

Descriptions of Grail fragments

Hindi

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1 Overview of the data

1.1 Basic selectional requirements

Hindi is an SOV language. The following sentence shows the basic word-order of Hindi:

(1) Example (Dayal, 1996, ex.6)

Anu-ne kitaab khariidii
Anu-[erg] book buy-[pres]
“Anu bought a/the book.”

[Grail: Basics]

With the following lexicon we can derive sentences with the basic word order.

$\text{anu} : \square_{nom}np$
 $\text{kitaab} : \square_{acc}np$
 $\text{khariidii} : \square_{acc}np \setminus_1 (\square_{nom}np \setminus_1 s)$

Noun phrases are decorated with a box feature denoting the case of the noun phrase. Actually, this case feature could be left underspecified for *Anu* and *kitaab*, because both can get nominative and accusative case. One could leave this feature unspecified against the specified feature of the verb and use subsumption checking to derive the right feature relation between the verb and its arguments. For this we use an extension to Grail to handle the feature checking by using the ALE subsumption checking. For now we simplify the fragment by adding the specific case features to the noun phrases.

Verbs As Hindi is an SOV language we specify the selectional requirements of intransitive verbs by selection of a noun phrase on the left while checking the nominative case feature. A transitive verb selects first for a noun phrase with accusative case and continues as given by the type-assignment of an intransitive verb. The following macros show how transitive and intransitive verbs can be typed.

$IV : \square_{nom}np \setminus s$
 $TV : \square_{acc}np \setminus IV$

Sample sentences

$\text{Anu kitaab khariidii} \vdash s$
 (=John bought a book)

1.2 Directionality of complement clauses

Dayal (1996) argues that there is a correlation between finiteness and the directionality of complement clauses. It depends on the tense of the verb in the embedded clause at which direction the complement clause occurs. As the following examples show, an infinite complement clause occurs in a preverbal position, while finite complements occur at the right periphery of the matrix clause.

- (2) Anu [kyaa karnaa] jaantii hai
 Anu what do[inf] know [pres]
 “What does Anu know to do?”
 * “Anu knows what to do.”
- (3) Anu jaantii hai [ki kyaa karnaa hai]
 Anu know [pres] that what do be-[pres]
 “Anu knows what is to be done.”
 * “What is such that anu knows it has to be done.”

The interpretation of the wh-elements inside these complements differs with the tense and aspect features of the complement clause. The wh-element takes matrix scope when the complement clause is non-finite, and the embedded wh-phrase has narrow scope when it appears in the finite complement clause in the right periphery. This scopal difference will be analyzed further in section 1.4

[Grail: Types for complement clauses]

To differentiate between the selection of a non-finite complement clause to the left and a finite complement clause to the right, one should concentrate on different structural postulates. Structural postulates are rules that will change the word-order or composition relation under influence of a special feature. When applied it can extrapose a finite complement clause after it is selected by the auxiliary, or move an infinite clause to the preverbal position after it is merged with the auxiliary. As the matter is not relevant for the analysis of wh-phrases, I choose to assign two types for the auxiliary selecting for complement clauses: one that selects for a complement clause to the left and one that selects to the right.

To illustrate the use of the different verbal type-assignments, the wh-phrases are now simply typed as: $\square_{wh}\square_{accnp}$. In section 1.4 we will introduce higher order type-assignments for these entries to derive wh-scrambling and get the different scopal relations.

jaantiihai : $((\square_{nomnp}\backslash_1s)/_1s)$ - think[pre]
 jaantiihai : $s\backslash_1(\square_{nomnp}\backslash_1s)$ - think[pre]
 karnaa : $\square_{accnp}\backslash_1s$ - do[inf]
 karnaahai : $\square_{accnp}\backslash_1s$ - do[pres]
 kyaa : $\square_{wh}\square_{accnp}$ - what

Sample sentences For now interrogative phrases are simply typed as *s*, the same type as declarative sentences. Note that this is a simplification and derives ungrammatical sentences. With this kind of type-assignment you cannot discriminate between different kind of auxiliaries that either select for a relative clause or an interrogative clause.

- (4) Anu kyaa karnaa jaantii hai $\vdash s$
 (=What does Anu know to do?)
- (5) Anu jaantii hai kyaa karnaa hai $\vdash s$
 (=Anu know what is to be done.)

1.3 Long-distance movement

In Hindi the *wh*-phrase can stay in its base position or it is displaced and appears at the front of the sentences. The following interrogative clause shows this optionality. The *wh*-phrase can occur either preverbally at the direct object position or move to the front of the matrix clause. The semantics of the interrogative clause is not changed with *wh*-scrambling. In both sentences the *wh*-phrase has matrix scope over the clause.

- (6) a. Raviine kisko dekhaa?
 Ravi[erg] whom saw
 Who did Ravi saw?
- b. Kisko Raviine dekhaa

This displacement not only comes about for movement of a *wh*-phrase out of a matrix clause, but also when the *wh*-phrase is deeper embedded inside a complement clause, provided there are no intervenors. When the *wh*-phrase is deeper embedded in a complement clause it can also stay, but then a scope marker is inserted in the matrix clause (see section 1.7). In the following examples the *wh*-phrases are displaced and appear in the matrix clause, where it binds the argument position of the verb in the embedded complement clause.

- (7) a. Kisko Siitaa-ne soctaa hai ki ravii-ne dekhaa hai?
 whom Sita[erg] thinks [pres] that Ravi-[erg] see [pres]
 "Who does Sita think that Ravi saw?"
- b. Siitaa-ne kisko soctaa hai ki ravii-ne dekhaa hai?
 Sita[erg] whom thinks [pres] that Ravi-[erg] see [pres]

[Grail: Wh-movement postulates]

Some more words need to be added to the lexicon:

soctaa : $(\Box_{nom} np \setminus_1 s) /_1 s$ - think(pre)
 kisko : $\Box_{wh} \Box_{acc} np$ - who
 Raviine : $(\Box_{nom} np$ - Ravi (erg)

With the simple first-order type assignment to wh-phrases ($\Box_{wh} \Box_{case} np$) we can get the right displacement properties by implementing structural postulates. These rules displace the wh-phrase from its argument position to the front of the structure by recursively applying the rule to the feature decorated phrase.

As the verbs select for arguments to the left, we only need the left extraction postulates in order to move the phrase to a fronted position.

$$\begin{aligned} \Diamond_{wh} A \bullet_1 (B \bullet_1 C) \vdash (\Diamond_{wh} A \bullet_1 B) \bullet_1 C & \quad [Wh1] \\ \Diamond_{wh} B \bullet_1 (A \bullet_1 C) \vdash A \bullet_1 (\Diamond_{wh} B \bullet_1 C) & \quad [Wh2] \end{aligned}$$

Sample sentences With the given postulates and type-assignments, we can now derive the following sentences.

- (8) Kisko Raviine dekhaa $\vdash s$
 (=Who did Ravi see?)
- (9) Kisko Anu soctaa ki ravii-ne dekhaa $\vdash s$
 (=Who did Anu think that Ravi saw)

1.4 Scope of wh-phrases

Long-distance movement of a wh-phrase in Hindi gives an existential reading. The argument position of the verb phrase where the wh-phrase is abstracted from is bound by the existential quantifier. Furthermore it will have a functional reading where it's looking for all propositions that makes that interpretation true. For now we will leave the discussion on the different kinds of readings (pair-list, functional or individual) and abstract away from this propositional binding. I will merge this propositional reading with the existential reading into a special binder \mathcal{U} . A sentence such as: "Kisko Raviine dekhaa" would get the meaning and is rewritten using the new binder.

$$\begin{aligned} \lambda p. \exists x (\text{person}(x) \wedge p = \wedge \text{see}(\text{ravi}, x)) \\ \rightsquigarrow \mathcal{U}x (\text{person}(x) \wedge \wedge \text{see}(\text{ravi}, x)) \end{aligned}$$

[Grail: Quantifier types]

With the simple type-assignments of section ??, we cannot derive the interpretation for interrogatives as abstracting over the displaced argument. As the movement postulates have no influence on the semantics the moved phrase will be interpreted as argument of the verb phrase. However, in long-distance wh-movement you would want to have the meaning of the wh-phrase having scope over the matrix clause, abstracting over the argument of the verb phrase where it's displaced from (Vermaat, 1999, 2004). In order to derive this kind of meaning one needs to turn to higher-order type assignments.

To derive the scope relations, we have adopted the type assignment for quantifier phrases to type the Hindi wh-phrases.

$$\begin{aligned} \text{kyaa} &: s/1(\diamond_{wh} \square_{wh} \square_{accnp} \setminus_1 s) - \lambda P.(\exists x.(P x)) \\ \text{kisko} &: s/1(\diamond_{wh} \square_{wh} \square_{accnp} \setminus_1 s) - \lambda P.(\exists x.(P x)) \end{aligned}$$

Sample sentences Again we will derive the same sentences as in section 1.3, but now we will get the right interpretation where the displaced wh-phrase has scope over the matrix clause verb.

- (10) Kisko Anu dekhaa $\vdash s$
(=Who did Ravi see?)
- (11) Kisko Siitaa-ne soctaa ki ravii-ne dekhaa $\vdash s$
(=Who did Sita think that Ravi saw)

1.5 Embedded Wh-phrases

Dayal (1996) indicates that the scope of the embedded wh-phrase depends on location and the tense feature of the complement clause. The wh-phrase gets matrix scope in case the infinite complement clause is preverbally or narrow scope in case of the finite clauses in the right periphery.

[Grail: Q-types]

To be able to get the right scope readings for embedded wh-phrases we need to adapt the type-assignment introduced in the previous section such that it can take scope over the clause they are embedded in. Hendriks (1993) suggested a special quantifier type to clarify the scopal relations between different quantifier types. We will adopt his proposal and apply them to the special instances of the wh-phrases. These types take propositional arguments and quantify over these instances.

$$\begin{aligned} \text{kyaa} & : q(\langle \diamond_{wh} \square_{wh} \square_{acc} np, s, s \rangle - \langle \lambda P.(\exists x.(P x)), \lambda Q.Q \rangle) \\ \text{kisko} & : q(\langle \diamond_{wh} \square_{wh} \square_{acc} np, s, s \rangle - \langle \lambda P.(\exists x.(P x)), \lambda Q.Q \rangle) \end{aligned}$$

The logical rule for decomposing these Q-types was originally proposed by Hendriks (1993), and later translated to type-logical grammar by Moortgat (1996). As explicated in Moortgat (1996) one needs special set of postulates to get the right interaction mechanism to let the in-situ binder get scope outside of its local domain. The following set of postulates form an alternative to the sets introduced in a presentation by Moortgat (?).

$$\begin{aligned} B \bullet_1 (A \bullet_{nw} C) & \vdash A \bullet_{nw} (B \bullet_1 C) & [Pnw] \\ (A \bullet_{nw} B) \bullet_1 C & \vdash A \bullet_{nw} (B \bullet_1 C) & [Pnw1] \\ B \bullet_{se} (A \bullet_1 C) & \vdash A \bullet_1 (B \bullet_{se} C) & [Pse] \\ A \bullet_{se} (B \bullet_1 C) & \vdash (A \bullet_{se} B) \bullet_1 C & [Pse1] \end{aligned}$$

Sample sentences In comparison to the previous sample sentences you will now see that the quantifier phrase depending on its position can take scope over either the embedded complementizer clause or over the whole matrix clause. Applying the lexical semantics the sentences reduce to the right interpretations.

(12) Anu kyaa karnaa jaanti hai $\vdash s$
(=What does Anu know to do?)

Anu jaanti hai ki kyaa karnaa hai $\vdash s$
(=Anu know what is to be done.)

[Grail: Note]

The type-assignment of the wh-phrase does not discriminate between extraction out of the matrix clause level or an interrogative clause, both typed as s . Due to this it can either take scope over the matrix verb clause or stay embedded. While we would like to derive the embedded reading for the second sentence and the matrix clause reading for the first sentence. The next section shows how we can prevent certain unwanted readings.

1.6 Sentential differences

Section 1.4 we introduced higher-order type-assignments for wh-phrases to derive the different scope readings. This type-assignments overgenerates because it doesn't discriminate on the different sentential levels. We will now change the selectional requirements of the verbs and the Q-types such that there will be different levels where the wh-phrases can or cannot take scope over due to the requirements of the sentential types they can be combined with.

[Grail: S-derivability relations]

With the scope postulates one can derive the different scope readings for a certain class of generalized quantifiers. In (Bernardi, 2002, Ch.6), Bernardi illustrates this in addition to the sentential subtyping of the different classes of quantifier phrases. Another usage for this subtyping system would be to allow or disallow the extraction out of certain classes.

$$\diamond \square s \vdash s \vdash \square \diamond s$$

We adopt this subtyping to decorate the different sentential levels in the Hindi-fragment, and by doing so we can prevent certain scope readings. Interrogative clauses are analyzed as $\square_f \diamond_f s$, while declarative clauses get the featureless type s . A similar distinction can be made between finite and infinite verb forms. In this way finite clauses are typed s and infinite (complement) clauses are typed $\square_f \diamond_f s$.

As the auxiliaries *jaantii* (=know), *soctaa* (=think) can select for an embedded declarative clause or an interrogative, the selected complement clause gets the type $\square_f \diamond_f s$. This type will be used to type interrogative clauses, but from this type the basic type s can be derived.

Lexicon The following words get a different type-assignment in the lexicon.

kyaa : $q(\diamond_{wh} \square_{wh} \square_{acc} np, \square_f \diamond_{fs}, s) - \lambda P. (\exists x. (P x))$
 jaantiihai : $\square_f \diamond_{fs} \setminus_1 (\square_{nom} np \setminus_1 s) - \lambda P \lambda x ((\text{know}(\text{pre}) P)x)$
 jaantiihai : $(\square_{nom} np \setminus_1 s) /_1 \square_f \diamond_{fs} - \lambda P \lambda x ((\text{know}(\text{pre}) P)x)$
 karnaa : $\square_{acc} np \setminus_1 \square_f \diamond_{fs} - \text{do}(\text{inf})$
 karnaahai : $\square_{acc} np \setminus_1 s - \text{do}(\text{pre})$

Sample sentences The following pair of sentences illustrates how the sentential types are used. The first sentence is typed with $\square_f \diamond_{fs}$ to indicate that is used as an interrogative clause, while the second sentence gets the declarative type in syntax. With these sentential types we can now prevent the derivation of certain unwanted readings.

- (13) Anu kyaa karnaa jaanti hai $\vdash \square_f \diamond_{fs}$
 (=What does Anu know to do?)
- (14) Anu jaanti hai kyaa karnaa hai $\vdash s$
 (=Anu know what is to be done.)

1.7 Wh-scope marker

Apart from long-distance movement, there is the possibility that the wh-phrase stays *in-situ*. In these instances Hindi needs a scope marker to mark the structure as an interrogative clause.

Example 15 shows a scope-marking structure in Hindi.

- (15) Scope marking structure in Hindi (Dayal, 1994, ex.3, p.138)

Jaun **kyaa** soctaa hai meri **kis-se** baat karegii?
 John what think-[pres] Mary who-with will-talk
 "who does John think Mary will talk to?"

The wh-elements do not move, but may scramble. So also the sentence in 1.7 is a grammatical structure.

- (16) Jaun kyaa soctaa hai ki kis-se merii baat karegii ?
 John what think- [pr] that who-[ins] mary will-talk
 "Who does John think Mary will talk to?"

The scope marking constructions have unbounded dependency (Dayal (1994), ex.8(b), p.140). However, every intermediate clause must have a scope marker in it as the following example shows.

- (17) Jaun **kyaa** soctaa hai, anu **kyaa**/* \emptyset kahegii, meri **kis-se**
 John what thinks Anu what will-say Mary who-with
 baat karegii?
 will-talk
 "Who does John think Anu will say Mary will talk to?"

Dayal (1994) gives many more examples on wh-constructions in Hindi, but we will first analyze the basic setting.

Function of *kyaa*

There has been much debate over the function and the role of wh-scope marker in Hindi, also with respect to scope marking constructions in other languages. Some researchers (McDaniel (1989), Mahajan (2000)) claim that the scope-marker is an expletive: at a certain point in the derivation (LF) the embedded wh-phrase takes the place of the scope marker and in this way takes scope over the whole embedded clause. Dayal (1994, 2000) claims that it is a real wh-phrase that binds the embedded clause.

The first approach is called the direct dependency approach (= DDA), Dayal's approach is called the indirect dependency approach (= IDA). The main discussion point between the two approaches is the way the embedded wh-phrase is bound by the scope marker such that it can take the right interpretation. In the DDA the wh-scope marker and the embedded wh-phrase get into a direct relationship, while in the IDA they get indirectly connected by coindexing (the trace of) the scope marker with the embedded CP.

[Grail: Scope marking]

The only element we need to lexicalize is the wh-scope marker. In Hindi the scope marker is the wh-phrase *kyaa* which is also used as a normal wh-phrase. The object wh-phrase *kyaa* is typed as a generalized quantifier with some additional wh-features. This type cannot be used to type the wh-scope marker. As type-logical grammar is resource sensitive, we will not be able to derive a sentence with two phrases typed with an *np* while they are not selected by the respective verb phrases.

Apart from the resource sensitivity of type-logical grammar, the use of *kyaa* as scope marker differs from the use of *kyaa* as *wh*-phrase: the scope marker doesn't function as an argument for the matrix verb and it doesn't in itself have interrogative meaning. This is why we assign it a different type in the lexicon. *Kyaa* has to form a 'bridge' between the predicate of the matrix clause and the interrogative complement clause. The only way to realize this syntactically is when *kyaa* incorporates the matrix verb phrase with its requirements for selecting further argument and then select for the complement clause. In this way we get a function over the complement clause and the semantic interpretation that the interrogative is propositionally bound by the matrix verb phrase.

$$\text{kyaa} : (IV/1 \square_f \diamond_f s) /_1 (IV/1 s) - \lambda P. (\lambda T. (\lambda x. ((P T) x)))$$

Sample sentences Due to the parser the full sentence cannot be analyzed. We need to split it up in two parts, this is also beneficial for the readability of the analysis.

- (18) Jaun *kyaa* soctaa hai whemb $\vdash s$
 (=John thinks ...)
- (19) ki kisse merii baat karegii $\vdash \square_f \diamond_f s$
 (=... who Mary will talk to.)

2 Open problems

2.1 Multiple *wh*-questions

The embedded clause in scope marking constructions can contain multiple *wh*-phrases. The scope marker extends the scope of both *wh*-phrases.

- (20) Multiple embedded *wh*-elements (Dayal (1994), ex. 7(b), p.140).

Jaun **kyaa** soctaa hai **kaun kahaan** yaayegaa?
 John what thinks who where will-go
 "Who does John think will go where?"

2.2 Selectional requirements of the verb

Selectional requirements of the matrix verb: the matrix verb must be able to take an embedded *wh*-question as a complement, whereas the complement clause has to

be an embedded question. (ex11, p.141)

- a. * Jaun **kyaa** soctaa hai meri ravi-se baat karegii?
John what thinks Mary Ravi-with will-talk
- b. Jaun **kyaa** jaantaa hai meri **kis-se** baat karegii?
John what knows Mary who-with will-talk
- c. * Jaun **kyaa** puuchtaa hai meri **kis-se** baat karegii?
John what asks Mary who-with will-talk

(21) In contrast with German, in Hindi scope marking with factive islands is possible. (ex.33(b), p. 166).

tum-ko **kyaa** pataa calaa meri **kyuuN** nahiiN aayegii?
you-[dat] what discovered Mary why not will-come
“Why did you discover that Mary won”t come?”

[Mahajan (2000)]

Mahajan (2000) presents similar data as Dayal (1994). He calls the construction a *wh-expletive construction*.

(22) In Hindi there is no partial movement, neither of the expletive, nor of the wh-in-situ. (ex.1, p. 317) If there is no overt wh-scrambling *kyaa* is obligatory.

Siitaa-ne *kyaa*/∅ soctaa ki ravii-ne kis-ko dekhaa ?
Sita[erg] KYAA thought that Ravi[erg] who saw
“Who did Sita think that Ravi saw?”

(23) Long-distance wh-scrambling is also possible in Hindi. According to Mahajan the syntax, and therefore the semantics, of this construction is different from the wh-expletive construction. (ex. 4, p.318)

- a. Kis-ko_i siitaa-ne soctaa ki ravii-ne *t_i* dekhaa ?
who Sita[erg] thought that Ravi[erg] saw
- b. Siitaa-ne kis-ko_i soctaa ki ravii-ne *t_i* dekhaa ?
Sita[erg] who thought that Ravi[erg] saw
“Who did Sita think that Ravi saw?”

(24) The expletive *kyaa* appears preverbal at the same position of the direct object. Mahajan indicates that it acts as a kind of verbal clitic, for instance it cannot be intervened by an adverb. (ex. 7, p.319)

* Siitaa-ne kyaa abhii abhii soctaa ki ravii-ne kis-ko
 Sita[erg] KYAA now now thought that Ravi[erg] who
 dekhaa ?
 saw
 "Who did Sita think just now that Ravi saw?"

- (25) The embedded wh-phrase can partial move to an intermediate clause. (ex. 12, p.320)

Raam-ne kyaa socaa ki kon sa aadmii ravii-ne kahaa
 Ram[erg] KYAA thought that which man Ravi[erg] said
 ki aayaaa thaa ?
 that came be-[pst]
 "Which man did Ram think that Ravi said came?"

- (26) Overt wh-extraction with kyaa in the matrix clause are ill-formed, even with multiple wh-phrases embedded (ex. 14, p. 320)

- a. ?? Kis-ko siitaa-ne kyaa socaa ki ravii-ne dekhaa?
 who Sita[erg] KYAA thought that Ravi[erg] saw
 "Who did Sita think that Ravi saw?"
- b. ?? Kis-ko siitaa-ne kyaa socaa ki ravii-ne kyaa
 who Sita[erg] KYAA thought that Ravi[erg] what
 ciiz dii ?
 thing gave
 "Who did Sita think that Ravi gave what?"

- (27) Kyaa cannot co-occur with negative quantifiers (ex.20, p.321).

* Koi bhii nahii kyaa soctaa thaa ki kon aayegaa?
 noone KYAA thinks be-[pst] that who come-[fut]
 %"Who did noone think that will come?"

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