

On the semantics of *wh*-*

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Abstract. It is argued that a theory of the semantics of *wh*-expressions, and *wh*-pro-forms in particular, should not only fit the semantics of *wh*-interrogatives. It should also provide a simple and unified cross-categorial semantics for *wh*- which takes into account the semantics of morphologically and cross-linguistically plausible paradigm-mates, while deriving rather than stipulating the correct types for traces/variables, and allowing *in-situ* interpretation. Accordingly, it is proposed that *wh*-pro-forms are variants of demonstratives, with *wh*- a proximity value next to PROXIMAL or DISTAL (or rather: their unvalued counterpart). The familiar phenomenon of deferred reference with demonstratives is taken to underlie the cross-categorial semantics of demonstratives, hence that of *wh*-expressions as well. *Wh*-expressions end up functioning as unselectively bound, presuppositionally restricted variables.

Keywords: *wh*-expressions, demonstratives, *wh*-questions, deferred reference, indeterminate pronouns

1. Introduction

The question of motivating a particular semantics for *wh*-expressions is usually approached from the perspective of a theory on the semantics of interrogative clauses. Given such a theory, it is natural to adopt whatever semantics for *wh*-expressions best facilitates the desired composition of the clause. This has resulted in two general approaches to the semantics of *wh*-expressions. Some authors treat *wh*-expressions as operators that bind a variable in the question nucleus. Others assume that the *wh*-expressions themselves are variables in the question nucleus, bound by a separate operator at the clausal edge.

The first approach, which takes *wh*-expressions to be variants of existential quantifiers, wrapped in a mechanism that fits them into the semantic make-up of the interrogative clausal edge, goes back to Karttunen 1977 (and further, to Katz & Postal 1964, a.o.) and was developed by Higginbotham 1993, Heim 1994, Cresti 1995, and later work. Under this approach, a *wh*-expression like *who* can be characterized as in (1):

$$(1) \quad \llbracket who \rrbracket = \llbracket wh- someone \rrbracket = \lambda R_{\langle e, \langle st, t \rangle \rangle} \lambda p_{\langle s, t \rangle} \exists x [\text{person}(x) \wedge R(x)(p)]$$

The basic idea is that C_{+wh} has the denotation in (2a): it combines with the proposition expressed by the IP (the question nucleus) to yield the set of propositions (“proto-question”) in (2b).¹ Abstracting over the trace/variable left by *who* yields (2c); this combines with *who* in (1) to yield (2d). Note that it is the existential quantifier provided by *who* that ends up binding the variable in the question nucleus.

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¹ For the sake of simplicity I omit from (2a) the restriction to true propositions.

- (2) $[_{CP} \text{who}_i [_{C'} [_{C+wh} \text{did}] [_{IP} \text{Mary kiss } t_i]]]?$
- $\lambda q_{\langle s,t \rangle} \lambda p_{\langle s,t \rangle} \cdot p = q$
 - $\lambda p_{\langle s,t \rangle} \cdot p = \wedge \text{Mary kiss } x$
 - $\lambda x_e \cdot \lambda p_{\langle s,t \rangle} \cdot p = \wedge \text{Mary kiss } x$
 - $\lambda p_{\langle s,t \rangle} \cdot \exists x [\text{person}(x) \wedge p = \wedge \text{Mary kiss } x]$

The second approach, which I will end up advocating here, and which treats *wh*-expressions as unselectively bound (sorted or presuppositionally restricted) variables goes back to Hausser & Zaefferer (1979); it was developed later by Rullmann (1995), Cresti (1998), Rullmann & Beck (1998), Kratzer & Shimoyama (2002), and others. (3) illustrates Rullmann & Beck's (1995) proposal. A fronted *wh*-expression undergoes reconstruction, yielding (3b), and is then interpreted as a definite DP (with the associated presuppositions) containing a free variable unselectively bound from the clause edge, resulting in (3c):

- (3) a. $[_{CP} [\text{which woman}]_i [_{C'} [_{C+wh} \text{did}] [_{IP} \text{Mary kiss } t_i]]]$
 b. $[_{CP} [_{C+wh} \text{did}] [_{IP} \text{Mary kiss } [\text{the woman } x_j]]]$
 c. $\lambda p \exists x_j [p = \wedge \text{Mary kissed the } (\lambda y. \text{woman}(y) \wedge y = x_j)]]$

The present paper approaches the semantics of *wh*-expressions from the opposite starting point. We look at the syntactic and morphological properties of *wh*-expressions, considering how they fit into the adverbial and pronominal paradigms they belong to, and how *in-situ wh*-expressions and *wh*-traces function. We argue that a simple and independently motivated semantics for *wh*-expressions can be developed by identifying them as denatured demonstratives, unvalued for PROXIMAL, MEDIAL or DISTAL. This analysis in turn supports the unselective binding approach to interrogative clauses.

2. Some desiderata for a variable theory of *wh*-expressions

In this section, I outline the issues surrounding the interpretation of *wh*-expressions that the semantics I will be proposing is designed to explain. By way of illustration, I will sketch in each case to what extent the existential quantifier approach manages to meet these desiderata. This will also serve to motivate my choice for the variable approach in section 3.

2.1. *In situ wh*-phrases

As observed by Heim (1994), the assumption that *wh*-phrases are not pure existential quantifiers but carry with them the mechanism needed to fit them into the interrogative clause edge, as in (1), implies that they are only interpretable in that position, and not *in situ*.² For

² Von Stechow & Heim (2000) propose a simplified semantics for *wh*-expressions by which they denote “bare” existential generalized quantifiers. Fitting this GQ into the clausal edge is achieved by postulating that C adjoins to CP, creating just the necessary lambda-chain. In essence, this is a return to Karttunen (1977), who also analyzed *wh*-expressions as generalized quantifiers, fitted into the clause edge by a dedicated composition rule. While this expedient renders *wh*-expressions interpretable *in situ*, it does not of course yield the correct semantics for *wh*-in-situ. E.g., in (6a) below *which senator* cannot be replaced *salva veritate* by *some senator*.

most instances of *wh-in-situ*, such as English (4) and Chinese (5) (from Bayer & Cheng 2017, q.v. for a literature review), this problem can be overcome by the classical assumption that the *in situ* operator undergoes *wh*-raising at LF.

- (4) who said what?
 (5) Húfēi mǎi-le shénme Mandarin Chinese
 Hufei buy-PRF what
 ‘What did Hufei buy?’

However, the literature also contains many examples like (6) (from Hankamer 1975:67:(33)) where *wh*-raising is implausible (see Dayal 2016 for an overview of the literature):

- (6) a. In order to foil this plot, we must find out which agent has [_{NP} bats that are trained to kill which senator]
 b. * We must find out which senator_i Philby has [_{NP} bats that are trained to kill t_i]
 c. $\lambda R_{\langle e, \langle st, t \rangle \rangle} \lambda p_{\langle s, t \rangle} \exists x [\text{senator}(x) \wedge R(x)(p)]$

Which senator in (6a) is contained in a strong (CNPC) island, which blocks overt extraction in (6b). Although movement analyses for such cases have been proposed (e.g., Huang’s 1982a proposal that LF movement is not subject to Subjacency, or the Pied Piping analysis of Nishigauchi 1990 and later work; but see Von Stechow 1996 for critical discussion), allowing covert movement to differ crucially from overt movement undermines the hypothesis that covert movement can be characterized as movement at all, hence the concept of LF as a syntactic level of representation. The more cautious approach to such examples has been to assume that at least some *wh-in-situ*, *which senator* in (6a) among them, remain *in situ* at LF and are interpreted there. This approach has been implemented by the (further) development of unselective binding theories of *wh-in-situ* (going back to Baker 1970; including Pesetsky’s 1987 treatment of such cases), which have successfully focused on languages with indeterminate pronouns (Kuroda 1965). In addition, one well-known proposal (Cole and Hermon 1998) holds that in some (*in-situ*) languages *wh*-expressions are variable containing open sentences, whereas in other (*wh*-movement) languages, including English, they include an operator as in (1) (but see Bruening 2007 for critical discussion). This is not the place to relitigate the literature on this topic; what is relevant for our purposes is that even languages like English, with data like (6), present a serious challenge for theories that treat *wh*-expressions as (modified) existential quantifiers. The proposal in section 3 below addresses this problem by treating all *wh*-expressions as non-operators.

2.2. Paradigmatic status: morphology

If *wh*-expressions were built on existential quantifiers with an interrogative “wrapper”, we would expect this to be reflected in their morphology. In particular, we would expect that *wh*-pro-forms (pronominals, pro-adverbs) would often be transparently derived from their existential siblings in the relevant pronominal paradigms. However, this is not the case.

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time	when	< sometime ?	
degree	how	< somewhat ?	
amount	kiek		(Lithuanian)
quality	kakoj		(Russian)

A concrete proposal based on the hypothesis that *wh*-expressions are modified existentials was offered by Cresti (1995): *who* is derived from *someone* by addition of the *wh*-feature in (12b).⁴

- (12) a. $\llbracket \text{someone} \rrbracket = \lambda P_{\langle e,t \rangle} \exists x [\text{person}(x) \wedge P(x)]$
 b. $\llbracket \text{wh-} \rrbracket = \lambda P_{\langle et,t \rangle} \lambda R_{\langle e,\langle st,t \rangle \rangle} \lambda p_{\langle s,t \rangle} \cdot P(\lambda x_e. R(x)(p))$
 c. $\llbracket \text{who} \rrbracket = \llbracket \text{wh- someone} \rrbracket = \lambda R_{\langle e,\langle st,t \rangle \rangle} \lambda p_{\langle s,t \rangle} \exists x [\text{person}(x) \wedge R(x)(p)]$

The obvious problem is that (12b) will only work for DPs, which denote generalized quantifiers. Can the other *wh*-pro-forms in (11) be semantically related to the corresponding existential pro-forms in the same way? Consider, e.g., the manner adverbial *how*, and assume, for concreteness, that manner adverbials denote sets of events (type $\langle v,t \rangle$). To achieve the result in (13c), we would need the modified *wh*-feature in (13b) (setting aside the fact that *somehow* is not a plausible source for *how* for morphological reasons, as discussed above, as well as having a “widening” aspect to its semantics that is not covered by (13a)).

- (13) a. $\llbracket \text{somehow} \rrbracket = \lambda P_{\langle \langle v,t \rangle, t \rangle} \exists x_{\langle v,t \rangle} [\text{manner}(x) \wedge P(x)]$ [*v* for event]
 b. $\llbracket \text{wh}' \rrbracket = \lambda P_{\langle \langle \langle v,t \rangle, t \rangle, t \rangle} \lambda R_{\langle \langle v,t \rangle, \langle st,t \rangle \rangle} \lambda p_{\langle s,t \rangle} \cdot P(\lambda x_{\langle v,t \rangle}. R(x)(p))$
 c. $\llbracket \text{how} \rrbracket = \llbracket \text{wh}' \text{ somehow} \rrbracket = \lambda R_{\langle \langle v,t \rangle, \langle st,t \rangle \rangle} \lambda p_{\langle s,t \rangle} \cdot \exists x_{\langle v,t \rangle} [\text{manner}(x) \wedge R(x)(p)]$

This is not to say that a generalization is not possible. If we allow ourselves a type-flexible generalized feature wh_g - of type $\langle \langle \langle \alpha, t \rangle, t \rangle, \langle \langle \alpha, \langle st, t \rangle \rangle, \langle st, t \rangle \rangle \rangle$ as in (14), it will combine with an existential quantifier of any type $\langle \langle \alpha, t \rangle, t \rangle$ to yield the corresponding interrogative (assuming it leaves a trace that functions as a variable of type α – see the next section).

- (14) $\llbracket wh_g \rrbracket = \lambda P_{\langle \langle \alpha, t \rangle, t \rangle} \lambda R_{\langle \alpha, \langle st, t \rangle \rangle} \lambda p_{\langle s, t \rangle} \cdot P(\lambda x_\alpha. R(x)(p))$

My objection to this approach is not that it will not work technically. In fact, there is no technical requirement under the quantificational approach that *wh*-expressions be derived from indefinite pro-forms at all. One might give up on postulating a transparent semantic relation between *wh*-expressions and their indefinite counterparts, and simply assume that each of the *wh*-expressions in (11) sits in the lexicon with whatever unanalyzed semantics we need in order to arrive at the desired semantics of interrogative clauses. However, if we want to explain how *wh*-expressions come to have the semantics they have, how they are semantically related to their paradigm-mates, and how we can semantically characterize the structure of the pronominal paradigm, then the existential approach appears to lead us to a *wh*-feature along the lines of (14). Either way, from an explanatory standpoint it seems implausible that such simple morphemes as *who* or *how*, and especially such a simple feature

⁴ For *which man*, Cresti considers two options: that the *wh*-feature has applied to *some*, or to *some man*.

As before, this instance of *how* is the *wh*- variant of a hypothetical existential generalized quantifier ranging over numbers. However, *how* now needs to take an additional argument: first, the DP it is adjoined to, and then the C' the DP is the specifier of. This entails that the *wh*-feature in *how*, defined in (18c), can no longer be treated as a version of the generalized *wh_g*- feature in (14): we have drifted further away from finding a common semantics that relates *wh*-pro-forms to their paradigmatic siblings. I suspect any solution for pied piping along these general lines will face similar challenges. The analysis in section 3 below on the other hand provides a relatively simple semantics for the feature *wh*- that extends to pied piping structures (see Sternefeld 2001a, 2001b for earlier non-operator treatments).

2.4. Trace typing

It is standardly assumed that downstairs, deleted copies in a movement chain function as variables. However, there is precious little discussion in the literature on the question of deriving the correct types for these variables, and hence, accounting for how they compose. The usual procedure is to simply stipulate that the trace has whatever type is needed to end up with the desired result for the containing clause.⁵ One of my goals here is to work towards a solution that helps develop a principled theory on how traces come to have the types they have.

I want to follow the general approach I advocated in Ruys (2015). Under the copy theory of movement, the type of a trace-copy is determined by its internal composition in the usual way. All copies of a constituent are subject to the same rules of composition, which lead to a particular type and denotation (note that a trace constituent may be of unlimited size, so that its possible trace status is not detectable “down inside”). Once a constituent is recognized as a downstairs copy it is taken to function as a variable; but the type arrived at in the composition process still determines its type. There are various options here: my specific proposal is that the trace may either function as a variable of the full type arrived at in the composition process (which will lead to the semantic reconstruction phenomena discussed in Ruys 2015), or default to a basic type (e, or d).

Depending on the implementation, a quantificational type for *wh*-expressions, with an interrogative wrapper, can stand in the way of a motivated theory of trace typing along these lines. Consider again the supposed denotation of manner-*how* in (13c) (repeated as (19a)):

- (19) a $\llbracket \text{how} \rrbracket = \lambda R.\lambda p.\exists x[\text{manner}(x) \wedge R(x)(p)]$, type $\langle\langle\langle v,t \rangle, \langle st,t \rangle \rangle, \langle\langle s,t \rangle, t \rangle\rangle$
 b. $\llbracket \text{how}_i \rrbracket^g = g(x_i)$, type $\langle v,t \rangle$

⁵ The apparently simple options turn out not to be. For instance, allowing the trace to have whatever type permits local composition to proceed opens up an infinity of options, most of which are only filtered out at the tree root when the variable runs out of options for finding a binder (assuming it must be bound) – if we want to avoid unlimited backtracking, as is desired from a minimalist perspective, this is not an optimal solution. Conversely, forcing the trace to take the lowest possible type (that fits its environment) is not only incompatible with theories of semantic reconstruction for operator-type expressions; it fails, e.g., for displaced VP modifiers. These could not leave traces of, say, type $\langle v,t \rangle$ that combine with VP of the same type via intersection, as the option would be blocked by type v , unless, again, look-ahead were allowed.

Given this denotation, I see no non-stipulative way of arriving at the desired type of the trace in (19b). Observe, that this problem arises not only for manner-*how* but also for other modifier-type *wh*-pro-adverbs, such as locatives.

One way of dealing with the issue is to modify the desired type of the trace. For instance, one could adopt Landman & Morzycki's (2003) proposal that manners are event kinds. The trace of *how* could then default to a basic type (that of event kinds), more or less in accordance with the above proposal. A rule that shifts a kind to the set of its realizations would then allow the trace to combine with VP in the usual way. But it is unclear whether such an approach could be extended to locative and other modifier *wh*-expressions.

Alternatively, one could extend the trace typing procedure outlined above with the option to allow the trace type to be derived by some simple functions from the full type of the trace constituent; in particular, say that any trace constituent of quantificational type $\langle\langle\alpha,t\rangle,t\rangle$ may function as a variable of type α . This will not solve the problem for wrapped quantificational *wh*-denotations, as in (19a), but if we assume in addition that *wh*-expressions are bare existential quantifiers, with the embedding in the interrogative clausal edge taken care of in some other way, as in von Stechow & Heim (2020) (cf. footnote 2), the trace type might be derived without further stipulation. It is not clear to me at this point whether this approach is tenable.

Again, finding such solutions becomes harder once we take pied-piping structures into account, but I will not elaborate on this here. My proposal in the next section will deal with trace typing in a straightforward manner.

The preceding sections have shown that on the existential operator analysis, *wh*-pro-forms are odd ducks, with no semantic or morphological relation to their supposed paradigm-mates, and puzzling properties *in situ* as either traces or unmoved operators. The next section argues that we can address these issues by treating *wh*-pro-forms as demonstratives.

3. A proposal

The discussion in the previous section leads to the following desiderata for a theory on the semantics of *wh*-expressions, and *wh*-pro-forms in particular. We want to provide a unified cross-categorial semantics for *wh*- that is simple, and which takes into account the semantics of paradigm-mates, while deriving (not stipulating) the correct types for traces/variables and allowing *in-situ* interpretation.

My point of departure is Diessel's (2003) finding that cross-linguistically, interrogative pro-forms are most closely related to demonstrative pro-forms, which he observes are similar in various respects. They occupy the same syntactic categories, they are subject to the same morphological derivations, sometimes allowing forms of affixation that do not occur with other categories, and they can be marked for the same semantic features.

In many languages, *wh*-expressions are clearly morphologically related to demonstratives. This can be illustrated with the following paradigm from Lezgian (from Haspelmath 1993:188; via Diessel 2003):

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(20)

	demonstratives	interrogatives
person/thing	im	him / wuž
place	inag	hinag
place:at	ina	hina
place:on	inal	hinal
place:in	inra	hinra
direction:to	iniz	hiniz
direction:from	inaj	hinaj
amount	iq'wan	hiq'wan
quality	i' xtin	hi' xtin
manner	ik'	hik' (a)

At the same time, Diessel argues that demonstratives and interrogatives are generally not derived from each other, either synchronically or diachronically (although the Lezgian data would allow such an analysis). His explanation for their similarities is that they serve similar pragmatic functions, and that in addition they are neither functional nor lexical items, but belong to a third category that they are unique to.

I propose instead that the reason why interrogative pro-forms and demonstrative pro-forms are similar is that interrogatives are in fact in fact demonstratives. Consider the compound paradigm in (21), which illustrates two familiar observations. First, demonstratives, like interrogatives, occur across syntactic categories and denote across ontological domains. Secondly, demonstratives usually allow between one and three feature values, such as proximal or distal, marking proximity to the interlocutors.

(21)

	proximal	medial	distal	<i>u/wh</i>	
thing	this	that		what	
locative	here	there		where	
allative	hither	thither		whither	
ablative	hence	thence		whence	
time	then			when	
degree	yay			how	
person	der			wer	(German)
amount	tiek			kiek	(Lithuanian)
quality	takoј			kakoј	(Russian)
manner	kō	sō	a	dō	(Japanese)

My proposal is that *wh*- be regarded as an additional possible proximity value, next to proximal, medial and distal. If this is so, we understand why demonstratives and interrogatives behave so similarly, as observed by Diessel (2003). In addition, we understand why interrogatives tend not to be marked for proximal, medial or distal, as observed by Diessel: these features are in complementary distribution.⁶

⁶ This does not preclude of course that a deictic expression is adjoined to a *wh*-pro-form, as in *who here wants ice cream?* Perhaps this might explain the exception noted by Diessel: Amele (Papua) has *ai* 'where proximal' vs. *ana* 'where distal' (Roberts 1987).

The most important point for our purposes is that like *wh*-expressions, demonstratives denote across ontological domains, with a common semantic core (deixis). If we find a solution for the cross-categorical semantics of demonstratives, we may automatically solve the cross-categoriality problem for *wh*-expressions, as well. I will briefly discuss my proposal for the semantics of demonstratives, and then return to interrogatives.

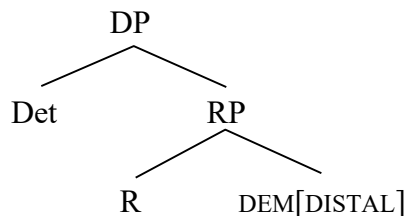
3.1. A cross-categorical semantics for demonstratives

This section summarizes the approach to the cross-categorical semantics of demonstratives proposed in Ruys (2022, in prep). We start from Nunberg’s (1993) phenomenon of deferred reference. Consider (22) and (23):

- (22) [pointing at a recovered patient, to refer to the medication that cured him:]
That (molecule) worked great!

Nunberg argues that in analyzing such examples, where the speaker gestures at one thing while intending to refer to another, we need to distinguish between the *index* (a feature of the utterance context; in (22): the patient) and the *referent* (in (22): the medication). These are mediated by a relation *R* (here: a function from patients to the medication they took) that the interlocutors need to construct from context and world knowledge. Elbourne (2008) implements this by postulating a free variable *R* in the internal syntax of the demonstrative, which I adapt as follows:

- (23) *that*:



- (24) a. $\llbracket \text{DEM}[\text{DISTAL}] \rrbracket^{\text{g,c}}$ = $(\lambda x:\text{far from speaker}(x).x)(\delta_c)$
 $\equiv \delta_c$ [with presupposition δ_c is distal]
- b. $\llbracket \text{R DEM}[\text{DISTAL}] \rrbracket^{\text{g,c}}$ = $g(\text{R})(\delta_c)$
- c. $\llbracket \text{Det} \rrbracket^{\text{g,c}}$ = $\lambda P.\iota x[\text{P}(x)]$ ⁷
- d. $\llbracket \text{Det} [\text{R DEM}[\text{DISTAL}]] \rrbracket^{\text{g,c}}$ = $\lambda P.\iota x[\text{P}(x)](g(\text{R})(\delta_c)) \equiv \iota x[g(\text{R})(\delta_c)(x)]$

I assume in Ruys (2022) that the demonstrative feature *DEM* refers to the demonstratum in the utterance context (written as δ_c), subject to a presupposition triggered by the proximity value: (24a). *R* is a free variable, its value constructed from context and world knowledge but constrained by its sister and the head that selects for it. The function denoted by *R* applies to δ_c (24b); its output in the case of DP demonstratives must be a set of individuals, for the definite determiner *Det* to be able to apply to it (24c). The DP ends up denoting the unique object *x* that has the salient relation *R* with the demonstratum, as in (24d). I assume further

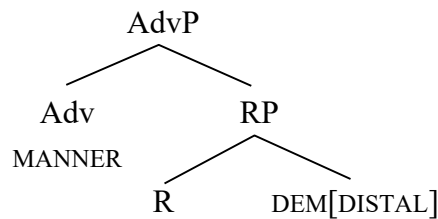
⁷ I follow the notational convention from Elbourne 2008 that uses ι to denote the presuppositional definite determiner meaning.

that R may either default to IDENT ($\lambda x \lambda y. y=x$), as proposed by Elbourne 2008, in which case reference is not deferred but (24d) = δ_c , or it may take on any other value the interlocutors construct, e.g., a function from patients to the medications they took.

The presence of R in turn explains why demonstratives can exist cross-categorially, with a shared demonstrative core. Ruys (2022, in prep) argues that in the case of manner demonstratives, quality demonstratives, and even locative demonstratives, the demonstratum in the utterance context (the target of a gesture or a mental directing of attention) is never itself the denotation of the demonstrative. E.g., with manner demonstratives, one gestures at an individual involved in an event taking place in a particular manner, or perhaps at the event itself, while the demonstrative denotes a (salient) manner in which that event is taking place: the manner is not a possible demonstratum (briefly, because a manner cannot be proximal or distal; see Ruys (2022, in prep) for further discussion). The fact that one can use manner demonstratives at all is thus due to the presence of R which mediates between demonstratum and referent. (26) from König & Umbach (2018) illustrates this for the Japanese distal manner demonstrative *a* (see also Coulmas 1982):

- (26) Hanako-wa *a* odor-u.
Hanako-TOP thus (distal) dances-PRS

(27) *a*:



- (28) a. $\llbracket \text{DEM}[\text{DISTAL}] \rrbracket^{\text{g,c}} = (\lambda x: \text{far from speaker}(x).x)(\delta_c)$
 $\equiv \delta_c$ [with presupposition δ_c is distal]
- b. $\llbracket \text{R DEM}[\text{DISTAL}] \rrbracket^{\text{g,c}} = \text{g}(\text{R})(\delta_c)$
- c. $\llbracket [\text{Adv MANNER}] \rrbracket^{\text{g,c}} = \lambda x_{\langle v,t \rangle}: \text{manner}(x).x$ [v for events]
- d. $\llbracket [\text{Adv MANNER}] [\text{R DEM}[\text{DISTAL}]] \rrbracket^{\text{g,c}} = (\lambda x: \text{manner}(x).x)(\text{g}(\text{R})(\delta_c)) \equiv \text{g}(\text{R})(\delta_c)$
 [with presupposition that value of R applied to δ_c yields a manner]

With the DP demonstrative *that* in (23) we saw that the definite determiner can only combine with RP if R yields a set of individuals as value; in (27), R's output type and properties are constrained by categorial and other features of the adverbial head in the same way. The MANNER-feature in particular requires its complement to have the type and properties of a manner. This forces the speaker/hearer to supply a value for R that is a function from the demonstratum δ_c to a manner, e.g., a function that takes an individual and yields a salient manner in which the salient event that individual is involved in is taking place. The interested reader is referred to Ruys (2022, in prep) and Ruys (2023) for further discussion.

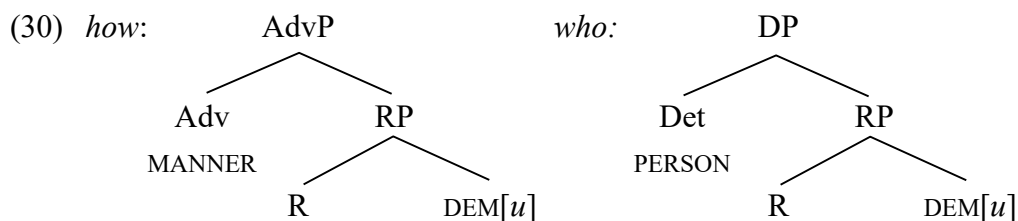
3.2. Application to *wh*-demonstratives

The basic intuition underlying my treatment of *wh*-pro-forms as demonstratives is that they signal an unspecified proximity value: by asking *what* (thing, person, manner, etc.), one indicates that the choice between *this* (thing, person, manner, etc.) and *that* (thing, person, manner, etc.) is undecided. Technically, I propose to implement this by the following pair of assumptions. First, *wh*- is actually the unvalued state of the demonstrative feature: DEM[*wh*-] is DEM[*u*]. Second, (constituents containing) unvalued features function as variables. This second assumption, borrowed from Ruys (2015), is illustrated in (29):

- (29) a. John_{[Case[nom]]} [T was] kissed John_{[Case[u]]}
 b. (John) λx. [T was] kissed x

Following Chomsky (1998), we assume that *John* is first merged with an unvalued Case-feature, which renders it visible for attraction by the probe T. We assume in addition that while T values this Case feature as NOM, the Case feature on the downstairs copy of *John* remains unvalued, and this is what marks it (or some dominating node, depending on the conditions on pied piping, which I cannot address here) as a downstairs (trace) copy that needs to be interpreted as a variable (of type e, if that is the type of the DP *John* under its regular interpretation). We extend this account by postulating that interpretable features (such as demonstrative features) can also be unvalued, in which case they also function as variables.

Consider now the English manner and person interrogatives in (30):



- (31) a. $\llbracket \text{DEM}[u]_i \rrbracket^{g,c} = g(x_i)$
 b. $\llbracket \text{Adv MANNER} [R \text{ DEM}[u]_i] \rrbracket^{g,c} = g(R)(g(x_i))$
 presupposing that $g(R)(g(x_i))$ is a manner
 c. $\llbracket \text{Det PERSON} [R \text{ DEM}[u]_i] \rrbracket^{g,c} = (\lambda x:\text{person}(x).x)(\lambda P.\iota x[P(x)](g(R)(g(x_i))))$
 $\equiv \iota x[g(R)(g(x_i))(x)]$, presupp. it's a person

The unvalued DEM feature functions as a variable: (31a). Its type is determined as before: since a demonstrative feature is regularly of type e, so is the variable. The rest of the composition proceeds as before, as well. The adverbial head in *how* coerces R into a function from individuals to manners. The definite determiner in *who* forces R to yield a set of individuals. Since ϕ -features (not indicated here) and presuppositional features such as

PERSON are features of D or of higher projections, they apply to the referent (the output of R), not to the index, as observed by Nunberg (1993).⁸

Consider this derivation with *who*:

- (32) a. $[_{CP} \text{ who}_k [_{C'} \text{ did Mary kiss } \text{who}_k]]$
 b. $[_{k} [\text{Det PERSON } [_{i} \text{ R dem}[u]_i]]_k \text{ did Mary kiss } [_{k} [\text{Det PERSON } [_{i} \text{ R dem}[u]_i]]_k]_k$
 c. $[[\text{Det PERSON } [_{i} \text{ R dem}[u]_i]]_k]^{g,c} = g(x_{k,e})$
 d. $[[C']^{g,c} = \lambda x_k . \text{ Mary kiss } x_k$
 e. $[[[_{i} \text{ R dem}[u]_i]]^{g,c} = \iota x [g(R)(g(x_i))(x)]_e$
 f. $[[\text{who } C']^{g,c} = (\lambda x_k . \text{ Mary kiss } x_k) (\iota x [g(R)(g(x_i))(x)])$
 $\quad \equiv \text{ did Mary kiss } \iota x [g(R)(g(x_i))(x)]$
 g. $[[\text{CP}_{wh}]^{g,c} = \lambda p \exists x_i [p = \wedge \text{ Mary kiss } \iota x [g(R)(x_i)(x)]]$
 h. $[[\text{CP}_{wh}]^{g,c} = \lambda p \exists x_i [p = \wedge \text{ Mary kiss } x_i]$

(32a) contains two copies of *who*, shown in detail in (32b). Both copies have the same internal structure, yielding the interpretation in (31c) above. However, as the lower copy is recognized as a trace it functions as a variable of the same type as its regular interpretation: see (32c). This trace is λ -bound at the C' level in (32d), e.g. with the familiar mechanism from Heim & Kratzer (1998) that splits off the index, which in turn triggers lambda-abstraction. The upstairs copy of *who* in (32e) composes with this predicate. Since the *wh*-expression does not have an operator semantics it cannot apply to C' and bind the variable. Instead, the C' predicate applies to *who*: *who* undergoes semantic reconstruction, yielding (32f).⁹ I have no specific proposal to make about the mechanics of the subsequent operations, namely the process of unselective binding itself, and the procedure that lifts the CP_{wh} denotation to a set of propositions. The reader may consult Rullmann & Beck (1998), Kratzer & Shimoyama (2002), Cable (2010) a.o. for possible approaches. The outcome should be that the CP_{wh} yields the set of propositions given in (32g), where existential closure binds the $DEM[u]$ variable. Finally, we assume as before that R can default to IDENT (no deferred reference), which results in (32h) (still with the presupposition that the value of x_i is a person).

The derivation with *manner-how* is different mainly in that R cannot default to IDENT:

- (33) a. $[_{CP} \text{ how}_k [_{C'} \text{ did Peter kiss John } \text{how}_k]]$
 b. $[_{k} [\text{Adv MANNER } [_{i} \text{ R DEM}[u]_i]]_k \text{ did Peter kiss John } [_{k} [\text{Adv MANNER } [_{i} \text{ R DEM}[u]_i]]_k]_k$
 c. $[[\text{Adv MANNER } [_{i} \text{ R DEM}[u]_i]]_k]^{g,c} = g(x_k, \langle v, t \rangle)$
 d. $[[C']^{g,c} = \lambda x_k . \text{ Peter kiss John } x_k$
 e. $[[[\text{Adv MANNER } [_{i} \text{ R DEM}[u]_i]]]^{g,c} = g(R)(g(x_i)) / \text{presupposed a manner}$

⁸ The demonstrative counterpart of *who* is spelled out as *he* or *she* in English: see Ahn (2022), Ruys (2023).

⁹ Unlike Lechner (2013), I follow Cresti (1995) in assuming that semantic reconstruction is, or at least can be, intensional.

- f. $\llbracket \text{how } C' \rrbracket^{\text{g}^c} = (\lambda x_k . \text{Peter kiss John } x_k) (g(R)(g(x_i)))$
 $\equiv \text{Peter kiss John } g(R)(g(x_i))$
- g. $\llbracket \text{CP}_{\text{wh}} \rrbracket^{\text{g}^c} = \lambda p \exists x_i \exists R [p = \wedge \text{Peter kiss John } R(x_i)]$

The derivation proceeds much as in (32). Manner-*how*, like the manner adverbial in (27), has the type of a VP modifier, say $\langle v, t \rangle$ (which combines with VP via predicate modification, i.e., intersection). As a result, its trace has this type as well. The upstairs copy of *how* also has this non-operator type, so like *who* it undergoes semantic reconstruction. However, the MANNER feature forces R to lift the uninterpretable DEM-feature (a type e variable) to the type of a manner modifier, so R cannot default to IDENT.¹⁰ Instead, absent a salient function of the required type, R must also undergo existential closure, resulting in (33g) (where $R(x_i)$ is presupposed to have the properties of a manner).

Independent evidence for this analysis comes from island effects. In general, adjuncts cannot be extracted from weak islands. We can attribute this to a ban on binding other than e-type variables across islands (Frampton 1999). Likewise, adjuncts cannot remain *in situ* inside islands, since this would require binding the R-variable across an island. The fact that arguments are interpretable inside islands (see example (6a) above) is in line with our analysis, since with e-type *wh*-expressions R can default to IDENT.¹¹ This analysis holds the promise of explaining a known but puzzling exception, exemplified here by (34) from Huang (1982b) (see also Kiss 1993, Bayer 2006): *wh*-adverbials inside islands are acceptable, in case the interlocutors can conceptualize them as object-denoting. Those circumstances would allow R to remain a free variable mapping object to modifier, so that only the object-denoting variable DEM feature is bound across the island.

- (34) $[_{CP}$ ni xiang kan $[_{DP}$ $[_{CP}$ ta shemeshihou pai de] dianying]]?
 you want see he when film DE movie
 ‘you want to see movies that he filmed *when*?’

4. Conclusion

I have offered a semantics for *wh*-pro-forms that meets the desiderata outlined in section 2. By postulating that *wh*-expressions are unvalued uninterpretable variants of demonstratives, we account for their semantic and morphological relation to these paradigm-mates. The cross-categoriality of *wh*-pro-forms is analyzed by the same mechanism that allows regular demonstratives to function cross-categorially; there is independent evidence for this mechanism from the phenomenon of deferred reference. By treating *wh*-pro-forms as non-operator expressions, the correct types for trace-variables follow automatically from the simple mapping principle proposed in Ruys (2015). For the same reason, *in-situ* interpretation of *wh*-pro-forms is unproblematic; consequently, pied piping allows the same treatment if followed by reconstruction.

¹⁰ Note that here, as well in the treatment of regular demonstratives, we must allow R to have a flexible type. This is achieved in Ruys (2015) by making the type of a variable dependent on the assignment function.

¹¹ Given our approach it is plausible to treat *which*, the *wh*-counterpart of determiner *that*, as being of type e, with the lexical NP as an appositive (triggering a conventional implicature).

Given the extensive literature on *wh*-expressions, there are bound to remain many more open questions than I have provided answers. To mention just a few: more work is needed to explore from the perspective I have offered the treatment of pair-list and functional readings, the analysis of relative clause operators, free relatives, and determinatives, and the treatment of indeterminate pronouns in other positions, especially in view of the implementation of unselective binding, among many other issues.

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