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INTERROGATIVE QUANTIFIERS WITHIN SCOPE

1. Overview*

I will outline a semantics of interrogative sentences which is primarily designed to cope with the phenomenon of the so-called (pair-)list or distributive reading of *wh*-interrogatives, which is typically found in *wh*-interrogatives containing universal quantifiers (as, for example, in *Who does everyone like?*). There is an ongoing debate on whether the list reading is to be regarded as a certain kind of scope reading – ordinary quantifier outscoping *wh*-phrase – or as a certain kind of functional reading (see, e.g., Groenendijk/Stokhof 1984, May 1985, Engdahl 1986, Chierchia 1993). Relying on an investigation of *wh*/*Q*-interaction in German, I will, at the outset, argue that the list reading is to be analysed as a scope reading since its occurrence is determined by the same factors which determine scope interaction between ordinary quantifiers. Thus, *wh*-phrases appear to be (inherently) quantifiers which participate in scope interaction in the same way as other quantifiers do. The main challenge for such a view is to provide for a semantics which regards the scope relation 'ordinary quantifier outscoping interrogative quantifier' semantically as a true instance of a quantifier scope relation. The paper's main part is devoted to the presentation of a new solution to this challenge, whose decisive ingredients are: (i) an analysis of interrogative sentences as definite descriptions of (pluralities of) propositions or kinds of (pluralities of) propositions; (ii) a novel view of the meaning of *wh*-phrases, which are claimed to be semantically a highly specific element in *wh*-interrogatives – by introducing a maximality predicate, for example, interrogative quantifiers are primarily responsible for *wh*-clauses' exhaustive readings; (iii) an analysis of exhaustivity as "weak" or "strong" depending on whether one looks at a *wh*-clause's denotation only or also at the way the denotation is described; (iv) a systematic distinction between

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'extensional' predicates like *know* and 'intensional' predicates like *wonder* with respect to the types of interrogatives they can embed; (v) a systematic distinction between declaratives, *yes/no-* and alternative interrogatives, on the one hand, and *wh*-interrogatives, on the other, with respect to the type of definite description they are; and (vi) the view that it is the occurrence of an interrogative quantifier, not the kind of entity denoted, which is the common semantic trait of interrogative sentences.

The proposal can – to some extent – be seen as a variant of Karttunen's (1977) approach, which takes an interrogative to denote the set of propositions which jointly constitute the complete true answer, but it also integrates aspects of the analyses developed by Groenendijk/Stokhof (1984), Berman (1991, 1994), Higginbotham (1991), Dayal (1991), Lahiri (1991), Schwarz (1993) and Heim (1994). It is, as far as I can see, the first general solution within a Karttunen semantics to the problems posed by an ordinary quantifier's outscoping a *wh*-phrase and it seems the first proposal whatsoever which does full semantic justice to *wh*/*Q*-interaction being a case of quantifier interaction. The proposal is not a variant of a 'quantifying into questions' account. It crucially differs from Karttunen/Peters (1980), Higginbotham/May (1981), Belnap (1982), Higginbotham (1991, 1996), and Groenendijk/Stokhof (1984) in that ordinary quantifiers are 'quantified in' in distributive (=list) readings in exactly the same way as in non-distributive readings or in declarative sentences. Thus, there is no analog to the diverse special semantic operations of Groenendijk/Stokhof, Higginbotham/May, Belnap and Karttunen/Peters which combine quantifiers and sentences with *wh*-phrases – operations, which clearly differ from standard 'quantifying in' operations (cf. Chierchia 1993).

From a general semantic point of view the most characteristic trait of the proposal is the successful convergence between the semantics of noun phrases and the semantics of sentences. This convergence allows us to reduce many characteristics of interrogatives to semantic properties that are well-known in the realm of noun phrases (properties like definiteness, plurality or transparency).

2. *WH*/*Q*-Interaction in German

It is anything but a trivial affair to take *wh*/*Q*-interaction as a scope phenomenon. My reason for doing so, after looking at German *wh*-interrogatives in some detail, is the perfect fit between the factors which determine scope interaction between ordinary, non-interrogative quantifiers and the factors which determine *wh*/*Q*-interaction. Let's look at some examples in order to illustrate this claim.

(1)a. Jeder Kritiker hat einen der Romane rezensieren
every critic has one the novels review
müssen. (unambiguous)
must
Every critic had to review one of the novels.
∀∃:√ ∃∀:*

b. Einen der Romane hat jeder Kritiker rezensieren
one the novels has every critic review
müssen. (ambiguous)
must
One of the novels, every critic had to review.
∀∃:√ ∀∃:√

After examining the intuitions of many speakers and testing the readings' availability in certain critical contexts, the facts came out as indicated: in (1a) the subject, being in the sentence's initial position, has unequivocally wide scope, but in (1b), where the direct object is in the initial position, both readings are possible (cf. Pafel 1993). Necessary qualifications aside (see below), the pattern exhibited in (1) – sentences of the form 'subject preceding direct object' being unambiguous, sentences of the form 'direct object preceding subject' being ambiguous – is a striking trait in German scope relations (cf. Frey 1993: §10).[1]

Now compare the sentences in (2):

(2)a. Welcher Kritiker hat jeden Roman rezensieren
which critic has every novel review
müssen? (unambiguous)
must
R1 Which critic is such that he had to review every novel?
R2 *For every novel: which critic had to review it?

[1] Japanese and Korean display the same pattern, see Hoji (1986), Joo (1989), Kim (1991), and Aoun and Li (1993). As for scope relations, topicalization in English has a very similar effect to topicalization (or scrambling) in German. Compare the contrast in (1) with the contrast between (i) and (ii):

(i) Some reporters put tape recorders in every room.
(unambiguous: *some* > *every*; Reinhart 1983: 191)
(ii) In every room, some reporters have put tape recorders. (ambiguous; ibid. 192).

(2)b. Welchen Roman hat jeder Kritiker rezensieren
which novel has every critic review
müssen? (ambiguous)
must
R1 Which novel is such that every critic had to review it?
R2 For every critic: which novel did he have to review?

We find the same pattern of ambiguity/unambiguity as in (1). In particular, the list or distributive reading R2 is possible only in (2b), where the *wh*-phrase is a direct object in the initial position. The similarity between (1) and (2) suggests that the list reading is a reading with an ordinary, i.e., non-interrogative, quantifier outscoping a *wh*-phrase. The data show that, broadly speaking, word order is an important factor for scope relations. Besides word order, the grammatical status of an object – as direct or indirect object – can be important. Whereas the sentences in (3) with a direct object are unambiguous (regardless of the intonation pattern one uses), the sentences in (4) with an indirect object are ambiguous.

(3)a. Einer von ihnen hat jeden Roman rezensiert. (unambiguous)
one of them has every novel reviewed
One of them reviewed every novel.

b. Wer von ihnen hat jeden Roman rezensiert? (unambiguous)
who of them has every novel reviewed
Who of them reviewed every novel?

(4)a. Mindestens einer von uns hat jedem
at-least one of us has everyone
geholfen. (ambiguous)
helped
At least one of us helped everyone.

b. Wer hat jedem geholfen? (ambiguous)[2]
who has everyone helped
Who helped everyone?

[2] It must be noted that not all speakers get a list reading here.

Depending on the kind of quantificational element (*ein* 'one' vs. *jeder* 'every', *wieviele* 'how many' vs. *welche* 'which') and the structure of the quantifier (non-partitive vs. partitive), sentences with the subject in the so-called 'Vorfeld'[3] and a direct object in the 'Mittelfeld' can be ambiguous: compare the ambiguous sentences in (5) with the unambiguous sentences in (3).[4] As for (5a), it is crucial that it is not the noun *Kritiker* 'critic' that bears the main accent in the subject noun phrase – otherwise the noun phrase would not be a quantificational one.[5]

(5)a. Ein Kritiker hat jeden Roman
one critic has every novel
rezensiert. (ambiguous; ∀∃ with certain intonation only)
reviewed
One critic reviewed every novel.

b. Wieviele Kritiker haben jeden Roman
how-many critics have every novel
rezensiert? (ambiguous)
reviewed
How many critics reviewed every novel?

But, interestingly, the reading with wide scope of the direct object vanishes in case both quantifiers are situated in the Mittelfeld:

[3] The 'Vorfeld' is the position in front of the finite verb in V2-clauses. The 'Mittelfeld' is the domain between the finite verb in V1/V2-clauses or the complementizer in V-end-clauses, on the one hand, and the verbal complex, on the other. In (3) to (5) the Mittelfeld only encompasses the object, in (6), however, it encompasses subject and object.

[4] One referee suggests the (epistemic) possibility that the difference between (2a) and (3b), on the one hand, and (5b), on the other, could be explained by the semantics of *how many* phrases. Reconstruction, however, does not do the trick. Note in this context the difference between (5b) and (6b) below.

[5] The difference between the quantificational and the non-quantificational use of indefinite noun phrases can be vividly exemplified by the sentences (i) and (ii). (i), with a non-quantificational indefinite – main accent on the noun – only has a generic reading, whereas (ii), with a quantificational indefinite – main accent on the quantificational element – has two scope readings (*one* > *always*; *always* > *one*), but no generic reading (upper case indicates accentuation).

(i) Eine KATze fällt IMmer auf ihre Füße.
Cats always land on their feet.

(ii) EIne Katze fällt IMmer auf ihre Füße.
One cat always lands on its feet.

(6)a. Doch hat ein Kritiker jeden Roman
but has one critic every novel
rezensiert. (unambiguous)
reviewed
But one critic reviewed every novel.

b. Wann haben wieviele Kritiker jeden Roman
When have how-many critics every novel
rezensiert? (unambiguous)
reviewed
When have how many critics reviewed every novel?

So far, we have investigated unembedded *wh*-interrogatives only. But there is no change in possible readings when the presented *wh*-interrogatives get embedded.[6] See, for example, the embedded interrogatives in (7): the one in (7a) is as unambiguous as (2a), and the one in (7b) is as ambiguous as (2b):

(7)a. Sie weiß, welcher Kritiker jeden Roman hat
she knows which critic every novel had
rezensieren müssen.
review must
She knows which critic had to review every novel.

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[6] Szabolcsi (1997: §2.1) claims that in many cases an embedded interrogative has a pair-list reading only when the matrix verb is an extensional verb like *know* or *find out*. See the contrast between (i) – with the intensional matrix verb *wonder* – and (ii) – with the extensional matrix verb *find out*:

(i) John wonders which boy more than two dogs bit. (pair-list:*) [=(28) in Szabolcsi 1997]

(ii) John found out which boy more than two dogs bit. (pair-list:√) [=(26) in Szabolcsi 1997]

I couldn't detect similar contrasts in German: *wh*/*Q*-interaction in German seems not to depend on the embedding predicate. (iii), for example, seems not to have a pair-list reading. This is confirmed by the fact that there is no relevant non-contradictory reading of (iv).

(iii) Fritz weiß, welchen Jungen mehr als zwei Hunde gebissen haben.
Fritz knows which boy more than two dogs bit.

(iv) *Fritz kennt zwar keinen Jungen, den mehr als zwei Hunde gebissen haben, aber er weiß, welchen Jungen mehr als zwei Hunde gebissen haben.
Fritz knows no boy who was bitten by more than two dogs, but he knows which boy more than two dogs bit.

(7)b. Sie weiß, welchen Roman jeder Kritiker hat
she knows which novel every critic had
rezensieren müssen.
review must
She knows which novel every critic had to review.

These examples can give us an impression to what extent the factors which determine *wh/Q*-interaction overlap with the factors which determine scope interaction between ordinary quantifiers. Looking at it in greater detail, it becomes obvious that there is not only an overlap, but an identity of factors (see Pafel 1991; Kuno 1991 comes to a very similar result investigating *wh/Q*-interaction in English; see also Liu 1990: §5 and Beghelli 1997). On this empirical result we base the assumption that *wh/Q*-interaction is a special case of quantifier interaction, probably even a trivial one. And it is this assumption which primarily motivates our search for a semantics which regards the scope relation 'ordinary quantifier outscoping interrogative quantifier' semantically as a true instance of a quantifier scope relation.

With regard to this aim, it is not necessary to presuppose a definite way in which *wh/Q*-interaction's being a special case of quantifier interaction is implemented in a theory of scope. But the facts we have presented tend to show that looking exclusively at c-command relations of the quantifiers and their traces – which is a widespread procedure, see, e.g., the works referred to in footnote 1 – is not sufficient to determine the scope relations of our examples: the sentences (3a, b) and (4a, b), (5a) and (3a, 6a), (5b) and (2a, 6b) differ in their possible scope readings respectively, but they do not differ with respect to the c-command relations of the quantifiers and their traces – under standard syntactic assumptions. Instead, the detailed investigation of the facts help us see the determination of relative scope as a multi-factor phenomenon. But this is not our topic.[7]

Viewing *wh/Q*-interaction as a special case of quantifier interaction is compatible with the fact that functional or relational readings of interrogatives cannot, as Engdahl (1986) has argued, be analysed as a case of quantifying in – if it makes sense to draw a distinction between functional

[7] That scope is a multi-factor phenomenon has been emphasized by Kroch (1974), Ioup (1975a, b) and VanLehn (1978), but it has fallen in disregard since then. Recently, such a view has found new supporters from different quarters (Alshawi (ed.) 1992, Kuno 1991, Kurtzman and MacDonald 1993, Liu 1990, Pafel 1991, 1993, 1997, the contributors in Szabolcsi (ed.) 1997). See Kuno (1991) and Pafel (1997: §3.5.3) for multi-factor scope models which embrace ordinary quantifiers' interaction and *wh/Q*-interaction in English and German respectively.

readings as in (8), on the one hand, and list readings, on the other, as two different sorts of readings none of which can be reduced to the other.

(8) Who do you expect every Englishman to admire most?
His mother. (Engdahl 1986: 163)

It is, of course, tempting to reduce list readings to functional readings, but as the latest version of such a reduction, i.e., Chierchia (1993), makes clear, even if one abstains from quantifying into questions and quantifies over functions instead, list readings and what he calls "plain functional" readings (as in 8) still have to be distinguished as two different kinds of readings. Thus the existence of (plain) functional readings as in (8) seems perfectly compatible with regarding *wh*/*Q*-interaction as a scope phenomenon.

Chierchia (1993) proposes to correlate list readings with (the absence of) Weak Crossover (WCO) configurations: list readings are ruled out whenever such a reading leads to a WCO configuration at the level of Logical Form. He regards this correlation as confirmation that list readings can be analysed as a certain kind of functional reading. In functional readings – he assumes – the trace of the *wh*-phrase (a "functional trace") bears two indices – an f-index (subscript) bound by the *wh*-phrase and an a-index (superscript) bound by a c-commanding noun phrase. The asymmetry in (9) – (a) having a list reading, but (b) not – is considered to be a consequence of the fact that the LF (10a) is wellformed, but the LF in (10b) is not: in order to bind the a-index of the functional trace in (9b) *everyone* has to cross over the trace leading to a configuration to be ruled out by the same constraint that rules out the classical WCO construction in (11) – see Chierchia (1993: 213f).

(9)a. Who does everyone like?
b. Who likes everyone?
(10)a. $[\text{who}_i\ \text{everyone}_j][t_j\ \text{like}\ t_i^j]$
b. $[\text{who}_i\ \text{everyone}_j][t_i^j\ \text{like}\ t_j]$
(11) Who_j does his_j mother love t_j

German seems to provide counterevidence to such a correlation of list readings and WCO. The following sentences with the direct object occupying the Vorfeld are perfectly acceptable:

(12)a. [Eine von den Aufgaben]$_j$ hat jeder, der sie$_j$ gestellt
one of the problems has everyone who she pose
bekam, gelöst.
got solved
One of the problems is such that everyone who had to solve it solved it eventually.

b. [Welche Aufgabe]$_j$ hat jeder, der sie$_j$ gestellt
which problem has everyone who she pose
bekam, gelöst?
got solved
Which problem is such that everyone who had to solve it solved it eventually?

Under standard syntactic assumptions these sentences are cases of WCO:

(13) $XP_j \ldots [\ldots \alpha_j \ldots] \ldots t_j \ldots$
('α' being the pronoun and 't' the trace of the XP in the Vorfeld)

If the sentences in (12) are indeed cases of WCO, then WCO cannot be the reason for the unavailability of a list reading in sentences like (2a), (3b) or (6b).[8] If we want to uphold the correlation we have to come up with analyses such that (12) are not cases of WCO. We have (i) to make non-standard syntactic assumptions and/or modify the constraint which rules out WCO and (ii) we have to show that sentences like (2a), (3b) or (6b) cannot be generated in such a way as to avoid a WCO configuration.[9] It is up to those who want to uphold the correlation to come up with analyses consistent with the correlation.

There are further problems for the correlation. The sentences (3b) and (4b) as well as (5b) and (2a, 6b) differ with respect to the availability of a list reading, but – under standard syntactic assumptions – they do not

[8] Cf. Chierchia (1993: 223n32).

[9] One possibility that comes to mind is to assume the possibility in German of base-generating object and subject in this order. This would explain why there is no WCO violation in (12), but in order to uphold the correlation one must find a reason why in sentences (2a), (3b) and (6b) the base position of the object cannot be in front of the base position of the subject. Another possibility was suggested by a referee. We (i) modify the constraint on WCO in such a way that it is not operative when scrambling is involved and (ii) assume that in (12) the XP in the Vorfeld "is part of a chain one of whose links is in a scrambled position". Now, a reason must be given why scrambling is possible in (12), but not in (2a), (3b) and (6b).

differ with respect to the c-command relations between the universal quantifier and the *wh*-trace. Last, but not least, the suggested correlation does not explain the analogies between *wh*/*Q*-interaction and scope interaction between ordinary quantifiers.

But there is a problem for viewing the list reading as a scope reading. In many cases the list reading of *wh*-interrogatives is possible only with quantificational elements like *every* or *each*, but not with quantificational elements like *most*, *almost every*, or *not every*. German counterparts of the sentences in (14) are unambiguous, they do not exhibit a list reading. They are as unambiguous as the English sentences in (14) seem to be.

(14)a. We know which novel most of them reviewed. (unambiguous; cf. Liu 1990: 206)

b. We know which novel almost (/not) everyone reviewed. (unambiguous)

This unambiguity is prima facie unexpected if *wh*/*Q*-interaction is quantifier interaction, since comparable sentences with ordinary quantifiers are ambiguous:

(15) Einen der Romane haben die meisten Kritiker
one the novels have the most critics
rezensieren müssen.
review must
most > one:√ one > most:√
One of the novels, most critics had to review.

Can we conclude from data as in (14) that, for some reason, non-universal quantifiers cannot outscope a *wh*-phrase? We will approach this question by first looking at sentences with universal quantifiers which exclusively have a distributive reading, i.e., interrogatives with quantifiers which do NOT have a non-distributive reading. Sentence (16a) is a case in point. It differs in this respect from (16b), which is clearly ambiguous:[10]

(16)a. Was hat eigentlich jeder für eine Note bekommen?
what has actually every for a grade received
What grade has everyone received?

[10] See Pafel (1991: 151). This contrast has been independently observed by Swart (1992: 397f.) with regard to very similar Dutch sentences.

b. Was für eine Note hat eigentlich jeder bekommen?
what for a grade has actually every received
What grade has everyone received?

(The contrast in (16) would remain the same if the sentences were embedded.) Sentence (16a) is characterized by the so-called *was für* split: the *wh*-phrase *was für eine Note* ('what kind of grade') shows up as a discontinuous constituent in s-structure (subextraction of *was*):

(17) Was_1 hat eigentlich jeder [t_1 für eine Note] bekommen?
what has actually every for a grade received

That (16a) does indeed not have a non-distributive reading is shown by the unacceptability of (18). The first sentence in this conjunction (*Ich möchte nicht von jedem wissen, was er für eine Note bekommen hat* 'I don't want to know of everybody what grade he received') is a denial of the second sentence, that contains an embedded version of (16a), (*Ich möchte wissen, was jeder für eine Note bekommen hat* 'I want to know what grade everyone received') if the second sentence's embedded interrogative is interpreted distributively. Thus, this conjunction would be a consistent statement only if the embedded counterpart of (16a) had a non-distributive reading. But there is no relevant non-contradictory reading of (18).[11]

(18) *Ich möchte nicht von jedem wissen, was er für eine Note bekommen hat, sondern ich möchte wissen, was jeder für eine Note bekommen hat.
I don't want to know of everybody what grade he received, but I want to know what grade everyone received.

It is the missing non-distributive reading, and no other cause, which is responsible for the unacceptability of (18). This is emphasized by the fact that the conjunction is no longer obviously contradictory if we substitute the unambiguous *was jeder für eine Note bekommen hat* (≈16a) by the ambiguous *was für eine Note jeder bekommen hat* (≈16b).

Since the *was für* split construction forces a distributive reading in certain *wh*-interrogatives with universal quantifiers, it is an apt testing ground for whether *wh*-interrogatives with non-universal quantifiers can

[11] The intended reading of *von jedem* 'of everyone' in the first conjunct of (18) is the one where it specifies the 'topic' of the knowledge, not its 'source'. The same holds for *von den meisten* 'of most' in (22) below.

have a distributive reading. Sentence (19) is a case where a *most*-quantifier is substituted for the universal quantifier in (16a).

(19) Was haben eigentlich die meisten für eine Note bekommen?
what have actually the most for a grade received
What grade have most received?

In a situation as in (20), where the range of *most* consists of six students (s_1 to s_6) and the distribution of the grades is as indicated, a felicitous answer to the question (19) is (21):

(20) $\langle s_1, 1(A)\rangle$, $\langle s_2, 1(A)\rangle$, $\langle s_3, 2(B)\rangle$, $\langle s_4, 2(B)\rangle$, $\langle s_5, 3(C)\rangle$, $\langle s_6, 4(D)\rangle$

(21) Die meisten haben entweder eine Eins oder eine Zwei bekommen.
Most have received either grade A or grade B. (*most* > *or*)

This answer is consistent with a distributive reading. If we test (19) for the existence of a non-distributive reading, the result is the same as in (18): the non-distributive reading doesn't seem to exist.

(22) *Ich möchte nicht von den meisten wissen, was sie für eine Note bekommen haben, sondern ich möchte wissen, was die meisten für eine Note bekommen haben.
I don't want to know of most students what grade they received, but I want to know what grade most students received.

Once more, the conjunction is no longer obviously contradictory if we substitute *was die meisten für eine Note bekommen haben* (what the most for a grade got have) by *was für eine Note die meisten bekommen haben* (what for a grade the most got have), which displays a non-distributive reading as well as a distributive reading (the distributive reading is harder to get than in sentences like (19).

As is to be expected by now, other quantifiers besides those with *every* and *most* can outscope an interrogative quantifier. In (23), for example, *at least five students* has wider scope than the interrogative quantifier. The sentence's meaning can be paraphrased as "With regard to at least five students I have to know what grade they get".[12]

[12] The interrogative's reading in (23) is a 'choice reading' in the sense of Groenendijk and Stokhof (1984: 451).

(23) Ich muß wissen, was zumindest fünf Studenten für eine
I must know what at-least five students for a
Note bekommen.
grade receive
I have to know what grade at least five students get.

But note that the sentences become questionable when a negative quantifier outscopes the *wh*-phrase (cf. Swart 1992: 400 for Dutch):

(24) ??Was hat eigentlich nicht einer (/nicht jeder) für eine Note bekommen?
What grade has no-one (/not everyone) got?

Was für constructions are not the only cases where a non-universal quantifier can outscope a *wh*-phrase. The so-called partial movement construction in (25) displays a distributive reading, but not a non-distributive one (see Pafel 1996b: 238f).

(25) Was glaubt jeder, welche Note er bekommen wird?
what believes everyone which grade he receive will
What grade does everyone believe that he will receive?

Thus, considerations analogous to the *was für* split cases will give us non-universal quantifiers outscoping interrogative quantifiers. *How many* questions are a further case in point. The question Q in (26), for example, seems to display a distributive reading too, as the answer A indicates.[13]

(26) Q: Wieviele Aufgaben haben die meisten gelöst?
A: Die meisten haben zwei oder drei Aufgaben gelöst.
How many problems have most students solved? Most of them solved two or three problems.

Note that if these considerations are correct there are sentences where a non-universal quantifier can, and sentences (cf. 14) where a non-universal quantifier cannot outscope an interrogative quantifier.

So much for *wh*/*Q*-interaction as a scope phenomenon.

[13] As for English, Liu (1990: 194ff.) argues that *Who did most of the students see?*, *Who did most of the students think won the prize* and *Who did most of the students think John chose?* do have a reading with *most* outscoping *who*. But the distributive reading vanishes when *who* is replaced by a *which*-phrase (ibid. p. 206f.).

3. (Some) Requirements for a Semantics of Interrogatives

The following five requirements are the most important objectives our semantics of interrogatives strives to satisfy. The first one is an immediate consequence of the assumption that *wh/Q*-interaction is a case of quantifier scope interaction.

(R1) The semantics should analyse the scope relation 'ordinary quantifier outscoping interrogative quantifier' as a true instance of a quantifier scope relation, the outscoping ordinary quantifier not being restricted to a universal one.

This presupposes that the semantics should be designed in such a way that the scope relation 'ordinary quantifier outscoping interrogative quantifier' amounts to the distributive reading and the converse scope relation 'interrogative quantifier outscoping ordinary quantifier' to the non-distributive reading.

The second requirement concerns the problem – raised by Karttunen/Peters (1980: 200), Lahiri (1991: §3.2.3) and Chierchia (1993: 208) – that a quantifying into questions account makes the prediction that a sentence like *Did everyone come?* can get the same reading as *Who came?* or *Who came and who didn't?*, since it should have the 'quantified in' reading: "For every x, did x come?" This prediction, however, is not borne out. In addition, it seems that alternative interrogatives, too, do not have list readings. The sentence *Tell me whether everyone wants coffee or tea* seems, for example, not to have such a reading.

(R2) The semantics should provide for the reason why *yes/no-* (as well as alternative) interrogatives with universal quantifiers do not display any distributive readings.

(R1) and (R2) are the central requirements we want to come to terms with. The means and assumptions introduced in satisfying them are, as we will see, of importance for the satisfaction of independent requirements for a semantics of interrogatives (this partly explains our choice of these other requirements).

It has been observed that interrogative-embedding predicates come in classes with different semantical properties. Of special importance is the distinction between 'extensional' predicates like *know* and 'intensional' ones like *wonder*, to use Groenendijk and Stokhof's terminology. These two classes differ, first, with respect to the possible entailments from sentences containing them: whereas, for example, (27a) is a valid infer-

ence, (27b) is not, the sentences differing only with regard to the embedding predicate (cf. above all, Groenendijk/Stokhof 1982, 1984, 1989).

(27)a. John knows who walks. Mary walks. Ergo, John knows whether Mary walks.
b. John wonders who walks. Mary walks. Ergo, John wonders whether Mary walks.

Second, the two classes differ with respect to 'quantificational variability': whereas (28a) has a reading which can be roughly paraphrased as (29a), (28b) does not have the reading (29b). In other words, *know* displays quantificational variability, but *wonder* does not (see Berman 1991).

(28)a. For the most part, she knows which novels have been reviewed.
b. For the most part, she wonders which novels have been reviewed.
(29)a. For most novels, she knows whether they have been reviewed.
b. For most novels, she wonders whether they have been reviewed.

Thus, the third requirement is as follows:

(R3) The semantics should account for the fact that there are two classes of interrogative-embedding predicates – 'extensional' ones like *know* and 'intensional' ones like *wonder* – differing with respect to entailments and quantificational variability.

There are several types of valid inferences with respect to sentences containing extensional predicates which the semantics has to account for: see (30) and (31) – cf., once more, Groenendijk/Stokhof's works.

(30)a. John knows whether Mary walks. Mary walks. Ergo, John knows that Mary walks.
b. John knows whether Mary walks. Mary doesn't walk. Ergo, John knows that Mary doesn't walk.
(31)a. John knows who walks. Mary walks. Ergo, John knows that Mary walks.
b. John knows who walks. Mary doesn't walk. Ergo, John knows that Mary doesn't walk.

The inference (31b) is of special importance since it shows a 'strong exhaustivity' effect.

(R4) The semantics should account for the validity of inferences of the sort in (30) and (31) connecting interrogative-embedding

uses of extensional predicates with declarative-embedding uses of the same predicates. This includes an account of strong exhaustivity effects.

Wh-interrogatives do not always have an exhaustive reading.[14] (32a) can be true even if the person knows only one or two places where one can buy good wine. That is different in (32b): by adding the element *alles* ('all') an exhaustive reading becomes obligatory.

(32)a. Sie weiß, wo man in Paris guten Wein kaufen kann.
She knows where one can buy good wine in Paris.

b. Sie weiß, wo man in Paris alles guten Wein kaufen kann.
she knows where one in Paris all good wine buy can.

(R5) The semantics should account for the existence of non-exhaustive readings of *wh*-interrogatives.

We will not take an explicit stand concerning the relation between the semantics of embedded and unembedded interrogatives. Our primary topic is the embedded interrogative.

4. A New Look on the Semantics of *wh*-Phrases and *wh*-Interrogatives

Since the (re-)discovery of functional categories there is a strong tendency among syntacticians to synchronize the syntactic analyses of noun phrases and sentences as much as possible. As for semantics, there is no comparable search for convergences. But, now and then, the idea of semantic similarities between noun phrases and sentences arises. Let's assume that such a search for semantic similarities is not misplaced from the very beginning. What might sentences, in particular *wh*-clauses, resemble most: proper names, definite descriptions, existential quantifiers, or, perhaps, universal ones? *Wh*-clauses don't seem to be quantifiers as they do not display any scope behaviour – at least not with regard to negation or to universal or existential quantifiers. The following sentence pairs are logically equivalent:

[14] Cf. Belnap (1963, 1982), Åqvist (1965), Hintikka (1976), Berman (1991, 1994). These authors are at variance with Karttunen (1977) and Engdahl (1986) in assuming that non-exhaustivity is a semantic, and not only a pragmatic phenomenon. See Groenendijk and Stokhof (1984) and Reich (1997) for the detailed discussion of the pros and cons of the semantic and pragmatic views. Non-exhaustive readings come under the label of 'mention-some readings' and 'existential readings', among others.

(33)a. Wir wissen nicht, wer die Gewinner sein werden.
we know not who the winners be will

b. Wer die Gewinner sein werden, wissen wir nicht.
who the winners be will know we not
We do not know who will win.

(34)a. Jeder (/höchstens einer) weiß, wer die Gewinner
every (/at-most one) know who the winners
sein werden.
be will

b. Wer die Gewinner sein werden, weiß jeder
who the winners be will know every
(/höchstens einer).
(/at-most one)
Everyone (/at most one person) knows who will win.

The absence of scope behaviour precludes any analysis which treats *wh*-clauses as existential or universal quantifiers. But it is compatible with *wh*-clauses being proper names or definite descriptions.[15] This result is reinforced by the possibility of left dislocating a *wh*-clause – left dislocation being restricted to non-quantificational terms in Standard German.

(35) Wer die Gewinner sein werden, das weiß jeder.
who the winners be will that know every
Everyone knows who will win.

Assuming that they denote propositions, *wh*-clauses resemble ordinary definite descriptions more than proper names: there is – to speak in a Kripkean way – nothing like an initial 'baptism' where the clauses' reference is fixed by ostension or description, but there is a systematic relation between the denoted propositions and the meaning of the *wh*-clauses' parts. Note the possibility of modifying the sentences (33) to (35) in such a way that the interrogative is replaced by a definite description meaning *the answer to the question of who will win* without any change in the behaviour with regard to negation or the universal and existential quantifier.

Embedded declarative clauses behave similar to *wh*-clauses: they, too,

[15] Cf. Higginbotham (1991: 48): "indirect questions are singular terms".

do not show any scope behaviour and resemble ordinary definite descriptions more than proper names. If they denote propositions they either are a third kind of referential expression or they are definite descriptions (e.g., ιp [⟨S⟩ = p]).[16] In either case the declarative clause denotes an individual proposition. In this respect, however, *wh*-clauses seem to differ: they are often definite descriptions of PLURALITIES of propositions, i.e., of mereological sums of propositions. In a case like (36a), the interrogative in its list reading describes exhaustively the propositions which count as true answers to the corresponding question *Which novel does each of the four critics review?* Assume a situation where the parts of the plurality of propositions in (36b) correspond to the only true answers. In such a situation the plurality (36b) is the denotation of the *wh*-clause.

(36)a. We know which novel each of the four critics reviews.

b. **⟨Review(a,kundera's-latest-novel)⟩ [=p_1] ⊕**
⟨Review(b,márquez's-latest-novel)⟩ [=p_2] ⊕
⟨Review(c,rushdie's-latest-novel)⟩ [=p_3] ⊕
⟨Review(d,updike's-latest-novel)⟩ [=p_4]

An immediate benefit from viewing *wh*-clauses as definite descriptions is that it is straightforward to give structurally identical analyses to sentence pairs as in (37) with so-called adverbials of quantity. The noun phrase *the reviewed novels* in (37a) denotes the range of the *most*-quantifier in the same way as the embedded interrogative *Which novels are being reviewed* does in (37b) (see (38) for illustration; cf. Berman 1991, 1994; Lahiri 1991; Chierchia 1993). That is, *for the most part* takes as its range the denotation of the definite description – be it nominal or sentential. If the concerned reviewed novels are Kundera's, Márquez's, Rushdie's and Updike's latest novel, then (37a) is true if we know at least three of them. In the same situation (37b) is true if we know at least three propositions of the form "x is being reviewed" with x being one of the four novels.

(37)a. For the most part, we know the reviewed novels.

b. For the most part, we know which novels are being reviewed.

(38)a. We know most of [[the reviewed novels]]

b. We know most of [[which novels are being reviewed]]

Before I can develop this view on the semantics of *wh*-clauses, I will have to present some background assumptions – two ontological and two semantical ones.

[16] As for the representation language, an expression with angle brackets denotes a proposition. The meaning of *That Mary won* might be represented as ιp [⟨**Won(mary)**⟩ = p]. See below for the meaning of the ι-operator.

First, we rely on mereology, i.e., we rely on the existence of "pluralities" ("fusions", "sums") of individuals. Mereology is ontologically innocent in the sense that it does not postulate additional entities besides the individuals which make up the plurality. If one takes the part-of relation ($\leqslant$) to be a primitive, one can define the fusion of **a** and **b** or the plurality consisting of **a** and **b** (formally, $\mathbf{a} \oplus \mathbf{b}$) as the entity that has all and only the parts of **a** and **b** as parts (see, among others, Simons 1987 and Lewis 1991: 72ff for a presentation of mereology along these lines).[17] The semantics of interrogatives that we will present is, however, not essentially committed to this view of mereology. It could easily be developed along the lines of a conception (see, e.g., Landman 1989 and Schwarzschild 1992) which takes pluralities to be sets of entities – sets in the sense of set theory. Second, we will assume that the universe of discourse encompasses propositions (and therefore pluralities of propositions), but we can be silent with regard to the nature of propositions. The ontological commitment to propositions is common to most semantic theories of interrogatives. Third, as for our representation language, $\iota x[\phi x]$ is defined as a referential term to denote the entity (individual, plurality, or mass) that is maximal with respect to ϕ, i.e., that is ϕ and has all entities that are ϕ as parts. ι is considered to be a syncategorematic expression. Fourth, using insights of Sharvy (1980), Link (1983), Heim (1991) and Schwarzschild (1992), $\iota x[\phi x]$ – as defined above – is intended to represent the meaning of (certain classes of) definite noun phrases.[18]

[17] I will not make use of Link's (1983) lattice-theoretic approach to plural semantics for two reasons. First, Link commits himself to the view that entities like novels or critics are atoms which have no parts. But such an atomism is required neither by mereology nor by plural semantics. Second, the lattice-theoretic approach seems to postulate additional entities beyond the entities which make up a plurality (see Link 1983: 307 and, for the relation between the domain of individuals and the set of atoms, 313f.). Thus, Link's approach seems to be not ontologically innocent. I cannot detect an argument on Link's side to the effect that plural semantics is damned to lose its innocence.

[18] The question of whether definite descriptions are referential terms (as Frege thought) or quantifiers (as Russell argued) is still subject to controversy. With regard to scope, definite descriptions seem to behave as quantifiers in modal and epistemic contexts. We cannot adequately discuss this question here, but we can at least give a hint to how their behaviour in modal contexts might be analysed consistent with a referential analysis (as for epistemic contexts, see the proposed analyses of the sentences in (93) below). A natural reading of (ia), for example, can be paraphrased as (ib): it is (metaphysically) possible that there are exactly x planets, x being necessarily even – see Kripke (1979: 10):

(i)a. The number of planets might have been necessarily even.
b. $\Diamond\exists x$ (there are exactly x planets and $\Box$ (x is even))

The sentence is true under this reading since it is plausible to assume that the number of planets might have been 8 – 8 being necessarily even. It looks as if we could cope with this reading only if we take the definite description a quantifier having intermediate scope – i.e.,

With this background, we can come back to the view of interrogatives as definite descriptions of pluralities of propositions. As we will see, some interrogatives can be represented as ι-terms. But *wh*-interrogatives often are descriptions of a somewhat different form, namely of the form "the smallest plurality with the property ϕ" (39a). In representing such a description formally we assume a close relative to the ι-operator – which we will call the μ-operator. $\mu x[\phi x]$, too, is a referential term, but it denotes the entity that is minimal with respect to ϕ, i.e., that is ϕ and is part of all entities that are ϕ. As for our example (36a), the question we have to answer is what the property Q in (39b) might be such that the plurality consisting of $\mathbf{p_1}$, $\mathbf{p_2}$, $\mathbf{p_3}$ and $\mathbf{p_4}$ can be the denotation of the interrogative, and we have to answer the question of why we need the μ-operator, i.e., cannot hold on to the ι-operator.

(39)a. the smallest plurality with the property ϕ $(=\mu p[\phi p])$
b. $\mu p[Qp] = \mathbf{p_1} \oplus \mathbf{p_2} \oplus \mathbf{p_3} \oplus \mathbf{p_4}$

Apart from the μ-operator, there is not much that is new. The proposal looks like a Lahiri-inspired updating of Karttunen. But, now, I come to the aspect of my proposal that distinguishes it sharply from the better-known semantics of interrogatives. I take *wh*-phrases to be semantically a most specific element of *wh*-interrogatives. In a sentence like *Which novels have been reviewed* the *wh*-phrase is an element which is responsible for exhaustivity as well as factivity. It is proposed to have the meaning given in (40): there is an x which is maximal with respect to the property of being novels which have been reviewed – we take $\exists^{max}x[\phi x]$ as an abbreviation for $\exists x[\phi x \wedge \forall y(\phi y \rightarrow y \leq x)]$.[19]

(40) $\exists^{max}x[\mathbf{*Novel}(x) \wedge \mathbf{Have\text{-}been\text{-}reviewed}(x)](\psi x)$
$\downarrow$ exhaustivity; $\downarrow$ factivity

The general form of such a quantifier, whose range consists of at most

being in the scope of $\Diamond$, but having $\Box$ in its scope. But we can cope with this reading holding on to the referential analysis of definite descriptions sketched above if we take the description to contain a variable (*the number of planets existing in w*) apt to be bound by a quantifier on possible situations. Then the natural reading of (ia) can be analysed as indicated by the following paraphrase: "There is a possible situation w such that it is necessarily the case that the number of planets existing in w is even" (cf. Heim 1991: 504).

[19] Whereas **Novel** is a predicate true of individual novels only, ***Novel** is true of pluralities of novels (cf. the star notation in Link 1983):

(i) $\mathbf{*Novel}(x) =_{df} \mathbf{Novel}(x) \vee \exists y \exists z(x = y \oplus z \wedge \mathbf{*Novel}(y) \wedge \mathbf{*Novel}(z))$

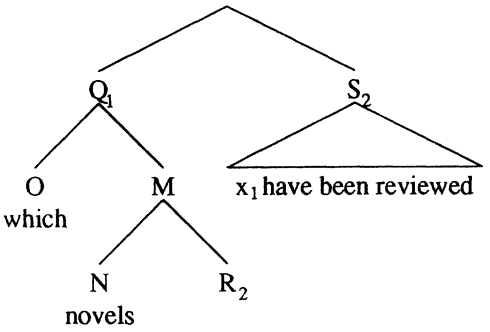
one plurality – an individual being the smallest possible plurality – is as follows:

(41) $\exists^{max}x[\phi x \wedge \delta x](\psi x)$

Maximality is not an essential property of the meaning of *wh*-phrases – we will come back to that in section 8, when we look at non-exhaustive readings of *wh*-interrogatives. Factivity, however, could be an essential property of the meaning of *wh*-phrases. Factivity means that in *Which* ϕ *are* Δ the *wh*-phrase only quantifies on ϕ which are Δ. How can we account for this dependence of the *wh*-phrase's meaning on the meaning of the sentence it is part of? I will stipulate that, at the level where scope relations are represented, a *wh*-phrase contains an anaphoric element with the same content as the scope of the *wh*-phrase. See (42b) for illustration: the anaphoric element R and the scope of the *wh*-phrase, S, are coindexed.

(42)a. which novels have been reviewed

b.



The semantic composition of the interrogative quantifier can be illustrated with the help of a λ-categorial language as follows:

(43) 1. N ≫ ***Novel**
2. R_2 ≫ **HR**(z) [=**Have-been-reviewed**(z)]
3. λ-abstraction ⇒ λz[**HR**(z)]
4. M ≫ λy[***Novel**(y) ∧ λz[**HR**(z)](y)]
5. λ-conversion ⇒ λy[***Novel**(y) ∧ **HR**(y)]
6. O ≫ λPλQ[$\exists^{max}$x[Px](Qx)]
7. Q_1 ≫ λPλQ[$\exists^{max}$x[Px](Qx)](λy[***Novel**(y) ∧ **HR**(y)])
8. 2x λ-conversion ⇒ λQ[$\exists^{max}$x[***Novel**(x) ∧ **HR**(x)](Qx)]

(The composition of *novels* and R_2 – step 1 up to 5 – is analogous to the composition of a noun and a restrictive relative clause.)

This view of *wh*-phrases is obviously not as simple as the standard view which regards them as identical in meaning to the corresponding indefinite

noun phrases.[20] The overall benefits of the theory will help decide whether the more complicated view should be accepted.

The last step of the analysis is the construction of the description representing the entire interrogative clause. I will not assume that any overt or covert (s-)syntactic part of the interrogative corresponds to the description operator. Instead, I will assume that the structure where scope relations are represented and the anaphor included in the *wh*-phrase is resolved, i.e., (44), is enriched by an element C whose meaning might be represented by $\lambda Q[\mu p[Qp]]$ and an element F whose meaning might be represented by $\lambda T[\langle T\rangle \leqslant q]$ (see (45)). The structure (45) is interpreted as indicated in (46).

(44) $[Q_1[Q_2 \ldots [Q_n[S_{x_1,x_2,\ldots,x_n}]]]]$

(45) $[C[Q_1[Q_2 \ldots [Q_n[S_{x_1,x_2,\ldots,x_n} - F]]]]]$

(46) $\mu p[\mathbf{Q_1}[\mathbf{Q_2} \ldots [\mathbf{Q_n}[\langle \mathbf{S}\rangle \leqslant p]]]]$

Formally, the transformation from (44) to (45) can be considered as one possible outcome of two operations:

(47) a. Chomsky-adjoin some element of {E, F} to some node N dominating S, provided that neither N immediately dominates a [+wh]-Q nor any node dominated by N and dominating S.[21]

b. Create a new projection whose head is some element of {A, B, C, D} having the whole structure to be the outcome of (a) as complement.

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[20] Often the standard view relies on a morphosyntactic analysis of *wh*-phrases as consisting of a *wh*-element and an indefinite similar to the one in (i) proposed by Katz and Postal (1964: 34f., 92).

(i) wh + *some* + *one* → *who*
wh + *some* + *thing* → *what*

I don't think that there is much in favour of such an analysis. As for the following languages, there are indefinite pronouns with the structure "interrogative pronoun + X" or "X + interrogative pronoun" (with X = nil as a subcase), but, as far as I know, there are no interrogative pronouns with the overt structure "X + indefinite pronoun" or "indefinite pronoun + X".

(ii) a. *somewhere* = *some* + *where*
b. *irgendwann* = *irgend* + *wann* (German, 'sometime or other', *wann* = *when*)
c. *nanika* = *nani* + *ka* (Japanese, 'something', *nani* = *what*)
d. *coś* = *co* + *ś* (Polish, 'something', *co* = *what*)
e. *sheme* + nil (Mandarin, Chinese, 'something', *sheme* = *what*)

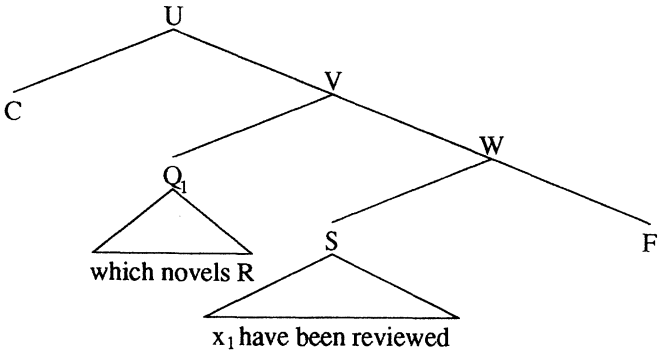
Not to mention languages with no morphosyntactic relations between indefinite and interrogative pronouns.

[21] I am indebted to a referee for the observation that a former version of this operation was too restrictive.

Note that the adjunction operation in (a) allows for distinct adjunction sites in certain cases. The elements in (47a, b) besides C and F will be motivated in the course of our investigation. Only near the end (section 9) will we see that the 'triggering' of the operations and the choice of the suitable elements can be accounted for in a systematic fashion.

Now we can combine all elements of the analysis. In the case of (42) *Which novels have been reviewed*, there is just one quantifier Q, which happens to be [+wh]. Thus, (42b) – where the anaphor included in the *wh*-phrase is resolved – is to be transformed to (48), which gets the interpretation indicated by the outcome of step 12 in (49): the smallest plurality p such that there is an x, x being maximal with respect to the property of being novels which have been reviewed, such that the proposition "x have been reviewed" is part of p; or shorter: the smallest plurality that contains the proposition "x have been reviewed", x being the reviewed novels.

(48)



(49)

1. $S \gg \mathbf{HR}(y)$ [=**Have-been-reviewed**(y)]
2. $F \gg \lambda T[\langle T\rangle \leq q]$
3. $W \gg \lambda T[\langle T\rangle \leq q]\ (\mathbf{HR}(y))$
4. λ-conversion $\Rightarrow \langle \mathbf{HR}(y)\rangle \leq q$
5. λ-abstraction $\Rightarrow \lambda y[\langle HR(y)\rangle \leq q]$
6. $Q_1 \gg \lambda R[\exists^{max}x[\mathbf{*Novel}(x) \wedge \mathbf{HR}(x)](Rx)]$ [cf. 43]
7. $V \gg \lambda R[\exists^{max}x[\mathbf{*Novel}(x) \wedge \mathbf{HR}(x)](Rx)]$
   $(\lambda y[\langle HR(y)\rangle \leq q])$
8. 2x λ-conversion $\Rightarrow$
   $\exists^{max}x[\mathbf{*Novel}(x) \wedge \mathbf{HR}(x)](\langle \mathbf{HR}(x)\rangle \leq q)$
9. λ-abstraction $\Rightarrow \lambda q[\exists^{max}x[\mathbf{*Novel}(x) \wedge \mathbf{HR}(x)]$
   $(\langle \mathbf{HR}(x)\rangle \leq q)]$
10. $C \gg \lambda Q[\mu p[Qp]]$

11. $U \gg \lambda Q[\mu p[Qp]](\lambda q[\exists^{max} x[*\mathbf{Novel}(x) \wedge \mathbf{HR}(x)] (\langle \mathbf{HR}(x) \rangle \leq q)])$
12. 2x λ-conversion $\Rightarrow \mu p[\exists^{max} x[*\mathbf{Novel}(x) \wedge \mathbf{HR}(x)] (\langle \mathbf{HR}(x) \rangle \leq p)]$

In order to get a distributive interpretation, we add a "distributor" at the level where scope relations are represented. The distributor is an element which can optionally be inserted unless the operations in (47) applied. Only for the sake of the formulas' transparency will we simplify the distributor giving it the form (EACH OF $x_j)_k$ and a meaning represented as $\forall x'[x'^* \leq x]$ with x corresponding to x_j and $*\leq$ meaning 'atomic part.' Not wanting to be committed to atomism the distributor should, more adequately, have the form (EACH P_i OF $x_j)_k$ and a meaning represented as $\forall x'[\mathbf{At(om)}(x', x, \phi)]$ with x corresponding to x_j and ϕ to P_i. The three-place atom relation expresses 'relative atomicity,' i.e., atomicity relative to the property ϕ.[22] Using the simplified distributor the sentence *Which novels have been reviewed* could, for example, denote the plurality of propositions in (50c).

(50)a. (which novels $R)_3$ (EACH OF $x_3)_1$ [x_1 have been reviewed]
b. $\mu p[\exists^{max} x[*\mathbf{Novel}(x) \wedge \forall x'[x'^* \leq x]\ \mathbf{Has\text{-}been\text{-}reviewed}\ (x')]$
$\forall x'[x'^* \leq x]$
$\langle \mathbf{Has\text{-}been\text{-}reviewed}(x') \rangle \leq p]$
c. $\langle \mathbf{Has\text{-}been\text{-}reviewed(kundera's\text{-}latest\text{-}novel)} \rangle \oplus$
$\langle \mathbf{Has\text{-}been\text{-}reviewed(márquez's\text{-}latest\text{-}novel)} \rangle \oplus$
$\langle \mathbf{Has\text{-}been\text{-}reviewed(rushdie's\text{-}latest\text{-}novel)} \rangle \oplus$
$\langle \mathbf{Has\text{-}been\text{-}reviewed(updike's\text{-}latest\text{-}novel)} \rangle$

Representations like the one in (50a) are considered to be unambiguous representations of the scope relations: a quantifier has scope over all the elements to its right or – if we conceive these representations as shorthand for a branching structure – all the elements it c-commands. Note that the scope of the *wh*-phrase includes the distributor, having consequences for the resolving of R (compare the *wh*-phrase's interpretation in (49) with the one in (50)). Transforming (50a) along the two operations in (47) we can get the following structure, the semantic composition of the relevant part of which illustrated in (52).

(51) $[_U$ C $(_V$ $[_{Q_3}$ which novels R] $(_{W'}$ $[_{Q_1}$ EACH OF $x_3]$
$(_W$ $[_S$ x_1 have been reviewed] F)))]

(52) 1. $W \gg \lambda T[\langle T \rangle \leq q](\mathbf{HR}(y))$

[22] $\mathbf{At}(x, y, \phi) =_{df} \phi x \wedge x \leq y \wedge \neg\exists z(\phi z \wedge z \leq x \wedge z \neq x)$.

2. λ-conversion $\Rightarrow \langle \mathbf{HR}(y)\rangle \leqslant q$
3. λ-abstraction $\Rightarrow \lambda y[\langle \mathbf{HR}(y)\rangle \leqslant q]$
4. $Q_1 \Rightarrow \lambda Q[\forall x'[x' *\leqslant x](Qx')]$
5. $W' \Rightarrow \lambda Q[\forall x'[x' *\leqslant x](Qx')](\lambda y[\langle \mathbf{HR}(y)\rangle \leqslant q])$
6. 2x λ-conversion $\Rightarrow \forall x'[x' *\leqslant x](\langle \mathbf{HR}(x')\rangle \leqslant q)$
7. λ-abstraction $\Rightarrow \lambda x[\forall x'[x' *\leqslant x](\langle \mathbf{HR}(x')\rangle \leqslant q)]$

With respect to (50b) it becomes obvious for the first time why we need the μ-operator. If we replaced it by the ι-operator (defined as above) with or without additionally replacing $\leqslant$ by $=$ in the third line of (50b), the description would become unsuitable: with the additional replacement, no entity would satisfy the description as no entity can be identical to each individual proposition in (50c); without the additional replacement, the description would only be satisfied by the plurality which has – along with everything else! – the propositions in (c) as parts.

To repeat, the characteristic feature of this analysis of *wh*-phrases is the location of maximality and factivity as part of the interrogative quantifier's meaning. Compare the Karttunen-analysis of *Which novels have been reviewed* in (53): maximality (built into λp) and factivity ($\check{}$p) are introduced in the derivation of the so-called proto-question *?it has been reviewed* (see (53a) for its meaning), the *wh*-phrase having the same meaning as the indefinite *some novel* (see (53b)) and being quantified into the proto-question yielding (53c) as the interpretation of the *wh*-clause.

(53) a. $\lambda p[\check{}p \wedge p = \hat{}\mathbf{Has\text{-}been\text{-}reviewed}(x)]$
b. $\lambda Q[\exists x(\mathbf{Novel}(x) \wedge Qx)]$
c. $\lambda p[\exists x(\mathbf{Novel}(x) \wedge \check{}p \wedge p = \hat{}\mathbf{Has\text{-}been\text{-}reviewed}(x))]$

There is a further difference. The singular/plural-distinction played no role in the *wh*-phrases' semantic representation in Karttunen's system, but it does in our framework. The sentence (54a), for example, denotes a proposition only if there is exactly one novel that has been reviewed.[23]

[23] Schwarz (1993) observes that certain *wh*-clause embedding verbs require a plural *wh*-phrase in (non-multiple) *wh*-clauses:

(i) Sie ratterte runter, welche Lieder sie kennt.
She listed which songs she knows.
(ii) *Sie ratterte runter, welches Lied sie kennt.
She listed which song she knows.

He argues that this shows that the number of the *wh*-phrase is relevant for the meaning of the whole *wh*-clause.

(54)a. which novel has been reviewed
b. $\mu p[\exists^{max} x[\mathbf{Novel}(x) \wedge \mathbf{Has\text{-}been\text{-}reviewed}(x)]$
$\langle \mathbf{Has\text{-}been\text{-}reviewed}(x) \rangle \leqslant p]$

With a little help from a referee I detected that Dayal (1991) modified Karttunen (1977) in such a way that the singular/plural distinction and the uniqueness related to singular *which*-phrases shows up in the semantic representation. (54a) gets the following semantic representation:

(54)c. $\lambda p[\exists x\ (x = \iota y[\mathbf{Novel}(y) \wedge \mathbf{Has\text{-}been\text{-}reviewed}(y)] \wedge \check{}p \wedge$
$p = \hat{}\mathbf{Has\text{-}been\text{-}reviewed}(x))]$

The representation of *Which novels have been reviewed* is identical to (54c) apart from **Novel** being substituted by ***Novel**. The way uniqueness is represented in (54c) has much in common with the way we account for maximality and factivity. It differs from our account in that the predicate '$x = \iota y[\mathbf{Novel}(y) \wedge \mathbf{Has\text{-}been\text{-}reviewed}(y)]$' is NOT part of the semantic representation of the *wh*-phrase, but is introduced via the question operator (QUE*, see Dayal 1991: 251).

5. The Distributive or List Reading of *wh*-Clauses

Now we are ready to provide for an analysis of the distributive or list reading of the *wh*-clause in a sentence like (55a). This time, we have two quantifiers with the *each*-quantifier outscoping the *wh*-quantifier. Thus, in (55c) the universal quantifier outscopes the existential quantifier. The description means: the smallest p such that for each x, x being one of the four critics, there is a y, y being the novel which x reviewed, such that the proposition "x reviews y" is part of p. Or, perhaps more comprehensively: the smallest plurality that, relative to each x, contains a proposition "x reviews y", x being one of the four critics and y being the novel x reviews. In a situation where critic **a** reviews Kundera's latest novel, critic **b** reviews Márquez's latest novel, and so on, the description denotes the plurality of propositions in (e).

(55)a. We know which novel each of the four critics reviews.
b. (each of the four critics)$_1$ (which novel R)$_2$ [x_1 reviews x_2]
c. $\mu p[\forall x[x *\leqslant \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}]$
$\exists^{max} y[\mathbf{Novel}(y) \wedge \mathbf{Review}(x, y)]$
$\langle \mathbf{Review}(x, y) \rangle \leqslant p]$

d. $\mu p[\langle \mathbf{Review(a, kundera's\text{-}latest\text{-}novel)}\rangle \leqslant p \wedge$
$\langle \mathbf{Review(b, márquez's\text{-}latest\text{-}novel)}\rangle \leqslant p \wedge$
$\langle \mathbf{Review(c, rushdie's\text{-}latest\text{-}novel)}\rangle \leqslant p \wedge$
$\langle \mathbf{Review(d, updike's\text{-}latest\text{-}novel)}\rangle \leqslant p]$

e. $= \mathbf{p_1} \oplus \mathbf{p_2} \oplus \mathbf{p_3} \oplus \mathbf{p_4}$ (cf. (39b))

Step-by-step the description (55c) can be constructed as follows:

(56) $[_U$ C $(_v$ $[_{Q_1}$ each of the four critics] $(_{w'}$ $[_{Q_2}$ which novel R] $(_w$ $[_S$ x_1 reviews $x_2]$ F)))]

(57)
1. S $\gg$ $\mathbf{R}(u, v)$ [= **Review**(u, v)]
2. F $\gg$ $\lambda T[\langle T\rangle \leqslant q]$
3. W $\gg$ $\lambda T[\langle T\rangle \leqslant q](\mathbf{R}(u, v))$
4. λ-conversion $\Rightarrow$ $\langle \mathbf{R}(u, v)\rangle \leqslant q$
5. λ-abstraction $\Rightarrow$ $\lambda v[\langle \mathbf{R}(u, v)\rangle \leqslant q]$
6. $Q_2 \gg \lambda R[\exists^{max} y[\mathbf{Novel}(y) \wedge \mathbf{R}(u, y)](Ry)]$
7. $W' \gg \lambda R[\exists^{max} y[\mathbf{Novel}(y) \wedge \mathbf{R}(u, y)](Ry)](\lambda v[\langle \mathbf{R}(u, v)\rangle \leqslant q])$
8. 2x λ-conversion $\Rightarrow$ $\exists^{max} y[\mathbf{Novel}(y) \wedge \mathbf{R}(u, y)]$
$(\langle \mathbf{R}(u, y)\rangle \leqslant q)$
9. λ-abstraction $\Rightarrow$ $\lambda u[\exists^{max} y[\mathbf{Novel}(y) \wedge \mathbf{R}(u, y)]$
$(\langle \mathbf{R}(u, y)\rangle \leqslant q)]$
10. $Q_1 \gg \lambda P[\forall x[x *\leqslant \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}](Px)]$
11. $V \gg \lambda P[\forall x[x *\leqslant \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}](Px)]$
$(\lambda u[\exists^{max} y[\mathbf{Novel}(y) \wedge \mathbf{R}(u, y)](\langle \mathbf{R}(u, y)\rangle \leqslant q)])$
12. 2x λ-conversion $\Rightarrow$ $\forall x[x *\leqslant \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}]$
$\exists^{max} y[\mathbf{Novel}(y) \wedge \mathbf{R}(x, y)](\mathbf{R}(x, y)\rangle \leqslant q)$
13. λ-abstraction $\Rightarrow$ $\lambda q[\forall x[x *\leqslant \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}]$
$\exists^{max} y[\mathbf{Novel}(y) \wedge \mathbf{R}(x, y)](\langle \mathbf{R}(x, y)\rangle \leqslant q)]$
14. C $\gg$ $\lambda Q[\mu p[Qp]]$
15. U $\gg$ $\lambda Q[\mu p[Qp]]$ (– see step 13 –)
16. 2x λ-conversion $\Rightarrow$ $\mu p[\forall x[x *\leqslant \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}]$
$\exists^{max} y[\mathbf{Novel}(y) \wedge \mathbf{R}(x, y)]\langle \mathbf{R}(x, y)\rangle \leqslant p]$

With the semantics sketched, the distributive or list reading is represented unequivocally as a reading in which the interrogative quantifier is outscoped by a non-interrogative quantifier. It is really quantifier scope which is at stake: the opposite scope relation cannot yield a list reading (see below (58)) and the non-interrogative quantifier, since it has wide scope, retains the meaning it has when it is in the scope of an interrogative quantifier. We thus satisfy requirement (R1). As we will see in section 11, treating *wh*/*Q*-interaction semantically as a true instance of a quantifier scope interaction distinguishes the proposed analysis sharply from analyses

like Karttunen/Peters (1980), Higginbotham/May (1981), Belnap (1982), Groenendijk/Stokhof (1984), and Higginbotham (1991, 1996). The proposed analysis is not a variant of the quantifying into questions approach, since the universal quantifier is not quantified into a 'question'. We didn't even make use of any semantic entity which one could call a question (a plurality of propositions is not a candidate for a question since an individual is the limiting case of a plurality). Nor did we use the concept of an answer to a question in our analysis. More on that in section 11 below.

Sentence (58a) is true in its non-distributive reading if, for example, we know that every critic reviews Updike's latest novel. See (59) and (60) for the details.

(58)a. We know which novel everyone of the four critics reviews.

b. (which novel R)$_2$ (everyone of the four critics)$_1$ [x_1 reviews x_2]

c. $\mu p[\exists^{max} y[\mathbf{Novel}(y) \wedge \forall x[x *\leq \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}]\ \mathbf{Review}(x, y)]$
$\langle \forall x[x *\leq \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}]\ \mathbf{Review}(x, y)\rangle \leq p]$

(59) $[_U$ C $(_v$ $[_{Q_2}$ which novel R] $(_{W'}$ $(_W$ $[_{Q_1}$ everyone of the four c.] $[_S$ x_1 reviews x_2]) F))]

(60)
1. S $\gg$ $\mathbf{R}(u, v)$ [= $\mathbf{Review}(u, v)$]
2. λ-abstraction $\Rightarrow$ $\lambda u[\mathbf{R}(u, v)]$
3. $Q_1 \gg \lambda P[\forall x[x *\leq \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}]Px]$
4. $W \gg \lambda P[\forall x[x *\leq \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}]Px](\lambda u[\mathbf{R}(u, v)])$
5. 2x λ-conversion $\Rightarrow$ $\forall x[x *\leq \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}]\mathbf{R}(x, v)$
6. $F \gg \lambda T[\langle T\rangle \leq q]$
7. $W' \gg \lambda T[\langle T\rangle \leq q](\forall x[x *\leq \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}]\mathbf{R}(x, v))$
8. λ-conversion $\Rightarrow$ $\langle \forall x[x *\leq \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}]\mathbf{R}(x, v)\rangle \leq q$
9. λ-abstraction $\Rightarrow$ $\lambda v[\langle \forall x[x *\leq \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}]\mathbf{R}(x, v)\rangle \leq q]$
10. $Q_2 \gg \lambda R[\exists^{max} y[\mathbf{Novel}(y) \wedge \forall x[x *\leq \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}]$
$\mathbf{R}(x, y)]Ry]$[24]
11. $V \gg \lambda R[\exists^{max} y[\mathbf{Novel}(y) \wedge \forall x[x *\leq \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}]$
$\mathbf{R}(x, y)]Ry](\lambda v[\langle \forall x[x *\leq \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}](\mathbf{R}(x, v))\rangle \leq q])$
12. 2x λ-conversion $\Rightarrow$ $\exists^{max} y[\mathbf{Novel}(y) \wedge \forall x[x *\leq \mathbf{a} \oplus \mathbf{b} \oplus$
$\mathbf{c} \oplus \mathbf{d}]\mathbf{R}(x, y)]\ \langle \forall x[x *\leq \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}](\mathbf{R}(x, y))\rangle \leq q$
13. λ-abstraction $\Rightarrow$ $\lambda q[\exists^{max} y[\mathbf{Novel}(y) \wedge \forall x[x *\leq \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus$
$\mathbf{d}]\mathbf{R}(x, y)]\langle \forall x[x *\leq \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}](\mathbf{R}(x, y))\rangle \leq q]$
14. $C \gg \lambda Q[\mu p[Qp]]$
15. $U \gg \lambda Q[\mu p[Qp]]$ (– see step 13 –)

[24] R in (58b) gets the same interpretation as [(everyone of the four critics)$_1$ [x_1 reviews x_2]].

16. 2x λ-conversion ⇒
$\mu p[\exists^{max} y[\mathbf{Novel}(y) \wedge \forall x[x *\leq \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}]\mathbf{R}(x, y)]$
$\langle \forall x[x *\leq \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}](\mathbf{R}(x, y))\rangle \leq p]$

In (59) we have chosen to transform the structure (58b) in such a way that F is an adjunct to the node W that immediately dominates the maximal projection *everyone of the four critics*. Thus, the described proposition is an individual general proposition (e.g., "every critic reviews Updike's novel"), not a plurality of (four) singular propositions (e.g., "**a** reviews Updike's novel" ⊕ "**b** reviews Updike's novel" ⊕ "**c** reviews Updike's novel" ⊕ "**d** reviews Updike's novel"). We would have got this last plurality if F were an adjunct to S.

Now, this kind of semantics does not generally supply a successful interpretation of distributive readings of sentences with non-universal quantifiers, i.e., does not yet completely satisfy requirement (R1). In a situation where all of our four critics review a novel, (61c) doesn't denote anything. This description means: the smallest plurality that, relative to most x, contains a proposition "x reviews y", x being one of the four critics and y being the novel x reviews.[25] There is no smallest plurality with such a property in a situation where $\mathbf{p}_1$ up to $\mathbf{p}_4$ are true propositions. Each of the five pluralities of propositions in (61d) contains enough propositions such that for most critics there is a suitable proposition. But none of the five pluralities in (61d) can claim to be the smallest plurality. Technically speaking, the reason is that there is more than one minimal witness set of a *most*-quantifier – a universal quantifier, however, has one and only one witness set.

(61) a. We know which novel most of the critics review.
b. (most of the critics)$_3$ (EACH OF x_3)$_1$ (which novel R)$_2$
[x_1 review x_2]
c. $\mu p[\exists x[\mathbf{Most}_v(x, \langle v *\leq \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}\rangle)]$
$\forall x'[x' *\leq x]$
$\exists^{max} y[\mathbf{Novel}(y) \wedge \mathbf{Review}(x', y)]$
$\langle \mathbf{Review}(x', y)\rangle \leq p]$

[25] *f* being the function that assigns to each plurality relative to a concept or open proposition ϕv the number of its individuals, $\mathbf{Most}_v(x, \langle \phi v\rangle)$ might be true iff $f_v(x, \langle \phi v\rangle) > 1/2$ $f_v(\iota[\phi y], \langle \phi v\rangle)$. For the relativity of number to concepts see Frege (1884). If one does not want to be committed to atomism, the question "How many parts does this entity have?" does not make sense, unless it is determined what kind the parts are supposed to be. Thus, in (61c), $\mathbf{Most}_v(x, \langle v *\leq \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}\rangle)$ should be replaced by $\mathbf{Most}_v(x, \langle v \leq \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d} \wedge$ ***Critic**$(x)\rangle)$, since we want to avoid atomism.

d. $\mu p[\mathbf{p}_1 \oplus \mathbf{p}_2 \oplus \mathbf{p}_3 \leqslant p \vee \mathbf{p}_2 \oplus \mathbf{p}_3 \oplus \mathbf{p}_4 \leqslant p \vee \mathbf{p}_1 \oplus \mathbf{p}_3 \oplus \mathbf{p}_4 \leqslant p \vee \mathbf{p}_1 \oplus \mathbf{p}_2 \oplus \mathbf{p}_4 \leqslant p \vee \mathbf{p}_1 \oplus \mathbf{p}_2 \oplus \mathbf{p}_3 \oplus \mathbf{p}_4 \leqslant p]$

This might be a satisfying result if *wh*-phrases, in general, could not be outscoped by non-universal quantifiers. But we have argued in section 2 that there are cases to the contrary (see (19), (23), (26)). We will take up the problem of the wide scope of non-universal quantifiers in section 8.

The non-distributive reading of *wh*-clauses with *most*-quantifiers is quite unproblematic, see (62) for an example (note that in (62c) the F-element is adjoined to a node that dominates the maximal projection *most of the four critics*).

(62) a. We know which novel most of the four critics review.
b. (which novel $R)_2$ (most of the four critics)$_1$ [x_1 review x_2]
c. [C which novel $R]_2$ [([most of the four critics]$_1$ [x_1 review x_2]) F])]
d. $\mu p[\exists^{max} y[\mathbf{Novel}(y) \wedge \exists x[\mathbf{Most}_v(x, \langle v *\leqslant \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}\rangle)] \mathbf{Review}(x, y)] \langle \exists x[\mathbf{Most}_v(x, \langle v *\leqslant \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}\rangle)] \mathbf{Review}(x, y)\rangle \leqslant p]$

6. Multiple *wh*-Interrogatives

The analysis of multiple *wh*-interrogatives is rather straightforward. In (63), let *who* be interpreted as d-linked to our four critics. If the underlying situation is as indicated in (36b), i.e., **a** reviews Kundera's latest novel, **b** reviews Márquez's latest novel, and so on, then the *wh*-clause in (63a) denotes the same plurality as the distributively read *wh*-clause *Which novel each of the four critics reviews* in (55a). But, to get this result, it is necessary to introduce a distributor that distributes over the value of the variable introduced by the interrogative quantifier (*who* R).[26]

(63) a. We know who reviews which novel.
b. (who $R)_3$ (EACH OF $x_3)_1$ (which novel $R')_2$ [x_1 reviews x_2]
c. $\mu p[\exists^{max} x[x \leqslant \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d} \wedge \phi x] \forall x'[x' *\leqslant x] \exists^{max} y[\mathbf{Novel}(y) \wedge \psi y] \langle \mathbf{Review}(x', y)\rangle \leqslant p]$

[26] For reasons of transparency, we have left the 'factivity'-predicates ϕ and ψ uninstantiated in (63c). See (d) for the instantiations.

d. $\mu p[\exists^{max}x[x \leqslant \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d} \wedge \forall x'[x' *\leqslant x]$
$\exists^{max}y[\mathbf{Novel}(y) \wedge \mathbf{Review}(x', y)]\mathbf{Review}(x', y)]$
$\forall x'[x' *\leqslant x]\exists^{max}y[\mathbf{Novel}(y) \wedge \mathbf{Review}(x', y)]$
$\langle \mathbf{Review}(x', y)\rangle \leqslant p]$

e. $\mu p[\langle \mathbf{Review(a,kundera's\text{-}latest\text{-}novel)}\rangle \leqslant p \wedge$
$\langle \mathbf{Review(b,márquez's\text{-}latest\text{-}novel)}\rangle \leqslant p \wedge$
$\langle \mathbf{Review(c,rushdie's\text{-}latest\text{-}novel)}\rangle \leqslant p \wedge$
$\langle \mathbf{Review(d,updike's\text{-}latest\text{-}novel)}\rangle \leqslant p]$

f. $= \mathbf{p}_1 \oplus \mathbf{p}_2 \oplus \mathbf{p}_3 \oplus \mathbf{p}_4$

Curiously, if *who* in (63a) is replaced by *which critic* the semantic interpretation of the subject *wh*-phrase must remain the same in order for the *wh*-clause to have the same interpretation. That is, we have to interpret the SINGULAR *which*-phrase as a quantifier on pluralities, we cannot interpret it as $\exists^{max}x[x *\leqslant \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d} \wedge \phi x]\psi x$. Strange as this consequence might seem, it appears to be a general feature of the widest scope *wh*-phrase in multiple *wh*-interrogatives to have a reading as an existential quantifier on pluralities followed up by a distributor ($\exists^{max}x[\phi x]\forall x'[x' *\leqslant x]$). For the evaluation of the following sentences the situation will be as follows: critic **a** reviews the novels **k**, **m**, **r** and **u**, critic **b** reviews novel **m**, critic **c** novel **r**, and critic **d** novel **u**. Intuitively, sentence (64a) is true if we know with respect to at least three critics which novels they review. But the sentence is not true if we only know that **a** reviews the novel **k**, **m**, **r**, and **u**. That means that if we analyse (64a) as hinted at in (64b), the *wh*-clause must denote the plurality in (c), but not the one in (d).

(64)a. Zum größten Teil wissen wir, welche Kritiker welche Romane rezensieren.
For the most part, we know which critics review which novels.

b. We know most of $[\![$*welche Kritiker welche Romane rezensieren*$]\!]$

c. $\langle \mathbf{R(a, k \oplus m \oplus r \oplus u)}\rangle \oplus \langle \mathbf{R(b, m)}\rangle \oplus \langle \mathbf{R(c, r)}\rangle \oplus \langle \mathbf{R(d, u)}\rangle$

d. $\langle \mathbf{R(a, k)}\rangle \oplus \langle \mathbf{R(a, m)}\rangle \oplus \langle \mathbf{R(a, r)}\rangle \oplus \langle \mathbf{R(a, u)}\rangle \oplus \langle \mathbf{R(b, m)}\rangle \oplus$
$\langle \mathbf{R(c, r)}\rangle \oplus \langle \mathbf{R(d, u)}\rangle$

Thus, there is a distributive interpretation of the subject *wh*-phrase, but not of the object *wh*-phrase. The opposite is true in (65). This sentence is true only if we know with respect to three novels which critics review them. But it is not true if we only know that novel **m** is reviewed by **a** and **b**, and novel **r** by **a** and **c** (which amounts to a majority of propositions in (d), but not in (c)). Thus, (65a)'s *wh*-clause denotes the plurality in (c).

(65)a. Zum größten Teil wissen wir, welche Romane welche Kritiker rezensieren.
For the most part, we know which critics review which novels.
b. We know most of ⟦*welche Romane welche Kritiker rezensieren*⟧
c. $\langle \mathbf{R(a, k)} \rangle \oplus \langle \mathbf{R(a \oplus b, m)} \rangle \oplus \langle \mathbf{R(a \oplus c, r)} \rangle \oplus \langle \mathbf{R(a \oplus d, u)} \rangle$
d. $\langle \mathbf{R(a, k)} \rangle \oplus \langle \mathbf{R(a, m)} \rangle \oplus \langle \mathbf{R(a, r)} \rangle \oplus \langle \mathbf{R(a, u)} \rangle \oplus \langle \mathbf{R(b, m)} \rangle \oplus \langle \mathbf{R(c, r)} \rangle \oplus \langle \mathbf{R(d, u)} \rangle$

If the widest scope *wh*-phrase in multiple *wh*-interrogatives is – at logical form – generally represented as a quantifier on pluralities followed up by a distributor, it becomes less mysterious that a singular widest scope *wh*-phrase is represented in such a way too. But it remains to be shown what syntactic property of the singular *wh*-phrase might reasonably induce such a representation that differs from its representation when it is not the widest scope *wh*-phrase in a multiple *wh*-interrogative.[27]

Our analysis predicts that it is not necessarily the case that *Which critic reviews which novel* denotes a plurality of propositions such that the Review-relation is one-to-one. That is, the *wh*-clause can be non-vacuous in case two critics review one and the same novel. But it is vacuous if a critic reviews more than one novel. This treads a middle ground between Higginbotham/May (1981) and Dayal (1991), on the one hand, where the semantics imposes a one-to-one relation, and Engdahl (1986), on the other, where no such restrictions are imposed by the semantics.

Assuming these analyses, the *wh*-clause *Which novel each critic reviews* (with a list reading) and the multiple *wh*-clause *Which critic reviews which novel* can denote the same plurality in some situations. Nevertheless, the clauses are different descriptions. There even are situations where they differ in their denotation. If only three of the four critics review a novel, the multiple *wh*-clause denotes a plurality of three propositions, but the list reading clause does not denote any plurality of propositions.

7. *Yes/no*-Interrogatives and Declaratives

We will interpret *yes/no*-interrogatives as descriptions containing an existential quantifier on the concepts true and false. Deviating from our strategy so far, we will first analyse a proposition, such as the one expressed by the sentence *Mary is coming*, as consisting of the predication of

[27] It has been proposed that the initial *wh*-phrase in multiple interrogatives might have an abstract expletive element adjoined to it which is associated with a *wh*-phrase in situ (see Brody 1995: 31, 50ff., Pafel 1996b: 251f.). If this idea could successfully be elaborated, we would have a syntactic property characteristic of widest scope *wh*-phrases.

the concept true to the proposition "Mary is coming": $\langle\pi(\langle$**Come(mary)**$\rangle$, **true**$)\rangle$, π being the predication relation, **true** denoting the concept of truth. The phenomenon called Verum focus (or polarity focus) seems to be independent evidence for the assumption of a truth-property as part of the proposition: (66b) is an appropriate paraphrase for (66a) (cf. Höhle 1992) – *dass* 'that' (as well as *wann* 'when') is being stressed.

(66)a. Wir wissen, DASS Marie kommt, aber nicht WANN.
We know that Mary will come, but not when.
b. We know that it is true that Mary will come, but we do not know when she will come.

Second, *yes/no*-interrogatives are considered to be descriptions of individual propositions, not of pluralities of propositions. (The maximality's omission in (67b) is not crucial.)

(67)a. We know whether Mary is coming.
b. $\iota p[\exists x[x \leqslant$ **true** $\oplus$ **false** $\wedge\ \pi(\langle$**Come(mary)**$\rangle, x)]$
$\langle\pi(\langle$**Come(mary)**$\rangle, x)\rangle = p]$
[if Mary is coming, (b) denotes:]
c. $\iota p[\langle\pi(\langle$**Come(mary)**$\rangle,$ **true**$)\rangle = p]$
d. $\langle\pi(\langle$**Come(mary)**$\rangle,$ **true**$)\rangle$

(Cf. *Wir wissen, OB Marie kommt* 'We know whether Mary is coming' meaning *We know whether it is true or not that Mary is coming.*) As for (67), it would not make much difference if we held on to the μ-operator. But it does make a huge difference in *yes/no*-interrogatives containing ordinary quantifiers. In section 3, we raised the requirement (R2) that the semantics should abstain from predicting list readings of *yes/no*-interrogatives. We would be making such a prediction if we held on to the μ-operator. (68b), for example, denotes the same as *Which critics come* in a situation where all critics come. But this cannot be an adequate analysis of the *whether*-clause in (68a) since it does not denote a plurality: *For the most part, she knows whether everyone of the four critics comes* does not have the reading "For most p of $[\![$*whether everyone of the four critics comes*$]\!]$ she knows p" (cf. *For the most part, she knows which critics come* that has such a reacting). But, if we do not adhere to μ, the problem vanishes. (68c) and (d) are vacuous descriptions: no entity can, for example, be identical to each of the propositions "critic **a** comes", "critic **b** comes" etc. (presupposing a situation where all the critics come). (68e), finally, delivers the adequate interpretation.

(68)a. She knows whether everyone of the four critics comes.

b. $\mu p[\forall x[x *\leq \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}]$
$\exists y[y \leq \mathbf{true} \oplus \mathbf{false} \wedge \pi(\langle \mathbf{Come}(x)\rangle, y)]$
$\langle \pi(\langle \mathbf{Come}(x)\rangle, y)\rangle \leq p]$

c. $\iota p[\forall x[x *\leq \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}]$
$\exists y[y \leq \mathbf{true} \oplus \mathbf{false} \wedge \pi(\langle \mathbf{Come}(x)\rangle, y)]$
$\langle \pi(\langle \mathbf{Come}(x)\rangle, y)\rangle = p]$

d. $\iota p[\exists y[y \leq \mathbf{true} \oplus \mathbf{false} \wedge \forall x[x *\leq \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}]$
$\pi(\langle \mathbf{Come}(x)\rangle, y)]$
$\forall x[x *\leq \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}]$
$\langle \pi(\langle \mathbf{Come}(x)\rangle, y)\rangle = p]$

e. $\iota p[\exists y[y \leq \mathbf{true} \oplus \mathbf{false} \wedge \forall x[x *\leq \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}]$
$\pi(\langle \mathbf{Come}(x)\rangle, y)]$
$\langle \forall x[x *\leq \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}]\pi(\langle \mathbf{Come}(x)\rangle, y)\rangle = p]$

As for alternative interrogatives, the semantic interpretation is not the problem. It is their syntax and the construction of their logical form that pose questions I won't go into (I am ignoring the truth-element here as in many other cases where it is of no direct concern).[28]

(69)a. Tell me whether Bill wants coffee or tea.

b. $(_{+\mathrm{wh}}$ coffee or tea $\mathrm{R})_1$ [Bill wants x_1]

c. $\iota p[\exists^{\max}[x \leq \mathbf{coffee} \oplus \mathbf{tea} \wedge \mathbf{Wants}(\mathbf{bill}, x)]$
$\langle \mathbf{Wants}(\mathbf{bill}, x)\rangle = p]$

Such an analysis predicts that alternative interrogatives do not have list readings (cf. (R2)).

Embedded declarative clauses, too, denote individual propositions only. If they are definite descriptions, their logical structure – after the operations in (47) – and their meaning might appear as follows:

(70)a. Wir wissen, dass Marie kommt.
We know that Mary is coming.

b. [A [(T [Marie kommt]) E]]
$A \gg \lambda M[\iota p[Mp]] \quad T \gg \lambda N[\pi(\langle N\rangle, \mathbf{true})] \quad E \gg \lambda O[\langle O\rangle = q]$

c. $\iota p[\langle \pi(\langle \mathbf{Come}(\mathbf{mary})\rangle, \mathbf{true})\rangle = p]$

d. $\langle \pi(\langle \mathbf{Come}(\mathbf{mary})\rangle, \mathbf{true})\rangle$

The element T is introduced into the logical form via the syntactic position which *dass* 'that' occupies; one might say that it represents the meaning of this position.

[28] I take $\mathbf{coffee} \oplus \mathbf{tea}$ to denote two kinds of stuff.

More new elements are necessary to build the logical structure of *whether*-clauses. Both elements, $Q^{t,+wh}$ (meaning $\lambda Q[\exists x[x \leqslant \textbf{true} \oplus \textbf{false} \wedge \phi x](Qx)]$) as well as G ($\lambda U[\pi(\langle U\rangle, y)]$), must be 'licensed' by *ob* 'whether'.[29]

(71)a. Wir wissen, ob Marie kommt.
We know whether Mary is coming.
b. $[Q^{t,+wh}$ (G [Marie kommt])]
c. $[_U$ A $(_V$ $Q^{t,+wh}$ $[_{W'}$ $(_W$ G $[_S$ Marie kommt]) E])]
d. $\iota p[\exists x[x \leqslant \textbf{true} \oplus \textbf{false} \wedge \pi(\langle \textbf{Come(mary)}\rangle, x)]$
$\langle \pi(\langle \textbf{Come(mary)}\rangle, x)\rangle = p]$[30]

One might wonder whether a view which groups declaratives, *yes/no*- and alternative interrogatives together loses the relationship of *yes/no*- and alternative interrogatives to *wh*-interrogatives. But this is not the case. It is the occurrence of an interrogative quantifier which is the common semantic trait of interrogatives. More on the classification of clauses according to the type of definite description they represent will be presented in section 9.

With regard to the two inferences in (72) – compare requirement (R4)

[29] One might prefer to identify $Q^{t,+wh}$ and *whether*. But, first, it is difficult to prove independently that *whether* is a quantifier, and, second, as for unembedded *yes/no*-interrogatives, we have to postulate $Q^{t,+wh}$ anyway since no suitable overt element is present. Furthermore, the identification would widen the gap to an account of alternative interrogatives (as (69a), for example).

[30] This description's construction in detail:

1. S $\gg$ **Come(mary)**
2. G $\gg \lambda U[\pi(\langle U\rangle, y)]$
3. W $\gg \lambda U[\pi(\langle U\rangle, y)](\textbf{Come(mary)})$
4. λ-conversion: $\pi(\langle \textbf{Come(mary)}\rangle, y)$
5. E $\gg \lambda T[\langle T\rangle = q]$
6. W′ $\gg \lambda T[\langle T\rangle = q]$ $(\pi(\langle \textbf{Come(mary)}\rangle, y))$
7. λ-conversion: $\langle \pi(\langle \textbf{Come(mary)}\rangle, y)\rangle = q$
8. λ-abstraction: $\lambda y[\langle \pi(\langle \textbf{Come(mary)}\rangle, y)\rangle = q]$
9. $Q^{t+wh} \gg \lambda Q[\exists x[x \leqslant \textbf{true} \oplus \textbf{false} \wedge \pi(\langle \textbf{Come(mary)}\rangle, x)](Qx)]$
10. V $\gg \lambda Q[\exists x[x \leqslant \textbf{true} \oplus \textbf{false} \wedge \pi(\langle \textbf{Come(mary)}\rangle, x)](Qx)]$
$(\lambda y[\langle \pi(\langle \textbf{Come(mary)}\rangle, y)\rangle = q])$
11. 2x λ-conv.: $\exists x[x \leqslant \textbf{true} \oplus \textbf{false} \wedge \pi(\langle \textbf{Come(mary)}\rangle, x)](\langle \pi(\langle \textbf{Come(mary)}\rangle, x)\rangle = q)$
12. λ.abstrac.: $\lambda q[\exists x[x \leqslant \textbf{true} \oplus \textbf{false} \wedge \pi(\langle \textbf{Come(mary)}\rangle, x)](\langle \pi(\langle \textbf{Come(mary)}\rangle, x)\rangle =$
$q)]$
13. A $\gg \lambda M[\iota p[Mp]]$
14. U $\gg \lambda M[\iota p[Mp]]$ (– see step 12 –)
15. 2x λ-conv.: $\iota p[\exists x[x \leqslant \textbf{true} \oplus \textbf{false} \wedge \pi(\langle \textbf{Come(mary)}\rangle, x)](\langle \pi(\langle \textbf{Come(mary)}\rangle, x)\rangle =$
$p])$

– our analysis is very similiar to the one in Groenendijk/Stokhof (1982).[31] The inferences are valid because the *that-* and *whether*-clauses are codenotational in (a) and (b) respectively.[32] Nevertheless, they are distinct definite descriptions, they differ in 'sense'.

(72)a. John knows whether Mary walks. Mary walks. Ergo, John knows that Mary walks.
b. John knows whether Mary walks. Mary doesn't walk. Ergo, John knows that Mary doesn't walk.

The inference in (73), however, – relying on a strong exhaustivity effect – is not made valid by the denotations of the embedded clauses themselves: *who came* denotes a plurality of propositions of the form "x came", but not of the form "x didn't come".

(73) John knows who came. Mary didn't come. Ergo, John knows that Mary didn't come.

But the naturalness of this inference can be explained by relying on an analogy to nominal definite descriptions. The sentence (74) – with the object not used as a concealed question – has an opaque as well as a transparent (*de re*) reading.[33]

(74) John knows the president of the US.
opaque reading:
John knows Clinton and knows that he is the president of the US.
transparent reading:
John knows Clinton.

The opaque reading is the preferred reading, the transparent one is in need of very special circumstances. This is not an accident: the opaque *de re* reading seems to be in general the most prominent reading of definite descriptions in attitude contexts (see Haas-Spohn 1989: 81).

If nominal descriptions have two readings in attitude contexts, sentential ones should too. Thus, *John knows who came* should have two readings:

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[31] And – as a referee informed me – similar to David Lewis' *'Whether'-report* (in: Tom Pauli et al. (eds.), 320311: Philosophical essays dedicated to Lennart Åqvist on his fiftieth birthday. Uppsala 1982: 194–206), which I was unable to acquire.

[32] As for (72b), this is true only if $\langle \pi(\langle \mathbf{Walk(mary)} \rangle, \mathbf{false}) \rangle$ and $\langle \pi(\langle \neg \mathbf{Walk(mary)} \rangle, \mathbf{true}) \rangle$ are the same proposition.

[33] As for attitude sentences, I follow Haas-Spohn (1989: 75) in distinguishing *de re*/*de dicto* from opaque/transparent: the *de re*/*de dicto* distinction refers to an attitude's kind of content, whereas the opaque/transparent distinction refers to the way the attitude's content is presented (is the attitude's subject supposed to agree with this mode of presentation or not?).

(75) John knows who came.
opaque reading:
John knows the true propositions of the form "x came" and knows that they constitute the smallest plurality of true propositions of the form "x came".
transparent reading:
John knows the true propositions of the form "x came".

Now we can come back to (73). This inference is only valid in the opaque reading of the *wh*-clause (given that we add as a background assumption that John knows Mary and that he doesn't mix her up with someone else). Thus, the inference's naturalness can be explained by the prominence of the definite descriptions' opaque *de re* reading.[34]

It is well known that strong exhaustivity effects are problems for Karttunen (1977): the incompatibility of *John knows who came* with *John doesn't know that Mary didn't come* was unaccounted for (cf. Groenendijk/Stokhof 1982, Heim 1994, Higginbotham 1996). Nevertheless, this problem can – as we have just seen – be solved within a Karttunen semantics for interrogatives in a broader sense (for a solution along the lines of Karttunen – different from the one proposed here – see Heim 1994). It also is a well known problem for Karttunen that in a situation where only linguists came *John knows who came* does not automatically entail *John knows which linguists came*. This problem, too, seems to vanish since we analyse interrogatives as sentential definite descriptions capable of an opaque reading. If the interrogatives have an opaque reading *John knows who came* does not entail *John knows which linguists came* even if the ones who came were all linguists given that John might not know this. But there is symmetric entailment if both sentences are read in the transparent way.

Thus, it is possible to account for strong exhaustivity effects within a – broadly conceived – Karttunen semantics, i.e., we do not have to switch to partition semantics for explaining these effects.

8. Interrogatives Denoting Kinds

So far, requirement (R1) of section 3 is not yet fulfilled completely. What is missing is a semantic account for the scope relation 'non-universal quantifier outscoping interrogative quantifier', a scope relation exemplified

[34] The transparent reading of (75) corresponds to the "knowing without knowing that one knows"-situations, which Berman (1991, 1994) has in mind.

by (76) – cf. section 2. The semantic analysis of the distributive reading in section 5 was restricted to universal quantifiers outscoping interrogative ones.

(76) Sie weiß, was die meisten Kritiker für einen Roman rezensiert haben.
She knows what kind of novel most critics reviewed.

In trying to provide for such an account, we will, once more, draw an analogy to the semantics of noun phrases, this time to noun phrases which can be claimed to be kind-referring. With Carlson (1977) bare plurals are the most prominent case in point. As for German, indefinite noun phrases with the (singular) indefinite article *ein-* 'a' – being non-quantificational (cf. footnote 5) – can also be claimed to be kind-referring since they display a behaviour very similar to bare plurals (Pafel 1997).[35] See, for example, the indefinite noun phrase in (77a). Analysing it as a definite description of a kind (see 77b; cf. Carlson 1977: 216 (for bare plurals) and Krifka et al. 1995: 66) the whole sentence's truth-condition amounts to an existential quantification of the form presented in (77c) – **Inst** means instantiation, which relates kinds to their instances or specimens.[36]

(77)a. Eine Gedichtauswahl hat er in den siebziger Jahren veröffentlicht.
He published a selection of poems in the seventies.
b. $\iota k[\forall y(y \textbf{ Inst } k \leftrightarrow \textbf{Selection-of-poems}(y))]$
c. $\exists x[x \textbf{ Inst } \iota k[\forall y(y \textbf{ Inst } k \leftrightarrow \textbf{Selection-of-poems}(y))]]$ **Published(he**, x)

As for the nature of kinds, I will assume – we will shortly see why – that a kind is not identical to (the mereological sum of) its instances and that

[35] We do not take the contrast in (i) as evidence that bare plurals can, but singular indefinite noun phrases cannot refer to kinds (differing from Krifka et al. 1995: 10).

(i)a. Dinosaurs are extinct.
b. *A dinosaur is extinct. (nontaxonomic reading)

Instead, the contrast might be interpreted as a restriction imposed by *extinct* and similar predicates on the form of the noun phrase referring to a 'well-established kind'. Note that some of the sentences which, according to Krifka et al. (1995: 78), contain "kind-referring" bare plurals allow the bare plural's substitution by a singular indefinite noun phrase without any (significant) change of meaning (e.g., *German teenagers watch six hours of TV daily* and *A German teenager watches six hours of TV daily* or *Potatoes contain vitamin C* and *A potato contains vitamin C*).

[36] k and k′ below are variables that range over kinds only. Instantiation corresponds to the realization relation of Krifka et al. (1995: 66).

a kind's identity is not determined by its instances. Instead, a kind's identity is determined by the criterion it imposes on its possible instances. That means, that $\iota k[\forall y(y\ \mathbf{Inst}\ k \leftrightarrow \phi y)]$ and $\iota k[\forall y(y\ \mathbf{Inst}\ k \leftrightarrow \psi y)]$ denote the same kind iff the property ϕ is identical to the property ψ.

The wide scope reading of a non-universal quantifier can be accounted for if *wh*-interrogatives can, under certain circumstances, denote kinds too, namely kinds of pluralities of propositions. If, for example, the embedded clause in (76) describes the kind @ every instance of which is a plurality of at least three propositions of the form "x reviewed y", x being one of our four critics and y being the kind of novel x reviewed, then the whole sentence is true if: $\exists p[p\ \mathbf{Inst}\ @]\mathbf{Know}(\mathbf{she}, p)$. Such a kind-description is proposed to have the form given in (78a): the smallest kind such that for all x, x instantiates the kind iff x is ϕ.

(78) $\sigma k[\forall x(x\ \mathbf{Inst}\ k \leftrightarrow \phi x)]$
= the kind which is 'smallest' with respect to ϕ.

A kind k is 'smallest' with respect to ϕ iff x is an instance of k iff x is ϕ and part of the smallest plurality y which is such that every ϕ has a part of y which is ϕ as a part. The embedded clause in (76), for example, describes the smallest kind @ every instance of which is a plurality of at least three propositions of the form "x reviewed y", x being one of our four critics and y being the kind of novel x reviewed (I assume that *was für*-phrases unequivocally are quantifiers on kinds):

(79)a. (die meisten Kritiker)$_3$ (EACH OF x_3)$_1$ (was für einen Roman R)$_2$ [x_1 haben x_2 rezensiert]

b. $\sigma k[\forall p(p\ \mathbf{Inst}\ k \leftrightarrow \exists x[\mathbf{Most}_v(x, \langle v\ {}^*\leqslant \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}\rangle)]$
$\forall x'[x'\ {}^*\leqslant x]$
$\exists^{max} y[\mathbf{Kind\text{-}of\text{-}novel}(y) \wedge \mathbf{Reviewed}(x', y)]$
$\langle \mathbf{Reviewed}(x', y)\rangle \leqslant p)]$

We can also account for the reading of (80a) where *two unicorns* outscopes the *wh*-phrase, but has only scope over the embedded clause.[37]

(80)a. I wonder where two unicorns live.

b. (two unicorns)$_3$ (EACH OF x_3)$_1$ (where R)$_2$ [x_1 live (at) x_2]

[37] This reading's existence has been attested by Bennett (1979) and Belnap (1982). Compare Groenendijk and Stokhof's (1984) choice readings and Higginbotham's (1991, 1993) examples *Where can I find two screwdrivers* and *What does somebody here think*, which are claimed to have a reading with the ordinary quantifier outscoping the *wh*-phrase.

c. $\sigma k[\forall p(p\ \mathbf{Inst}\ k \leftrightarrow \exists x[\mathbf{Two}_v(x, \langle {}^*\mathbf{Unicorn}(v)\rangle)]$[38]
$\forall x'[x' \ {}^*\leqslant x]$
$\exists^{max} y[{}^*\mathbf{Place}(y) \wedge \mathbf{Live\text{-}at}(x', y)]$
$\langle \mathbf{Live\text{-}at}(x', y)\rangle \leqslant p)]$

But if a negative, i.e., monotone decreasing, quantifier outscopes the *wh*-phrase, a curious description is the result. (81c), for example, describes a kind that has each thing as an instance except the pluralities consisting at least of all the propositions of the form "x reviewed y", x being one of our four critics and y being the kind of novel x reviewed. Assuming that the embedded clause is supposed to denote 'propositional entities' (i.e., propositions or kinds of propositions), the missing restriction to pluralities of propositions might account for the unacceptability of (81a).[39]

(81)a. ??Ich möchte wissen, was nicht jeder Kritiker für einen Roman rezensiert hat.
I would like to know what kind of novel not every critic reviewed.

b. (nicht jeder Kritiker)$_1$ (was für einen Roman R)$_2$ [x_1 hat x_2 rezensiert]

c. $\sigma k[\forall p\ (p\ \mathbf{Inst}\ k \leftrightarrow \neg\forall x[x\ {}^*\leqslant \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}]$
$\exists^{max} y[\mathbf{Kind\text{-}of\text{-}novel}(y) \wedge \mathbf{Reviewed}(x, y)]$
$\langle \mathbf{Reviewed}(x, y)\rangle \leqslant p)]$

Having a semantic account of the scope relation 'non-universal quantifier outscoping interrogative quantifier' the following problem still remains (cf. section 2): why does the *wh*-clause in (82a) have a distributive reading, but the one in (82b) does not?

(82)a. Wir wissen (/überlegen), wieviele Romane die meisten Kritiker rezensieren werden. (ambiguous; cf. 26)
We know (/wonder) how many novels most critics will review.

b. Wir wissen (/überlegen), welchen Roman die meisten Kritiker rezensieren werden. (unambiguous; cf. 14)
We know (/wonder) which novel most critics will review.

I suppose that the reason lies in the relative scope restrictions which allow the *most*-quantifier to outscope the *wh*-phrase in (82a), but not in (82b). That this might be a reasonable explanation is indicated by the contrast in (83), which shows that the relative scope behaviour of *wh*-phrases

[38] $\mathbf{Two}_v(x, \langle \phi v\rangle)$ is true iff $f_v(x, \langle \phi v\rangle) = 2$. Cf. footnote 25.
[39] For a different account of the unacceptability of sentences like (81a) see Beck (1996).

depends on their *wh*-element (*which* vs. *how many*), and that a non-interrogative quantifier can outscope a *how many*-phrase in circumstances where it cannot outscope a *which*-phrase.

(83)a. Welcher Kritiker hat jeden Roman rezensieren müssen? (unambiguous) [=2a]
Which critic had to review every novel?

b. Wieviele Kritiker haben jeden Roman rezensiert? (ambiguous) [=5b]
How many critics reviewed every novel?

I admit that this solution will ultimately have to be tested with respect to the theory of relative scope applied to German (see Pafel 1997: §3.5.3 for an account of German scope relations which predicts the contrasts in (82) and (83)).

That interrogatives can denote kinds is, as we will see immediately, an essential ingredient to the satisfaction of independent requirements for a semantics of interrogatives.

Requirement (R5) asks for an account of the non-exhaustive reading of *wh*-interrogatives. Such an account must, for example, provide for the difference between the sentences in (84): (84a) can be true even if the person knows only one or two places where one can buy good wine; (84b), however, is only true if the person knows all places where one can buy good wine (it is the element *alles* 'all' which forces this exhaustive reading).

(84)a. Sie weiß, wo man in Paris guten Wein kaufen kann.
She knows where one can buy good wine in Paris.

b. Sie weiß, wo man in Paris alles guten Wein kaufen kann.
she knows where one in Paris all good wine buy can.

To cope with this difference it seems necessary to assume a difference in the *wh*-phrases' meaning: *wo alles* expresses maximality, but *wo* need not do this and does not do it in (84a):[40]

[40] $^{\otimes}$**Place**(x) means that x is a true plurality of places, i.e., no individual place:

(i) $^{\otimes}\mathbf{Place}(x) =_{df} {}^{*}\mathbf{Place}(x) \wedge \exists y({}^{*}\mathbf{Place}(y) \wedge y \neq x \wedge y \leq x)$

Following the arguments and analyses of Reis (1992) and Reich (1997), I thus assume that *alles* does not only force a maximality interpretation of the *wh*-phrase, but imposes a non-singularity condition as well. Note the unacceptability of (ii) and the contrast in (iii):

(ii) *Ich weiß, wo man in Paris alles guten Wein kaufen kann.
I know where one in Paris all good wine buy can.
Nämlich nur hier.
Namely only here

(85)a. wo $\gg \exists x[$***Place**$(x) \wedge \delta x]\psi x$
b. wo alles $\gg \exists^{max}x[^{\otimes}$**Place**$(x) \wedge \delta x]\psi x$

Assuming kind-denotation non-exhaustive *wh*-clauses no longer pose a problem. The *wh*-clause in (86a), for example, describes the kind whose instances are propositions of the form "one can buy good wine at x in Paris", x being a plurality of places where one can buy good wine in Paris. Sentence (86a) is true if: $\exists p[p$ **Inst** @**]Know(she**, p) – @ being the kind denoted in (86b).

(86)a. She knows where one can buy good wine in Paris.
b. $\sigma k[\forall p(p$ **Inst** $k \leftrightarrow$
$\exists x[$***Place**$(x) \wedge$ **One-can-buy-good-wine-at-in-Paris**$(x)]$
$\langle$**One-can-buy-good-wine-at-in-Paris**$(x)\rangle \leqslant p)]$

Kind-denotation is also an essential ingredient for the satisfaction of (R3), which asks for an account of the difference between 'extensional' and 'intensional' interrogative embedding predicates (*know* and *wonder* as representatives) with respect to entailments and quantificational variability.

The inference *John knows who walks*; *Mary walks*; *ergo*, *John knows whether Mary walks* is valid, since the *whether*-clause does denote an (im)proper part of the *wh*-clause's denotation (*wh*-clauses embedded under *know* can denote pluralities of propositions). The distinct behaviour of 'intensional' predicates finds an explanation if interrogatives embedded under, e.g., *wonder* obligatorily denote kinds of (pluralities of) propositions. If a kind is not identical to (the mereological sum of) its instances (see above), a kind is not a true plural entity, but an individual. Now we can say that the inference *John wonders who walks*; *Mary walks*; *ergo*, *John wonders whether Mary walks* is not valid, since the *whether*-

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(iii)a. *Welches Buch hat er alles gelesen?
which book has he all read

b. Welche Bücher hat er alles gelesen?
which books has he all read
Which book(/s) has he read? (examples from Reis 1992)

There is evidence that *wo alles*, as assumed in (85b), is one constituent, i.e., one *wh*-phrase, as it can occupy the position in front of the finite verb in V2-clauses, i.e., the Vorfeld: *Wo alles bist du gewesen?* 'Where have you been?'. This is a standard test for constituency in German. Thus, *wo alles* can be considered a discontinuous constituent in (84b). For further arguments see Pafel (1991: 170f.) and Reis (1992).

clause does not denote any proper or improper part of the *wh*-clause's denotation.[41]

The fact that interrogatives embedded under *wonder* obligatorily denote kinds of (pluralities of) propositions explains why *wonder* does not show quantificational variability effects: with our analysis the effect presupposes that *wonder* could have a proposition-denoting clause as object.

(87)a. For the most part, she wonders which novels have been reviewed.

b. For most p of [[which novels have been reviewed]] she wonders p.

There is a further, related difference between these two classes of predicates. Sentences like (86a) with *know* embedding a kind-denoting interrogative amount to an existential quantification on the instances of the described kind (86c), but sentences with *wonder* do not. The reason lies – once more – in the obligatoriness of the kind-denotation of *wonder*'s object. The reason for this obligatoriness must presumably be sought in the lexical semantics of *wonder*.[42]

To this distinction there is an analog in the realm of noun phrases: the distinction between the so-called referentially transparent and the referentially opaque reading of noun phrases (see Zimmermann 1993 for a recent analysis). Analogous to *know*, the object of *find* being referentially transparent can denote a particular individual (*We found the exit*) or a kind of individuals (*we found a purse*), the last case amounting to an existential quantification "There is an instance of the kind 'purse' that we found". Analogous to *wonder*, the object of *seek* – if it is referentially opaque – cannot denote a particular individual, but obligatorily denotes a kind (*we seek a unicorn*) with the sentence not amounting to an existential quantification.[43]

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[41] Even if Mary is the only one who walks the kind denoted by *who walks* and the one denoted by *whether Mary walks* are not identical, as the kinds impose different criteria on their instances. See (89) for the denotation of *yes/no*-interrogatives embedded under *wonder*.

[42] This view on extensional and intensional predicates differs from the similar one in Groenendijk and Stokhof (1989) in that the interrogatives embedded by extensional and intensional predicates are not taken to be of different "semantic type" and to be related via type-shifting rules.

[43] Here we see once more that I am more or less compelled to assume that a kind's identity is not determined by its instances: if the referentially opaque object of *seek* denotes a kind, *a proof of the decidability of predicate logic* and *a proof of the completeness of arithmetic* must denote different kinds (with no instances, necessarily) as the two sentences *We are seeking a proof of the decidability of predicate logic* and *We are seeking a proof of the completeness of arithmetic* differ in meaning. If, instead, a kind's identity is determined by the criterion it imposes on its possible instances, the kind *a proof of the decidability of*

Let's have a look at distributive readings of interrogatives embedded under intensional predicates. The embedded *wh*-interrogative in (88a), for example, denotes the kind every instance p of which is such that all true propositions of the form "critic x reviews novel y" are part of p. That means that the kind (88b) has at most one instance (see 88c,d for an example).

(88)a. She wonders which novel each of the four critics reviews.

b. $\sigma k[\forall p(p\ \mathbf{Inst}\ k \leftrightarrow \forall x[x\ {}^*\!\leqslant \mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c} \oplus \mathbf{d}]$
$\exists^{max} y[\mathbf{Novel}(y) \wedge \mathbf{Review}(x, y)]$
$\langle \mathbf{Review}(x, y)\rangle \leqslant p)]$

c. $[@ = (b)]$
$\forall p(p\ \mathbf{Inst}\ @ \leftrightarrow p = \langle \mathbf{Review(a,kundera's\text{-}latest\text{-}novel)}\rangle \oplus$
$\langle \mathbf{Review(b,márquez's\text{-}latest\text{-}novel)}\rangle \oplus$
$\langle \mathbf{Review(c,rushdie's\text{-}latest\text{-}novel)}\rangle \oplus$
$\langle \mathbf{Review(d,updike's\text{-}latest\text{-}novel)}\rangle)$

d. $\forall p(p\ \mathbf{Inst}\ @ \leftrightarrow p = \mathbf{p}_1 \oplus \mathbf{p}_2 \oplus \mathbf{p}_3 \oplus \mathbf{p}_4)$

Whether-clauses embedded under *know* have been analysed as descriptions of INDIVIDUAL propositions (section 7). *Whether*-clauses embedded under *wonder*, consequently, will be analysed as descriptions of KINDS of INDIVIDUAL propositions.

(89)a. She wonders whether Mary came.

b. $\iota k[\forall p(p\ \mathbf{Inst}\ k \leftrightarrow \exists x[x \leqslant \mathbf{true} \oplus \mathbf{false} \wedge \pi(\langle \mathbf{Came(mary)}\rangle, x)]$
$\langle \pi(\langle \mathbf{Came(mary)}\rangle, x)\rangle = p)]$

Given this view, (90) could be part of the meaning of *S wonders Q*.

(90) S wants to know the instances of Q

Kinds help account for the analysis of a sentence like *We know who came* in a situation where nobody came. In such a situation, the *wh*-clause cannot denote any propositions as there is no proposition that would satisfy the description: if there is no x that is maximal with respect to **Came**(x) then $\mu p[\exists^{max} x[\mathbf{Came}(x)]\langle \mathbf{Came}(x)\rangle \leqslant p]$ is a vacuous referential term. But then the sentence *We know who came* should be unacceptable in such a situation. Now, the sequence (91) is strange indeed – as strange as (92), and, if our analysis is correct, for the same reason.[44]

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predicate logic describes is determined by the criterion of being a proof of the decidability of predicate logic and the kind *a proof of the completeness of arithmetic* describes is determined by the criterion of being a proof of the completeness of arithmetic.

[44] The English translations seem to have a strain of strangeness too.

(91) Wir wissen, dass niemand gekommen ist. Also wissen wir, wer gekommen ist.
We know that nobody came. Therefore we know who came.

(92) Wir wissen, dass es keinen König von Frankreich gibt. Also kennen wir den König von Frankreich nicht.
We know that there is no king of France. Therefore we do not know the king of France.

Strange as they might be, these sequences should probably not be considered as fully unacceptable. As for (91), the *wh*-clause would denote something in case it were interpreted as $\sigma k[\forall p(p \textbf{ Inst } k \leftrightarrow \exists^{max} x[\textbf{Came}(x)] \langle \textbf{Came}(x) \rangle \leq p)]$: it would denote a kind that has no instances. If, in additon, we admit that *S knows* ιk [ψk] is true if x knows that there is no instance of $\iota k[\psi k]$, then *We know who came* can come out as true in a situation where nobody came.[45]

Along these lines, there might be a way to cope with the definite description's *de dicto* or attributive reading in (93a) as well as with the full acceptability of (93b).

(93)a. Bond believes that the author of this letter is a spy.
b. John believes that the present king of France is bald.

If we interpreted the definite description in these cases as denoting a kind – *the author of this letter* denoting the kind the criterion of which is the property of being author of this letter and *the present king of France* denoting the kind the criterion of which is the property of being present king of France – we could existentially quantify on the instances of the kinds (as we did at kind-denoting indefinites) such that the embedded sentences amount to general propositions of the form "there is an instance of kind @ which is F".

9. Features of Clauses

Can declarative clauses also denote kinds (of propositions)? If one assumes this to be the case certain examples of *de re*/*de dicto* ambiguities can be analysed as being grounded on the declarative's ability to denote propositions or kinds of propositions. Sentence (94), for example, has a *de dicto* reading (belief content = "One of them is a spy") as well as a *de*

[45] A referee observes that the sequence *We know who came. Nobody did* is quite alright, but that sequences like *We know the king of France. There is no such king* are strange. The reason seems to be that only with respect to propositional knowledge (*Wissen* in German) is it the case that *S knows* $\iota k[\psi k]$ is true if x knows that there is no instance of $\iota k[\psi k]$.

re reading (belief content = "x is a spy", x being one of the people denoted by *them*). In the *de dicto* reading the embedded clause denotes the individual (general) proposition $\langle \exists x[x *\leq \mathbf{them}]\mathbf{Spy}(x)\rangle$, in the *de re* reading it denotes a kind whose instances are (singular) propositions of the form "x is a spy", x being one of the people denoted by *them*. Provided that *them* denotes $\mathbf{a} \oplus \mathbf{b} \oplus \mathbf{c}$, then in the *de re* reading the embedded clause denotes the kind whose instances could be the propositions "**a** is a spy", "**b** is a spy" and "**c** is a spy". Similar as in (77), the truth condition of the *de re* reading of (94) amounts to an existential quantification: "There is an instance (a singular proposition) of the kind denoted by the embedded clause that Ralph believes". Note that this analysis of the *de re* reading does not amount to quantifying into an attitude context.

(94) Ralph believes that one of them is a spy.
de dicto reading:
Ralph believes $\iota p[\langle \exists x[x *\leq \mathbf{them}]\mathbf{Spy}(x)\rangle = p]$
de re reading:[46]
Ralph believes $\iota k[\forall p(p\ \mathbf{Inst}\ k \leftrightarrow \exists x[x *\leq \mathbf{them}](\langle \mathbf{Spy}(x)\rangle = p))]$

If not only interrogatives, but declaratives too can be kind-denoting, one could venture the following schematic picture. Two features, [±"PLURAL"] and [±"INDEFINIT"], which can directly be interpreted semantically, are assigned to clauses. Declarative clauses and *whether*-interrogatives[47] are [−"PLURAL"] denoting (kinds of) individual propositions, and *wh*-interrogatives are [+ "PLURAL"] denoting (kinds of) pluralities of propositions. [−"INDEFINIT"]-clauses denote (pluralities of) propositions, [+"INDEFINIT"]-clauses denote kinds of (pluralities of) propositions.

(95)

	declaratives and *whether*-interrogatives	*wh*-interrogatives
"PLURAL"	−	+
"INDEFINIT"		
−	$\iota p[\phi p]$	$\mu p[\phi p]$
+	$\iota k[\psi k]$	$\sigma k[\psi k]$

With this background, we can propose an answer to the question of which features trigger the logical form transformation in (47) above and determine the choice of the elements introduced, that are non-existent on s-structure. The following overview lists the features of the (a)-clauses in

[46] I do not pretend this to be a sufficient representation of the reading's *de re* character.
[47] This is a cover term for *yes/no*- and alternative interrogatives.

(b), the result of the transformation in (c), the semantic representation of the introduced elements in (d), and, finally, (part of) the semantic representation of the (a)-clauses in (e).

(96)a. that one of them is a spy (*de dicto*)
b. [−"INDEFINIT"], [−"PLURAL"]
c. [A [[[*one of them*]$_1$[x_1 is a spy]] E]]
d. A $\gg \lambda Q[\iota p[Qp]]$ E $\gg \lambda T[\langle T\rangle = q]$
e. $\iota p[\langle \exists x[x *\leq$ **them**$]$**Spy**$(x)\rangle = p]$

(97)a. that one of them is a spy (*de re*)
b. [+"INDEFINIT"], [−"PLURAL"]
c. [B [[one of them]$_1$[[x_1 is a spy] E]]]
d. B $\gg \lambda Q[\iota k[\forall p(p$ **Inst** $k \leftrightarrow Qp)]]$ E $\gg \lambda T[\langle T\rangle = q]$
e. $\iota k[\forall p(p$ **Inst** $k \leftrightarrow \exists x[x *\leq$ **them**$](\langle$**Spy**$(x)\rangle = p))]$

(98)a. (we know) which novels have been reviewed
b. [−"INDEFINIT"], [+"PLURAL"]
c. [C [[which novels R]$_1$[[x_1 have been reviewed] F]]]
d. C $\gg \lambda Q[\mu p[Qp]]$ F $\gg \lambda T[\langle T\rangle \leq q]$
e. $\mu p[\exists^{max} x[*$**Novel**$(x) \wedge$ **Have-been-reviewed**$(x)]$
$\langle$**Have-been-reviewed**$(x)\rangle \leq p]$

(99)a. (we wonder) which novels have been reviewed
b. [+"INDEFINIT"], [+"PLURAL"]
c. [D [[which novels R]$_1$[[x_1 have been reviewed] F]]]
d. D $\gg \lambda Q[\sigma k[\forall p(p$ **Inst** $k \leftrightarrow Qp)]]$
F $\gg \lambda T[\langle T\rangle \leq q]$
e. $\sigma k[\forall p(p$ **Inst** $k \leftrightarrow \exists^{max} x[*$**Novel**$(x) \wedge$ **Have-been-reviewed**$(x)]$
$\langle$**Have-been-reviewed**$(x)\rangle \leq p)]$

10. Inverse Linking and List Reading

We have seen that some kinds of interrogatives can be analysed in the same way as some kinds of definite and indefinite noun phrases, namely as ι-terms. But we had to posit additional operators to cope with other kinds of interrogatives. Now, there is evidence for the existence of the μ- and σ-operator in the realm of noun phrases: (certain) inverse linking readings of noun phrases can felicitously be represented with the help of these operators. The noun phrase *the speakers of all factions* in (100) can be analysed as denoting the minimal plurality x such that for every faction y the speakers of y are part of x. It is this plurality of speakers who agree on a common declaration.

(100) The speakers of all factions agreed on a common declaration.

And in (101) *politicians from all factions* might denote the smallest kind such that some x is an instance of it iff for every faction y politicians belonging to y are part of x. The sentence is true if some instance of this kind, i.e., some plurality of politicians from all factions, agreed on a common declaration.

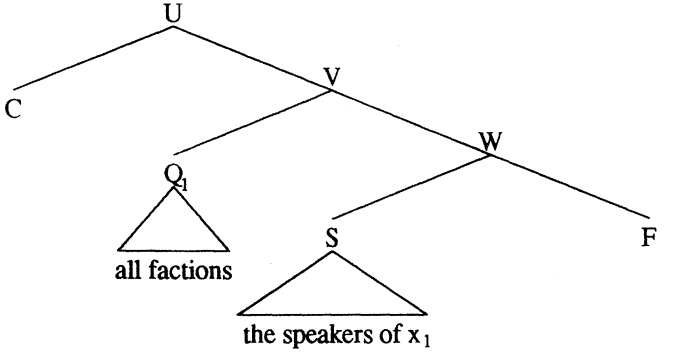
(101) Politicians from all factions agreed on a common declaration.

Thus, inverse linking readings of noun phrases and list readings of interrogatives can both be represented by μ- and σ-terms. In addition, it is possible to conceive the construction of their logical form as governed by the same operations with the same elements as the logical form of interrogatives. See, for example, the analysis of *the speakers of all factions*:

(102)a. the speakers of all factions

b. (all factions)$_1$[the speakers of x_1]

c.



d. $\mu x[\forall y[\mathbf{Faction}(y)](\iota z[\mathbf{*Speaker\text{-}of}(z, y)] \leqslant x)]$

11. Comparison with Other Accounts

The proposed analysis of the distributive reading is embedded in a – broadly conceived – Karttunen semantics of interrogatives. Karttunen (1977) could not derive the reading of *We know which novel every critic reviews* where the universal quantifier – having more than one individual in its range – outscopes the *wh*-phrase, but has scope only over the embedded clause. Karttunen/Peters (1980) considered this a failure and formulated a semantic rule which makes this reading's derivation possible. (103) is interpreted via (104):

(103) $[_{Q_2}\ [_{NP}$ every critic$]_n\ [_{Q_1}$ which novel$_k$ [x_n reviews x_k]]]

(104) $Q'_2 = \lambda p[\neg\neg NP'(\lambda x_k[\neg Q'_1(p)])]$

(Karttunen/Peters 1980: 190)

The rule is based on the fact that the universal *every X* is the dual of *which X*, which is considered as having the same meaning as *some X*. In effect the rule gives the universal quantifier *every X* the same meaning as its dual, i.e., as *some X*. Thus, *which novel every critic reviews* gets exactly the same semantic representation as *which critic reviews which novel*:

(105) $\lambda p[\exists x \exists y(\mathbf{Critic}(x) \wedge \mathbf{Novel}(y) \wedge {}^{\vee}p \wedge p = {}^{\wedge}\mathbf{Review}(x, y))]$

In this account a universal quantifier is quantified in in different ways depending on whether it is outscoped by a *wh*-phrase or outscopes the *wh*-phrase.

The main reason why – relying on a Karttunen semantics – we are not committed to such a move is that we make use of the μ-operator instead of the λ-operator and the part-of relation $\leqslant$ instead of the identity relation $=$. This makes it possible for universal quantifiers to outscope interrogative quantifiers while retaining their normal meaning and not being quantified in in a peculiar way. A further difference is that Karttunen and Peters's account is restricted to universal quantifiers outscoping interrogative ones.

Let us compare the proposed analysis with (non-functional) analyses of the distributive reading embedded in partition semantics, i.e., with the Higginbotham/May account[48] and the Groenendijk/Stokhof account.[49]

The Higginbotham/May account takes interrogative sentences to refer to "abstract questions", which can be elementary or complex. Elementary abstract questions are "partitions of the possible states of nature into families of mutually exclusive (and possibly jointly exhaustive) alternatives" (Higginbotham 1991: 48, 1993: 196). Complex abstract questions are sets of sets of elementary abstract questions or are equivalent to such sets.[50] The elements of an alternative "can be thought of as statements", and an alternative "corresponds to the true state of nature if and only if all the statements that it contains are true" (1991: 49, 1993: 196).[51] The list reading of *Which novel does every critic review?* can be represented by the following logical form.

[48] See Higginbotham and May (1981), May (1985, 1989); Higginbotham (1991, 1996).

[49] See Groenendijk and Stokhof (1982, 1984, 1989).

[50] Complex abstract questions "form a hierarchy of orders, with abstract questions of order n being sets of sets of abstract questions of orders $\leqslant n - 1$" (Higginbotham 1991: 48) and elementary abstract questions being of order null. But Higginbotham shows that "all orders above 1 are redundant: for each abstract question Q, of any order, there is an abstract question of order at most 1 having all the same partial answers and all the same presuppositions" (ibid. p. 72).

[51] In Higginbotham (1996: 371) an alternative or possibility is taken to be a set of propositions.

(106) [Every x: critic(x)][WH y: novel(y)](?x reviews y)

This logical form denotes a complex abstract question which is built up in the following simplified form. (107a) – corresponding to a *yes/no*-question – denotes an elementary abstract question consisting of two alternatives only:[52]

(107)a. (?x reviews y)
b. $Q_1 = \{A_1, A_2\}$, with A_1 = {'x reviews y'},
A_2 = {'x doesn't review y'}

If we stick to the situation with four critics (**a**, **b**, **c**, **d**) and four novels (**k**, **m**, **r**, **u**), (108a) – corresponding to the *wh*-question *Which novel does x review?* – denotes an elementary abstract question with four alternatives:

(108)a. [WH y: novel(y)](?x reviews y)
b. $Q_2 = \{A_3, A_4, A_5, A_6\}$, with
A_3 = {'x reviews novel **k**', 'x doesn't review novel **m**', 'x doesn't review novel **r**', 'x doesn't review novel **u**'}
A_4 = {'x doesn't review novel **k**', 'x reviews novel **m**', 'x doesn't review novel **r**', 'x doesn't review novel **u**'}
A_5 = {'x doesn't review novel **k**', 'x doesn't review novel **m**', 'x reviews novel **r**', 'x doesn't review novel **u**'}
A_6 = {'x doesn't review novel **k**', 'x doesn't review novel **m**', 'x doesn't review novel **r**', 'x reviews novel **u**'}

The operation which makes the question Q_2 out of the question Q_1 is a product operation called "refinement" (see Higginbotham 1991: 68, cf. the translation rule (52) in Higginbotham 1996: 373). The denotation of (109a) is the set containing as its only element the set whose elements are the four elementary questions corresponding to *Which novel did* **a** *review?*,*Which novel did* **b** *review?*, *Which novel did* **c** *review?*, *Which novel did* **d** *review?*.

(109)a. [Every x: critic(x)][WH y: novel(y)] (?x reviews y) (=106)
b. $Q_3 = \{\{Q_2^{\mathbf{a}/x}, Q_2^{\mathbf{b}/x}, Q_2^{\mathbf{c}/x}, Q_2^{\mathbf{d}/x}\}\}$,
with $Q_2^{\alpha/x}$ being identical to Q_2 apart from every occurrence of 'x' being substituted by 'critic α'.

This process making a complex question out of a minor complex one is called "generalization" (see Higginbotham 1991: 70, cf. the translation rule (75) in Higginbotham 1996: 378). The operations refinement and

[52] I have omitted assignments of values to variables.

generalization are such that the logical form (110a) gets exactly the same interpretation as (109a); it is (110b) which represents the non-distributive reading (cf. Higginbotham 1991: 71f):

(110)a. [WH y: novel(y)][Every x: critic(x)](?x reviews y)
b. [WH y: novel(y)](?[Every x: critic(x)](x reviews y))

This means that it is not the relative scope of the *wh*-phrase and the ordinary quantifier which is decisive for the distributive/non-distributive distinction. It is the relative scope between '?' and the ordinary quantifier which is decisive. This makes it clear that this account does not treat the scope relation 'ordinary quantifier outscoping interrogative quantifier' as a true instance of a quantifier scope relation: the relevant operations 'refinement' and 'generalization' differ from standard 'quantifying in' operations.

Much the same is true with the Groenendijk/Stokhof account. An interrogative has a question or a set of properties of questions as meaning – a question being a partition of a set of possible worlds into mutually exclusive sets of possible worlds, i.e., into mutually exclusive propositions. They distinguish between pair-list reading and choice reading: pair-list reading is the reading with wide scope of a univeral quantifier or a conjunction, choice reading is the reading with wide scope of a non-universal quantifier or a disjunction. The meaning of an interrogative with a pair-list reading is still a partition – not a set of sets of partitions as in the Higginbotham/May account – but the meaning of an interrogative with a choice reading is a set of properties of partitions.[53]

The essential step in the derivation of the list reading of *Which novel does every critic review?* is the step where *every critic* and *which novel* he_0 *reviews* are combined. *Every critic* is represented as $\lambda P[\forall x(\mathbf{Critic}(w)(x) \rightarrow P(w)(x))]$, and *which novel* he_0 *reviews* is represented as $\lambda y[\mathbf{Novel}(w)(y)]\mathbf{Reviews}(w)(x, y)$ with $\lambda y[\mathbf{Novel}(w)(y)]$ being a restricted λ-abstractor. A special rule – the rule (AB-T)[54] – turns the quantificational term and the one-place abstract into the two-place abstract (111a), which is equivalent to (111b). The rule (AB-T) reduces the universal quantifier to a restricted λ-abstractor.

[53] See Groenendijk and Stokhof (1984: §4.2.3) for the reasons why they do not want to 'lift' the meaning of an interrogative with a pair-list reading to a set of properties of partitions.

[54] "If α is a term, translating as α', and β is an n-place abstract, translating as β', then the n + 1-place abstract formed from them translates as follows:

(AB-T) $\lambda x_n[\underline{live}(\alpha')(a)]\beta'$"(Groenendijk and Stokhof 1984: 511).

($\underline{live}(\alpha) = \lambda a \lambda x \forall P[\alpha(P) \rightarrow P(a)(x)]$)

(111)a. $\lambda x[\mathbf{Critic}(w)(x)]\,\lambda y[\mathbf{Novel}(w)(y)]\,\mathbf{Reviews}(w)(x, y)$
b. $\lambda x \lambda y[\mathbf{Critic}(w)(x) \wedge \mathbf{Novel}(w)(y) \wedge \mathbf{Reviews}(w)(x, y)]$

This two-place relation is "lifted" to the following equivalence relation on worlds:

(112) $\lambda w \lambda w'[\lambda x \lambda y[\mathbf{Critic}(w)(x) \wedge \mathbf{Novel}(w)(y) \wedge \mathbf{Reviews}(w)(x, y)] = \lambda x \lambda y[\mathbf{Critic}(w')(x) \wedge \mathbf{Novel}(w')(y) \wedge \mathbf{Reviews}(w')(x, y)]]$

This relation induces a partition whose cells are propositions, one of which is the proposition that critic **a** reviews novel **k**, critic **b** reviews novel **m**, critic **c** reviews novel **r** and critic **d** reviews novel **u**, no critic reviewing any other novel.

As with the Higginbotham/May account, the scope relation between the universal quantifier and the *wh*-phrase is not to be correlated with the distributive/non-distributive distinction. This time the reason is that *wh*-phrases are analysed in the same way as universal quantifiers, i.e., as restricted λ-abstractors (Groenendijk/Stokhof 1984: 512 even give *which* α the same translation as *every* α). In this account we get the non-distributive reading of *Which novel does every critic review?* if we (i) combine the translations of *every critic* and he_0 *reviews* him_1 by the standard quantifying-in operation yielding $\forall x(\mathbf{Critic}(w)(x) \rightarrow \mathbf{Reviews}(w)(x, y))$ and (ii) combine this zero-place abstract and the translation of the *wh*-phrase via rule (AB-T) to $\lambda y[\mathbf{Novel}(w)(y)]\,\forall x(\mathbf{Critic}(w)(x) \rightarrow \mathbf{Reviews}(w)(x, y))$. This result holds when the additional rule – the rule (LIFT-AB-T; ibid. §4.3.2) – for choice readings is taken into account: different scope relations do not lead to different reading (cf. Chierchia 1993: 228).

Thus the main difference between our proposal and the considered accounts of distributive readings – be they functional or non-functional, partition-based or not – lies in the fact that we treat the distributive/non-distributive distinction semantically as a true instance of a quantifier scope relation.

This is not the place for a thorough comparison between (variants of) Karttunen semantics and partition-based semantics of interrogatives – since the pragmatics of questions and answers would have to be taken into consideration – but viewing interrogatives as definite descriptions makes it possible to account for semantic phenomena (strong exhaustivity effects, extensional vs. intensional predicates, coordination,[55] among

[55] Being viewed as definite descriptions, interrogatives seem not to raise any additional problems with regard to coordination in comparison to the problems raised by coordinating noun phrases.

others) with regard to which a partition semantics has been claimed to be superior to Karttunen (1977).

A major difference to partition-based as well as to Karttunen- and Hamblin-like semantics is that a semantic notion of 'question' (and 'answer') does not play a foundational role in our account. This means that there is nothing one could call a 'question' which would be an element common to the meaning of all interrogatives. Kinds of (pluralities of) propositions are the most promising candidates for being identified with 'questions.' But in our account interrogatives embedded under extensional predicates often do not denote such kinds, which can even be denoted by declaratives (see 94 above). Pluralities of propositions cannot be identified with questions, either, since an individual is the limiting case of a plurality. Nor can 'proper' pluralities of propositions (i.e., individual propositions excluded) be called questions since *whether*-interrogatives and some *wh*-interrogatives (*Which novel is Kundera's latest one?*) denote individual propositions while interrogatives embedded under intensional predicates obligatorily denote kinds. As we have covered relevant parts of the semantics of interrogatives we come to the heretical conclusion that semantic notions of question and answer are not of great importance in this context. As we have already remarked, it is the occurrence of an interrogative quantifier which is the common semantic trait of interrogatives.

12. Conclusion

The *wh*/*Q*-interaction can be semantically modelled as a true instance of a quantifier scope relation, without modifying the standard view on the semantics of quantifier scope relations. This is our main result. We have, further, given our reasons for assuming that *wh*/*Q*-interaction should indeed be considered a quantifier scope interaction. The main result was achieved basically by the analysis of interrogatives as definite descriptions and a novel account of the meaning of *wh*-phrases. The first element made it possible to identify semantic properties of interrogatives – which seemed interrogative-specific – with properties well-known from the realm of noun phrases (singular/plural, definit/indefinit, transparent/opaque, among others). The main result is embedded in a – broadly conceived – Karttunen semantics of interrogatives, which copes with several semantic phenomena (above all, strong exhaustivity effects) with regard to which a partition semantics has been claimed to be superior to Karttunen (1977).

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