Covert pied-piping in English multiple *wh*-questions

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In this paper we argue for the existence of covert pied-piping in *wh*-questions through a previously unnoticed pattern of intervention effects in superiority-obeying English multiple *wh*-questions. We show that the preference of covert pied-piping is for movement of larger constituents, unlike overt pied-piping. We argue that this discrepancy stems from conflicting requirements of PF and LF: overt pied-piping feeds both LF and PF, but covert pied-piping feeds LF only. The study of covert pied-piping thus reveals the true preference of LF and Core Syntax with regard to pied-piping: larger pied-piping constituents are preferred over smaller ones. This preference can be overridden by certain PF constraints that apply to overt pied-piping.

Keywords: pied-piping, covert movement, multiple *wh*-questions, intervention effects, focus alternatives

1 Introduction

Much recent work on syntactic and semantic theory has debated the status of covert movement in grammar. At the same time, much empirical work has been done to better describe and explain the pied-piping observed with overt *wh*-movement. In this paper we ask the question: *Does covert wh-movement also trigger pied-piping?* We argue that the existence of covert pied-piping can be detected through the use of *focus intervention effects* (Beck, 2006; Beck and Kim, 2006; Cable, 2007; Grohmann, 2006; Kotek, forthcoming; Tomioka, 2007; Mayr, 2010; Sauerland and Heck, 2003). We present a novel pattern of focus intervention effects in superiority-obeying English multiple *wh*-questions, which we argue is evidence for the existence of covert pied-piping.

Adopting the theory that focus intervention effects occur when the interpretation of a

wh-phrase is interrupted by certain focus-sensitive interveners (Beck, 2006), we show that the logic of intervention can be used to diagnose areas in the derivation in which Rooth-Hamblin focus alternatives are computed. We then use this diagnostic to investigate the status of the (phonologically) in-situ *wh*-phrase in superiority-obeying English *wh*-questions such as those in (1). In such questions, it has been argued that the lower *wh* covertly moves to C by LF (Karttunen, 1977; Huang, 1982; Hagstrom, 1998; Pesetsky, 2000; Beck, 2006; Cable, 2007, 2010).

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

　　　a.　✓ I know [*which* student read a book from *which* library].

　　　b.　＊ I know [*which* student read **no** book from *which* library].

Building on previous work by Sauerland and Heck (2003), Cable (2007) shows that focus intervention effects occur inside overtly pied-piped constituents. We argue that the ungrammaticality of (1b) is the result of a focus intervention effect inside a *covertly* pied-piped constituent. That is, the surface-in-situ *wh*-word *which* covertly moves at LF and pied-pipes a constituent containing the intervener *no*. The contrast in (1) and other examples presented in section 3 is neatly predicted by the semantics of pied-piping constituents proposed by Cable (2007), together with Beck's (2006) system of focus intervention.

Furthermore, we demonstrate that the constituent pied-piped with *wh* corresponds to the *largest* among the corresponding overt pied-piping possibilities for a parallel single *wh*-question. This, we 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, shows us 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 (Heck, 2008, 2009).

The paper is structured as follows: in section 2 we provide background on Beck's (2006) theory of focus intervention effects in *wh*-questions, and on its extension to overt pied-

piping constructions (Cable, 2010). We present the use of focus intervention effects as a diagnostic for covert movement versus Rooth-Hamblin focus alternative computation. In section 3 we show that assuming that intervention correlates with focus alternative computation, the data motivates the existence of *covert pied-piping*. We show that covert *wh*-movement prefers to pied-pipe larger constituents, in contrast to overt *wh*-movement which tends to prefer smaller pied-piping constituents. In section 4 we argue that the different preferences for overt vs. covert pied-piping result from conflicting constraints on the PF and LF interfaces: the true preference of LF and Core Syntax is for larger pied-piping constituents, but this can be overridden by PF constraints, often result in smaller overt pied-piping. Section 5 is the conclusion.

2 Background: Intervention effects in overt pied-piping

In this section we present Beck's (2006) theory of focus intervention effects for English questions and its extension to intervention inside pied-piping constituents (Cable, 2007, 2010).[1] We 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. We will then use this diagnostic to address the question: *Does covert pied-piping exist and, if so, how large is it?* The answer to that question will be the main goal of section 3.

2.1 Beck's (2006) theory of focus intervention effects

Pesetsky (2000) observes a correlation between Superiority (Kuno and Robinson, 1972; Chomsky, 1973, a.o.) and intervention effects in English multiple questions with D-linked *wh*-phrases. Motivating examples are given in (2): (2a–b) show that English generally al-

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[1]We discuss alternative theories of intervention (Tomioka, 2007; Grohmann, 2006; Mayr, 2010) in an appendix to this paper. Although such theories exist, as we discuss in the appendix, they have not been applied to English data. We show that the application of these theories to our data presents problems that we believe are unsolvable.

lows both superiority-obeying questions and superiority-violating questions with D-linked *wh*-phrases. Examples (2c–d) show that when certain interveners—here, negation—are introduced into the questions, only the superiority-obeying structure is grammatical. The superiority-violating question is ungrammatical.[2]

(2) **D-linked questions can violate Superiority but superiority-violating questions are sensitive to intervention:**

    a.   *Which* boy ___ read *which* book?   ✓Superiority-obeying, no intervener

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

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

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

Other operators that give rise to an intervention effect include **only**, **very few**, **never**, and **no one**, as shown in examples (3–6) below from Pesetsky (2000).[3]

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[2]Pesetsky (2000) reports that in cases of intervention in multiple *wh*-questions such as (2), many speakers report that the question is ungrammatical while some others report that the question's single-pair reading is maintained (ia) but its pair-list reading is lost (ib). For this reason, the multiple *wh*-questions which are crucial to our argumentation (section 3) are presented with explicit contexts which make their pair-list readings appropriate. See Dayal 2002 for more discussion of the semantics of the readings, Pesetsky 2000 for a discussion of the judgments.

(i) **Single-pair and pair-list readings of *Which boy didn't read which book?*:**

    a.   John didn't read Robinson Crusoe.

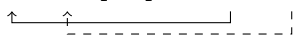   b.   John didn't read Robinson Crusoe, Bill didn't read Moby Dick, and Fred didn't read Don Quixote.

[3]The characterization of the set of interveners has been a source of debate in recent literature. Beck (2006) and Beck and Kim (2006) have identified a number of focus-sensitive operators, including *only*, *also*, *even*, and negation, as a relatively cross-linguistically stable set of interveners. The Beck (2006) theory of intervention is discussed and adopted here.
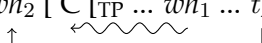
Other authors have observed that the set of interveners can vary across languages and have proposed correspondingly different theories for intervention itself. For Beck (1996) intervention in German questions is caused by certain quantifiers and time adverbials like *often* and *always*; in more recent work on German, other

(3) **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 ___?

(4) **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 ___?

(5) **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 ___?

(6) **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 ___?

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: Pesetsky proposes that 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. The resulting structures are given in (7a–b):

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

    a.   [$_{CP}$ *wh$_1$ wh$_2$* [C [$_{TP}$ ... t_1 ... t_2]]]   Superiority-obeying

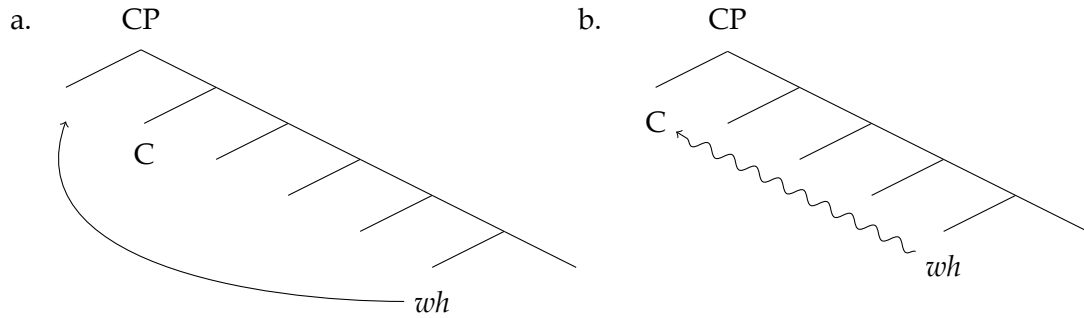   b.   [$_{CP}$ *wh$_2$* [C [$_{TP}$ ... *wh$_1$* ... t_2]]]   Superiority-violating

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downward entailing elements and time adverbials have also been argued to be interveners (Grohmann, 2006; Mayr, 2010). Tomioka (2007) and others additionally discuss intervention by NPIs and disjunction in Japanese and Korean.

See more discussion of alternative theories of intervention in the appendix.

5

When the (phonologically) in-situ *wh*-phrase does not undergo covert movement (wh_1 in 7b), it is interpreted via *Rooth-Hamblin alternative computation* (Hamblin, 1973; Kratzer and Shimoyama, 2002, a.o.).[4] These two strategies for establishing a relation between the interrogative C and *wh* and assigning *wh* a semantics are schematized in (8a,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.
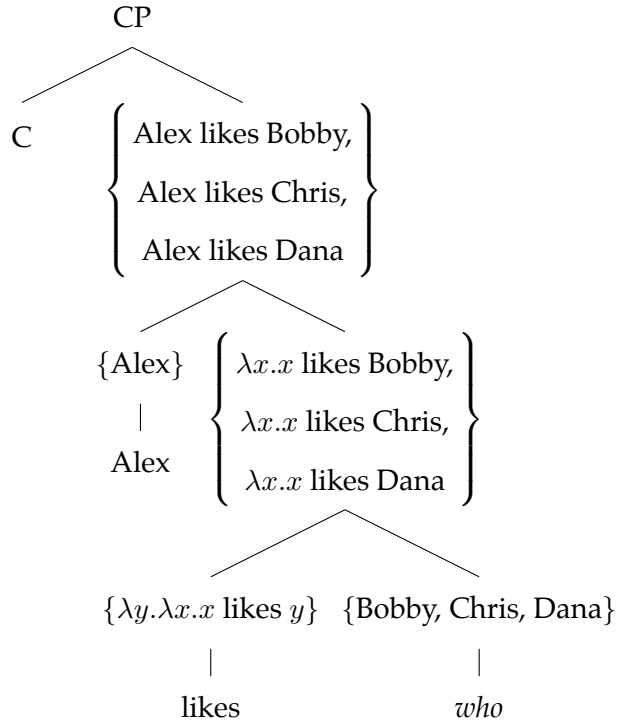
(8)   **Interpretation of *wh* using covert movement and using Rooth-Hamblin alternatives:**

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 (Hamblin, 1973; Rooth, 1985, 1992). This computation has been argued to supply operators such as focus operators and question complementizers with a relevant set of alternative denotations or propositions. Consider the LF representation for the *wh*-in-situ pseudo-English question "Alex likes *who*?" in (9) below. Focus-semantic values—also referred to as *alternatives*—are given for each node.

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[4]Here and throughout, we use straight arrows to indicate movement and curly arrows to indicate areas in which Rooth-Hamblin alternatives are computed. These curly arrows are used here as a notational convenience only. Dashed arrows indicate covert movement.

(9) **A toy LF of question interpretation through Rooth-Hamblin alternative computation:**

$$
\begin{array}{c}
\text{CP} \\
\diagup \quad \diagdown \\
\text{C} \quad \left\{ \begin{array}{l} \text{Alex likes Bobby,} \\ \text{Alex likes Chris,} \\ \text{Alex likes Dana} \end{array} \right\}
\end{array}
$$

In (9), 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 *alternatives* compose pointwise at each nonterminal node,[6] resulting in the complement of the

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[5] The semantics of *what* and *who* in Beck (2006) are given below:

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

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

[6] In this paper we will not be presenting computations of Rooth-Hamblin alternatives beyond the toy example in (9). We refer the reader to Hamblin (1973); Rooth (1985, 1992) and subsequent work on the technical details of Rooth-Hamblin (focus) alternative computation.

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.

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

(10)   **Description of a focus intervention effect:**

When a focus-sensitive operator occurs between an LF-in-situ *wh*-word and its associated complementizer, 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 illicit configuration is schematized in (11b). In essence, the problem 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 by the the *wh*-word will be interpreted by the intervener instead of by C, thus disrupting the question interpretation.[8,9]

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

[8]It is worth noting that for intervention effects to occur as theorized by Beck (2006) in structures such as (11b), 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.

[9]Note that there may also be another problem when interpreting configuration (11b). Standard focus-sensitive operators utilize both the focus-semantic value and the ordinary semantic value for their interpretation (Rooth, 1985, 1992), but the ordinary semantic value for the complement of the intervener in (11b) will be

(11) **Focus alternative computation, but not covert movement, is sensitive to intervention effects:**

a. CP

C

intervener

wh

b. * CP

C

intervener

wh

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 (11a).

The Beck (2006) schema for intervention effects between an in-situ *wh*-phrase and C is summarized in (12). 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 (13) below. This is consistent with the findings of Pesetsky (2000).

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

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

(13) **The interaction of superiority and interveners at LF (cf 7):**

a. Superiority-obeying questions: no intervention effects

$^\checkmark$[$_{CP}$ *wh$_1$* *wh$_2$* [C [$_{TP}$ ... **intervener** ... *t$_1$* ... *t$_2$*]]]

b. Superiority-violating questions: intervention effects

* [$_{CP}$ *wh$_2$* [C [$_{TP}$ ... **intervener** ... *wh$_1$* ... *t$_2$*]]]

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undefined (see footnote 5). See Beck (2006) for more technical discussion.

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Following this logic, focus intervention effects can diagnose whether or not covert *wh*-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 *wh*-phrase has covertly moved above the scope of the intervener.

2.2 Intervention effects in pied-piping constituents and Cable's theory of pied-piping

Cable (2007, 2010) shows that intervention effects also occur in superiority-obeying English questions inside pied-piping constituents (14). This work builds on a study by Sauerland and Heck (2003) who show a similar effect in German (15).

(14) **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 ___?

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

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

(15) **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) is adjoined

to 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 (16a) below, Q adjoins to the *wh*-containing DP "a picture of *which* president"; in (16b), Q adjoins to the PP "of *which* president"; in (16c), 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 (16a).[10]
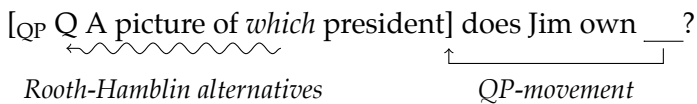
(16) **Different sizes of pied-piping corresponds to different positions of Q-adjunction:**

Base structure: C 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 (16), then, two steps occur: first, a movement step of QP 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.

(17) **Interpreting (16a) 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 sensitive to intervention effects, as in the schema in (18). That is, if a focus-sensitive operator

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[10]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.

11

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 (the Beck schema, 12).

(18) **Intervention schema for *wh*-pied-piping (Cable, 2007, cf Sauerland and Heck 2003):**

    * [$_{QP}$ Q ... **intervener** ... *wh* ...]$_i$ ... t_i ...

Cable argues that the configuration in (18) explains the ungrammaticality of examples (14b–d): an intervener—**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.

Cable offers further evidence to show that (18) is the relevant structural configuration for these contrasts—i.e., that an intervener *between* the *wh* and the edge of the pied-piping (Q) is the source of ungrammaticality in (14b–d). For example, the intervention effect in (14b) can be avoided by pied-piping a smaller constituent which does not include the potential intervener (19). In addition, placing an intervener inside QP but below the *wh*-word does not trigger intervention (20).

(19) **No intervention if the intervener is not inside the pied-piping constituent:**

    a.   * [$_{QP}$ Q **No** pictures of *which* president] does Jim own ___?   (=14b)

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

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

(20) **No intervention if the intervener is inside pied-piping constituent but below *wh*:**

    ✓ [*Which* picture containing **no** presidents] does Jim own ___?

In this paper we investigate the syntax and semantics of multiple *wh*-questions. Following the work presented in section 2.1, we assume that the (phonologically) in-situ *wh*-phrase moves to C by LF. The question that we set out to answer in this paper is: does covert *wh*-movement pied-pipes material along with the *wh*-word? And, if so, how much? We will use the presence or absence of intervention effects inside potentially covertly pied-piped
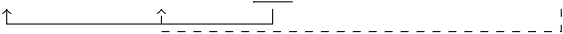
constituents as a diagnostic for regions where covert movement has occurred and regions where Rooth-Hamblin alternatives are computed. We elaborate on this logic in section 3, where we present a novel pattern of intervention effects in English superiority-obeying questions.

3   Diagnosing covert pied-piping

In this section we will argue based on the pattern of focus intervention effects in English multiple *wh*-questions that covert pied-piping exists, and furthermore that covert pied-piping of larger constituents is preferred over that of smaller constituents. Our main focus will be on questions such as (21) below, where we assume that the (phonologically) in-situ *wh*-phrase moves to C by LF.[11]

(21)   **Superiority-obeying multiple question: the lower *wh* covertly moves to C at LF:**

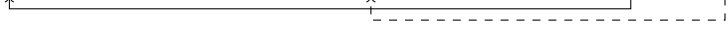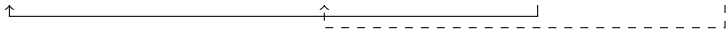   *Which* student *...which...* C ___ read a book from *which* library?

Given that in superiority-obeying questions the in-situ *wh*-phrase covertly moves to C by 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 (22), corresponding to the possible sizes of overt pied-piping in examples such as (16) above.[12]

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[11]Although we present this as an assumption to facilitate the discussion, below we will show that the pattern of intervention effects that we observe further supports the conclusion that the lower *wh* could not be interpreted in-situ in English superiority-obeying questions.

[12]See discussion in section 2.2 and Cable (2010) for arguments that Q can't be merged with VP and larger constituents in English.

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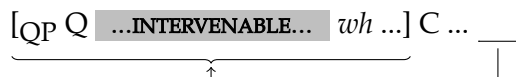
Which student read a book from *which* library?

  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

The movement of the lower QPs in (22) is covert, and thus all three of the LF representations in (22) 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.

We instead propose the use of focus intervention effects as a diagnostic for the existence and size of covert pied-piping. The different sizes of covert pied-piping in (22)—corresponding to different QP sizes—*predict different regions that should be sensitive to intervention effects.*

The logic of this diagnostic is as follows. As we saw in section 2.2, 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 (18′ below). In the Cable (2007, 2010) theory for the semantic interpretation of pied-piping constituents, *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, we 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 (23).

(18′) **Intervention in overt pied-piping (Cable, 2007, cf Sauerland and Heck 2003):**

$[_{\text{QP}}$ Q ...INTERVENABLE... *wh* ...] C ... ___

(23) **Intervention in covert pied-piping:**

... C ... $[_{\text{QP}}$ Q ...INTERVENABLE... *wh* ...]

The different covert pied-piping options in (22) predict different regions to be intervenable, represented by the gray shading in (24). (In (24) and subsequent examples, the lower QP is represented in-situ, to reflect the linearization at PF.) If the largest QP is chosen, (24a), the entire region between *a* and *wh* is intervenable. If the smaller QP in (24b) is chosen, only the preposition *from* is inside the intervenable region. If the smallest QP in (24c) is chosen, there is little or no intervenable region between Q and *wh*.

(24) **Different covert pied-piping options predict different intervenable regions:**

Which student read a book from *which* library?

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

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

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

In what follows, we will use the size of the intervenable region as a diagnostic for the presence of covert pied-piping and its size. We use the interveners **no**, **only**, and **very few**, placed inside regions suspected of being intervenable. If the presence of an intervener in our examples causes an intervention effect, the conclusion will be that the intervener occurs inside an intervenable region. We will show that the intervenable regions we find occur inside covertly pied-piped constituents—that is, between *wh* and Q (schema in 18)—and not between an in-situ *wh* and C (schema in 12). Since it has been argued that intervention effects only affect the pair-list reading of a question for some speakers (Pesetsky, 2000), we present each example in a context designed to bring out the pair-list reading of the multiple

15

question and satisfy its presuppositions (Dayal, 2002).[13]

We begin with our baseline example (21), repeated below in (25) with a context supporting its pair-list interpretation. The question is reported to be grammatical and felicitous in this context.

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

    a. <u>Context:</u> 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. Having read all the book reports...

    b. ✓ I know [*which* student read a book from *which* library].

Next, we consider an example in which the determiner *a* is replaced with the determiner *no* (26), which we saw to be an intervener in cases of overt pied-piping in section 2.2. 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.

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

    a. <u>Context:</u> 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. Having read all the book reports...

    b. * I know [*which* student read no book from *which* library].

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[13] Note that Reinhart (1998) develops a theory that allows for the interpretation of a multiple wh-question without requiring movement of the (phonologically) in-situ *wh*-phrase. However, this theory can only derive a single-pair reading of the question and not a pair-list reading (see Dayal 2002 for discussion). Crucially, the examples in this section are given in a pair-list context and thus cannot be interpreted using Reinhart's choice-function mechanism.

The contrast between (26) and its baseline (25) tells us that the intervener *no* is in an intervenable region.[14] 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* (27a). If, however, a smaller pied-piping constituent is targeted for movement—*from which library* (27b) or *which library* (27c)—we expect *no* to be outside the intervenable region and therefore not cause an intervention effect. Therefore, the intervention contrast observed in (26) is predicted by pied-piping of the largest option as in (27a) but not (27b–c).

(27) **Different covert pied-piping options predict different intervenable regions; only (27a) predicts (26):**

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.

(28) **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. Having read all the book reports...

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[14]Note that, for some speakers, the determiner *no* in object position is generally slightly degraded. Nonetheless, native speakers report a strong contrast with the example in (26) 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 a confounding outlier.

b. ✓ I know [*which* student read less than three books from *which* library].

Furthermore, an intervention effect is observed not only with *no* but also with *only* and with *very few*, as shown in (29–30) below. We note that the judgment with *very few* appears to be less sharp than with *no* and *only*.[15]

(29) **Intervention effect caused by the presence of *only* in the question:**

    a. <u>Context:</u> 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. Having read through the records...

    b. * I know [*which* collector sold only PICTURES of *which* president].

(30) **Intervention effect caused by the presence of *very few* in the question:**

    a. <u>Context:</u> We at McDonalds 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. Having looked at the sales records...

    b. ?? I know [*which* branch sold very few burgers with *which* topping].

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[15]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 Herberger (2000); Büring (1996); 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 we consider.

With these results in mind, the main contrasts that we aim to explain are the minimal pairs in (31–32) below. We argue that these contrasts are the result of intervention effects, caused by placing the focus-sensitive 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*.

(31) **Minimal pair: *no* causes intervention effect in multiple question**

    a.   ✓ I know [*which* student read a book from *which* library].   (=25)

    b.   * I know [*which* student read **no** book from *which* library].   (=26)

(32) **Minimal pair: *only* causes intervention effect in multiple question**

    a.   ✓ I know [*which* collector sold two pictures of *which* president].

    b.   * I know [*which* collector sold **only** PICTURES of *which* president].   (=29)

Note that the ungrammaticality of (31b) 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 (33), we see that movement of the manner *wh*-word *how* is ungrammatical over both sentential negation and the negative determiner *no*.

(33) **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 (31b) were due to a negative island 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 (34) below, we see that sentential negation (shown to trigger negative islands in (33a) above) does not trigger ungrammaticality, in contrast to (31b). Therefore the ungrammaticality of (31b) cannot be due to a so-called negative island effect.

(34) **Sentential negation does not cause a negative island effect (cf 31b):**

 ✓I know [*which* student did**n't** read a book from *which* library].

Similarly, we note that the contrasts in (31–32) cannot be due to a general Beck (2006) focus intervention effect between the in-situ *wh*-phrase and C. As we saw in section 2.1, 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 (35) 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 (35a–b) on the one hand and the ungrammatical (31b) and (32b) on the other hand.[16]

(35) **No intervention effect with higher intervener:**

 a. ✓ I know [*which* student did**n't** read a book from *which* library].   (=34)

 b. ✓ I know [*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 (36).

(36) **No intervention effect with intervener below *wh*:**

 a. ✓ I know [*which* student read *which* book containing **no** princesses].

 b. ✓ I know [*which* student read *which* book discussing **only** princesses].

Combining all our findings, we observe intervention effects in questions in which the intervener occurs *above* and *near* the *wh* as in (31b) and (32b), but not in questions that contain a high intervener such as (35). Therefore, we know that the interveners in (31b) and (32b) are inside intervenable regions but the ones in (35) are not. Consequently, it cannot be the case that the *wh* in the superiority-obeying questions that we are examining remains in-situ

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[16]Also recall that, for the pair-list readings we target here, the surface in-situ *wh*-phrase cannot be interpreted in-situ through a choice-function mechanism such as Reinhart (1998). See also footnote 13.

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 (37). 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.

(37) *No* **causes intervention effect because it is in intervenable region inside QP:**

     a.   ✓ I know [*which* student read [$_{QP}$ Q a book from *which* library]].   (=25)

     b.   * I know [*which* student read [$_{QP}$ Q **no** book from *which* library]].   (=31b)

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 (38a). Similarly, since intervention only affects the region between the *wh*-word and Q, this approach also explains the lack of intervention in (38b).

(38) **No intervention effect when intervener is outside intervenable region:**

     a.   ✓ I know [*which* student did**n't** read [$_{QP}$ Q a book from *which* library]]. (=34)

     b.   ✓ I know [*which* student read [$_{QP}$ Q   *which* book containing **no** princesses]].
        (=36a)

Finally, the evidence from intervention presented here allows us 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 (27), repeated below. Note that only (27a) predicts the intervention effect that we have observed. If (27b–c) were possible candidates for covert pied-piping, we would predict no intervention effect in (37b). 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.

(27) **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].

To summarize the findings of this section, we have presented evidence for the existence of covert pied-piping from the pattern of intervention effects in superiority-obeying English multiple *wh*-questions. We 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* and *near* 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 its 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 constituent we should find a region that is sensitive to intervention effects, under Beck's (2006) theory of focus intervention effects. However, unlike overt pied-piping, covert pied-piping must choose the largest possible candidate for movement and smaller constituents are not viable candidates. In the next section, we discuss the reasons for this discrepancy between the sizes of overt and covert pied-piping.

4   Pied-piping and the interfaces

In this section we address the differing sizes of pied-piping in overt vs. covert movement. As is well known, overt pied-piping can target constituents of varying sizes, as shown in (39). Furthermore, we have seen in example (19)—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 we 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 derviations which the grammar considers, and × indicates those which the grammar does not consider.)

(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 we find that the least pre-ferred among the overt pied-piping options is the only candidate for covert pied-piping, (41a). Moreover, as we've 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, we suggest that possible QP sizes are the same across overt and covert pied-piping.

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; Cable, 2012, forthcoming, a.o.; see also Richards 2010). We argue that this very linearly-oriented preference is a PF interface constraint:

(42) **The leftness preference of *wh*-phrases: a PF constraint**

    Wh-phrases prefer to be closer to the left edge of the clause.

We 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 ___?

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 (43) below. Although the syntactic and semantic content of the two examples are very similar, speakers report a difference in their acceptability. Example (43a), which contains a large pied-piping constituent with the *wh* deeply embedded is judged by speakers to be perfectly acceptable. This contrasts sharply with (43b), which is ungrammatical. This contrast is attributed to the fact that the *wh* is near the left edge of the pied-piping constituent in (43a) but not in (43b) (data from Cable, 2012).

(43) **Large pied-piping is grammatical if the *wh* is at the edge of the 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 (44), remains grammatical, so long as the *wh*-word is near the left edge of the pied-piping constituent. Thus, we see that 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.

(44) **Pied-piping remains grammatical even with very 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 (42) also results in corrollaries such as Heck's (2008; 2009) Edge Generalization:

(45) **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 (46a). 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 (46c) (data from Cable, 2012).

(46) **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].

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 (47a), where we see that secondary *wh*-movement is not possible, is also interpretable. (47c) 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.

(47) **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].

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 (43–44).

We propose that this PF constraint in (42) is the source of differences in size between pied-piping for overt and covert movements. By hypothesis, covert movement only affects

the LF interface, and therefore the choice of covertly-moved QP size will not affect the PF linearization:[17]

(48) **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 thus help disentangle the preferences of PF vs. LF with regard to pied-piping size. The intervention pattern we found supports the conclusion that only the largest pied-piping is possible for covert movement. Hence, we learn that the preference of LF and Core Syntax is for larger pied-piping.[18] This preference can be overridden by the

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[17]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 (42). The choice of QP size in (48), on the other hand, simply cannot affect the PF output, due to the general unavailability of multiple *wh*-fronting in English.

[18]Formally, this preference for larger covert pied-piping could be thought of as a transderivational application of the constraint Attract Closest (Relativized Minimality: Rizzi 1990; Minimal Link Condition: Chomsky 1995, 2000; also Shortest Move: Chomsky 1993). That is, we could imagine the grammar considering the three derivations in (48) in parallel, differing only in the position where Q is merged. The derivation with the largest QP (48a) will result in the optimal satisfaction of Attract Closest-type constraints for the probing of QP by C. See Reinhart (2006) for more on transderivational constraints and motivations for them.

One could also imagine another proposal similar in spirit, in which the merger of Q happens countercyclically. In this variant, C probes from above for positions where Q could grammatically be merged and countercyclically produces a QP to Attract. Due to the top-down nature of probing (Chomsky, 2000), this would also yield a preference of Core Syntax for larger QPs. 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 countercyclic.

In this paper we will leave open such questions about the deeper motivations for the preference of LF and Core Syntax for larger pied-piping.

PF constraints that govern overt pied-piping such as (42), resulting in the complex patterns of pied-piping that we have seen in this section.

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 pied-piping option 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.

5 Conclusion

In this paper, we address the question of whether covert movement triggers pied-piping. Unlike pied-piping triggered by overt movement, covert pied-piping is not reflected in surface word order. Instead, here we utilized the unique syntax/semantics of pied-piping constituents to form a diagnostic for the existence and size of *covert* pied-piping. We argued that covert movement does trigger pied-piping, and that the preference of covert pied-piping is for movement of larger constituents, unlike overt pied-piping.

The core data discussed in this paper exhibits a previously unobserved pattern of *focus intervention effects* in English multiple *wh*-questions. We showed that a small region *near* and *above* the surface-in-situ *wh*-word in superiority-obeying multiple questions is *intervenable*—that is, the insertion of a focus-sensitive operator in this region causes the disappearance of the multiple question's pair-list interpretation.

In this paper we adopt Beck's (2006) theory of focus intervention effects which affect regions of Rooth-Hamblin alternative computation. Following Cable (2007), the region between a *wh*-word and the edge of its pied-piping constituent will be a region of alternative computation and therefore be intervenable. Thus the existence of intervention in these regions *near* and *above* the surface-in-situ *wh*-word constituents evidence for a pied-piping constituent around the *wh*-word. Alternative explanations were also discussed and shown

28

to not derive the observed contrasts. (See the appendix for other approaches to intervention effects and their applicability to the data here.) The contrasts observed here therefore form an argument for the existence of covert pied-piping.

Furthermore, the diagnostic employed here helps determine the *size* of covert pied-piping. Whereas in overt movement, different sized constituents containing the *wh*-phrase can be chosen for pied-piping, we showed that in covert movement, only the largest pied-piping constituent is considered by the grammar. We explain this contrast in terms of the different interface constraints which are fed by overt and covert movement: overt movement feeds both PF and LF, while covert movement feeds only LF. We yield the conclusion that the true preference of Core Syntax and LF is for pied-piping *larger* constituents. In overt movement, however, certain surface-oriented PF constraints are shown to override this choice of pied-piping.

The observations presented here also constitute a further argument for the Beck (2006) theory of focus intervention effects. We extend the empirical scope of the phenomenon of "focus intervention" in English—building on previous work on superiority-obeying and superiority-violating questions (Pesetsky, 2000; Beck, 2006) and intervention in overt pied-piping (Cable, 2007)—and show that this novel data is best accounted for in Beck's theory. At its core, this amounts to further empirical support for Beck's thesis that the alternatives utilized for focus interpretation (Rooth, 1985, 1992) and alternatives utilized for *wh*-question interpretation (Hamblin, 1973) are the same formal objects and that they interact in non-trivial ways.

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6 Appendix

Although this paper assumes the Beck (2006) theory of intervention effects, it is important to note that in recent years several alternative proposals have been made about the nature of intervention effects. These proposals analyze several partially overlapping sets of data for different languages, with earlier work concentrating on the explanation of the dataset in Beck (1996) and later work focusing on the Beck (2006) data. This lack of convergence with regard not only to the correct characterization of the phenomenon itself but the set of environments that it applies to has prompted several researchers to suggest that we are, in

fact, dealing with more than one phenomenon (see Yang 2011; Szabolcsi 2006 for discussion). Below we briefly present three prominent proposals, which make widely different proposals as to the nature of interveners as well as of intervention, and discuss their possible application to the data in this paper. As we will see, these theories were not designed to analyze English data. We point out several problems with any straightforward attempt to revise the theories to deal with the data presented in our paper.

6.1 Grohmann (2006)

Grohmann (2006) presents a theory of the German data in Beck (1996) together with other data regarding multiple *wh*-questions which is not discussed by Beck. Grohmann argues against Beck's characterization of intervention effects, as well as the set of interveners that cause ungrammaticality in German multiple *wh*-questions. So-called "intervention effects," under Grohmann's theory, are instead violations of the following Topicalizability Generalization:

(49) **Topicalizability Generalization (Grohmann, 2006):**
   Only topicalizable elements may appear in between two *wh*-phrases; non-topicalizable elements may only follow (in German multiple *wh*-questions).

Although this approach seems promising for describing the German data, and may help reduce the set of phenomena that researchers in this domain must explain as "intervention effects," this theory cannot be adopted to explain the contrasts presented in this paper.

First, the Grohmann analysis does not apply to intervention inside DPs. In Grohmann's analysis intervention effects occur when a non-topicalizable element is forced to be in a topic position in the CP periphery. In contrast, *wh*-words are moved to a focus position. As Sauerland and Heck (2003) have shown and as was discussed in section 2.2, intervention can occur inside overt pied-piping constituents in German, as in example (15) repeated here as (50). Grohmann does not discuss pied-piping, so we will assume as is standard that the pied-piping constituent containing the *wh*-word in (15) has moved to the canonical po-

sition for *wh*-movement. As a result, the pied-piping constituent headed by the intervener *kein* 'no' will be in a focus position in the CP periphery and not a topic position. As so-called "intervention effects" only occur when non-topicalizable items are moved to a topic position in this theory, Grohmann's (2006) view of intervention will fail to account for the contrast in this example.

(50) **Data with *wh*-word and intervener inside a single DP, unexplained by Grohmann (2006) (example from 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.' (=15)

The contrasts we present in this paper which form the argument for covert pied-piping crucially are cases of intervention which occurs *within* DPs, similar to the German example in (50). Grohmann's (2006) theory cannot explain such contrasts, even for overt pied-piping in German.

Second, as Grohmann (2006) points out himself, this theory is not clearly extendable to English multiple *wh*-questions. In particular, recall the contrasts between superiority-obeying and superiority-violating multiple *wh*-questions in English, first discussed by Pesetsky (2000). An example from section 2.1 is repeated here:

(51) **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 ___?

If Grohmann's (2006) theory were applied to English, we would be forced to predict an intervention effect in *both* or *neither* (51a) and (51b) (and in similar examples given in section 2.1 with other interveners). Both sentences involve much of the same material between the two *wh*-phrases (including the item we consider to be the intervener in question here, *only*), and thus would be predicted to equally violate—or equally pass—the Topicalizability

Generalization (49). The correct prediction is made only if we assume, as in Pesetsky (2000), Beck (2006) and Cable (2007), that in superiority-obeying questions, the in-situ *wh* moves to C at LF, but in superiority-violating questions the in-situ *wh* is indeed in-situ at LF. This view of English *wh*-question formation is at odds with Grohmann's theory, which explicitly discounts the possibility of covert phrasal *wh*-movement.

6.2 Tomioka (2007)

Tomioka (2007), building on Japanese and Korean intervention effect data, presents a view of intervention similar in spirit to Grohmann (2006)—Tomioka argues that the problem with intervention is not a semantic one, as argued in Beck (2006), but rather one of conflicting discourse-prosodic requirements. The basic assumptions are the following: in a *wh*-question, everything except the *wh* itself must be backgrounded. Things to the left of the *wh* are more prominent and tend to be new, while things following the *wh* are older and are easier to background. In Japanese, this trend is clearly marked by prosody, where everything following the *wh*—between *wh* and the sentence-final question particle—is prosodically reduced. Intervention is caused when an Anti-Topic Item (ATI)—an item that cannot be backgrounded, and belonging to roughly the same set of interveners defined in Beck (2006)—occurs in a region of the question preceding the *wh*. Recall that this region must be backgrounded; the presence of an item that cannot be backgrounded in this region leads to conflicting discourse-prosodic requirements, resulting in an intervention effect. This correctly predicts that scrambling of the *wh* above the ATI can alleviate the intervention effect, since the ATI will now be in the prosodically reduced portion of the question. An example is shown below in (52), where the intervener *dareka* 'someone' causes ungrammaticality in (52a), but scrambling of the *wh*-phrase over *dareka* in (52b) is grammatical.

(52) **Indefinite expressions are interveners in Japanese; scrambling avoids intervention (Tomioka, 2007):**

a. * **Dareka**-ga   *nani*-o   yon-da   no?

someone-**NOM** what-**ACC** read-**PAST** Question

Intended: '*What* did **someone** read?'

b. ✓ *Nani*-o$_i$ **dareka**-ga t_i yon-da   no?

what-**ACC** someone-**NOM**   read-**PAST** Question

'*What* did **someone** read?'

Although this theory makes interesting predictions for Japanese, we believe there are problems with its application to English cases. First, Tomioka (2007) does not consider intervention in *wh*-movement languages at all, and in particular not the Pesetsky (2000) pattern of intervention discussed in section 2.1. Tomioka's theory does not distinguish between surface-in-situ *wh*-phrases which do or do not covertly move. Thus, no contrasts are predicted between English superiority-obeying and superiority-violating multiple *wh*-questions under the Tomioka theory applied to English.

Second, Tomioka (2007) does not consider cases of intervention in which the *wh* is contained within a phrase headed by an intervener, which were the crucial test cases in our paper. Again, it is not clear how to explain contrasts such as the ones that have occupied us in the paper, e.g. (53), in a theory without movement.

(53) **Intervention effect only with intervener inside QP, not with high intervener:**

a. ✓ I know [*which* student did**n't** read a book from *which* library].

b. * I know [*which* student read **no** book from *which* library].

More worrisome, we believe that Tomioka (2007) makes incorrect predictions for Japanese questions with configurations such as the ones discussed in our paper. Examples (54a–b) below are judged by speakers to be similarly (un)acceptable. In (54a) an intervener *dareka* 'someone' occurs above the *wh*-word *nani* 'what,' which is predicted by Tomioka to cause an intervention effect. (An intervention effect caused by *dareka* was previously shown in

(52).) Native speakers report that (54a) may be slightly degraded, but not clearly ungrammatical like baseline Japanese intervention examples such as (52a). In (54b) we have an order that is predicted by Tomioka to be acceptable, because the *wh*-word occurs before the intervener (cf 52b), but this sentence is not judged by speakers to be better than its counterpart in (54a). Consequently, we are unsure how to extend Tomioka's (2007) theory to our test cases.

(54) **Data with *wh*-word and intervener inside a single DP, unexplained by Tomioka (2007):**

   a.   ? [**Dareka**-no [*nan*-no   shashin]]-o mi-ta   no?

        someone-**GEN** what-**GEN** picture-**ACC** see-**PAST** Question

        '[**Someone**'s [picture of *what*]] did you see?'

   b.   ? [*Dare*-no [**nanika**-no   shashin]]-o mi-ta   no?

        who-**GEN** something-**GEN** picture-**ACC** see-**PAST** Question

        '[*Whose* [picture of **something**]] did you see?'

6.3   Mayr (2010)

Mayr (2010) presents a study of intervention effects in German together with a general proposal for the compositional semantics of *wh*-questions. He shows that his semantics for questions makes the prediction that non-upward-entailing quantifiers will be interveners if they contain *wh*-words in their scope. This is supported by the observation (similar to an observation in Grohmann 2006) that non-upward-entailing quantifiers are indeed interveners in the following configuration (55) in German. The Mayr proposal thus focuses on data with a structural configuration similar to that of Beck (2006)—that is, intervention between an in-situ *wh*-word and C.

(55)   * [C ... Non-DE-QP ... *wh* ...

Although there is interesting insight in this theory about the nature of interveners, we note that it is not clearly extendable to the data we discuss. In Mayr's analysis, *wh*-words

are analyzed as quantifiers. As such, they cannot be contained within the restriction of another quantifier for interpretation, and therefore must always move (covertly or overtly) outside of any containing quantifier to a position where they can be interpretable. In the cases studied in this paper, this theory predicts that the *wh* word must always move out of the restriction of the potentially intervening determiner in DP. Consequently, either no intervention is expected to occur in such configurations, or all such questions are expected to be uninterpretable.

Moreover, Mayr did not consider English data in his analysis. German differs significantly from English in the use of covert movement in the interpretation of in-situ *wh*-words. In particular, Mayr adopts the idea that in-situ *wh*-words in German never undergo covert movement for interpretation (Beck, 2006). As Beck shows, such an approach for English would incorrectly predict that the entire region above the in-situ *wh*-phrase in an English superiority-obeying question is intervenable.