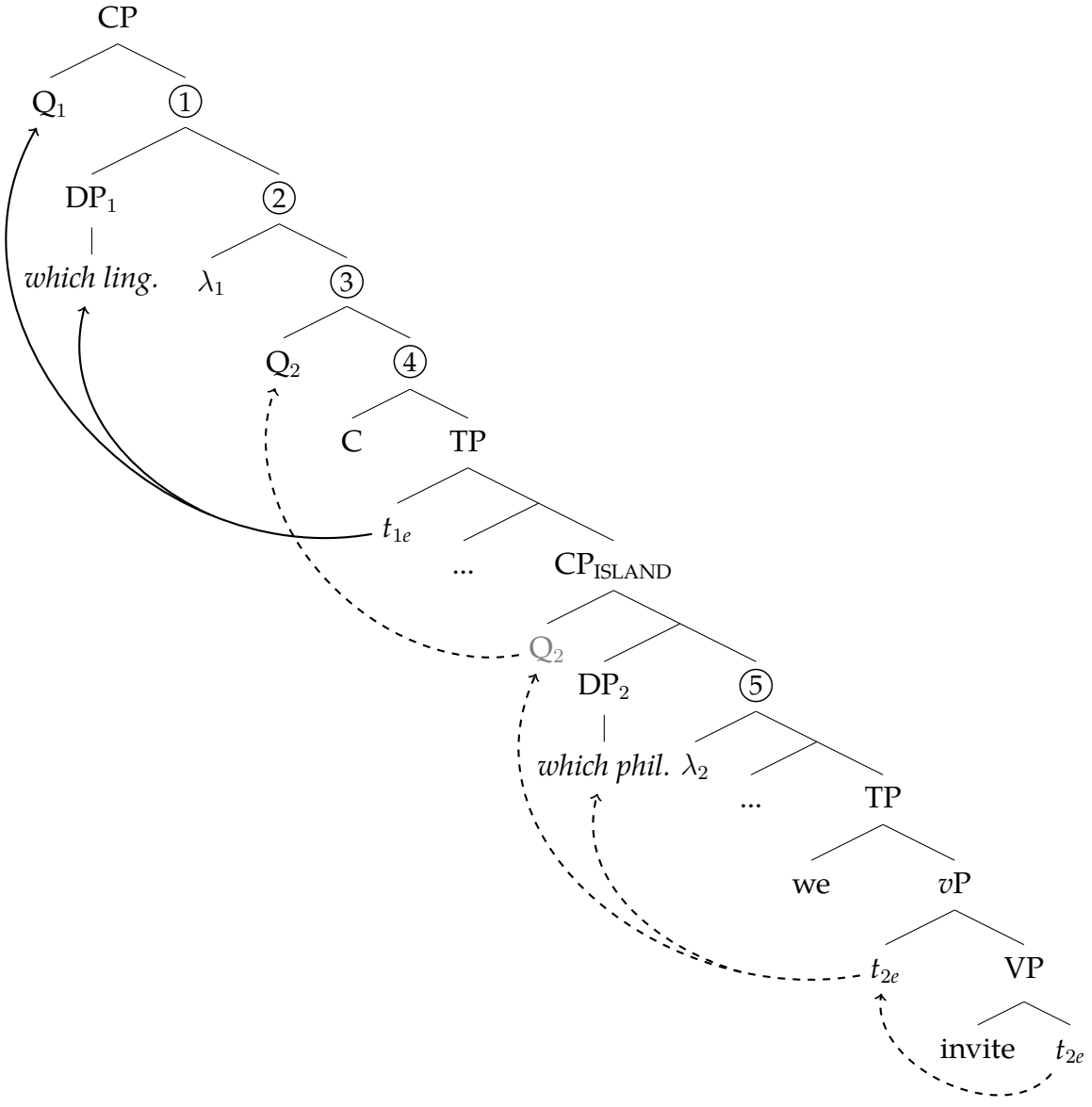
Finally, I turn to the derivation of questions with islands, e.g. *Which linguist will be offended if we invite which philosopher?*. This derivation proceeds like a regular superiority-obeying

question, with the exception that QP movement is restricted to the island itself. I illustrate this by showing movement to the edge of the island in (43). I assume that QP movement cannot escape the island, but Q-movement is not restricted in this way:

(41) **A restriction on movement out of islands:**
Phrasal movement cannot escape islands, but feature movement is unrestricted. That is, QP-movement cannot leave an island, but Q-movement can.

An LF for a question with an island is given in (42):

(42) **The derivation of a superiority-obeying question with an island:**



Here, QP_2 moves to the island's edge, and the restriction on QP movement out of islands then requires that Q moves alone from there to C. This is in contrast to in ordinary superiority-obeying questions, where I have argued that a longer step of QP-movement, beyond the partial movement step motivated in Chapter 5 is possible, for example in order to avoid an intervention effect. In (42), such movement is blocked by the island, and we therefore predict sensitivity to intervention effects above the island.

The derivation of the LF in (42) is given in (43). Again, here I illustrate the derivation of a pair-list reading. The single-pair reading will be obtained if Q_2 moves above DP_1.

(43) **The derivation of a superiority-obeying question with an island:**[27]

a. $[\![⑤]\!]^o = \lambda x.\ \lambda w.$ we invite x in w

b. $[\![DP_2]\!]^o$ is undefined
$[\![DP_2]\!]^f = \{y : y \in \textit{philosopher}\}$

c. $[\![CP_{ISLAND}]\!]^o$ is undefined
$[\![CP_{ISLAND}]\!]^f = \{\lambda w.$ we invite y in $w : y \in \textit{philosopher}\}$

d. $[\![TP]\!]^o$ is undefined
$[\![TP]\!]^f = \{\lambda w.\ x$ will be offended if we invite y in $w : y \in \textit{philosopher}\}$

e. $[\![④]\!]^o = [\![TP]\!]^o$ is undefined
$[\![④]\!]^f = [\![TP]\!]^f = \{\lambda w.\ x$ will be offended if we invite y in $w : y \in \textit{philosopher}\}$

f. $[\![③]\!]^o = [\![④]\!]^f = \{\lambda w.\ x$ will be offended if we invite y in $w : y \in \textit{philosopher}\}$
$= \lambda q_{\langle s,t\rangle}.\ \exists y \in \textit{philosopher}\ [q = \lambda w.\ x$ will be offended if we invite y in $w]$

g. $[\![②]\!]^o = \lambda x.\lambda q_{\langle s,t\rangle}.\exists y \in \textit{philosopher}\ [q = \lambda w.x$ will be offended if we invite y in $w]$

h. $[\![DP_1]\!]^o$ is undefined
$[\![DP_1]\!]^f = \{y_e : y \in \textit{linguist}\}$

i. $[\![①]\!]^o$ is undefined
$[\![①]\!]^f = \{\{\lambda w.\ x$ will be offended if we invite y in $w : y \in \textit{phil.}\} : x \in \textit{ling.}\}$

j. $[\![CP]\!]^o = [\![①]\!]^f = \{\{\lambda w.\ x$ will be offended if we invite y in $w : y \in \textit{phil.}\} : x \in \textit{ling.}\}$
$= \lambda Q_{\langle st,t\rangle}.\ \exists x \in \textit{linguist}\ [Q = \lambda q_{\langle s,t\rangle}.\ \exists y \in \textit{philosopher}$
$[q = \lambda w.\ x$ will be offended if we invite y in $w]]$

[27] I will not give a detailed analysis of the conditional here.

Multiple questions in German

A final point to note in this section is that *partial movement* and its modeling in this chapter do not affect the analysis I have proposed for multiple questions in German. As discussed in section 2.4.3 above, I assume that the possibility of overt scrambling in German makes covert scrambling/QP-movement impossible. This means that the derivations for all German questions have the structure that I have proposed for superiority-violating questions in English, as shown above. See also section 2.4.3.

6.4.3 Predictions for intervention effects

Turning our attention to the pattern of intervention effects predicted by the current proposal, this proposal predicts more instances of intervention than traditionally expected:

(44) **Predictions for intervention effects in English multiple questions:**

a. In all superiority-violating questions, above the in-situ *wh*.

b. Inside QPs, between *wh* and Q.[28]

c. Above the landing site of the covertly moved QP in superiority-obeying questions, if QP-movement is restricted to a position below an intervener.

The prediction in (44a) has been well established for English.[29] The prediction in (44b) has been verified for overt pied-piping in English and in German. It will be shown to hold for covert pied-piping in Chapter 3. The prediction in (44c) is contrary to the common belief that superiority-obeying questions in English are immune from intervention effects, but it is supported by the data presented in Chapter 4 and by findings of the current chapter: QP can normally covertly move above an offending intervener at LF, and therefore such questions do not normally exhibit intervention effects. However, when movement is restricted, e.g. using islands or variable binding, intervention re-emerges.

The schemas below illustrate how the LFs I have proposed above explain the fact that intervention effects are observed *above* an island in a superiority-obeying question but not *inside* it: QP can move farther than the nearest *v*P, to a landing site above an intervener that occurs *inside* the island, (45a), but QP cannot escape the island. Instead, only Q-movement is possible above the island. Q and *wh* are related via focus-alternatives and therefore the introduction of an intervener outside the island causes an intervention effect, (45b).[30]

[28] More precisely, between *wh* and the moved Q, which is adjoined to the spine above QP.

[29] But see Chapter 4 for some exceptions; those exceptions do not affect the discussion here.

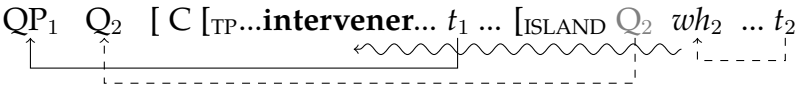
(45) **Superiority-obeying questions with restricted movement and intervention:**

a. No intervention when intervener is *inside* the island:

✓ [$_{CP}$ QP_1 Q_2 [C [$_{TP}$ ... t_1 ... [$_{ISLAND}$ t_Q wh_2 ...**intervener**... t_2 ...

b. Intervention when intervener is *above* the island:

* [$_{CP}$ QP_1 Q_2 [C [$_{TP}$...**intervener**... t_1 ... [$_{ISLAND}$ Q_2 wh_2 ... t_2 ...



As discussed in section 6.2, an alternative derivation we might entertain is that Q is adjoined to the island and projects a QP. This would allow pied-piping of the entire island (cf. Nishigauchi, 1990). However, such a derivation yields incorrect predictions for the behavior of intervention effects in questions with islands, as sketched in (46):

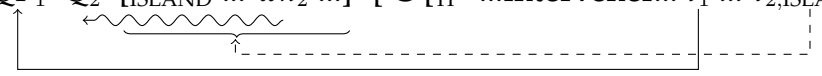
(46) **The opposite (incorrect) predictions are made if the entire island is pied-piped:**

a. Intervention when intervener is *inside* the island:

* [$_{CP}$ QP_1 Q_2 [$_{ISLAND}$ ...**intervener**... wh_2 ...] [C [$_{TP}$... t_1 ... $t_{2,ISLAND}$ ...

b. No intervention when intervener is *above* the island:

✓ [$_{CP}$ QP_1 Q_2 [$_{ISLAND}$ ... wh_2 ...] [C [$_{TP}$ ...**intervener**... t_1 ... $t_{2,ISLAND}$ ...



In (46a), an intervener occurs *inside* the question. Since here Q occurs outside the island, *wh* remains in-situ inside the island and is related to Q via focus-alternatives. Hence, here we predict intervention effects to occur, contrary to facts. In (46a), an intervener occurs *above* the question. Here, since QP_2 has been moved to C, it is above any offending intervener inside TP. Hence, we predict no intervention effects in this structure, again contrary to facts. I propose that such a derivation is made impossible by Cable's (2010) QP-intervention condition, which disallows functional material between Q and *wh*. Hence, Q cannot be merged outside the island and trigger a movement as described here.

Finally, turning our attention to German, we note that no change has been made to the predictions for intervention effects made by our proposal—partial covert movement is not possible in German multiple questions. Only one QP is constructed and moved

[30] To keep the schemas readable, here and in (46), I do not show the final movement step of Q_1 out of QP in Spec,CP. I also do not show the successive cyclic movement of QP-movement that I assume to take place, following standard assumptions.

overtly to C. Any other *wh*-words are interpreted via non-projecting Q-particles in the CP layer. The non-projecting Qs are related to *wh* via focus alternatives. Hence, we predict sensitivity to intervention between Q and *wh*. To escape intervention, the in-situ *wh* must overtly scramble above the intervener. The predictions in (47) below are indeed borne out by the data (cf. Beck, 1996a, 2006; Sauerland and Heck, 2003; Mayr, to appear).

(47) **Predictions for intervention effects in German multiple questions:**

a. In all multiple questions, above the in-situ *wh*.

b. Inside QPs, between *wh* and Q.

6.4.4 Summary

In this section I laid out the details of the assumptions that must be made in order to (a) model partial *wh*-movement as QP-movement, and (b) explain the behavior of partial movement in online sentence processing—that is, that partial movement *always* occurs in the derivation of superiority-obeying questions, and that it targets the first position c-commanding the base-position of the in-situ *wh* at which it is interpretable. A larger movement step is assumed only if it is necessary, for example in order to construct an appropriate antecedent for ellipsis or to avoid an intervention effect.

I proposed to achieve these two goals via an operation I called Q-Fission. This operation applies to QP as part of its movement: QP is taken back to the workspace, decomposed into its two daughters, and subsequently each daughter is merged separately back into the derivation so that they occupy positions at which they are interpretable. I drew a parallel between this operation and the behavior of quantifier float, which is reported not to be possible at the base-position of the quantified phrase. I then showed how this operation would combine with the theory of Chapter 2 to derive the correct LFs and to predict the correct behavior of English and German with regard to intervention effects.

Although I believe this modification to the system can derive the facts we have seen in Chapters 5-6, I will not adopt it here. Instead, I believe the proposal in Chapter 2 should be combined with a general theory of QR/scrambling, which does not use QPs to model covert *wh*-scrambling in English but instead views it as a special case of QR/scrambling of other nominals. While it would be advantageous to have just one operation in natural language that derives pied-piping, we have already seen that not only *wh*-movement but other $\overline{\text{A}}$-operations too involve pied-piping, with different sizes of moved constituents. Therefore, I hope that the modeling of pied-piping in overt and covert scrambling can be handled independently of the theory interrogative movement.

6.5 A note on single-pair readings and intervention effects

Before concluding this chapter, a final note about the status of the single-pair and pair-list readings of questions that exhibits intervention effects is in order. As we have seen, the intervention effects observed in section 6.1.2 were all diagnosed by the unavailability of a pair-list reading of the question. The single-pair reading, on the other hand, remained available to the speakers who I have consulted. A similar observation has been reported for superiority-violating questions in English and for German questions in footnotes in previous work (Beck, 2006; Pesetsky, 2000, cf. also Beck 1996a). Although it has been known for quite a long time, this fact has never received much attention in the literature. However, I believe that it is important to keep this fact in mind when investigating intervention effects.[31]

In what follows, I provide a brief exploration of the nature of the surviving single-pair reading of questions with intervention effects. First, in section 6.5.1 I discuss a particular kind of single-pair reading originally observed in Wiltschko (1997) for German, that I will suggest is the "true" single-pair reading of multiple questions. I will argue that this reading and its distribution are also observed in English, and explain how this might be derived within the theory I have proposed in this chapter. In section 6.5.2 I will argue that the surviving single-pair in intervened questions is *not* a true single-pair and also not a functional reading, but instead a kind of echo question reading.

6.5.1 Wiltschko's observation

Wiltschko (1997) notices a correlation between superiority and the possible readings of German multiple questions. While superiority-obeying questions can have both single-pair and pair-list answers, superiority-violating questions may only receive pair-list interpretations. The single-pair reading is unavailable with superiority-violating questions. Thus, when a question is provided in a context that establishes that there could only be one pair in the answer set, the superiority-violating variant of the question is ungrammatical:

[31] As is well known, judgments about intervention effects are notoriously difficult, even in controlled situations. They become even more complicated when the single-pair reading may interfere with the judgment. To avoid that, here and throughout I this dissertation, present questions in contexts that support a pair-list reading of the question. Where possible, I additionally illustrate possible pair-list answers to the questions.

(48) **Ungrammaticality caused by blocking of pair-list reading (German):**
Context: Peter is walking his stubborn dog on the leash. The dog is dragging really hard in the direction of his favorite tree.

a. *Wer*$_1$ führt denn hier *wen*$_2$ an der Leine?
who leads PRT here whom on the leash
'Who is leading whom here on the leash?'

b. **Wen*$_2$ führt denn hier *wer*$_1$ an der Leine?

In Kotek (2012, 2014b), I have shown that the same observation holds for Hebrew multiple questions (data based on examples in Wiltschko 1997):

(49) **Ungrammaticality caused by blocking of pair-list reading (Hebrew):**
Context: I am sure that Peter and Mary must have talked to each other on the phone.

a. ata yodea *mi*$_1$ hitkašer le-*mi*$_2$?
you know who called to-whom
'Do you know who called whom?'

b. *ata yodea le-*mi*$_2$ hitkašer *mi*$_1$?

I argue here that a similar effect to the one described above is also found in English. The situation in English is complicated by the fact that superiority violations are only possible with D-linked *wh*-phrases, leading to more elaborate examples than necessary for German and Hebrew. However, consider examples (50)–(51) below. In the given contexts, only the superiority-obeying questions are possible, (50-51a), and the superiority-violating variants are ungrammatical, (50-51b).[32,33]

[32]Barss (2000) argues that D-linked superiority-violating questions lack the pair-list answer and instead can only have a single-pair answer. However, I believe that both superiority-obeying and superiority-violating questions of the kinds I investigate here allow a pair-list reading. This becomes clear when contrasted with the examples presented here, as well as with examples presented in section 4.3.1, which clearly disallow such a reading.

[33]David Pesetsky (p.c.) offers the following context, with the judgment that a single-pair reading is available if the phonologists are for some reason more salient than the syntacticians. I agree with this judgment, and believe that it points to the importance of the context in the examples we have seen in this section. In particular, it is important that only one pair is logically possible in these contexts. It is not sufficient that the answer happens to be true of just one pair. Hence, I propose we see cases of "true" single-pair, which should be distinguished from "accidental" single-pair, which is a special case of a pairlist construal of the question.

(i) **Superiority-violating question with an apparent single-pair reading (English):**
Context: To foster the atmosphere in our Linguistics unit, every day one syntactician and one pho-

(50) **Superiority-violating question can only have a pair-list reading (English):**
Context: Scientists have discovered a new planetary system, consisting of just two stars. They appear to be interacting with one another because of their gravitational fields. Researchers are now asking:

a. *Which* one ____ revolves around *which* one?

b. * *Which* one does *which* one revolve around ____?

(51) Context: The Jones family has two sons who always fight with one another. They're even fighting right now. I wonder,

a. *Which* one ____ hit *which* one first, this time?

b. * *Which* one did *which* one hit ____ first, this time?

Note that all questions can have felicitous pair-list readings, given an appropriate context; only the single-pair reading is impossible here.[34]

Here I propose to adopt Fox's (2011) explanation of this fact as a scope economy effect (Fox, 2000), following a proposal in Golan (1993): a superiority-violating question is possible only when its meaning is different from that of its superiority-obeying counterpart. That is, economy principles like "shortest move" are relativized to interpretation: one convergent derivation blocks another if it has shorter links and results in an interpretively equivalent LF representation. Derivations resulting in non-equivalent LFs are not compared and hence cannot block each other. This is explained by Fox's (2011) cross-derivational Semantically Sensitive version of Shortest Move (SSSM) principle:[35]

nologist go out to lunch together, at the department's expense. You know who all went out to lunch together this week, so tell me:

a. *Which* syntactician ____ took *which* phonologist out to lunch today?

b. *Which* phonologist did *which* syntactician take out ____ to lunch today?

[34]Nissenbaum (2000b) notices a similar finding in questions with an overtly moved *wh*-phrase and a lower quantifier, *each*. Example (i) can only have a pair-list reading, where *each* has apparently QRed above the *wh*.

(i) *Which* car did you persuade *each* republican senator to borrow ____ [after getting an opponent of *pg* to put a bomb in *pg*]?

Nissenbaum (2000b) attributes the possibility of a pair-list interpretation here to Fox's (2000) *scope economy* principle, arguing that covert movement of the quantifier above the *wh*-phrase is allowed because it creates a new scope relation that did not exist with the quantifier in-situ. I note that more needs to be said in order to predict that the pair-list reading is *forced* in this case. This could perhaps be related to the fact that distribute quantifiers such as *each* tend to take wide scope. A related question that I leave open at this point is whether Nissenbaum's finding extends to other quantifiers as well.

[35]In the present theory, "*wh*-phrase" will be replaced with "QP" in the definition of SSSM.

(52) **Semantically Sensitive version of Shortest Move (SSSM):**
C must Attract the closest *wh*-phrase it can to derive a designated semantic interpretation.

Under SSSM we predict that superiority-violating questions should allow pair-list readings, because overtly raising wh_2 over wh_1 yields a different meaning than overtly raising wh_1 above wh_2: the domain exhaustivity presupposition and the point-wise uniqueness presupposition of the pair-list reading of the multiple question (Dayal, 2002, see also section 1.2, 2.3.3) apply to different sets in the discourse, resulting in two distinct meanings of the superiority-obeying and superiority-violating questions. The definitions of the two presuppositions of the multiple question are repeated in (53) below.

(53) **The presuppositions of a multiple question (Dayal, 2002):**

a. Domain exhaustivity: every member of the set quantified over by the overtly moved *wh* is paired with a member of the set quantified over by the in-situ *wh*.

b. Point-wise uniqueness (*functionhood*): every member of the set quantified over by the overtly moved *wh* is paired with no more than one member of the set quantified over by the in-situ *wh*.

In (54)–(55), the member of the pair that is subject to exhaustivity is marked in bold, and the unbolded member is subject to pair-wise uniqueness.

(54) **Superiority-obeying question: *which student cooked which dish?***

a. Pair-list: ⟨**student 1**, *dish a*⟩
⟨**student 2**, *dish b*⟩
⟨**student 3**, *dish c*⟩
⋮

b. Single-pair: ⟨**student 1**, *dish a*⟩

(55) **Superiority-violating question: *which dish did which student cook?***

a. Pair-list: ⟨**dish a**, *student* 1⟩
⟨**dish b**, *student* 2⟩
⟨**dish c**, *student* 3⟩
⋮

b. Single-pair: ⟨**dish a**, *student* 1⟩

For the superiority-obeying question in (54a), exhaustivity and uniqueness apply to the students. The answer must pair each contextually relevant student with exactly one dish (but some dishes may not be mentioned at all, or some may be mentioned more than once). For the question in (55a), exhaustivity and uniqueness apply to the dishes. The answer must therefore pair each dish with exactly one student (but some students may not be mentioned at all, or some may be mentioned more than once). Hence, these two answers are distinct from one another.

However, SSSM predicts that superiority-violating questions should not allow single-pair readings. This is so because applying the exhaustivity and uniqueness presuppositions to the first member of a single-pair or to the second member of that pair necessarily results in the same meaning. Hence, the single-pair answers to (54) and (55) necessarily pick out the exact same pair. Consequently, the availability of the single-pair answer to the more-economical superiority-obeying question (54b) blocks that same answer from being available to the less-economical superiority-violating question (55b). I note that this logic crucially relies on a notion of cross-derivational economy that makes a superiority-obeying question preferable to a violating one.

If English and German are modeled as identical except in whether the in-situ *wh* in a multiple question can undergo overt or covert scrambling, the notion of 'more economical' must obtain cross-derivationally, by comparing the resulting LFs of the obeying and violating questions for the single-pair reading in both languages. The derivation of a multiple question involves the construction of just one QP, which moves overtly to C. Crucially, the structure of a superiority-obeying question involves movement of a higher *wh*-phrase—one that is closer to the probe—compared to the movement in a superiority-violating question. The "shortest move" principle requires that the derivation with the smaller movement step be chosen, thus preferring the derivation of the superiority-obeying question over the violating one.[36]

[36]If we instead adopt the proposal made in section 6.4, where partial movement is modeled as covert QP-movement, we may have an explanation of Wiltschko's generalization that does not rely on cross-derivational economy for English. Recall that in section 6.4, I proposed the QP-preference principle: Construct as many QPs as possible in a derivation, unless doing so would change the meaning of the question. This preference is only over-ridden in the case of superiority-violating questions, because there is no other way to derive the correct meaning targeted by the violating question from a structure with multiple QPs. However, note that this is only true for the pair-list reading of the question, as explained above. The single-pair reading of the question is unchanged for the superiority-obeying and superiority-violating word orders. The QP-preference principle thus predicts that the single-pair reading of the question will be derived from a superiority-obeying structure. Note that this explanation does not straightforwardly extend to German,

6.5.2 On the nature of the surviving reading of an intervened question

With this background in mind, let us return to the status of the surviving single-pair reading of questions with intervention effects. For brevity, I will refer to such questions as "intervened questions." As noted above, it has been suggested in the literature that at least some speakers perceive a surviving single-pair reading in intervened questions. This has been reported, for example, for questions such as (56), from Pesetsky (2000).

(56) **Intervention effects affect superiority-violating questions:**

a. ✓ *Which* boy did**n't** ____ read *which* book? ✓sup.-obeying, intervener

b. *^{PL} *Which* book did**n't** *which* boy read ____? * sup.-violating, intervener

Pesetsky (2000, p. 60) remarks about examples such as (56) that "*For many speakers, at least as a first reaction, such examples are completely unacceptable. For other speakers (and perhaps for all speakers when the possibility is pointed out to them), the examples are acceptable so long as they receive a "single-pair" rather than a pair-list reading*."

Pesetsky (2000, p. 112, fn. 85) remarks that it was Beck (p.c.) who first brought this fact to his attention, in the context of German, although Beck (1996a, p. 3, fn. 2) does not mention improvement with a single-pair reading. Instead, she marks intervened questions with $\underline{\underline{??}}$ and writes: "*The "$\underline{\underline{??}}$" means that the data are incomprehensible (uninterpretable) rather than simply ungrammatical. I would accordingly ask native speakers to try and interpret the sentences, not simply judge whether they "sound bad"*."[37]

The fact that a single-pair reading of the question survives in intervened questions was observed more clearly in the data presented in this chapter, namely in superiority-obeying questions in which the lower *wh* is trapped inside an island, cf. section 6.1.2 above:

(57) **Non-bridge verbs are also an island for extraction:**

a. ✓ *Which* linguist shouted [that we **didn't** invite *which* philosopher]?

b. *^{PL} *Which* linguist **didn't** shout [that we invited *which* philosopher]?

Here it is important to note some characteristics of this reading. As it is difficult to pin-point the precise nature of this surviving single-pair reading, I begin by describing what this reading is *not*. First, this reading is not the "true" single-pair in the sense of

unless overt *wh*-scrambling in German is modeled using QPs.

[37] Throughout, I have chosen to use the notation "*^{PL}" instead of "$\underline{\underline{??}}$," which I hope is more transparent.

the reading observed by Wiltschko (1997), discussed above. Moreover, this reading does not appear to be an "accidental" single-pair—that is, a situation in which it is possible to have several pairs in the answer set but it just happens to be the case that the answer applies to just one pair. Finally, this reading does not appear to be a *functional* reading, where one can define a function to identify the relationship between the members of the pair.

(58) **A functional reading of a question:**

a. Q: *Who* does every boy love?
   A: His mother.

b. Q: *Which* boy likes *which* girl?
   A: Each boy likes the girl that sits next to him on the bus.

Instead, I believe this surviving reading of the question appears to be a kind of echo question reading. That is, the single-pair reading that remains available is one that requires strong contextual support, often including a sentence that already contains the illicit intervener, where the speaker simply failed to understand part of the information carried by that sentence. Below is an attempt to illustrate such a context:

(59) **Surviving single-pair in intervened question:**

John: I heard Chomsky doesn't believe the rumor that we invited Bob Stalnaker to our party.

Mary: I'm sorry, what's that? *Which* linguist **doesn't** believe the rumor [that we invite *which* philosopher]?

That is, the *wh*-phrases are used here as a kind of definite descriptions, roughly standing in for "the thing you said (that I didn't understand)." If so, this explains why this surviving reading is not sensitive to intervention effects: the *wh*-words, representing definite descriptions here, are not interpreted using focus-alternatives, as in-situ *wh*-words in questions are. However, here I will not attempt to provide an analysis for this reading, and will instead leave that to existing theories of echo questions. My main goal is to describe this reading well enough so it can be avoided as a potential confound when eliciting judgments with regard to intervention effects.

6.6 Chapter summary

This chapter gave additional support for *partial wh-movement* in English multiple questions, argued for in Chapter 5, and argued for an analysis of this movement as *covert scrambling*.

Section 6.1 concentrates on the behavior of superiority-obeying questions and shows that **intervention effects occur *above* the island but not *inside* it.**

Section 6.2 discusses the implications of partial movement for current theories of interrogative syntaxsemantics.

Section 6.3 argues that partial *wh*-movement should be modeled as ***covert scrambling***, making English and German parallel except for whether scrambling is overt or covert. I discuss benefits of this view for the theory of grammar and for language acquisition.

Section 6.4 spells out the assumptions that would have to be made if partial movement were to be modeled as QP-movement. Two principles governing the construction and movement of QPs were introduced:

- **The QP preference principle:** Construct as many QPs as possible in a derivation, unless doing so would change the meaning of the question.
- **The Laziness principle:** Prefer the smallest QP step movement that would lead to an interpretable structure for the question.

Section 6.4.2 introduces the operation ***Q-Fission*** to formalize partial movement, and shows how it can be integrated into the proposal of Chapter 2 to derive the meanings of multiple questions and their behavior with regard to intervention effects, while explaining the experimental results of Chapter 5.

After spelling these assumptions out, I argue that partial *wh*-movement should be modeled as covert scrambling, not as QP-movement, §6.4.4.

Section 6.5 extends Wiltschko's (1997) observation that only superiority-obeying questions have a "true" single-pair reading to English, and proposes an explanation within the theory developed here, §6.5.1, and argues that the surviving single-pair reading in intervened questions, evident in the data presented in §6.1.2 is argued an echo-question reading, §6.5.2.

Chapter 7

Conclusions and outlook

7.1 The thesis, briefly

This dissertation has developed and motivated a new syntax and semantics for *wh*-questions. The proposed theory combines Cable's (2007; 2010) Q-based syntax for *wh*-movement and pied-piping with a new and simple semantics that combines ingredients familiar from the literature in a novel way. I believe that this proposal is simpler and allows for wider empirical coverage than other recent theories (cf. Cable, 2007, 2010; Cheng and Demirdache, 2010; Fox, 2012; Nicolae, 2013), being able to model pied-piping (Ross, 1967), superiority effects (Chomsky, 1973), the readings of multiple questions (Dayal, 2002), the presuppositions of the question (Dayal, 1996; Fox, 2012), and focus intervention effects in multiple questions (Pesetsky, 2000; Beck, 2006, a.o.).

After presenting the core proposal, the remainder of the dissertation explored the syntax, semantics, and processing of in-situ *wh*-phrases in light of this proposal, focusing in particular on English and German multiple *wh*-questions. Data was brought to bear on the LF-position of in-situ *wh*-phrases in superiority-obeying and superiority-violating question—in particular on the interaction of these questions with focus interveners, their ability to host Antecedent Contained Deletion, and online processing of these questions.

The proposal I developed is summarized below. The proposal builds on Cable's theory in positing that interrogative movement is driven by Q-particles (silent in English, but visible in e.g. Tlingit). A Q-particle combines with a *wh*-containing phrase and projects a QP. The interrogative probe on C searches for Q-features. Following agreement, QP is attracted to C. If QP contains other material beside *wh*, the result is 'pied-piping.'

I did not adopt Cable's semantics for Q-theory, but developed instead a simpler semantics for questions, comprised of three interrogative ingredients:[1]

- C plays no role in the semantics of a question, and instead simply passes up the denotation of its sister.

  (1) **The semantics of the Complementizer:**
  $[\![\text{C}]\!] = \lambda P_{\tau}.\ P$

- *Wh*-words denote Hamblin sets (cf. Beck 2006, Cable 2007; 2010), e.g. for *what*:

  (2) **The semantics of *what*:**
  Ordinary semantic value: $[\![what]\!]^o$ is undefined
  Focus-semantic value: $[\![what]\!]^f = \{x_e : x \text{ is non-human}\}$

- Q-particles take a complement with a focus-semantic value of a set of propositions (or a set of such sets...), and lift it into the ordinary semantic value of the question. This is similar in spirit to the denotations of the question-clause-typing operators in Shimoyama (2001); Beck and Kim (2006), and yields Hamblin/Karttunen-style question denotations, i.e. sets of possible answers:

  (3) **The semantics of the Q-particle:**
  $[\![\text{Q } \alpha_{\sigma}]\!]^o = [\![\alpha_{\sigma}]\!]^f$
  $[\![\text{Q } \alpha_{\sigma}]\!]^f = \{[\![\text{Q } \alpha_{\sigma}]\!]^o\}$ $\qquad \sigma \in \{\langle s,t\rangle, \langle st,t\rangle, \langle\langle st,t\rangle,t\rangle, ...\}$

I proposed that in addition to projecting Q-particles, the derivation can contain *non-projecting Q-particles* (with the same semantics), adjoined to CP. The availability of multiple type-flexible Q-particles makes it possible to derive the pair-list reading of the question as a family of questions (Hagstrom, 1998; Fox, 2012; Nicolae, 2013, a.o.).

Earlier chapters in the dissertation, in particular Chapters 3-4, adopted the structures in (4a-b) as the LFs of the pair-list readings of superiority-obeying and superiority-violating English questions. German questions, both superiority-obeying and superiority-violating, were argued to be derived from LFs in which the in-situ *wh*-phrase is truly in-situ at LF and interpreted using a non-projecting Q-particle, as in (4b). The single-pair reading of the question is derived from a minimally different LF in which all the Q-particles occur above all the *wh*s in the question.

[1] Cable's original semantics for Q-theory is more complex, as it involves multiple ad-hoc complementizers that interpret questions with different combinations of in-situ and moved *wh*-words. It additionally fails to derive the pair-list reading of the question.

(4) **The LFs of superiority-obeying and superiority-violating English questions:**

a. [$_{\text{Spec,CP}}$ [$_{\text{QP}_1}$ Q wh_1] [$_{\text{QP}_2}$ Q [wh_2]] [C [$_{\text{TP}}$ ...t_1...t_2]]] superiority-obeying

b. [$_{\text{Spec,CP}}$ [$_{\text{QP}_2}$ Q wh_2] Q_1 [C [$_{\text{TP}}$ ... wh_1...t_2]]] superiority-violating

The syntax-semantics proposed here leads to a new descriptive generalization for intervention effects. An intervention effect is found when the relation between an in-situ *wh* and the Q-particle that must interpret it, established via focus-alternatives, is disrupted by another intervening focus-sensitive operator. This description allowed for a uniform explanation of intervention effects in questions and inside overt and covert pied-piping constituents. It also highlighted the irrelevance of the status of the question as superiority-obeying or superiority-violating for understanding intervention effects.

(5) **Configuration of an intervention effect:**

* [Q_i ... **intervener** ... wh_i ...]

Importantly, the derivation of superiority-obeying questions can involve covert movement of the surface in-situ *wh*-word: the syntax allows for the construction of two QPs, which are attracted to Spec,CP in order and tuck into C's specifiers. The resulting structure is one in which all *wh*s occur above any potential interveners in the question, predicting no intervention effects. The covert movement of QP_2 explains why the in-situ *wh* is able to host ACD. Superiority-violating questions, on the other hand, must be derived from structures in which the base-generated higher *wh* is truly LF-in-situ. We therefore predict sensitivity to intervention effects above the in-situ *wh*. The lack of covert movement of the in-situ *wh* also explains why it cannot host ACD.

Later chapters in the dissertation, in particular chapters 5-6, argued for a more nuanced picture, in which in-situ *wh*-phrases in superiority-obeying English questions undergo *partial wh-movement* to positions other than interrogative C, where they are interpreted using in-situ composition. I argued that this movement step should be modeled as *covert scrambling*, parallel to an overt scrambling step observed in German. The analysis of English and German multiple questions is therefore identical except for the question of whether the in-situ *wh* undergoes *overt* or *covert* scrambling. I argued that this view of the syntax of English questions restricts the expected cross-linguistic typology of *wh*-movement languages, and allows for better understanding of the acquisition of multiple

questions and intervention effects. Covert *wh*-scrambling is then just one of several ways of assigning in-situ *wh*-words wide scope, joining right-node raising, extraposition, A-movement, and the familiar *wh*-movement, as shown in chapters 4 and 6.

7.2 Optionality vs. determinism in interrogative syntax

The semantics I have developed in chapter 2 allows for flexibility in several aspects of the derivation of a question. First, in the absence of an intervener, superiority-obeying English questions can be derived from structures with just one QP, or from structures with two QPs. Second, the single-pair reading of the question can be derived from structures with just one Q-particle, or from structures with multiple Q-particles, as long as all of the Q-particles end up occupying positions higher than all of the *wh*-elements in the question. Finally, we have seen that covert movement of the surface in-situ *wh* can target any position in the structure, between the base-position of the *wh* and C.

This description raises an issue that recurs in different parts of the dissertation, which I would like to briefly address below, concerning optionality and determinism in the syntax of questions. This question of optionality vs. determinism can be fruitfully discussed in the context of the findings of Chapter 3. Recall the paradigm repeated in (6):

(6) ***No* causes intervention effect in superiority-obeying multiple question:**

a. ✓ *Which* student read [$_{QP}$ a book from *which* library]?

b. ✓ *Which* student **didn't** read [$_{QP}$ a book from *which* library]?

c. * *Which* student read [$_{QP}$ **no** book from *which* library]?

I argued that (6c) is ungrammatical because of an intervention effect inside a covertly moved QP. An intervention effect is avoided in (6b), in which the intervener is outside QP, because QP is able to move above the intervener in this example. Note, more accurately, that the data presented here is amenable to two alternative analyses. It is possible that the in-situ *wh*-word in such structures is not merged with a Q-particle at all; the *wh* is interpreted in-situ using focus alternatives computation between the base position of the *wh* and a Q-particle in the CP layer, predicting intervention effects above the in-situ *wh*. Alternatively, a large QP, corresponding to the *largest* option available to overt pied-piping in a corresponding simplex question, is constructed. The intervener occurs inside QP, disrupting the relation between *wh* and Q, predicting an intervention effect.

As discussed above, the QP that is constructed in the case of covert pied-piping must be the largest among the options available to overt pied-piping. This is the case despite the fact that smaller QPs *can* be targeted for *overt* pied-piping and that they are in fact *preferred* by many speakers over the option that is apparently chosen for covert pied-piping. This state of affairs, and in particular, the determinacy of the choice of QP size, is surprising given the optionality that we otherwise might expect in the derivation of *wh*-questions.

We have seen throughout the dissertation several other ways in which the syntactic derivation of multiple questions is not flexible in ways that the semantic proposal put forth here predicts that it should be:

(7) **Determinism in the derivation of superiority-obeying questions:**

a. The in-situ *wh* always undergoes a short QR/scrambling step to the nearest *v*P node.

b. The in-situ *wh* can move higher if necessary, for example to avoid an intervention effect or in order to construct and appropriate antecedent for ellipsis.

c. The constituent that is covertly pied-piped with the *wh* is the largest possible.

Note that the latter two properties dovetail with the "laziness principle" introduced in Chapter 6, repeated here for convenience:

(8) **The laziness principle:**
Prefer the smallest QP step movement that would lead to an interpretable structure for the question.

The principle in (8) dictates that the least amount of (phrasal) movement in the structure should be performed. Derivations in which the Q-particle is merged in higher positions in the structure, resulting in larger pied-piping constituents, are derivations that involve a shorter movement step. It appears, then, that the preference to minimize movement in the structure wins over other possible considerations that could have, all things being equal, entered into the computation of the size of QPs. This preference would explain the findings of Chapter 3, e.g. in (6).

Finally, note that despite the fact that the smallest movement possible in a question is no movement at all, this appears not to be an option in the derivation of superiority-obeying questions. In fact, superiority-violating questions with pair-list readings appear

to be the sole exception to the rule that every *wh*-phrase in the structure must undergo at least some movement following its merger into the derivation. This aspect of question syntax—the fact that in-situ *wh*-phrases in superiority-violating questions *cannot* move, not even in order to host ACD (which we have seen in Chapter 5 is generally possible even for DPs that the parser normally assumes to be interpreted in-situ) is particularly puzzling, and, I believe, is fully explained by the proposal I have developed here. However, I believe that understanding this ban on movement of in-situ *wh*-phrases in superiority-violating questions holds the key to understanding the nature of covert *wh*-movement in general. I hope to return to this issue in future work.

7.3 Extensions and open questions

There are, of course, many remaining issues regarding the syntax and semantics questions which I have not adequately addressed in this dissertation. I highlight several of them, with some brief discussion, below.

Declarative vs. interrogative C

The definition of the interrogative complementizer that I have adopted in the dissertation assigns to C an important role in the derivation of a question (driving interrogative probing and movement), but C plays no role in the derivation of the semantics of the question. Instead, the task of the interpretation of the question was relegated to Q. As we have seen, this has welcome consequences, allowing multiple Q-particles to be generated in the derivation, and allowing for the derivation of the pair-list reading of the question as a family of questions. It also introduced some difficulty, in requiring an obligatory movement step of Q out of QP.

Here I note one additional advantage of the Q-based system: It is compatible with Preminger's (2011) view of syntactic agreement, under which agreement must always be attempted but it is allowed to fail. Under Preminger's view, there is only one complementizer in the syntax of natural language. This complementizer hosts interrogative probes, which attempt to find an interrogative element in their scope, driving agreement and movement. This kind of derivational behavior is argued to drive successive cyclic movement, as *wh*-elements are believed to be able to land in specifiers of non-interrogative

clauses in the course of their movement to their final interpreted position. A declarative C, then is one that does not host an interrogative element (either because none was found, or because this element has moved to a higher position), and an interrogative C is one that does host such an element. Crucially, this syntax is compatible with the view I have presented in this dissertation, where C is semantically inert and only has one semantic interpretation. It is incompatible with theories that propose multiple C heads that are responsible for assigning the question its meaning, including recent proposals in Cable (2007, 2010); Fox (2012); Nicolae (2013).

The status of projecting and non-projecting Qs

The introduction of the non-projecting Q-particle into the theory (in addition to its projecting counterpart) brings to the surface the similarity between this operator and other focus-sensitive operators in natural language. As is well-known, the English focus-sensitive operator *only* has an adnominal form, where it attaches directly to the F-marked constituent that serves as its input, and additionally an adverb form, where *only* adjoins to the clausal spine and associates long-distance with an F-marked element in its scope.[2] These two options are illustrated in (9). A similar paradigm also exists in English for the focus-sensitive operator *even*.

(9) **Constituent and adverb *only*:**

a. John read *only* [Moby Dick]$_F$. Constituent *only*

b. John *only* read [Moby Dick]$_F$. Adverb *only*

The inclusion of a projecting Q-particle that originates in TP and moves to C, in addition to a non-projecting Q-particle that originates in C, highlights the similarity between the Q-particle and other focus-sensitive operators. This is particularly appealing, I believe, in light of the theory of intervention effects I have adopted in this dissertation, which links such effects to the nature of the projection of focus-alternatives (Beck, 2006). Questions remain, however. In particular, can one form of the operator be derived from the other, and what restrictions apply to their distribution within and across languages?

[2] I note that under the focus-movement theory, the F-marked constituent undergoes covert movement—with pied-piping of a similar size to the one observed in *wh*-movement—to the operator (Drubig, 1994; Krifka, 2006; Wagner, 2006; Erlewine and Kotek, 2014). Other theories, most prominently Rooth (1985, et seq.), assume that focus-association is achieved through Alternative Semantics, without any further movement of the F-marked constituent. The details of this debate need not concern us here.

Wh-indefinites

One advantage of Cable's original semantics for Q-particles that is lost here is the use of Q-particles with *wh*-indefinites in languages like Tlingit and Japanese, where the two share the same surface forms. In Cable's system, QPs hosted in interrogative Spec,CP are interpreted as interrogative phrases, and QPs that remain in TP undergo existential closure and are interpreted as *wh*-indefinites. Such an analysis is not possible in the proposal I have made in this dissertation, for two reasons. First, I argued that in-situ *wh*s in fact undergo partial covert movement to positions other than interrogative C, but are nonetheless interpreted as interrogatives, not *wh*-indefinites. Second, the semantics I have assigned to Q makes the existential closure mechanism unable to turn *wh*-indefinites into interrogative phrases.

I will not attempt to solve this issue here. However, I believe that the solution may come from an additional operator that takes one meaning of the QP and turns it into the other. Such an operator may be overt in some languages: for example, consider the data in (10) from Hebrew, where the addition of a morpheme turns a *wh*-word into a *wh*-indefinite. Note further that, as the translations make clear, this correlation between *wh*-words and *wh*-indefinites is not universal: in English, there indefinites are derived using the quantifier 'some' and not any *wh*-word, calling into question any mechanism that necessarily derives one from the other.

(10) ***Wh*-words and *wh*-indefinites in Hebrew:**

a.	mi	c.	ma	e.	matay	g.	eix
	who		what		when		how
	'who'		'what'		'when'		'how'
b.	mi-še-hu	d.	ma-še-hu	f.	ma-še-hu	h.	eix-še-hu
	who-that-he		what-that-he		when-that-he		how-that-he
	'someone'		'something'		'sometime'		'somehow'

More than two *wh*s

An issue I have not addressed at all in the dissertation is the structure of questions with three *wh*-phrases (with the exception of a very brief discussion of data in Chapter 6. There are several interesting aspects to such questions. Baker (1970) discusses the famous ambiguities in examples such as (11), where in a question with three *wh*-phrases, two interpretations are available:

(11) **Baker ambiguities:**
Who remembers *where* we bought *which* book?

a. John and Mary remember where we bought which book.

b. John remembers where we bought Moby Dick, Mary remember where we bought War & Peace, and Bill remembers where we bought Oliver Twist.

Dayal (1996) discusses cases of the so-called '*wh*-triangle', where the pair-list reading is blocked by an embedded clause:

Which student thinks that Bill knows where Mary bought which book?

(12) **Baker ambiguities:**
Which student thinks that Bill knows *where* Mary bought *which* book?

a. John (thinks that Bill knows where Mary bought which book).

b. * (John thinks that Bill knows where Mary bought Moby Dick) and (Sue thinks that Bill knows where Mary bought War & Peace).

Richards (1997) argues for a "Subjacency tax," where once a higher *wh* obeys subjacency, lower *wh*s are able to violate it. This offers an explanation for the fact that superiority effects disappear in questions with three *wh*-phrases (Kayne, 1984):

(13) **Superiority effects disappear with three *wh*-phrases:**

a. * Mary asked *what who* gave to John.

b. Mary asked *what who* gave to *whom*.

The cross-linguistic typology of questions

In section 6.3.3 I briefly discuss how the Q-based theory I propose here extends to cross-linguistically diverse language types, including *wh*-in-situ and multiple *wh*-fronting languages. However, additional work is needed in order to spell out the full cross-linguistic typology predicted by this system. For example, the interaction between scope rigidity, the availability of scrambling, and the possibility of covert movement—and how they affect the possible LFs of multiple questions—awaits further investigation. Some languages, such as Italian, have been claimed not to allow multiple questions at all, although nothing in the system I have proposed predicts this. Furthermore, this proposal does not currently discuss coordinated *wh*-questions:

(14) **Coordinated *wh*-questions:**
What and *when* did John eat
≈ What did John eat and when did John eat?

Wh-adjuncts

This dissertation has concentrated exclusively on questions with *wh*-arguments, and in particular, *which*-phrases. As is well known, *wh*-adjuncts behave differently than *wh*-arguments, for example in their ability to be extracted:

(15) ***Wh*-island (Chomsky, 1977):**
a. *What* do you wonder [whether to fix ____]?
b. * *Why* do you wonder [whether to fix the car ____]?

Wh-adjuncts additionally behave differently than *wh*-arguments with regard to superiority effects. The data appears very subtle, as shown below (the examples are offered without judgments):

(16) **Superiority effects with *wh*-adjuncts:**
a. *What* did you read ____ *when*?
b. *When* did you read *what* ____?

(17) a. *What* did you buy ____ *why*?
b. *Why* did you buy *what* ____?

(18) a. *Which* student ____ read *how many* books?
b. *How many* book did *which student* read ____?

The theory of intervention

This dissertation crucially relied on Beck's (2006) theory of intervention effects. Under this theory, intervention is caused when a focus-sensitive operator disrupts the focus-alternatives that are projected from an in-situ *wh*, which must be interpreted by a Q-particle. There are several unsatisfying aspects to this theory. Most importantly, it must assume that all interveners are focus-sensitive, despite the fact that not all interveners seem to be straightforwardly so. Although *only* can be argued to be focus-sensitive, it is

less clear that e.g. *every* or *never* are. As a consequence, this theory has little to say about the set of interveners in natural language.

It is important to note that what I have shown evidence for in this dissertation is a connection between intervention effects and movement vs. in-situ syntax for *wh*-elements. Chapters 4 and 6 show that when covert movement of a *wh*-element is restricted, for example using islands or variable binding, we observe an intervention effect. That focus is implicated in this phenomenon was assumed, following Beck, but not directly argued for here. A recent alternative analysis of intervention effects has been proposed in Mayr (2010, to appear) for German. This theory makes clear predictions for the set of interveners in natural language,[3] but I believe it does not easily predict that movement should be implicated in intervention in the way that I showed here.

Yes-no questions and alternative questions

The theory of questions I have proposed here applies to constituent questions, but I have not explored other types of questions, such as yes-no questions and alternative questions. Theories of such questions exist in the literature, and I leave to future work an integration of those theories with the proposal made here.

7.4 Final remarks

The nature of this document makes it difficult to offer a concise conclusion. Although multiple questions are in many ways quite complex, I believe that they offer a fertile ground for empirical investigation and discovery. I hope to have shown that the semantics of questions can be modeled in a fairly simple system, but that their syntax is rich and varied in ways that the semantics alone would not have led us to expect. I hope that my exploration of some aspects of this surprising behavior of multiple questions has contributed to our understanding of the inner workings of grammar, and that it has shed some light on possible directions for future work.

[3] See Chapter 3 for discussion of a prediction of this theory that I believe does not hold in English, regarding the status of 'more than *n*' as an intervener.

Appendix: Materials for Experiments 1–3

Below is the full of items used in Experiments 1–3. The same item paradigms were used in all three experiments, with different choices of determiner and placement/position of *also* as described in the body of the paper. In short: Experiments 1 and 3 compared the determiners *every* and *which*, while Experiment 2 compared the determiners *the* and *every*. Experiment 3 compared the behavior of a *high* and a *low* placement of *also*, while Experiments 1–2 did not contain *also*.

Recall that the experiments were conducted online, it was not possible to control the participants' screen size. Consequently, in order to ensure that the region of interest was read without interruptions that may artificially affect the data, all the sentences were presented on two lines, with the line break in target sentences always placed immediately following the verbal complex (that is, the first line of the sentence was the first line in the examples below, and the second line contained the text in the second and third lines—that is, the relative clause (in the second line) and the continuation (in the third line)).

1. The orderly learned which doctor was (also) planning to (also) monitor
   the/*every*/*which* patient that the duty nurse *did*/*was*
   and immediately updated the charts.

2. The principal determined which instructor was (also) able to (also) teach
   the/*every*/*which* class that the substitute teacher *did*/*was*
   and accordingly finalized the schedule.

3. The conductor asked which soloist was (also) willing to (also) play
   the/*every*/*which* piece that the brilliant protégé *did*/*was*
   and restructured the rehearsal accordingly.

4. The coordinator learned which tutor was (also) scheduled to (also) teach

the/every/which topic that the Physics professor *did/was*
and assigned them to classrooms.

5. The prosecutor asked which witness was (also) told to (also) discredit
the/every/which defendant that the corrupt detective *did/was*
but only one witness revealed anything.

6. The teacher found_out which student was (also) eager to (also) attend
the/every/which trip that the class president *did/was*
and organized the field trips accordingly.

7. The detective found_out which guard was (also) willing to (also) hassle
the/every/which prisoner that the sadistic warden *did/was*
and included the names in his report.

8. The analyst predicted which investor was (also) prepared to (also) buy
the/every/which stock that the hedge fund *did/was*
and then sent a$_m$emo to the bank management.

9. The realtor asked which trainee was able to (also) show
the/every/which property that the experienced secretary *did/was*
but nobody was (also) available that weekend.

10. The carpenter asked which apprentice was (also) qualified to (also) use
the/every/which technique that the licensed electrician *did/was*
and then assigned personnel to projects.

11. The choreographer determined which dancer was (also) ready to (also) perform
the/every/which dance_routine that the Russian ballerina *did/was*
and then started the dance recital.

12. The organizers found_out which announcer was (also) willing to (also) cover
the/every/which game that the notorious commentator *did/was*
and then finalized the broadcasting schedule.

13. The librarian learned which teacher was (also) planning to (also) borrow
the/every/which book that the visiting scholar *did/was*
and accordingly shortened the loan periods.

14. The attorney clarified which witness was (also) supposed to (also) support
the/every/which alibi that the undercover informant *did/was*
and then gave his closing argument.

15. The dispatcher clarified which apprentice was (also) scheduled to (also) accompany
the/every/which crew that the experienced engineer *did/was*
and sent the crews on their way.

16. The programmer realized which update was (also) certain to (also) solve
the/every/which problem that the old software *did/was*
but surprisingly decided not to tell anyone.

17. The focus-group explained which discount was (also) likely to (also) attract
the/every/which demographic that the Spring sale *did/was*
and then several TV ads were launched.

18. The secretary found_out which professor was (also) going to (also) question
the/every/which student that the disciplinary committee *did/was*
and then scheduled the hearings.

19. The general forgot which unit was (also) scheduled to (also) attack
the/every/which target that the nuclear submarine *did/was*
and sent a messenger to headquarters.

20. The biologist discovered which reptile was (also) likely to (also) have
the/every/which gene that the Tyrannosaurus Rex *did/was*
and proposed additional tests.

21. The admiral specified which ship was (also) ordered to (also) attack
the/every/which position that the navy jet *did/was*
and then the joint army-navy exercise began.

22. The engineer explained which apprentice was (also) asked to (also) service
the/every/which engine that the sick crew_member *did/was*
and then called the train company.

23. The colonel explained which officer was (also) ordered to (also) interrogate
the/every/which prisoner that the CIA agent *did/was*
and then described what methods not to use.

24. The log showed which detective was (also) sent to (also) arrest
the/every/which suspect that the FBI agent *did/was*
and additionally where the arrest took place.

25. The detective discovered which mobster was (also) about to (also) blackmail
the/every/which business that the street gang *did/was*
and immediately informed his superiors.

26. The sheriff knew which marshal was (also) excited to (also) chase
the/every/which fugitive that the state police *did/was*
but doubted that the fugitives would be caught.

27. The scientist discovered which antibody was (also) likely to (also) attack
the/every/which virus that the standard medication *did/was*
but needed funding to complete her study.

28. The warden guessed which inmate was (also) trying to (also) smuggle
the/every/which contraband that the corrupt guard *did/was*
and therefore intensified the security screens.

Bibliography

Akahane, Hitoshi. 2007. A phase-theoretic analysis of object omission. Ms.

Anderson, Catherine. 2004. The structure and real-time comprehension of quantifier scope ambiguity. Doctoral Dissertation, Northwestern University.

Aoun, Joseph. 1982. The formal nature of anaphoric relations. Doctoral Dissertation, Massachusetts Institute of Technology.

Aoun, Joseph, Norbert Hornstein, and Dominique Sportiche. 1981. Some aspects of wide scope quantification. *Journal of Linguistic Research* 1:67–95.

Aoun, Joseph, and Yen-hui Audrey Li. 1993. *Wh*-elements in situ: Syntax or LF? *Linguistic Inquiry* 24:199–238.

Arnon, Inbal, Neal Snider, Philip Hofmeister, Florian T. Jaeger, and Ivan A. Sag. To appear. Cross-linguistic variation in a processing account: The case of multiple *wh*-questions. In *Proceedings of BLS 32*.

Arregi, Karlos. 2002. Focus on Basque movements. Doctoral Dissertation, Massachusetts Institute of Technology.

Arregui, Ana, Charles Jr. Clifton, Lyn Frazier, and Keir Moulton. 2006. Processing elided verb phrases with flawed antecedents: The recycling hypothesis. *Journal of Memory and Language* 55:232–246.

Baayen, R. H. 2004. Statistics in psycholinguistics: A critique of some current gold standards. In *Mental Lexicon Working Papers*, 1–45. Edmonton.

Bachrach, Asaf, and Roni Katzir. 2009. Right-node raising and delayed spellout. In *Interphases: Phase-theoretic investigations of linguistic interfaces*, ed. Kleanthes K. Grohmann. Oxford University Press.

Baker, Carol L. 1970. Notes on the description of English questions: the role of an abstract question morpheme. *Foundations of Language* 6:197–217.

Barr, Dale J., Roger Levy, Christoph Scheepers, and Harry Tily. 2013. Random effects structure for confirm-atory hypothesis testing: Keep it maximal. *Journal of Memory and Language* 68:225–278.

Barss, Andrew. 2000. Minimalism and asymmetric *wh*-interpretation. In *Step by step: Essays on minimalist syntax in honor of Howard Lasnik*, 31–52. MIT Press.

Barwise, Jon, and Robin Cooper. 1981. Generalized quantifiers and natural language. *Linguistics and Philosophy* 4:159–219.

Bates, Douglas M., and Deepayan Sarkar. 2007. lme4: Linear mixed-effects models using S4 classes. R package version 0.9975-12, URL http://CRAN.R-project.org/.

Beaver, David, and Brady Clark. 2008. *Sense and sensitivity: How focus determines meaning*. Wiley-Blackwell.

Beck, Sigrid. 1995. Negative islands and reconstruction. In *On extraction and extraposition in German*. John Benjamins.

Beck, Sigrid. 1996a. Quantified structures as barriers for LF movement. *Natural Language Semantics* 4:1–56.

Beck, Sigrid. 1996b. *Wh*-construction and transparent Logical Form. Doctoral Dissertation, Universität Tübingen.

Beck, Sigrid. 2006. Intervention effects follow from focus interpretation. *Natural Language Semantics* 14:1–56.

Beck, Sigrid, and Shin-Sook Kim. 1997. On *wh*-and operator scope in Korean. *Journal of East Asian Linguistics* 6:339–384.

Beck, Sigrid, and Shin-Sook Kim. 2006. Intervention effects in alternative questions. *Journal of Comparative German Linguistics* 9:165–208.

Bever, Tom. 1970. The cognitive basis for linguistic structure. In *Cognition and the development of language*, ed. J. R. Hayes, 279–362. New York: Wiley.

Bobaljik, Jonathan. 1995. Morphosyntax: The syntax of verbal inflection. Doctoral Dissertation, Massachusetts Institute of Technology.

Bolinger, Dwight. 1978. *Asking more than one thing at a time*, 107–150. Dordrecht: Reidel.

Bošković, Željko. 2004. Be careful where you float your quantifiers. *Natural Language & Linguistic Theory* 22:681–742.

Bošković, Željko. To appear. Now I'm a phase, now I'm not a phase: On the variability of phases with extraction and ellipsis. *Linguistic Inquiry* .

Bošković, Željko, and Steven Franks. 2000. Across-The-Board movement and LF. *Syntax* 3:107–128.

Bouton, Lawrence F. 1970. Antecedent-contained pro-forms. In *Papers from the Sixth regional meeting, Chicago Linguistic Society*. Chicago, IL.: Chicago Linguistics Society.

Breakstone, Micha, Alexandre Cremers, Danny Fox, and Martin Hackl. 2011. On the analysis of scope ambiguities in comparative constructions: Converging evidence from real-time sentence processing and offline data. In *Proceedings of SALT 21*, 712–231.

Bruening, Benjamin. 2001. Syntax at the edge: Cross-clausal phenomena and the syntax of passamaquoddy. Doctoral Dissertation, Massachusetts Institute of Technology.

Büring, Daniel. 1996a. Drinking, accents, and negation. In *Proceedings of Workshop on Focus*, ed. Elena Benedicto, Maribel Romero, and Satoshi Tomioka, number 21 in University of Massachusetts Occasional Papers in Linguistics, 37–50. UMass, Amherst: GLSA.

Büring, Daniel. 1996b. A weak theory of strong readings. In *SALT VI*, ed. Teresa Galloway and Justin Spence.

Büring, Daniel. 2003. On D-trees, beans, and B-accents. *Linguistics and Philosophy* 26:511–545.

Cable, Seth. 2007. The grammar of Q. Doctoral Dissertation, Massachusetts Institute of Technology.

Cable, Seth. 2010. *The grammar of Q: Q-particles, wh-movement, and pied-piping*. Oxford University Press.

Cable, Seth. 2012. Pied-piping: introducing two recent approaches. *Language and Linguistics Compass* 6:816–832.

Cable, Seth. 2013. Pied-piping: comparing two recent approaches. *Language and Linguistics Compass* 7:123–140.

Cheng, Lisa Lai-Shen. 1991. On the typology of *wh*-questions. Doctoral Dissertation, Massachusetts Institute of Technology.

Cheng, Lisa Lai-Shen, and Hamida Demirdache. 2010. Trapped at the edge: On long-distance pair-list readings. *Lingua* 120:463–480.

Chierchia, Gennaro. 1993. Questions with quantifiers. *Natural Language Semantics* 1:181–234.

Chierchia, Gennaro. 2013. *Logic in grammar: Polarity, free choice, and intervention*. Oxford University Press.

Chomsky, Noam. 1955. The logical structure of linguistic theory. Draft, Harvard University, June 1955.

Chomsky, Noam. 1964. The logical basis of linguistic theory. In *Proceedings of the 9th International Congress of Linguists*.

Chomsky, Noam. 1973. Conditions on transformations. In *A festschrift for Morris Halle*. New York: Holt, Reinhart, and Winston.

Chomsky, Noam. 1977. On *Wh*-movement. In *Formal syntax*, ed. Peter Culicover, Thomas Wasow, and Adrian Akmajian, 71–132. New York: Academic Press.

Chomsky, Noam. 1981. *Lectures on government and binding*. Foris.

Chomsky, Noam. 1982. *Some concepts and consequences of the theory of government and binding*. Cambridge, Mass.: MIT Press.

Chomsky, Noam. 1986. *Barriers*. Linguistic Inquiry Monographs. MIT Press.

Chomsky, Noam. 1991. Some notes on economy of derivation and representation. In *Principles and parameters in comparative grammar*. MIT Press.

Chomsky, Noam. 1993. A minimalist program for linguistic inquiry. In *The view from Building 20*, ed. Kenneth Hale and Samuel Jay Keyser. MIT Press.

Chomsky, Noam. 1995. *The minimalist program*. MIT Press.

Chomsky, Noam. 1998. Minimalist inquiries: the framework. *MIT Occasional Papers in Linguistics* 15.

Chomsky, Noam. 1999. Derivation by phase. *MIT Occasional Papers in Linguistics* 18.

Chomsky, Noam. 2000. Minimalist inquiries: the framework. In *Step by step: Essays on minimalist syntax in honor of Howard Lasnik*. MIT Press.

Chomsky, Noam. 2008. On phases. In *Foundational issues in linguistic theory*, ed. Robert Freidin, Carlos Otero, and Maria Luisa Zubizarreta, 133–166. MIT Press.

Clifton, Charles Jr., Gisbert Fanselow, and Lyn Frazier. 2006. Amnestying superiority violations: processing multiple questions. *Linguistic Inquiry* 37:51–68.

Clifton, Charles Jr., Lyn Frazier, and Patricia Deevy. 1999. Feature manipulation in sentence comprehentsion. *Rivista di Linguistica* 11:11–39.

Collins, Chris. 2001. Economy conditions in syntax. In *Handbook of syntactic theory*, ed. Chris Collins and Mark R. Baltin. Blackwell publishing.

Comorovski, Ileana. 1989. Discourse and the syntax of multiple constituent questions. Doctoral Dissertation, Cornell University.

Constant, Noah. 2014. Contrastive topic: Meanings and realizations. Doctoral Dissertation, University of Massachusetts Amherst.

Culicover, Peter W. 1992. Topicalization, inversion, and complementizers in English. In *Going romance and beyond*. OTS Working Papers in Linguistics 91.

Culicover, Peter W., and Paul M. Postal, ed. 2001. *Parasitic gaps*. MIT Press.

Dayal, Veneeta. 1996. *Locality in wh quantification*. Kluwer Academic Publishers.

Dayal, Veneeta. 2002. Single-pair versus multiple-pair answers: *wh*-in-situ and scope. *Linguistic Inquiry* 33:512–520.

Diesing, Molly. 1992. *Indefinites*. Cambridge, Mass.: MIT Press.

Dornisch, Ewa. 2000. Overt quantifier raising in Polish. In *Proceedings of Generative Linguistics in Poland GLiP*, volume 1, 47–58.

Drubig, Hans Bernhard. 1994. Island constraints and the syntactic nature of focus and association with focus. *Arbeitspapiere des Sonderforschungsbereichs 340: Sprachtheoretische Grundlagen der Computerlinguistik* 51.

van Dyke, Julie A., and Richard L. Lewis. 2003. Distinguishing effects of structure and decay on attachment and repair: A cue-based parsing account of recovery from misanalyzed ambiguities. *Journal of Memory and Language* 49:285–316.

É Kiss, Katalin. 1986. Against the LF-movement of *wh*-phrases. Ms., Hungarian Academy of Sciences, Budapest.

Engdahl, Elisabet. 1983. Parasitic gaps. *Linguistics and Philosophy* 6:5–34.

Engdahl, Elisabet. 1986. *Constituent questions: With special reference to swedish*. Dordrecht: Reidel.

Epstein, Sam. 1992. Derivational constraints on A' chain formation. *Linguistic Inquiry* 23:235–259.

Erlewine, Michael Yoshitaka. 2014. Movement Out of Focus. Doctoral Dissertation, Massachusetts Institute of Technology.

Erlewine, Michael Yoshitaka, and Hadas Kotek. 2014. Intervention in focus pied-piping. In *Proceedings of NELS 43*, ed. Hsin-Lun Huang, Ethan Poole, and Amanda Rysling, volume 1, 117–130. Amherst: GLSA.

Erteschik-Shir, Nomi. 1973. On the nature of island constraints. Doctoral Dissertation, Massachusetts Institute of Technology.

Fanselow, Gisbert, Denisa Lenertova, and Thomas Weskott. 2008. Studies on the acceptability of object movement to Spec,CP. In *Language content & cognition: The discourse potential of underspecified structures*, ed. Anita Steube. Mouton de Gruyter.

Featherston, Sam. 2005a. Magnitude estimation and what it can do for your syntax: some *wh*-constraints in German. *Lingua* 115:1525–1550.

Featherston, Sam. 2005b. Universals and grammaticality: *Wh*-constraints in German and English. *Linguistics* 43:667–711.

von Fintel, Kai. 1999. NPI licensing, Strawson entailment, and context dependency. *Journal of Semantics* 16:97–148.

Foraker, Stephani, and Brian McElree. 2011. Comprehension of linguistic dependencies: Speed-accuracy tradeoff evidence for direct-access retrieval from memory. *Language and Linguistics Compass* 5:764–783.

Ford, Marylin, Joan Bresnan, and Ron Kaplan. 1982. A competence-based theory of syntactic closure. In *The mental representation of grammatical relations*, ed. Joan Bresnan, 727–796. Cambridge, Mass.: MIT Press.

Fox, Danny. 1995. Economy and scope. *Natural Language Semantics* 3:283–341.

Fox, Danny. 2000. *Economy and semantic interpretation*. Cambridge, Mass.: MIT Press.

Fox, Danny. 2002. Antecedent-contained deletion and the copy theory of movement. *Linguistic Inquiry* 33:63–96.

Fox, Danny. 2003. *On Logical Form*, chapter 2, 82–123. Oxford, UK: Blackwell Publishers.

Fox, Danny. 2011. Towards an alternative perspective on superiority. MIT handout.

Fox, Danny. 2012. The semantics of questions. Class notes, MIT seminar.

Fox, Danny, and Martin Hackl. 2006. The universal density of measurement. *Linguistics and Philosophy* 29:537—586.

Fox, Danny, and Jon Nissenbaum. 1999. Extraposition and the nature of covert movement. In *Proceedings of WCCFL 18*, ed. Sonya Bird, Andrew Carnie, Jason D. Haugen, and Peter Norquest, 132–144. Somerville, MA: Cascadilla Press.

Frampton, John. 1991. Relativized minimality: A review. *The Linguistic Review* 8:1–46.

Frazier, Lyn. 1999. *On sentence interpretation*. Dordrecht: Kluwer.

Frazier, Lyn, and Charles Jr. Clifton. 2000. On bound variable interpretations: The LF-only hypothesis. *Journal of Psycholinguistic Research* 29:125–139.

Frazier, Lyn, and Charles Jr. Clifton. 2001. Parsing coordinates and ellipsis: Copy α. *Syntax* 4:1–22.

Frazier, Lyn, and Charles Jr. Clifton. 2002. Processing D-linked phrases. *Journal of Psycholinguistic Research* 31:633–660.

Frazier, Lyn, and D. Fodor, Janet. 1978. The sausage machine: A new two-stage parsing model. *Cognition* 6:291–325.

Frazier, Lyn, and Keith Rayner. 1982. Making and correcting errors during sentence comprehension: Eye movements in the analysis of structurally ambiguous sentences. *Cognitive psychology* 14:178–210.

Gajewski, John R. 2005. Neg-raising: Polarity and presupposition. Doctoral Dissertation, Massachusetts Institute of Technology.

Giannakidou, Anastasia. 1997. The landscape of polarity items. Doctoral Dissertation, University of Groningen.

Gibson, Edward. 1998. Linguistic complexity: Locality of syntactic dependencies. *Cognition* 68:1–76.

Golan, Yael. 1993. Node crossing economy, superiority and D-linking. Ms., Tel-Aviv University.

Gračanin-Yuksek, Martina. 2007. About sharing. Doctoral Dissertation, Massachusetts Institute of Technology.

Groat, Erich, and John O'Neil. 1996. Spell-out at the LF-interface. In *Minimal ideas*, ed. Werner Abraham, Sam Epstein, Höskuldur Thráinsson, and Jan-Wouter Zwart, 113–139. Amsterdam: John Benjamins.

Groenendijk, Jeroen, and Martin Stokhof. 1984. Studies on the semantics of questions and the pragmatics of answers. Doctoral Dissertation, University of Amsterdam.

Grohmann, Kleanthes K. 2006. Top issues in questions: Topics—topicalization—topicalizability. In *Wh-movement: Moving on*, ed. Lisa Lai-Shen Cheng and Norbert Corver. MIT Press.

Grosu, Alexander. 1989. Pied-piping and the matching parameter. *Linguistic Review* 6:41–58.

Guerzoni, Elena. 2003. Why even ask? on the pragmatics of questions and the semantics of answers. Doctoral Dissertation, Massachusetts Institute of Technology.

Guerzoni, Elena. 2006. Intervention effects on NPIs and feature movement: towards a unified account of intervention. *Natural Language Semantics* 14:359–398.

Hackl, Martin, Jorie Koster-Hale, and Jason Varvoutis. 2012. Quantification and ACD: Evidence from real-time sentence processing. *Journal of Semantics* 29:145–206.

Hagstrom, Paul. 1998. Decomposing questions. Doctoral Dissertation, Massachusetts Institute of Technology.

Halle, Morris. 1997. Distributed Morphology: Impoverishment and fission. In *MIT working papers in linguistics 30*, 425–449.

Hallman, Peter J. 1997. Reiterative syntax. Master's thesis, University of California at Los Angeles.

Hamblin, Charles. 1973. Questions in Montague English. *Foundations of Language* 10:41–53.

Hankamer, Jorge, and Ivan A. Sag. 1976. Deep and surface anaphora. *Linguistic Inquiry* 7:391–428.

Harwood, Will. 2011. There are several positions available: English intermediate subject positions. In *Proceedings of ConSOLE XIX*, 1–25.

Heck, Fabian. 2008. *On pied-piping: wh-movement and beyond*. Berlin: Mouton de Gruyter.

Heck, Fabian. 2009. On certain properties of pied-piping. *Linguistic Inquiry* 40:75–111.

Heim, Irene. 1994. Interrogative semantics and Karttunen's semantics for *know*. In *Proceedings of IATL 1*.

Heim, Irene, and Angelika Kratzer. 1998. *Semantics in generative grammar*. Blackwell.

Herburger, Elena. 2000. *What counts: Focus and quantification*. MIT Press.

Higginbotham, James. 1993. Interrogatives. In *The view from Building 20*, ed. Kenneth Hale and Samuel Jay Keyser, 195–228. MIT Press.

Hofmeister, Philip, Florian T. Jaeger, Ivan A. Sag, Inbal Arnon, and Neal Snider. 2007. Locality and accessibility in *wh*-questions. In *Roots: Linguistics in search of its evidential base*, ed. Sam Featherston and Wolfgang Sternfeld. Mouton de Gruyter.

Hoji, Hajime. 1985. Logical Form constraints and configurational structures in Japanese. Doctoral Dissertation, University of Washington.

Honcoop, Martin. 1998. Dynamic excursions on weak islands. Doctoral Dissertation, University of Leiden.

Hornstein, Norbert. 1995. *Logical Form: from GB to Minimalism*. Cambridge, Mass.: Blackwell Publishers.

Horvath, Julia. 1986. *FOCUS in the theory of grammar and the syntax of Hungarian*. Foris, Dordrecht.

Horvath, Julia. 2006. Pied-piping. In *The Blackwell companion to syntax*, ed. Martin Everaert and Henk van Riemsdijk, volume 1, chapter 50, 569–630. Blackwell publishing.

Horvath, Julia. 2007. Separating "focus movement" from focus. In *Phrasal and clausal architecture*. John Benjamins.

Huang, C. T. James. 1995. Logical Form. In *Government and binding theory and the minimalist program*, ed. G. Webelhuth, 127–173. Blackwell.

Huang, Cheng-Teh James. 1982a. Logical relations in Chinese and the theory of grammar. Doctoral Dissertation, Massachusetts Institute of Technology.

Huang, Cheng-Teh James. 1982b. Move *wh* in a language without *wh* movement. *The Linguistic Review* 1.

Iatridou, Sabine, and Ivy Sichel. 2011. Negative DPs, A-movement, and scope diminishment. *Linguistic Inquiry* 42.

Jackendoff, Ray. 1972. *Semantic interpretation in generative grammar*. MIT Press.

Johnson, Kyle. 1996. When verb phrases go missing. *Glot International* 2.5:3–9.

Johnson, Kyle. 2000a. How far will quantifiers go? In *Step by step: Essays on minimalist syntax in honor of Howard Lasnik*, ed. Roger Martin, David Michaels, and Juan Uriagereka, 187–210. MIT Press.

Johnson, Kyle. 2000b. When verb phrases go missing. In *The first glot international state-of-the-article book*, ed. Lisa Lai-Shen Cheng and Rint P. E. Sybesma.

Johnson, Kyle, and Satoshi Tomioka. 1997. Lowering and mid-size clauses. In *Proceedings of the 1997 Tübingen Workshop on Reconstruction*, ed. Graham Katz, Shin-Sook Kim, and Winhart Haike, 185–206.

Just, Marcel A., Patricia A. Carpenter, and Jacqueline D. Wooley. 1982. Paradigms and processes and in reading comprehension. *Journal of Experimental Psychology: General* 111:228–238.

Karttunen, Lauri. 1977. Syntax and semantics of questions. *Linguistics and Philosophy* 1:3–44.

Kayne, Richard. 1984. *Connectedness and binary branching*. Foris, Dordrecht.

Kazanina, Nina, and Colin Phillips. 2000. Differential effects of constraints in the processing of russian cataphora. *The Quarterly Journal of Experimental Psychology* 63:371–400.

Kehler, Andrew. 2001. *Coherence, reference, and the theory of grammar. center for the study of language and information*. CSLI Publications.

Kennedy, Christopher. 1997. Antecedent-contained deletion and the syntax of quantification. *Linguistic Inquiry* 4:662–688.

Kertz, Laura. 2010. Ellipsis reconsidered. Doctoral Dissertation, University of California Davis.

Kim, Shin-Sook. 2002. Focus matters: Two types of intervention effects. In *Proceedings of WCCFL 21*.

Kim, Soowon. 1991. Chain scope and quantification structure. Doctoral Dissertation, Brandeis University.

Kishimoto, Hideki. 2005. *Wh*-in-situ and movement in Sinhala questions. *Natural Language & Linguistic Theory* 23:1–51.

Kitahara, Hisatsugu. 1996. Raising Q without QR. In *Minimal ideas*, ed. Werner Abraham, Sam Epstein, Höskuldur Thráinsson, and Jan-Wouter Zwart. Amsterdam: John Benjamins.

Kitahara, Hisatsugu. 1997. *Elementary operations and optimal derivations*. Cambridge, Mass.: MIT Press.

Klima, Edward. 1964. Negation in English. In *Readings in the philosophy of language*, ed. J. J. Katz and Jerry A. Fodor. Engelwood Cliffs, N.J.: Prentice-Hall.

Kobele, Gregory, and Harold Torrence. 2006. Intervention and focus in Asante Twi. In *ZAS papers in Linguistics*, volume 46, 161–184.

Kotek, Hadas. 2012. Readings of Hebrew multiple questions. In *Proceedings of WCCFL 30*, ed. Nathan Arnett and Ryan Bennett, 216–225. Somerville, MA, USA: Cascadilla Proceedings Project.

Kotek, Hadas. 2014a. Intervention out of islands. In *Proceedings of NELS 44*, ed. Leland Kusmer and Jyoti Iyer. Amherst: GLSA.

Kotek, Hadas. 2014b. *Wh*-fronting in a two-probe system. *Natural Language & Linguistic Theory* .

Kotek, Hadas, and Michael Yoshitaka Erlewine. to appear. Covert pied-piping in English multiple *wh*-questions. *Linguistic Inquiry* .

Kotek, Hadas, and Martin Hackl. 2013. A new syntax for multiple *wh*-questions: Evidence from real time sentence processing. Manuscript, MIT.

Kotek, Hadas, Yasutada Sudo, and Martin Hackl. 2012. *Many* readings of *most*. Presented at Chicago Linguistics Society (CLS) 48.

Kratzer, Angelika. 1991. The representation of focus. In *Semantik/semantics: An international handbook of contemporary research*, ed. Arnim von Stechow and Dieter Wunderlich, 825–834. Berlin: Mouton de Gruyter.

Kratzer, Angelika. 1995. Stage-level vs. individual level predicates. In *The generic book*, ed. Gregory Carlson and Francis Pelletier, 125–175. Chicago: Chicago University Press.

Kratzer, Angelika, and Junko Shimoyama. 2002. Indeterminate pronouns: the view from Japanese. In *The Proceedings of the Third Tokyo Conference on Psycholinguistics (TCP 2002)*.

Krifka, Manfred. 2001. Quantifying into question acts. *Natural Language Semantics* 9:1–40.

Krifka, Manfred. 2006. Association with focus phrases. In *The architecture of focus*, 105–136. Mouton de Gruyter.

Kuno, Susumu, and Jane J. Robinson. 1972. Multiple *wh* questions. *Linguistic Inquiry* 3.

Kuno, Susumu, and Kenichi Takami. 1997. Remarks on negative islands. *Linguistic Inquiry* 28:553–576.

Ladusaw, William A. 1980. *Polarity sensitivity as inherent scope relations*. Garland Publishing.

Larson, Richard K., and Robert Carlen May. 1990. Antecedent containment or vacuous movement: Reply to Baltin. *Linguistic Inquiry* 21:103–122.

Lasnik, Howard. 1999. Chains of arguments. In *Working minimalism*, ed. Sam Epstein and Norbert Hornstein, 189–215. Cambridge, Mass.: MIT Press.

Lasnik, Howard, and Mamoru Saito. 1984. On the nature of proper government. *Linguistic Inquiry* 15:235–290.

Lasnik, Howard, and Mamoru Saito. 1992. *Move α, conditions on its application and output*. Cambridge, Mass.: MIT Press.

Lebeaux, David. 1995. Where does the binding theory apply. In *University of Maryland Working Papers in Linguistics*, volume 3, 63–88.

Lebeaux, David. 2009. *Where does binding theory apply*. Linguistic Inquiry Monographs. MIT Press.

Lechner, Winfred. 2013. The syntax-semantics interfact. In *Syntax, an international handbook*, ed. Tibor Kiss and Artemis Alexiadou. Mouton de Gruyter, 2nd edition.

Legate, Julie Anne. 2002. Some interface properties of the phase. Ms. MIT.

Lewis, Richard L., Shravan Vasishth, and Julie A. van Dyke. 2006. Computational principles of working memory in sentence comprehension. *Trends in Cognitive Sciences* 10:447–454.

Linebarger, Marcia C. 1980. The grammar of negative polarity. Doctoral Dissertation, Massachusetts Institute of Technology.

Linebarger, Marcia C. 1987. Negative polarity and grammatical representation. *Linguistics and Philosophy* 10:325–387.

MacDonald, Maryellen C., Neal J. Perlmutter, and Mark S. Seidenberg. 1994. Lexical nature of syntactic ambiguity resolution. *Psychological review* 101:676–703.

Mahajan, Anoop K. 1990. The A/A-bar distinction and movement theory. Doctoral Dissertation, Massachusetts Institute of Technology.

Martin, Andrea E., and Brian McElree. 2008. A content-addressable pointer underlies comprehension of verb–phrase ellipsis. *Journal of Memory and Language* 58:879–906.

Martin, Andrea E., and Brian McElree. 2009. Memory operations that support language comprehension: Evidence from verb–phrase ellipsis. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 35:1231–1239.

Martin, Andrea E., and Brian McElree. 2011. Direct-access retrieval during sentence comprehension: Evidence from sluicing. *Journal of Memory and Language* 64:327–343.

May, Robert Carlen. 1977. The grammar of quantification. Doctoral Dissertation, Massachusetts Institute of Technology.

May, Robert Carlen. 1985. *Logical Form: Its structure and derivation*. Linguistic Inquiry Monographs. MIT Press.

Mayr, Clemens. 2010. The role of alternatives and strength in grammar. Doctoral Dissertation, Harvard.

Mayr, Clemens. to appear. Intervention effects and additivity. *Journal of Semantics* .

McCawley, James. 1982. Parentheticals and discontinuous constituent structure. *Linguistic Inquiry* 13:91–106.

Merchant, Jason. 2013. Voice and ellipsis. *Linguistic Inquiry* 44:77–108.

Miyagawa, Shigeru. 1995. Scrambling as an obligatory movement. In *Proceedings of the Nanzan Conference on Japanese Linguistics and Language Teaching*. Nanzan University.

Miyagawa, Shigeru. 2001. EPP, scrambling, and *wh*-in-situ. In *Ken Hale: a life in language*, ed. Michael Kenstowicz. Cambridge, Mass.: MIT Press.

Miyagawa, Shigeru. 2011. Optionality. In *The Oxford handbook of linguistic minimalism*, ed. Cedric Boeckx, 354–376. Oxford University Press.

Moltmann, Friederike, and Anna Szabolcsi. 1994. Scope interaction with pair-list quantifiers. In *Proceedings of NELS 24*, ed. Merce Gonzalez, 381–395. University of Massachusetts, Amherst: GLSA.

Murphy, Gregory. 1985. Processes of understanding anaphora. *Journal of Memory and Language* 24:290–303.

Nicolae, Andreea. 2013. Any questions? Doctoral Dissertation, Harvard.

Nishigauchi, Taisuke. 1986. Quantification in syntax. Doctoral Dissertation, University of Massachusetts Amherst.

Nishigauchi, Taisuke. 1990. *Quantification in the theory of grammar*. Kluwer.

Nishigauchi, Taisuke, and Tomohiro Fujii. 2006. Where the island remains (unrepairable). Ms.

Nissenbaum, Jon. 2000a. Covert movement and parasitic gaps. In *Proceedings of NELS 30*, ed. M. Hirotani, Coetzee A., Hall N., and Kim J.-Y., volume 2, 541–555.

Nissenbaum, Jon. 2000b. Investigations of covert phrase movement. Doctoral Dissertation, Massachusetts Institute of Technology.

Pesetsky, David. 1987. *Wh*-in-situ: movement and unselective binding. In *The representation of (in)definiteness*. MIT Press.

Pesetsky, David. 1998. Some optimality principles of sentence pronunciation. In *Is the best good enough*, ed. Pilar Barbosa, Danny Fox, Paul Hagstrom, Martha McGinnis, and David Pesetsky, 337–383. MIT Press.

Pesetsky, David. 2000. *Phrasal movement and its kin*. Cambridge, Mass.: MIT Press.

Pesetsky, David, and Esther Torrego. 2001. T-to-C movement: Causes and consequences. In *Ken Hale: A life in language*. MIT Press.

Phillips, Colin. 1996. Order and structure. Doctoral Dissertation, Massachusetts Institute of Technology.

Phillips, Colin. 2003. Linear order and constituency. *Linguistic Inquiry* 34:37–90.

Pica, Pierre, and William Snyder. 1995. Weak crossover, scope, and agreement in a minimalist framework. In *Proceedings of WCCFL 13*, ed. R. et al. Aranovich, 334–349. Stanford, CA: CSLI Publications.

Polinsky, Maria, Carlos Gomez Gallo, Peter Graff, and Ekaterina Kravtchenko. 2012. Subject preference and ergativity. *Lingua* 122:267–277.

Polinsky, Maria, and Eric Potsdam. 2013. Diagnosing covert A-movement. In *Diagnostics in syntax*, ed. Lisa Lai-Shen Cheng and Norbert Corver.

Polinsky, Maria, and Eric Potsdam. Forthcoming. Left edge topics in Russian and the processing of anaphoric dependencies. *Journal of Linguistics* .

Pope, Emily N. 1976. *Questions and answers in English*. The Hague: Mouton de Gruyter.

Preminger, Omer. 2011. Agreement as a fallible operation. Doctoral Dissertation, Massachusetts Institute of Technology.

Pritchett, Bradley L. 1992. *Grammatical competence and parsing performance*. The University of Chicago Press.

Ratiu, Dafina. 2005. Questions multiples en Roumain. Master's thesis, Université de Nantes.

Ratiu, Dafina. 2007. Evidence for (counter) cyclic movement from romanian. Paper presented at the 37th Linguistics Symposium on Romance Languages.

Reinhart, Tanya. 1997. Quantifier scope: How labour is divided between QR and choice functions. *Linguistics and Philosophy* 20:335–397.

Reinhart, Tanya. 1998. *Wh*-in-situ in the framework of the Minimalist Program. *Natural Language Semantics* 6:29–56.

Reinhart, Tanya. 2006. *Interface strategies: Optimal and costly computations*. Cambridge, Mass.: MIT Press.

Richards, Marc D. 2004. Object shift and scrambling in north and west Germanic: A case study in symmetrical syntax. Doctoral Dissertation, University of Cambridge.

Richards, Norvin. 1997. What moves where when in which language? Doctoral Dissertation, Massachusetts Institute of Technology.

Richards, Norvin. 2001. *Movement in language: Interactions and architectures*. Oxford University Press.

Richards, Norvin. 2010. *Uttering trees*. MIT Press.

Rizzi, Luigi. 1990. *Relativized minimality*. MIT Press.

Rizzi, Luigi. 2001. Relativized minimality effects. In *The handbook of contemporary syntactic theory*, ed. Mark R. Baltin and Chris Collins, 89–110. Blackwell, Oxford.

Roberts, Cragie. 1996. Information structure: Towards an integrated formal theory of pragmatics. In *OSU working papers in linguistics: Papers in semantics*, ed. J.H Yoon and A. Kathol, volume 49. The Ohio State University Department of Linguistics.

Rooth, Mats. 1985. Association with focus. Doctoral Dissertation, University of Massachusetts, Amherst.

Rooth, Mats. 1992. A theory of focus interpretation. *Natural Language Semantics* 1:75–116.

Ross, John Robert. 1967. Constraints on variables in syntax. Doctoral Dissertation, Massachusetts Institute of Technology.

Ross, John Robert. 1984. Inner islands. In *Proceedings of BLS 10*.

Rudin, Catherine. 1985. *Aspects of Bulgarian syntax: Complementizers and* wh *constructions*. Columbus, Ohio: Slavica.

Rullmann, Hotze. 1995. Maximality in the semantics of *wh*-constructions. Doctoral Dissertation, University of Massachusetts Amherst.

Rullmann, Hotze, and Sigrid Beck. 1998. Reconstruction and the interpretation of *which*-phrases. In *Proceedings of the 1997 Tübingen Workshop*, ed. G. Katz, S.-S Kim, and H. Winhart.

Sag, Ivan Andrew. 1976. Deletion and Logical Form. Doctoral Dissertation, Massachusetts Institute of Technology.

San Pietro, Steven A., Ming Xiang, and Jason Merchant. 2012. Accounting for voice mismatches in ellipsis. In *Proceedings of WCCFL 30*, ed. Nathan Arnett and Ryan Bennett, 303–312. Somerville, MA: Cascadilla Proceedings Project.

Sauerland, Uli, and Fabian Heck. 2003. LF-intervention effects in pied-piping. In *Proceedings of NELS 33*.

Shimoyama, Junko. 2001. *Wh*-constructions in Japanese. Doctoral Dissertation, University of Massachusetts Amherst.

Shimoyama, Junko. 2006. Indeterminate quantification in Japanese. *Natural Language Semantics* 14:139–173.

Simpson, Andrew. 2000. *Wh-movement and the theory of feature-checking*. John Benjamins.

Simpson, Andrew, and Tanmoy Bhattacharya. 2003. Obligatory overt *wh*-movement in a *wh*-in-situ language. *Linguistic Inquiry* 34:127–142.

Soh, Hooi Ling. 2005. *Wh*-in-situ in Mandarin Chinese. *Linguistic Inquiry* 36:143–155.

Sportiche, Dominique. 1988. A theory of floating quantifiers and its corollaries for constituent structure. *Linguistic Inquiry* 19:425–449.

Szabolcsi, Anna, and Frans Zwarts. 1993. Weak islands and an algebraic semantics for scope taking. *Natural Language Semantics* 1:235–284.

Szendrői, Kriszta. 2003. A stress-based approach to the syntax of Hungarian focus. *The Linguistic Review* 20:37–78.

Takano, Yuji. 1998. Object shift and scrambling. *Natural Language & Linguistic Theory* 16:817–889.

Tancredi, Chris. 1990. Not only EVEN, but even ONLY. Manuscript, MIT.

Tancredi, Chris. 1992. Deletion, deaccenting and presupposition. Doctoral Dissertation, Massachusetts Institute of Technology.

Tanenhaus, Michael K., and John C. Trueswell. 1995. Sentence comprehension. In *Speech, language, and communication. handbook of perception and cognition*, ed. Joanne L. Miller and Peter D. Eimas, volume 11, 217–262. San Diego, CA, US: Academic Press, 2nd edition.

Taraldsen, Knut Tarald. 1981. The theoretical interpretation of a class of marked extractions. In *Theory of Markedness in Generative Grammar: Proceedings of the 1979 GLOW Conference*, ed. Adriana Belletti, Luciana Brandi, and Luigi Rizzi, 475–516. Scula Normale Superiore di Pisa.

Tomioka, Satoshi. 2007a. Intervention effects in focus: From a Japanese point of view. In *Proceedings of the 2nd Workshop on Prosody, Syntax, and Information Structure (WPSI 2)*, ed. Shinichiro Ishihara, 97–117. Potsdam: Potsdam University Press.

Tomioka, Satoshi. 2007b. Pragmatics of LF intervention effects: Japanese and Korean interrogatives. *Journal of Pragmatics* 39:1570–1590.

Truckenbrodt, Hubert. 2013. An analysis of prosodic F-effects in interrogatives: prosody, syntax, and semantics. *Lingua* 124:131–175.

Tsai, Wei-tien Dylan. 1994. On nominal islands and LF extractions in Chinese. *Natural Language and Linguistic Theory* 12:121–175.

Tunstall, Susanne L. 1998. The interpretation of quantifiers: Semantics and processing. Doctoral Dissertation, University of Massachusetts Amherst.

Uribe Etxebarria, Miriam. 1994. Interface licensing conditions on negative polarity licensing: A theory of polarity and tense interactions. Doctoral Dissertation, University of Connecticut.

Wachowicz, Krystyna. 1974. On the syntax and semantics of multiple questions. Doctoral Dissertation, University of Texas.

Wagers, Matthew W., and Colin Phillips. 2009. Multiple dependencies and the role of the grammar in real-time comprehension. *Journal of Linguistics* 45:395–433.

Wagner, Michael. 2006. Association by movement: evidence from NPI-licensing. *Natural Language Semantics* 14:297–324.

Warren, Tessa, and Edward Gibson. 2002. The influence of referential processing on sentence complexity. *Cognition* 85:79–112.

Watanabe, Akira. 2001. *Wh*-in-situ languages. In *The handbook of contemporary syntactic theory*, ed. Mark R. Baltin and Chris Collins, 203–225. Oxford, UK: Blackwell.

Wilder, Chris. 1999. Right-Node Raising and the LCA. In *Proceedings of WCCFL 18*, ed. Sonya Bird, Andrew Carnie, Jason D. Haugen, and Peter Norquest.

Williams, Edwin. 1974. Rule ordering in grammar. Doctoral Dissertation, Massachusetts Institute of Technology.

Williams, Edwin. 1977. Discourse and Logical Form. *Linguistic Inquiry* 8:101–139.

Willis, Paul. 2008. The role of topic-hood in multiple-*wh* question semantics. In *Proceedings of WCCFL 27*.

Wiltschko, Martina. 1997. D-linking, scrambling and superiority in German. In *Groninger Arbeiten zur germanistischen Linguistik*, ed. Werner Abraham, volume 41. Rijksuniversiteit Groningen: Germanistisch Institut.

Wold, Dag. 1996. Long distance selective binding: the case of focus. In *Proceedings of SALT 6*, ed. Teresa Galloway and Justin Spence, 311–328.

Xiang, Ming, Brian Dillon, Matthew W. Wagers, Fengqin Liu, and Taomei Guo. 2014. Processing covert dependencies: an sat study on mandarin *wh*-in-situ questions. *Journal of East Asian Linguistics* 23:207–232.

Xiang, Ming, Boris Harizanov, Maria Polinsky, and Ekaterina Kravtchenko. 2011. Processing morphological ambiguity: An experimental investigation of russian numerical phrases. *Lingua* 121:548–560.

Zwicky, Arnold M. 1971. In a manner of speaking. *Linguistic Inquiry* 2:223–233.