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Scope-marking constructions in type-logical grammar

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Abstract

Scope marking constructions only appear in some languages and are characterized by the use of a specially reserved interrogative pronoun. The interrogative pronoun occurs in a main declarative clause while the sentence has an embedded interrogative clause. The whole construction is interpreted as an interrogative clause where the embedded interrogative pronoun indicates what kind of answer is being requested. In this paper, we show that we can account for these constructions along similar lines as for standard wh-question formation (Vermaat, Forthcoming). Our analysis is formulated in the multimodal variant of type-logical grammar (Moortgat, 1997).

Keywords German, Hindi, scope-marking constructions, semantic uniformity, structural variation, type-logical grammar, wh-question formation

20.1 Introduction

While languages may differ syntactically in the structural build of interrogative clauses, semantically interrogatives have a similar interpretation. In Vermaat (Forthcoming), we present a uniform account of wh-question formation by introducing a wh-type schema. The wh-type schema can be written out in the usual connectives of the base logic of multimodal categorial. To account for the syntactic differences, the grammatical reasoning system is extended with a structural module. The structural module consists of meaning preserving non-logical axioms that under feature control alter the dominance and precedence relations in a structure. With the uniform type schema proposed for

wh-phrases along with the restricted set of structural postulates, we account for the syntactic and semantic aspects of scope marking constructions in German and Hindi .

The term, *scope marking* is used by Dayal (2000). The phenomenon is sometimes referred to as *partial wh-movement* (McDaniel, 1989) or *was-constructions* (Van Riemsdijk, 1982). The following example illustrates a scope marking construction in German:

(20.57) German scope marking construction

Was_i	*glaubt*	*Miro*	*welches*	$Bild_i$	*Picasso*	t_i	*gemalt*	*hatte?*
what	believes	Miro	which	picture	Picasso		painted	had

"Which picture does Miro believe that Picasso had painted?"

Syntactically, the role of the scope marker in German and Hindi is close to the grammatical role of a relative complementizer phrase; like a complementizer it connects the subordinate clause to the matrix clause. Semantically, however, the scope marker not only connects the embedded interrogative clause to the main clause, but it also acts like a standard wh-phrase and associates to the gap in the embedded interrogative clause.

In this paper, we inspect scope marking constructions and show that scope markers fit the type schema that Vermaat (Forthcoming) proposes for wh-phrases. The syntactic and semantic aspects of scope-marking constructions follow directly. In section 20.2, due to limited space, we list the main points of the MMCG framework. For a complete overview of the deductive system, we refer to the handbook article of Moortgat (1997). In section 20.3, we present the type schema that we use to type interrogative pronouns along with an inference rule which merges a wh-phrase to the body of a question. In section 20.4, we give a small set of data which illustrates the basic construction of interrogative clauses with scope markers in German and Hindi. In section 20.5, we step-by-step construct the syntactic type of the German scope marker. We start with a syntactic analysis of the scope marker as an instance of the wh-type schema proposed for interrogative pronouns. The proposal is extended by unfolding the type for wh-questions which reveals the similarity between object wh-phrases and scope markers. The semantic representation of the scope marking construction on the basis of the Curry-Howard isomorphism shows a similar interpretation of scope marking constructions and direct questions. Additionally, in section 20.6 we present some further empirical support for our account. In section 20.7, we briefly discuss our analysis in comparison with current generative syntactic accounts. We summarize the main points of our proposal in the conclusion.

20.2 Theoretical background

Multimodal categorial grammar (MMCG), a version of type-logical grammar, is a lexicalized grammar system. Due to space constraints, we leave an overview of the theoretical background and only summarize the main points of the grammar framework:

- the deductive system distinguishes two parts which form the basis of the grammatical reasoning system:
    - an invariant core: the logical deductive system
    - a flexible extension: the structural module
- meaning assembly is accounted for in the deductive system via the Curry-Howard isomorphism
- structural manipulations are lexically controlled in terms of feature decorations encoded as unary operators $\Diamond$, $\Box$ and delimited by mode distinctions
- the structural module is severely restricted and limited to the following four instances of displacement postulates which we assume to be universally encoded

left displacement postulates move a feature decorated element on a left branch to a left branch one node higher:

$$\frac{\Gamma[(\Diamond\Delta_1 \circ \Delta_2) \circ \Delta_3] \vdash C}{\Gamma[\Diamond\Delta_1 \circ (\Delta_2 \circ \Delta_3)] \vdash C} \; [Pl1] \qquad \frac{\Gamma[\Delta_2 \circ (\Diamond\Delta_1 \circ \Delta_3)] \vdash C}{\Gamma[\Diamond\Delta_1 \circ (\Delta_2 \circ \Delta_3)] \vdash C} \; [Pl2]$$

right displacement postulates move a feature decorated element on a right branch to a right branch one node higher:

$$\frac{\Gamma[\Delta_1 \circ (\Delta_2 \circ \Diamond\Delta_3)] \vdash C}{\Gamma[(\Delta_1 \circ \Delta_2) \circ \Diamond\Delta_3] \vdash C} \; [Pr1] \qquad \frac{\Gamma[(\Delta_1 \circ \Diamond\Delta_3) \circ \Delta_2] \vdash C}{\Gamma(\Delta_1 \circ \Delta_2) \circ \Diamond\Delta_3 \vdash C} \; [Pr2]$$

20.3 Wh-type schema

For the type assignment of interrogative pronouns, we propose a type schema $\text{WH}(A, B, C)$ (Vermaat, Forthcoming). The wh-type schema is similar to the q-type schema, $q(A, B, C)$, which was proposed by Moortgat (1991) to account for in-situ binding of generalized quantified phrases. The three place type schema WH ranges over three arguments: B is the type of the body of the wh-question; A is the type of the gap hypothesis contained in the body; C is the type of the result of merging the body of the wh-question with the wh-phrase. Schematically, the following inference rule defines the merging of a arbitrary wh-phrase ($= \Gamma$) with a body of a wh-question ($= \Delta$) which contains a gap hypothesis ($= \Delta[A]$). The result of merging the wh-phrase to the

body is a structure where the wh-phrase replaces the gap hypothesis in the structure $(= \Delta[\Gamma])$.

The inference rule for the type schema along with its semantic decomposition is the following:

$$\frac{\Gamma \vdash wh : \text{WH}(A, B, C) \quad \Delta[x : A] \vdash \text{BODY} : B}{\Delta[\Gamma] \vdash wh \ \lambda x.\text{BODY} : C} \ [\text{WH}]$$

Cross-linguistically, we recognize different instances of interrogative pronouns. In some languages the wh-phrase occurs fronted, (ex-situ, abbr. ex), while in other languages the wh-phrases stays in-situ (abbr. in). Another variation is the structural position of the gap hypothesis that the wh-phrase associates with. The gap hypothesis may reside either on a left or on a right branch. Whether the gap hypothesis occurs on a left (l) or on a right (r) branch influences the application of the structural rules and in turn effects the merging of the interrogative pronoun to the final structure.

We distinguish the different structural variants of type schemata by adding a subscript for the final position of the wh-phrase (ex or in) and a superscript for the underlying structural position of the gap hypothesis (l or r). For example, $\text{WH}_{ex}^{r}(np, s, wh)$ is assigned to object wh-phrases in an SVO wh-fronting language. The wh-phrase associates to np-type argument hypotheses which occur on a right branch in the sentential body typed s and yields a wh-question of type wh .

20.4   Data

Scope marking constructions in German and Hindi are sentences with an embedded interrogative clause and a scope marker fronted (German) or cliticized to the verb (Hindi) in the main clause. The matrix verb phrase in scope marking constructions is a bridge verb, such as *glauben* (= 'believe') in German, which normally allows for long-distance displacement. To show the distinction between direct questions and scope marking constructions, we first present the basic formation of wh-questions in German and Hindi.

Interrogative clauses   The standard construction of a direct question in German and Hindig are illustrated in examples 20.58 and 20.59. In German, the interrogative pronoun appears in fronted position in the main clause. In Hindi, the interrogative pronoun may appear either fronted in the matrix clause or cliticized to the verb.

(20.58) German direct question

Welches	*Bild$_i$*	*glaubt*	*Miro*	*dass*	*Picasso*	t_i	*gemalt*	*hatte?*
which	picture	believes	Miro	that	Picasso		painted	had

"Which picture does Miro believe that Picasso had painted?"

(20.59) Hindi direct question (Mahajan, 2000, ex.4, p.318)

Kis-ko$_i$	*siitaa-ne*	*socaa*	*ki*	*ravii-ne*	*t$_i$*	*dekhaa?*
who	Sita[**erg**]	thought	that	Ravi[**erg**]		saw

"Who did Sita think that Ravi saw?"

Scope marking constructions An illustration of a scope marking construction in German has been presented in example 20.57 and is reprinted below as example 20.60 . The scope marker '*was*' appears in fronted position while the actual interrogative pronoun '*welches Bild*' is partially moved to the front of the embedded interrogative clause. Example 20.61 illustrates a scope marking construction in Hindi. The scope marker '*kyaa*' may occur either fronted or preverbally in the matrix clause. The interrogative pronoun '*kis-se*' occurs in-situ in the embedded interrogative clause.

(20.60) German scope marking construction

Was$_i$	*glaubt*	*Miro*	*welches*	*Bild$_i$*	*Picasso*	*t$_i$*	*gemalt*	*hatte?*
what	believes	Miro	which	picture	Picasso		painted	had

"Which picture does Miro believe that Picasso had painted?"

(20.61) Hindi scope marking construction (Mahajan, 2000, ex.1, p.317)

(kyaa)	*siitaa-ne*	*kyaa*	*socaa*	*ki*	*ravii-ne*	*kis-ko*	*dekhaa?*
KYAA	Sita[**erg**]	KYAA	thought	that	Ravi[**erg**]	who	saw

"Who did Sita think that Ravi saw?"

Although scope marking constructions differ structurally from the standard way of wh-question constructions, the overall interpretation of the scope marking construction is the same. In the coming section, we present an analysis for German scope markers which accounts for the syntactic differences and at the same time derives a similar semantic interpretation.

20.5   Analysis

For the analysis of interrogative clauses and scope marking constructions we assume basic categories s for main declarative clauses, s' for subordinate clauses headed by '*dass*' and s_s for declarative subordinate clauses. Wh-questions are typed as declarative clauses which are incomplete for a certain constituent, the answer to the wh-question: $s/_?A$ where $A \in \{np, iv\backslash iv, \ldots\}$. The wh-phrase determines which kind of answer category is required[1]. The index $\cdot_?$ is added to the binary con-

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[1]In this paper, we only regard argument wh-phrases, but the same line of reasoning applies to adjunct wh-phrases.

nective to capture the compositional difference between predicates and arguments on a sentential level and between questions and answers on a discourse level. The most salient category for argument wh-questions is $s/_?gq$ where gq is an abbreviation for generalized quantifiers: $s/(np\backslash s)$. To simplify the derivations, we abbreviate the categories assigned to interrogative clauses to wh $(= s/_?np)$ for main interrogative clauses and wh' $(= s'/_?np)$ for embedded interrogative clauses.

In German, main clauses appear in SVO word-order, while subordinate clauses have a head final SOV word-order. The general accepted mechanism behind this word-order difference is verb movement. Because we want to concentrate on the analysis of interrogative clauses, we fix the underlying word-order of main clauses and subordinate clauses in the lexicon. The type-assignments to syntactic objects such as transitive verbs, intransitive verbs, determiners and noun phrases are the common types assigned to lexical elements in categorial grammar fragments.

German scope marker 'was' Before we discuss how the wh-scope marker finds its position at the front of the matrix clause, we first discuss the grammatical role of the scope marker. As we mentioned in the introduction, the scope marker acts like a complementizer. The complementizer '*dass*' changes the type of the subordinate clause such that it can be selected by the matrix verb. In MMCG, *dass* (= 'that') is categorized as s'/s_s. In scope marking constructions, the matrix verb is a bridge verb which selects for an embedded declarative clause (glaubt $\vdash$ IV$/s'$). The embedded clause in a scope marking construction, however, is an interrogative clause. The scope marker changes the category of the embedded interrogative (wh') into a category which can be selected by the bridge verb (s'). Intuitively, the scope marker operates like a lever between the embedded interrogative clause and the matrix clause. As the following derivation illustrates, the scope marker selects the embedded interrogative and changes the type to an embedded interrogative clause (s'/wh'). wbpgh is an abbreviation for an embedded interrogative clause, '*welches Bild Picasso gemalt hatte*' $(= wh')$

$$\frac{\text{glaubt} \vdash \text{IV}/s' \quad \dfrac{was \vdash s'/wh' \quad \text{wbpgh} \vdash wh'}{was \circ \text{wbpgh} \vdash s'} \; [/E]}{\text{glaubt} \circ (was \circ \text{wbpgh}) \vdash \text{IV}} \; [/E]$$

Structurally, however, the scope marker must appear at the front of the main clause and causes the sentence to be interpreted as a wh-question. The assignment of category s'/wh' to scope marker does not

account for the structural position of the scope marker at the front of the main clause. The scope marker must have a type-assignment which accounts for 1) the connection of the embedded interrogative to the main clause and 2) the structural position of the scope marker at the front of main clause. To account for these two characteristic, we use the wh-type schema to assign an appropriate category to scope marker. The scope marker is an ex-sity type which an associates to a gap hypothesis of category s'/wh' on a left branch. The scope marker merges to a question body of type s and yields a question of type wh. The instantiation of the type schema for the German scope marker '*was*' becomes:

$$\mathsf{was} : \text{WH}_{ex}^{l}(\Diamond\Box(s'/wh'), s, wh)$$

On the basis of this type, the scope marking construction is derived as follows[2]. We only display the last steps in the derivation where '*wbpgh*' is an abbreviation for an embedded interrogative clause, '*welches Bild Picasso gemalt hatte*' ($= wh'$).

$$\cfrac{\cfrac{(\mathsf{glaubt}\circ\mathsf{Miro})\circ(\Diamond\Box(s'/wh')\circ\mathsf{wbpgh})\vdash s}{\Diamond\Box(s'/wh')\circ((\mathsf{glaubt}\circ\mathsf{Miro})\circ\mathsf{wbpgh})\vdash s}\ [Pl2]}{\mathsf{was}\circ((\mathsf{glaubt}\circ\mathsf{Miro})\circ\mathsf{wbpgh})\vdash wh}\ {\vdots\ \mathsf{was}\vdash\text{WH}_{ex}^{l}(\Diamond\Box(s'/wh'), s, wh)\atop [\text{WH}_{ex}^{l}E]}$$

The derivation of the scope marker construction can be paraphrased in prose as follows. After the embedded interrogative is built up as usual, the sub formula of the scope marker (s'/wh') functions as an hypothesis that resides at the structural position of the relative clause marker. The hypothesized scope marker changes the type of the embedded interrogative into a embedded declarative clause (s'). The embedded clause is selected by the main clause **glaubt Miro**. After the main clause is merged to the subordinate clause, the hypothesis is displaced to the front of the matrix clause via displacement postulate *Pl2*. When the hypothesis occurs in fronted position, the scope marker is merged to the structure replacing the its hypothesis. The complete expression becomes of type wh.

Wh-phrases and scope markers So far, we have concentrated on the similarity between scope markers and complementizer phrases. However, the wh-scope marker is semantically more similar to object

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[2]We use an abbreviated natural deduction rule to merge the scope marker to the body of the question.

wh-phrases. Semantically, it associates to the gap hypothesis in the embedded interrogative. However, due to the occurrence of another wh-phrase, it cannot bind the hypothesized argument position directly. The gap hypothesis is already bound by the embedded wh-phrase. We show that the meaning assembly of the scope marker causes the λ-operator of the embedded interrogative to be bound to the scope marker. The semantic similarity between scope markers and object wh-phrases accomplishes this interpretation.

To inspect the similarity between object interrogatives and scope markers, we need to unfold the *wh*-type inside the scope marker type. We derive the following type in an unabbreviated format.

$$\frac{\text{WH}^l_{ex}(\Diamond\Box(s'/wh'), s, wh)}{\text{WH}^l_{ex}(\Diamond\Box(s'/(s'/_?np)), s, (s/_?np))} \ [unfold]$$

Syntactically, the type for object wh-phrases is similar to the type assigned scope markers. The difference is that the object wh-phrase associates to np gap hypotheses and the scope marker associates to a $s'/(s'/np)$ gap. Mapping the syntactic type to a semantic type, the scope marker is actually reasoning over "lifted" types: $(A \rightarrow B) \rightarrow B$.

> object wh-phrase '*was*' : $\text{WH}^l_{ex}(\Diamond\Box np, s, s/_?np)$
> scope marker '*was*'　　: $\text{WH}^l_{ex}(\Diamond\Box(s'/(s'/np)), s, s/_?np)$

The semantic term assigned to scope markers reflects this similarity to object wh-phrases. Instead of applying a predicate P to the argument variable x, the predicate P is applied to the lifted argument variable: $\lambda Q.(Q \ x)$.

> object wh-phrase '*was*' : $\lambda Q^{et}.\lambda x^e.(Q \ x)$
> scope marker '*was*'　　: $\lambda P^{((et)t)t}.\lambda x^e.(P \ \lambda Q^{et}.(Q \ x)))$

The semantic representation computed for scope marking constructions is the same for direct questions. We present the meaning assembly for the last steps of the previous derivation in figure 1. For easiness of reading, the type for wh-questions is abbreviated back to $wh \ (= s/_?np)$.

Before mering the scope marker, the λ-operator, λy, binding the gap variable in the embedded interrogative has been subsumed by variable R of the hypothesized scope marker. At the point where the scope marker is merged to the structure, the λ-operator λQ pulls out the λ-operator of the embedded interrogative. The result is a λ-term where the gap variable is bound to a λ-operator which takes scope over the

$$((\mathbf{believe}\ (R\ \lambda y.((\mathbf{picture}\ y) \wedge ((\mathbf{painted}\ y)\ \mathbf{p})))) \ \mathbf{m})$$

$$\cfrac{(\diamondsuit\square(s'/wh') \circ ((\mathsf{glaubt} \circ \mathsf{miro}) \circ \mathsf{wbpgh}) \vdash s}{\vdots\ \mathsf{was} : \lambda P.\lambda x.(P\ \lambda Q.(Q\ x))}\ [\mathrm{WH}_{ex}^{l}]$$

$$\mathsf{was} \circ ((\mathsf{glaubt} \circ \mathsf{miro}) \circ \mathsf{wbpgh}) \vdash wh$$

$$\leadsto_{\beta*}\ \lambda x.((\mathbf{believe}\ ((\mathbf{picture}\ x) \wedge ((\mathbf{painted}\ x)\ \mathbf{p})))\ \mathbf{m})$$

FIGURE 1: Meaning assembly of a scope marking construction

main clause. Hence, interpreting the whole sentence as an interrogative.

The same approach applies to Hindi scope markers. The difference between German scope markers and Hindi, is the structural realization of the scope marker. The type-assignment of Hindi scope markers differs with respect to the category of the body of the question. Hindi scope markers occur optionally fronted or preverbally. For an analysis of Hindi scope marking constructions, we refer to Vermaat (Forthcoming).

20.6   Further empirical support

Multiple scope marker construction Constructions with multiple scope markers are derived by recursively binding the embedded question. Each embedded clause that intervenes the embedded interrogative and the main clause must contain another scope marker. These scope markers pass the semantic representation of the embedded argument position on to the main clause by binding the lambda abstraction of the embedded interrogative.

An example of a multiple scope marker construction is the sentence: '*Was glaubte Miro was Hans meint welches Bild Picasso gemalt hatte?*'. The intervening embedded clause is marked with another scope marker and thus binds the embedded argument position.

When the embedded wh-phrase does not occur in the final embedded clause, but occurs in an embedded clause higher up, the scope marker only appears in the clauses preceding the partially moved wh-phrase, for instance '*Was glaubte Miro welches Bild Hans meint dass Picasso gemalt hatte?*'. Due to the selectional requirements of the verb clause that follow the wh-phrase ($\mathsf{Hans\ meint} \vdash s/s'$) the subordinate clause that follows the embedded interrogative are merged to the invening clause using the relative complementizer phrase '*dass*'. If '*was*' would be applied, the derivation fails.

Multiple wh-phrases Another scope marking phenomenon in Hindi falls out when scope markers are typed as proposed in this paper. In

Hindi, a scope marking construction is also used when the matrix verb selects for an embedded interrogative and the embedded interrogative contains multiple wh-phrases. For instance the sentence:

(20.62) (Lahiri, 2002, ex.73, p.522)

Jaun	***kyaa***	*puucha*	*ki*	***kis-ne***	***kis-se***	*baat*	*kii?*
John	what	asked	that	who	who-with	talk	do-[**pres**]

"Who did John ask who talked to?"

The embedded clause '*ki kis-ne kis-se baat kii*' has two wh-phrases embedded and therefore becomes of type: $(s/_?np)/_?np$. The matrix verb *puucha* (= 'ask'), however, only selects for a single wh-question type. The hypothesis of the scope marker selects for a multiple wh-question type and yields a single wh-question type: $((s'/np)/(wh'/np))$. The whole phrase is interpreted as presented in the glosses of the example; one argument is bound at the main clause level the other is bound in the embedded clause.

20.7 Discussion

Syntactic accounts in the syntactic framework have proposed different mechanisms to derive the right interpretation of scope marking constructions. Two leading approaches are the direct dependency approach and the indirect dependency approach. The proposed analysis type-logical grammar shows, however, that the mechanism used to derive a syntactic account of the scope marking constructions results in a semantic representation similar to direct questions. The syntactic account of the two languages differs only on the structural position of the scope marker. The semantic representations of the two scope marker indicate that the two grammatical constructions are much closer to each other than is suggested in generative syntactic literature. Furthermore, the scope marker show a clear relation to the standard account of interrogative pronouns. The type-assignment of scope marker are semantically derivable from the types assigned to object wh-phrases.

20.8 Conclusion

In this paper, we have shown that we can account for scope marking constructions using the proposed analysis of wh-question formation. The analysis is an example of how the deductive system of MMCG can be used to analyze natural language phenomena and indicate differences and similarities between and across languages. Because the deductive system of MMCG is completely lexicalized, any phenomena and any grammar system is determined by assigning the right type of type-assignment to individual expressions. We have shown how the restricted

set of structural postulates along with derived inference rules for the base logic realizes scope marking constructions in German. We have illustrated that the similarity between object wh-phrases and scope markers results in a similar semantic representation of direct questions and scope marking constructions.

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