

LF-Intervention Effects in Pied-Piping*

Uli Sauerland and Fabian Heck

University of Massachusetts/Universität Tübingen and Universität Stuttgart

1. Introduction

It is well known that pied-piping constructions pose a problem to the syntax-semantics interface (see Chomsky 1977, May 1977, among others). In particular, as has been noted by von Stechow (1996b), the semantics of questions of Karttunen (1977) can only apply when the *wh*-word takes scope over the whole question. Therefore, in structures involving pied-piping, like in (1), this semantics cannot apply directly because the *wh*-word is buried in the pied-piped constituent and, hence, does not have scope over the question:

(1) [Whose book] did you read?

To render pied-piping structures interpretable, von Stechow (1996b) proposes that the *wh*-word undergoes covert extraction out of the pied-piped constituent, leading to a structure, where the *wh*-word outscopes the question:

(2) $\text{who } \lambda x [x\text{'s book }] \text{ did you read}$
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Von Stechow's argument was that at the time of his writing there simply was no alternative available to get the semantics of these structures right.

However, in more recent work Hagstrom (1998) and Sternefeld (2001) proposed an enriched semantics, that arrives at the desired interpretation for (1) without application of the covert extraction of the *wh*-word.

In this paper we provide an independent argument that supports von Stechow's proposal, i.e., we present evidence that suggests that a *wh*-word in pied-piping constructions indeed undergoes covert movement out of the pied-piped constituent. Specifically, we show

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that *wh*-in-situ and *wh*-in-pied-piping exhibit the same behavior with respect to so called LF-intervention effects and should hence be treated in a uniformly by covert movement. Our paper has the the following structure: In section 2, we show that *wh*-in-pied-piping is sensitive to LF-intervention effects. In section 3, we present arguments that indeed covert movement should be the account of both *wh*-in-pied-piping as well as *wh*-in-situ.

2. LF-intervention effects

Beck (1996) observes that *wh*-in-situ in German exhibits LF-intervention effects (cf. Takahashi (1990) on Japanese, Beck and Kim (1997) on Korean, Pesetsky (2000) on English): *Wh*-in-situ must not occur in the scope of negation or a quantifier.

Consider example (3) (Here and in what follows, **interveners** appear in **boldface** and the relevant *wh*-phrases appear in *italics*.)

- (3) *Ich frage mich wer **keinem** *was* erklärt hat
I ask myself who nobody what explained has

Beck presupposes that the in-situ *wh*-phrase undergoes covert movement to its scope position in the embedded SpecCP. She then attributes the ill-formedness of (3) to a constraint similar to the following:¹

- (4) *LF-Intervention constraint*: Covert movement in German must cross neither negation nor a quantifier. (to be revised)

Now, if Beck's generalization in (4) and von Stechow's assumption about covert extraction in pied-piping are combined, one arrives at the prediction in (5):

- (5) *Wh*-in-pied-piping exhibits LF-intervention effects.

In the first part of our argument will show that this prediction is indeed borne out. We will consider four different interveners (negative quantifiers, universal quantifiers, *genau* ('exactly'), and locational particles) corroborating (5).

In each case, we will show first that *wh*-in-situ is blocked by this intervener; second, we will show that *wh*-in-pied-piping is also blocked by this intervener, and finally we will provide evidence that the relevant examples do not suffer from the application of pied-piping *per se*.

¹Actually, Beck herself assumes a constraint that applies to LF-structures. We assume (4) for the reasons discussed in Sauerland (2001). For our purposes in this paper, though, the difference between the two conditions is irrelevant.

2.1. Negative quantifiers

Let us begin with cases where the negative quantifier *kein* ('no') acts as intervener for *wh*-phrases in-situ. Beck (1996) shows that *kein* must not c-command *wh*-in-situ *was* ('what') ((6) = (3)):

- (6) *Ich frage mich wer **keinem** *was* erklärt hat
 I ask myself who nobody what explained has

Note, that if the *wh*-phrase is scrambled overtly to a position above the intervener as in (7), no intervention effect is observed.

- (7) Ich frage mich wer *was*_i **keinem** t_i erklärt hat
 I ask myself who what nobody explained has
 'I wonder who did not explain what to anybody'

This leads Beck to assume that the problem in (6) is indeed to be attributed to some property of LF.

Now consider *wh*-in-pied-piping. The examples in (8) involve pied-piping of a degree construction in German. The behavior of the examples is parallel to the cases of intervention with *wh*-in-situ: (8b) shows that the *wh*-word in pied-piping constructions must not be in the scope of the intervener *kein*.

- (8) a. Fritz möchte wissen ein *wie* schnelles Motorrad du fahren darfst
 Fritz wants know a how fast motorbike you drive may
 'Fritz would like to know how fast a motorbike you are allowed to ride.'
 b. *Fritz möchte wissen **kein** *wie* schnelles Motorrad du fahren darfst
 Fritz wants know no how fast motorbike you drive may

By assumption, (8b) is ill-formed because covert extraction of the *wh*-word out of the pied-piped constituent crosses the negative quantifier *kein* thereby triggering an intervention effect. Note that if *kein* is replaced by the indefinite determiner *ein* ('a') the result is grammatical. This suggests that *wh*-in-pied-piping is subject to LF-intervention effects.

A question arises with respect to the status of the English variant of a degree question with and without negative quantifier, as in (9):

- (9) a. You ride a very fast motorbike.
 b. How fast a motorbike are you allowed to ride?
 c. *How fast no motorbike are you allowed to ride?

The ill-formedness of (9c) could not be caused by LF-intervention because the *wh*-in-pied-piping is not c-commanded by *no* in the surface representation, and furthermore, LF-intervention applies in fewer cases in English than in German (Pesetsky 2000). But, there is independent evidence that English has an additional constraint blocking (9c) that is not observed in German: In English declaratives, degree inversion with *no* is also blocked, as (10b) shows.

- (10) a. John rides so fast a motorbike!
 b. *John rides so fast no motorbike!

In German, however, the declarative sentence (11b) corresponding to (10b) is fully grammatical. Hence, the constraint violated in the German (8b) must be specific to *wh*-in-pied-piping, as LF-intervention would be. In English, on the other hand, a different constraint blocks all degree inversion with *no*. We leave the nature of the English constraint open, since all that matters for our argument is that it does not apply in German.

- (11) a. Ich darf ein so schnelles Motorrad fahren
 I may a so fast motorbike drive
 ‘I’m allowed to ride a motorbike that’s so fast.’
 b. Ich darf **kein** so schnelles Motorrad fahren
 I may no so fast motorbike drive
 ‘I’m not allowed to ride a motorbike that’s so fast.’

Finally, (12) provides an argument that the string *(K)ein 50 km/h schnelles Motorrad* indeed forms a constituent. (12) shows this using topicalization for (11b).

- (12) **Kein** 50 km/h schnelles Motorrad darfst nur du fahren.
 No 50 kmph fast motorbike may only you drive
 ‘Only you’re not allowed to ride a motorbike that’s 50 kmph fast.’

The reason why topicalization is relevant here is that in German only one constituent can be topicalized at a time, appearing to the left of the finite verb (*darfst* (‘may’) in (12b)). This strongly suggests that the examples in (8) indeed involve pied-piping.

2.2. Universal quantifiers

Next, consider universal quantifiers like *jeder* (‘everyone’). Let us again first have a look at *wh*-in-situ. As noted by Beck (1996) universal quantifiers are interveners for *wh*-in-situ although the intervention effect is not as easy to detect as with negative quantifiers. Take the example in (13) where the universal quantifier *jeder* (‘everyone’) c-commands the *wh*-word in-situ *wo* (‘where’): it is well-formed. However, Beck argues that (13) allows only

a distributive interpretation where *jeder* outscopes the question. Her assumption is that the universal quantifier QRs ‘out of the way’ in order to avoid an intervention effect with *wo*.

- (13) Ich frage mich wen **jeder** wo gesehen hat ($\forall\exists, *\exists\forall$)
 I ask myself who everyone where seen has
 *‘I wonder which person and which place are such that everyone saw the person in that place.’
 ‘I wonder for each *x*: who did *x* see where’

Beck (1996) furthermore points out that there are contexts where the QR-operation is not available for independent reasons and therefore the distributive interpretation is blocked. As a consequence, an intervention effect becomes unavoidable und ungrammaticality results:

- (14) *Ich frage mich wer **jedes** Problem wann gelöst hat
 I ask myself who every problem when solved has

Again, the LF-intervention effect disappears when the *wh*-in-situ is overtly scrambled past the intervener:

- (15) Ich frage mich wer wann₁ **jedes** t₁ Problem gelöst hat
 I ask myself who when every problem solved has
 ‘I wonder who solved every problem when.’

Now consider *wh*-in-pied-piping: Rapp (1992) observes the contrast in (16). (16a) involves pied-piping of a degree construction, headed by the definite determiner *das* (‘the’). In (16b) the definite determiner is replaced by a universal quantifier. Under the hypothesis that the *wh*-word *wievielte* (‘how many’) has to undergo covert extraction out of the pied-piped constituent, the contrast can be thought of as an LF-intervention effect.

- (16) a. Ich frage mich, das *wievielte* Auto zu schnell war
 I ask myself the how many-th car too fast was
 ‘I wonder: for what *n* was the *n*-th car too fast’
 b. *?Ich frage mich **jedes** *wievielte* Auto zu schnell war
 I ask myself every how many-th car too fast was

Rapp herself suggests that this contrast is due to a semantic incompatibility between the universal and the ordinal like the incompatibility between ordinals and indefinites in (17).²

²The incompatibility between ordinals and indefinites is obscured in declaratives. Consider (i):

- (17) *Ein *wievieltes* Auto war zu schnell?
 a how many-th car was too fast

We believe that Rapp's (1992) suggestion is indeed correct for indefinites, but not for universals. (18) shows that universals can occur with ordinals in declaratives:

- (18) **Jedes** dritte Auto war zu schnell
 every third car was too fast

We therefore take it that the contrast in (16) is not due to an general incompatibility between the universal quantifier and the ordinal, but should be attributed to an LF-intervention effect.

Note that (18) also involves topicalization and therefore demonstrates that the string *jedes dritte Auto* ('every third car') forms a constituent. Hence, (16) indeed involves pied-piping.

2.3. *Genau* ('exactly')

Although not discussed by Beck, the particle *genau* ('exactly') triggers LF-intervention. This observation seems to have gone unnoticed so far. Again we first consider cases that involve *wh*-in-situ in German:

- (19) a. *?Fritz ratterte runter wer gestern **genau** wann angekommen ist
 Fritz rattled off who yesterday exactly when arrived is
 b. Fritz ratterte runter wer gestern wann **genau** angekommen ist
 Fritz rattled off who yesterday when exactly arrived is
 'Fritz rattled off who arrived yesterday when exactly.'

Now turn to *wh*-in-pied-piping again. We see that *genau* in the examples in (20) manifests LF-intervention in the pied-piping context ((20a) is taken from Trissler 2000):

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- (i) Ein drittes Auto war zu schnell
 a third car was too fast

*'The third car of the cars we're talking about was too fast.'

'We talked about two cars so far, but there was a third one, and it was too fast.'

The indefinite cannot be used, if the car talked about is a member of a set of cars that was already introduced in the discourse. However, the indefinite can be used when only two cars have been introduced into the discourse so far. Namely, (i) can then be used to introduce a third car into the discourse. This is a case where *drittes Auto* is true of a unique car, but the indefinite is licensed because the novelty of this car. Note that, in questions like (17) the indefinite could not be licensed by novelty because of a semantic conflict between the novelty requirement and the presupposition of the question. Namely, the question presupposes that for some *n* the *n*-car was too fast, and asks what this *n* is. But, the novelty requirement presupposes that the *n*-th car be novel, and therefore no property of the *n*-th car could be presupposed.

- (20) a. *Susi möchte wissen [**genau** wann₁]₂ die Oma t₂ abgeholt wird
 Susi wants know exactly when the granny picked up will
 b. *Keiner hat Kai gesagt **genau** wieviel er essen soll
 noone has Kai told exactly how much he eat should

Genau ('exactly') can also appear in a position following its associated phrase. We assume that this is derived by some local overt movement of the associated phrase to the left:

- (21) a. **Genau** drei Kinder will Tom bekommen
 exactly three children wants Tom get
 'Tom wants to have exactly three children.'
 b. [Drei Kinder]₁ **genau** t₁ will Tom bekommen.
 three children exactly wants Tom get.
 'Tom wants to have exactly three children.'

As is typical for the LF-intervention effects, overt preposing of the *wh*-word to the left of *genau* can fix the structure ((22a) from Trissler 2000).

- (22) a. Susi möchte wissen [wann₁ **genau** t₁]₂ die Oma t₂ abgeholt wird
 Susi wants know when exactly the granny picked up will
 'Susi wants to know when exactly granny will be picked up'
 b. Keiner hat Kai gesagt [wieviel₁ **genau** t₁]₂ er t₂ essen soll
 noone has Kai told how much exactly he eat should
 'Nobody told Kai exactly how much he should eat.'

Therefore, intervention effects triggered by the particle *genau* suggest that *wh*-in-situ and *wh*-in-pied-piping should be treated in a uniform way with respect to LF-intervention.

It remains to be shown that an analysis of the relevant examples in terms of pied-piping is justified. Evidence can be offered by examples that involve topicalization; they suggest that *genau* and the phrase associated with it must form a constituent (see also (21)):

- (23) [**Genau** um 5]₂ kommt die Oma t₂
 exactly at 5 arrives the granny
 'Granny arrives exactly at 5 o'clock.'

Moreover, *genau* cannot be stranded:

- (24) *[Um 5]₂ kommt die Oma **genau** t₂
 at 5 arrives the granny exactly

Both facts point to the conclusion that the examples in (20) indeed involve pied-piping.

2.4. Locational particles

Another intervention effect is observed with the particles *mitten* ('in the middle') and *direkt* ('directly'). For our purposes, we call these *Locational Particles*. (We hasten to add that intervention effects with these elements trigger somewhat less robust judgments.) The first set of examples is concerned with intervention effects of locational particles in the context of *wh*-in-situ:

- (25) a. *Fritz ratterte runter wer **mitten** *worauf* saß
 Fritz rattled off who in the middle on where sat
 b. ??Fritz zählte auf wer **direkt** neben *wem* gegessen hat
 Fritz counted on who directly next to whom sat has

Because these particles are usually focussed, the presence of intervention effects in (25) follows from Kim's (2001) proposal that focus causes LF-intervention effects.

As usual, the intervention disappears if the *wh*-in-situ is moved overtly to the left of the particle ((26a)) or left out ((26b)).

- (26) a. Fritz ratterte runter wer *wo*₂ **mitten** t₂ drauf saß
 Fritz rattled off who where in the middle on sat
 'Fritz rattled off who sat in the middle of what.'
 b. Fritz zählte auf wer neben *wem* gegessen hat
 Fritz counted on who next to sat has
 'Fritz listed who sat next to whom.'

As before, a similar pattern is found with *wh*-in-pied-piping: (27) shows intervention effects in the context of *wh*-in-pied-piping, caused by locational particles:

- (27) a. *Fritz erzählte [**mitten** *wo-rauf*]₂ du t₂ gegessen hast
 Fritz told in the middle where on you sat have
 b. *?Fritz möchte wissen [**direkt** neben *wem*]₃ du t₃ gegessen hast
 Fritz wants know right next whom you sat have

And again, this follows if the *wh*-word has to undergo covert extraction out of the pied-piped constituent.

The LF-intervention effect disappears when the particle is left out ((28a)) or the *wh*-phrase is moved overtly ((28b)).

- (28) a. Fritz erzählte [wo_1 **mitten** t_1 drauf]₂ du t_2 gesessen hast
 Fritz told where in the middle on you sat have
 b. Fritz möchte wissen [neben wem]₂ du t_2 gesessen hast
 Fritz wants know next to whom you sat have

Topicalization and impossibility of stranding the particle strongly suggest that particle and associated phrase form one constituent and, hence, that pied-piping is involved:

- (29) a. [**Mitten** auf dem Platz]₂ war keiner t_2
 in the middle on the square was nobody
 b. [**Direkt** neben Maria]₂ sass keiner t_2
 right next Maria sat nobody
- (30) a. *[Auf dem Platz]₂ war keiner **mitten** t_2
 on the square was nobody in the middle
 b. *[Neben Maria]₂ sass keiner **direkt** t_2
 next Maria sat nobody right

3. Accounts for LF-Intervention Effects

In the previous section, we showed that both *wh*-in-situ and *wh*-in-pied-piping are sensitive to intervention effects. Now consider how to account for LF-intervention effects on various accounts of the interpretation of questions.

3.1. The Covert Movement Account

Recall that on the covert movement account of von Stechow (1996b), pied-piping requires covert movement of the *wh*-in-pied-piping to a position taking scope above the question. This movement is illustrated by (31) ((31)=(1)).

- (31) a. [Whose book] did you read?
 b. $\text{who } \lambda x [x\text{'s book }]$ did you read
 ↑

The presence of intervention effects with negation and quantifiers follows then straightforwardly from the constraint (4). Because we have shown in the previous section that there are more interveners than just negation and quantifiers, we revise (4) to (32).

- (32) Covert movement in German must not cross an intervener. (final)

Interveners are in addition to negation and quantifiers, at least *genau* ('exactly') and the particles *mitten* ('in the middle') and *direkt* ('directly'). We take it that movement *crosses* a phrase X if X c-commands the trace position and if the landing site c-commands X.

The assumption that both *wh*-in-situ and *wh*-in-pied-piping must move covertly to a position c-commanding the question and constraint (32) predict all the intervention effects observed in the previous section. Consider (33a) from (8) for an illustration. The *wh*-in-pied-piping must move as shown in (33b), but this movement crosses the intervener *kein* in violation of (32). Therefore, (33a) is ungrammatical.

- (33) a. *... **kein** *wie* schnelles Motorrad du fahren darfst
 no how fast motorbike you drive may
 b. *how₁ **no** t₁ fast motorbike you drive may
 ↑

3.2. The Hagstrom/Sternefeld Account

Consider next the Hagstrom/Sternefeld account. For concreteness, we assume the formalization of Hagstrom (1998). On this analysis, *wh*-in-pied-piping is interpreted by means of alternative semantics (AS) (cf. Hamblin 1973, Rooth 1985). Consider (34) for an illustration.

- (34) Whose movie did Tina see?

By assigning to *who* the set of all individuals as the AS-meaning, Hagstrom derives the AS-meaning in (35) for the pied-piped phrase.

- (35) $\llbracket \text{whose movie} \rrbracket_{AS} = \{ \llbracket \text{Coppola's movie} \rrbracket, \llbracket \text{Soderbergh's movie} \rrbracket, \dots \}$

The meaning of the question is formed by existential quantification over the AS-meaning as in (36):

- (36) $\lambda p: \exists x \in \llbracket \text{whose movie} \rrbracket_{AS}: p = \text{'Tina saw } x \text{'}$

To capture LF-intervention effects with *wh*-in-pied-piping on this approach, a natural idea is to block the computation of the AS-meaning of a phrase when intervention occurs. The constraint in (37) does precisely this.

- (37) $\llbracket XP YP \rrbracket_{AS}^g$ is not defined, if XP is an intervener and $\llbracket YP \rrbracket_{AS}^g$ is not a singleton.

Furthermore, Hagstrom and Sternefeld assume that the interpretation of *wh*-in-situ doesn't necessarily involve AS-meanings, but is accomplished by a different mechanism: choice function interpretation as discussed by Reinhart (1997). Therefore, constraint (37) predicts LF-intervention effects only with *wh*-in-pied-piping on their accounts. To capture *wh*-in-situ, then, requires a different stipulation. Specifically, (38) would account for LF-intervention effects with *wh*-in-situ within the Hagstrom/Sternefeld account.

- (38) $\llbracket \text{XP YP} \rrbracket^g$ is not defined, if either XP is an intervener and there is a free occurrence of a choice-function variable in YP (cf. von Stechow 1996a).

3.3. The Alternative Semantics Account

The Hagstrom/Sternefeld account requires two different intervention conditions because *wh*-in-situ and *wh*-in-pied-piping are interpreted by different mechanisms. Given the presence of LF-intervention effects in both constructions, it seems natural to attempt to extend alternative semantics to *wh*-in-situ. In this section, we consider a proposal along these lines (cf. Ramchand 1997, Kratzer and Shimoyama 2002, Beck 2003).

Consider example (39) with *wh*-in-situ as an illustration:

- (39) Who $\lambda x C_{[+wh]} x$ read what?

For *wh*-in-pied-piping, the Hagstrom/Sternefeld account assumes that *what* is interpreted in AS as the set of individuals. Assume now that *what*, when it occurs in-situ as in (39), also has this AS-interpretation. The complement of $C_{[+wh]}$ receives the alternative semantic interpretation in (40).

- (40) $\llbracket x \text{ read what} \rrbracket_{AS}^g = \{ \llbracket x \text{ read LGB} \rrbracket^g, \llbracket x \text{ read Heim\&Kratzer} \rrbracket^g, \dots \}$

The right question interpretation in (41) comes out when we analyse $C_{[+wh]}$ as the element relation, \in , rather than identity $=$. The interpretation (41) is identical to the standard Karttunen-semantics for (39): (41) denotes the set of propositions of the form x read y , where x and y are individuals.

- (41) $\lambda p: \exists x: p \in \llbracket x \text{ read what} \rrbracket_{AS}^{g[x/x]}$

In this way, the Hagstrom/Sternefeld approach to *wh*-in-pied-piping can be extended to *wh*-in-situ.

On this approach, the constraint in (42), which is identical to (37) suffices to capture LF-intervention effects with both *wh*-in-situ and *wh*-in-pied-piping.

(42) $[[XP YP]]_{AS}^g$ is not defined, if XP is an intervener and $[[YP]]_{AS}^g$ is not a singleton.

4. Comparing the Accounts

The occurrence of LF-intervention effects with both *wh*-in-situ and *wh*-in-pied-piping provides a strong argument for a uniform account of both. This argues against the Hagstrom/Sternefeld account, which assumes different interpretation mechanisms for *wh*-in-situ and *wh*-in-pied-piping. For this reason, we will not discuss this account any further, but instead talk about its variant, the alternative semantics account.

Since both the covert movement account and the alternative semantics account use a single mechanism to interpret *wh*-in-situ and *wh*-in-pied-piping, both accounts can handle LF-intervention effects with a single condition. Hence, the data in section 2 fail to distinguish between these two accounts.

One can object to the alternative semantics account that it introduces an additional mechanism, namely alternative semantics, in addition to movement. Alternative semantics has also been used to account for other phenomena, especially focus (Rooth 1985). However, these applications seem to be independent of the use of alternative semantics for *wh*-interpretation as focus marked phrases differ morphologically from *wh*-phrases. Furthermore, example (43) indicates that association with focus is not always sensitive to LF-intervention effects: (43) could be used if Tobias believes that the moon and the sun are round, but the earth is not. This shows that *nur* ('only') can associate with *Erde* ('earth') across the intervening negation *nicht* ('not').

(43) Tobias glaubt nur **nicht**, daß die ERDE rund ist.
Tobias believes only not that the earth round is

In example (44), though, we do find what might be described as LF-intervention effects with association with focus. (44) does seem to be false in a situation in which there are children who received something other than a bicycle from Tina.

(44) Tina hat nur **jedem** Kind ein FAHRRAD gegeben.
Tina has only every child a bicycle give

'Tina gave each child only one thing, namely a bicycle.'

*'Among the many different things the children got from Tina, the only one each of them received was a bicycle.'

While we have to leave much in this area of investigation for further research, our preliminary conclusion is that association with focus is not subject to intervention effects in the same way as *wh*-in-situ and *wh*-in-pied-piping are. Hence, even if an account of focus in

terms of alternative semantics is correct, this doesn't seem provide independent support for employing alternative semantics in the analysis of *wh*-phrases. This provides our first argument against the alternative semantics account.

Furthermore, we are aware of three empirical cases that we believe shed light on the question whether the covert movement or the alternative semantics account is correct. We discuss these in the following three sections.

4.1. Intervention Effects in Relative Clauses

The first argument for covert movement comes from the presence of LF-intervention effects in relative clauses. Using the locational particles of section 2.4, we can detect LF-intervention effects with *wh*-in-pied-piping in German relative clauses.³

- (45) a. Ich mag jedes Eßzimmer, in *dem* ein Tisch mittendrin steht
 I like every dining room in which a table in the middle stands
 b. *[?]Ich mag jedes Eßzimmer, **mit**ten in *dem* ein Tisch steht
 I like every dining room, middle of in which a table stands
- (46) a. Ich mochte noch nie jemand, [neben *dem*]₂ ich im Flugzeug t₂
 I liked yet never someone, next to who I in the plane
 gesessen habe
 sat have
 b. ??Ich mochte noch nie jemand, [**direkt** neben *dem*]₃ ich im
 I liked yet never somebody directly next to who I in the
 Flugzeug t₃ gesessen habe
 plane sat have

Furthermore, (47) shows that a relative clauses with the same meaning is acceptable if the *wh*-operator *wo* moves overtly out of the scope of the intervener. The *wo*-relative clause construction is dialectal, but for one of us (47) is fully acceptable and contrasts with (46b).

³Interestingly, Sells (1985) notes similar contrasts with the particle *right* in English relative clauses. However, our field-work has shown that not all speakers agree with Sell's data in (i). We therefore leave this matter for future research.

- (i) a. the lap [into *which*]₂ the soup spilled t₂
 b. *the lap [**right** into *which*]₂ the soup spilled t₂
- (ii) a. the opera singer [next to *whom*]₂ I sat t₂
 b. *the opera singer [**right** next to *whom*]₂ I sat t₂

- (47) Ich mochte noch nie jemand, *wo* ich im Flugzeug **direkt** neben
 I liked yet never someone where I in the plane direktly next to
 gesessen habe
 sat have
 ‘I never liked someone who I saw directly next to on the plane.’

On the covert movement account, the presence of LF-intervention effects in relative clauses follows straightforwardly. We assume that the relative clause operator must covertly move from the pied-piped phrase to a position where it takes scope over the entire relative clause. This covert movement is expected to be subject to the intervention constraint (32), just as covert movement of *wh*-in-pied-piping in questions is.

We do not know whether the alternative semantics account of pied-piping in questions can be extended to relative clauses in the first place. Such an extension seems very difficult to us: Consider for example the DP in (48a), with the lexical entries given in (48b).

- (48) a. the girl whose brother I met
 b. $\llbracket \text{girl} \rrbracket = \{\text{Mary, Ann, Sue}\}$
 $\llbracket \text{brother} \rrbracket = \{\langle \text{Mary, Mark} \rangle, \langle \text{Ann, Albert} \rangle, \langle \text{Sue, Steve} \rangle\}$
 $\llbracket \lambda x \text{ I met } x \rrbracket = \{\text{Albert}\}$

Recall that the AS-meaning $\llbracket \text{whose brother} \rrbracket_{\text{AS}}$ is defined as the set of individuals that are someone’s brother. With the lexical entries in (48b), we arrive at (49):

- (49) $\llbracket \text{whose brother} \rrbracket_{\text{AS}} = \{\text{Mark, Albert, Steve}\}$

Now, consider how the relative clause operator must combine (49) with its complement. We assume that the Comp position of the relative clause houses such an operator, and that it takes two arguments. In the example, the two arguments would be $\llbracket \lambda x \text{ I met } x \rrbracket$ and (49). But, note that the straightforward combination of the two in (50b) would yield the property of being Albert as interpretation of the relative clause. This result, however, is wrong; the correct interpretation of the relative clause would be the property of being Albert’s sister. Only the operator in (50b) yields the right result.

- (50) a. $\llbracket \text{REL} \rrbracket(\text{P})(\text{X}) = \{x \in X \mid P(x)\}$
 b. $\llbracket \text{REL} \rrbracket(\text{P})(\text{X}) = \{y \mid \exists x \in X : P(x) \wedge \text{brother}(y)(x)\}$

But, while (50b) gives the right result in this example, it cannot be in general part of the meaning of relative clauses. Therefore, we conclude that pied-piping cannot be analyzed by AS.

Sternefeld (2001) proposes a different analysis for pied-piping in relative clauses that is in the spirit of combinatorial logic (Curry and Feys 1958). His proposal relies on interpreting the relative pronoun as the identity function, $\lambda x.x$, and making use of function composition, as a means of combining the meanings of two constituents. In the following, I use \circ to indicate function composition as $f \circ g(x) = f(g(x))$. Sternefeld's approach yields the function composition in (51) for (48a), which is the right meaning for the relative clause:

$$(51) \quad \llbracket \lambda y \text{ I met } y \rrbracket \circ \llbracket \text{the} \rrbracket \circ \llbracket \lambda x \text{ brother of } x \rrbracket \circ \llbracket \lambda x.x \rrbracket$$

However, capturing intervention effects with pied-piping in relative clauses now requires a new assumption. A possibility that comes to mind is that function composition $f \circ g$ is only possible if g is not one of the intervening elements. If this is possible, though, the covert movement account remains preferable since it not only doesn't require this additional restriction, but in fact doesn't require function composition at all.


4.2. Intervention Effects with Quantifier Raising

As Beck (1996) already points out, *bona fide* covert movement, namely quantifier raising, is subject to LF-intervention effects. Beck gives the example (52):

- (52) *[?]**Kein** Produkt aus *jedem* EU-Land verkauft sich gut.
 No product from every EU-country sells itself well
 'No product that contains ingredients from every EU-country sells well.'

Beck actually considers the example well-formed, but only with the interpretation given. In our judgement, (52) is actually very marginal, but we agree with Beck that to the extent that (52) is interpretable only the interpretation given above is available.

We assume with Beck that quantifier raising of *every EU-country* is blocked.

$$(53) \quad \text{*every EU-country } \lambda x \text{ [no product from } x \text{]} \text{ sells well.}$$


We furthermore assume that a DP-internal interpretation of quantifiers is blocked because of a type mismatch. To account for the marginally available interpretation, we assume that the type issue can be resolved by coercing the phrase *product from every country* to the meaning *product containing ingredients from every country* which avoids the type-mismatch.

As far as we can see, the LF-intervention effect in (53) is unexpected on the pure alternative semantics account. Accounting for it would require adding significant compli-

cations to the assumptions about how quantifiers are interpreted, which seem otherwise unmotivated.

4.3. Multiple *Wh*-Phrases in Pied-Piping

In this section we consider constructions that at first seem to be problematic for both accounts of pied-piping. Such data have been brought up by Sternefeld (2001) as an argument for the AS-approach. Our goal is to show that an account on the covert movement approach is possible.

Consider first example (54) from von Stechow (1996b).

(54) Which mountain in which country did you climb?

Von Stechow (1996b) notes that a run-off-the-mill covert movement representation like (55a) makes a wrong prediction for (54). Namely, assuming that every mountain is in some country, (55) is equivalent to a representation without existential quantification over countries.

- (55) a. $\lambda p \exists x \in \llbracket \text{country} \rrbracket \exists y \in \llbracket \text{mountain in } x \rrbracket: p = \llbracket \text{you climbed } y \rrbracket$
 b. $\lambda p \exists y \in \llbracket \text{mountain} \rrbracket: p = \llbracket \text{you climbed } y \rrbracket$

But, this predicts no difference between (54) and (56). In fact, though, an answer naming only a single mountain or a set of single mountains is appropriate for (56), but odd for (54).

(56) Which mountain did you climb?

Sternefeld (2001) notes that (54) is also problematic for the alternative semantics approach to pied-piping. Within the set of assumptions we have introduced the meaning of *which* in AS could be defined as in (57), where (57b) would be the lexical entry used in case a *wh*-word occurs in the scope of *which*.

- (57) a. $\llbracket \text{which } P \rrbracket_{AS} = \{x \mid P(x) = 1\}$
 b. $\llbracket \text{which } P \rrbracket_{AS} = \{x \mid \exists p \in \llbracket P \rrbracket_{AS}: p(x) = 1\}$

But, it is easy to see that the equation in (58) holds, and therefore the same problem arises on the AS-approach.

(58) $\llbracket \text{which mountain in which country} \rrbracket = \llbracket \text{which mountain} \rrbracket$

Sternefeld (2001) proposes to solve the problem assuming a different phrase structure for the question. He assumes that the prepositional phrase *in which country* is understood as an appositive adjunct to the phrase *which mountain*, rather than as part of its restrictor. Furthermore, he assume that this appositive adjunct must be interpreted in the scope of the question.

Sternefeld couches this solution in the AS-approach, but we demonstrate it in (59) using the covert movement approach, also to show that the proposal is independent of the account of pied-piping. In (59), the condition “*y* is in *x*” is reconstructed into the scope of the question. We assume here that the appositive is interpreted conjunctively, though it may also be interpreted as a presupposition.

(59) $\lambda p \exists x \in \llbracket \text{country} \rrbracket \exists y \in \llbracket \text{mountain} \rrbracket: p = \llbracket \text{you climbed } y \text{ and } y \text{ is in } x \rrbracket$

The propositions that (59) contains each have as part of their content that *x* is in *y*, and therefore it is expected that simply indicating a mountain is insufficient to identify an element of (59).

Sternefeld’s solution, though, isn’t general enough: In example (60), the second *wh*-phrase occurs as an argument of the first and therefore couldn’t be analyzed as an appositive along the lines of (59). Still (60) shows a similar effect: The single term answers in (60a) are odd in reply to (59).

(60) Which relative of which child attended the pot-luck?
 a. #Heidi./# Heidi, John, and Neal.
 b. Nick’s mother, Alan’s dad, and Lucy’s granddad.

Actually, though the account of (60) follows once we adopt an approach to the interpretation of A-bar movement that assumes that the restrictor must be interpreted in the trace position of *wh*-movement (Sauerland 1998, Fox 1999, and others). Consider the representation in (61), where $\llbracket \text{the}_x \rrbracket(P)$ is to be interpreted as *x* (or more precisely $g(x)$), but with the presupposition that *x* have property *P*.

(61) $\lambda p \exists x \exists y: p = \llbracket \text{the}_x \text{ relative of the}_y \text{ child attended the pot-luck} \rrbracket$

For any pairs of values for *x* and *y*, (61) contains a proposition that, because of the presuppositions the two indexed definite determiners introduce, is defined only for worlds *w* such that *y* is a child and *x* is a relative of *y*. Because of these presuppositions, the elements of (61) are different from propositions that mean “*x* attended the pot-luck”. For example, (61) would contain the proposition *p* and *q* in (62) that are both sub-propositions of the proposition “Heidi attended the pot-luck”.

- (62) a. $p(w)$ is defined iff. Nick is a child in w and Heidi is a relative of Nick's in w where defined, $p(w) = 1$ iff. Heidi attended the pot-luck
 b. $q(w)$ is defined iff. Joe is a child in w and Heidi is a relative of Joe's in w where defined, $q(w) = 1$ iff. Heidi attended the pot-luck

The fact that appropriate answers to (60a) must indicate which child Heidi is a relative of therefore follows from the principle in (63).

- (63) Any answer to a question must uniquely identify one element of the question.

The answer "Heidi attended the pot-luck" doesn't uniquely identify an element of (61) because it doesn't distinguish between (62a) and (62b).

Note that the approach can be seen as a generalization of Sternefeld's strategy: The representation in (61) treats the entire restrictor of *which* as an appositive interpreted in the scope of the question. In this way, our proposal is similar to the suggestions Sternefeld (p.c.) and Heim (p.c.) raised. As far as we know, though, the observation that the puzzle is solved by adopting obligatory reconstruction of the restrictor, which is independently motivated, is new. In this way, the multiple *wh*-data are compatible with the covert movement approach. It remains to be seen, whether the AS-approach can also account for these data.

5. Conclusion

In section 1, we established that *wh*-in-situ and *wh*-in-pied-piping behave alike in one respect: Both are sensitive to LF-intervention effects in the sense of Beck (1996). Recall that this parallelism was established by means of data pairs like that in (64) ((64a)=(3), (64b)=(8)). (64) shows that *kein* ('no') triggers LF-intervention effects with both *wh*-in-situ and *wh*-in-pied-piping.

- (64) a. *Ich frage mich wer **keinem** was erklärt hat
 I ask myself who nobody what explained has
 b. *Fritz möchte wissen **kein** wie schnelles Motorrad du fahren darfst
 Fritz wants know no how fast motorbike you drive may

The parallelism between *wh*-in-situ and *wh*-in-pied-piping follows straightforwardly if both involve covert movement of the *wh*-phrase to SpecCP to take scope over the question (von Stechow 1996b). In section 2, we presented additional support for the covert movement analysis.

If the covert movement analysis is correct, as we claim, our result has interesting general implications for the theory of grammar. The result sheds light on the question whether covert movement is sensitive to islands. Our result lends support to the claim that

covert movement is not island sensitive, or at least not sensitive to the same islands overt movement is sensitive to. It is however sensitive to the LF-intervention constraint.

A second interesting result, we believe, is the following: Pied-piping presents an interface problem where the structures syntax produces do not straightforwardly fit the most straightforward semantics. In principle, such interface problems could be resolved by either additional syntactic mechanisms or by additional semantic mechanisms. In our case, covert movement is the syntactic mechanism, while alternative semantics is the semantic mechanism. Our result, in these terms, means that syntax has to shoulder the burden of resolving the mismatch, while the semantics can be kept as simple as possible. It is interesting to note that in a number of other syntax-semantics mismatches as for example in quantifier interpretation, it seems that also syntax must act to resolve any syntax-semantics mismatch (Fox 2000, Sauerland 1999). We believe that it will be interesting to investigate whether a generalization can be established that any syntax-semantics mismatch must be resolved in the syntax. Our results in this paper would contribute one case towards such a generalization.

References

- Beck, Sigrid. 1996. Quantified structures as barriers for LF movement. *Natural Language Semantics* 4.1–56.
- . 2003. A semantic explanation for intervention effects. Unpublished handout, University of Connecticut, Storrs.
- , and Shin-Sook Kim. 1997. On wh- and operator scope in Korean. *Journal of East Asian Linguistics* 339–384.
- Chomsky, Noam. 1977. On wh-movement. In *Formal Syntax*, ed. by P. Culicover, T. Wasow, and A. Akmajian, 71–132. New York: Academic Press.
- Curry, Haskell B., and Robert Feys. 1958. *Combinatory Logic, Volume I*. Amsterdam: North-Holland.
- Fox, Danny. 1999. Reconstruction, variable binding and the interpretation of chains. *Linguistic Inquiry* 30.157–196.
- . 2000. *Economy and Semantic Interpretation*. Cambridge, Mass.: MIT Press.
- Hagstrom, Paul. 1998. *Decomposing Questions*. Ph.D. dissertation, Massachusetts Institute of Technology, Cambridge, Mass.
- Hamblin, C.L. 1973. Questions in Montague English. *Foundations of Language* 10.41–53.
- Karttunen, Lauri. 1977. The syntax and semantics of questions. *Linguistics and Philosophy* 1.1–44.
- Kim, Shin-Sook. 2001. Intervention effects are focus effects. In *Proceedings of J/K 10*.
- Kratzer, Angelika, and Junko Shimoyama. 2002. Indeterminate pronouns: The view from Japanese. Unpublished ms., UMass Amherst and Kyushu Institute of Technology.
- May, Robert. 1977. *The Grammar of Quantification*. Ph.D. dissertation, Massachusetts Institute of Technology, Cambridge, Mass.
- Pesetsky, David. 2000. *Phrasal Movement and its Kin*. Cambridge, Mass.: MIT-Press.
- Ramchand, Gillian. 1997. Questions, polarity and alternative semantics. In *Proceedings of NELS 27*, ed. by K. Kusumoto, 383–396. Amherst, University of Massachusetts, GLSA.
- Rapp, Irene. 1992. Die w-Wörter *wie*, *wieviel-*, *wievielt-* im Rahmen einer DegP-Analyse. Technical report, Universität Tübingen, Tübingen.

- Reinhart, Tanya. 1997. *Wh-in-situ* in the framework of the minimalist program. *Natural Language Semantics* 6.29–56.
- Rooth, Mats. 1985. *Association with Focus*. Ph.D. dissertation, University of Massachusetts, Amherst.
- Sauerland, Uli. 1998. *The Meaning of Chains*. Ph.D. dissertation, Massachusetts Institute of Technology, Cambridge, Mass.
- . 1999. Relativized minimality effects with quantifier raising. Paper presented at ESCOL '99, University of Connecticut, Storrs.
- . 2001. On quantifier movement in German. Unpublished Manuscript, Tübingen University.
- Sells, Peter. 1985. Pied piping and the feature [wh]. Unpublished manuscript, Stanford University.
- Sternefeld, Wolfgang. 2001. Partial movement constructions, pied piping, and higher order choice functions. In *Audiatur Vox Sapientiae*, ed. by C. Féry and W. Sternefeld, 437–486. Berlin, Germany: Akademie Verlag.
- Takahashi, Daiko. 1990. Negative polarity, phrase structure and the ECP. *English Linguistics* 7.129–146.
- Trissler, Susanne. 2000. *Syntaktische Bedingungen für w-Merkmale: Zur Bildung interrogativer w-Phrasen im Deutschen*. Ph.D. dissertation, Universität Tübingen, Tübingen, Germany.
- von Stechow, Arnim. 1996a. Some remarks on choice functions and LF-movement. In *Proceedings of the Konstanz Workshop “Reference and Anaphorical Relations”*, ed. by K. v. Heusinger and U. Egli. Constance: Universität Konstanz.
- . 1996b. Against LF pied-piping. *Natural Language Semantics* 4.57–110.

(Sauerland)

Department of Linguistics
University of Massachusetts
Amherst MA 01003
U.S.A.

uli@alum.mit.edu

(Heck)

Institut für Anglistik
Universität Stuttgart
Keplerstrasse 17 / 4b (KII)
70174 Stuttgart
Germany

heck@ims.uni-stuttgart.de