

INFORMATION STRUCTURE AND SCOPE IN GERMAN

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Proceedings of the LFG06 Conference
Universität Konstanz

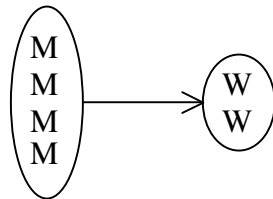
Miriam Butt and Tracy Holloway King (editors)
2006

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In example (1a), the NP *viele Männer* is both higher than *zwei Frauen* on the GF hierarchy and simultaneously precedes it. With neutral intonation, the only distributive reading is one in which the men distribute over the women, i.e. for each man, there is a potentially distinct set of two women that he courted. In such cases, we will say that *viele Männer* has distributive scope, and, since the scope follows linear precedence, we will call this a surface scope reading.

On the other hand, (1b), with fronting of the object, is ambiguous between two distributive readings. Firstly, *viele Männer* may have distributive scope, yielding the same interpretation as in (1a). In Kiss's (2001) approach, distributive scope in this case arises from the higher status of *viele Männer*, i.e. subject, on the GF hierarchy. Readings such as this in which scope does not follow linear order can be called inverse scope readings. However, an equally available interpretation is the surface scope reading in which *zwei Frauen* has distributive scope, i.e. for each of the two women, there is a potentially distinct set of many men who courted them. Since it is difficult to obtain this reading from the active in English, we signal this conventionally in the translation by employing the passive (even though the German construction is of course active). The distributive scope of *zwei Frauen* in this case is then attributed to its linear precedence, despite its lower rank (object) on the GF hierarchy. Thus in order for an NP to have distributive scope, it must either outrank all other elements on the GF hierarchy, or it must precede them.²

There is also of course a collective reading for both (1a) and (1b) in which there are at most two women and one set of many men involved in the courting event. This reading might be contextualised, for example, in a medieval setting in which a group of two women are surrounded by a sizeable group of male lute players, viz.



In collective readings there is no asymmetrical scope relationship.

Previous LFG approaches to quantifier scope within Glue Semantics (e.g., Crouch & van Genabith 1999; Dalrymple et al. 1997) tie the possibility of scope ambiguity to the existence of multiple proofs for a single utterance. The fact that both the surface and inverse scope readings are not always equally available in English is presumed to be due to either pragmatic or plausibility restrictions. However, the rather more systematic nature of the German data – in particular the correlation between displacement and additional scope readings as in (1b) – suggests an approach in which the availability of distributive readings is linked to word order and, in turn, to information structure given

2. We note that a parallel disjunctive analysis has been adopted for binding effects in German (Choi 1995, Bresnan 1998, Berman 2003). It is conceivable that an analysis tied to information structure, analogous to the one presented here, might be successfully applied to the binding data. We leave this however as a topic for future research.

that German scrambling and other forms of displacement are clearly information-structurally driven (e.g., Lenerz 1977).

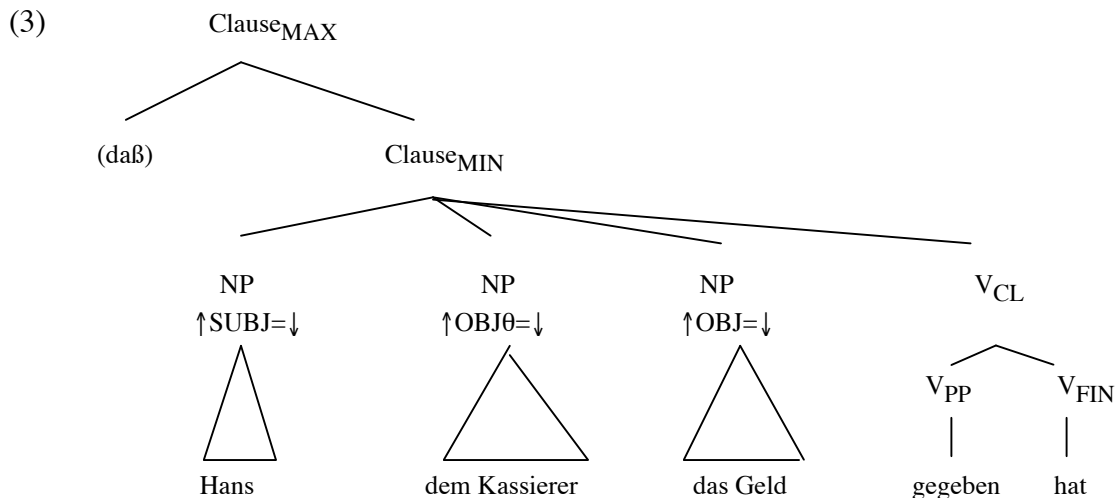
2. German Word Order and Information Structure

In this section, we outline our approach to German word order and information structure. In German, as is well-known, subordinate-clause word order differs, in the presence of complementizers, from main-clause word order. We consider first, in 2.1., subordinate-clause order in which the complementizer is initial and the verb or verb cluster is final. The remaining elements of the clause, i.e. arguments and adjuncts, lie between these in what is traditionally known as the “Mittelfeld” (middlefield). The order of elements in the middlefield is determined by a number of factors, but in particular the grammatical relation and information-structure status of each element. We introduce then the information-structure concepts which we believe to be word-order determinants. Secondly, in 2.2, we consider main-clause word order in which the finite verb is fronted and preceded by one element which has information-structure prominence.

2.1 Middlefield

In the spirit of Choi (1999) we assume a flat structure for the German middlefield, with word order within the middlefield determined by OT linear precedence constraints. The structure we propose for the subordinate clause in (2), with canonical word order, is (3).

- (2) Ich glaube, daß [Hans]_{SUBJ}[dem Kassierer]_{OBJ θ} [das Geld]_{OBJ} gegeben hat]
 I believe that Hans the cashier the money given has
 ‘I believe that Hans gave the money to the cashier.’



Note that, in order to avoid controversies over category labelling, we employ here schematic labels such as Clause_{MIN} for the middlefield and NP for noun phrase. The choice of category labels is essentially tangential to the issues raised in this paper.

The canonical word order in (2) follows the linear precedence constraint GF in (4), where > denotes “precedes”.

(4) SUBJ > OBJ θ > OBJ (GF)

Here objects are distinguished as OBJ (primary object, accusative case) and OBJ θ (secondary object, dative case).³ The domain of the constraint is the middlefield, i.e. it orders the daughters of Clause_{MIN}. The verb cluster V_{CL}, consisting in this example of the past participle *gegeben* ‘given’ and the finite auxiliary *hat* ‘has’, is obligatorily final.

We then use a three-term feature system to represent information structure concepts.

(5) \pm T(topic), \pm N(ew), \pm C(ontrastive)

The feature \pm T distinguishes topical from non-topical information. The concept of topic that is intended here is “aboutness topic”, in the sense of Reinhart (1981). Importantly, topics do not necessarily represent old information, nor are they necessarily unique in a given utterance. The feature \pm N straightforwardly distinguishes new from old information, while the feature \pm C distinguishes contrastive from non-contrastive information in the sense of Frey (2006). A summary of the possible feature combinations and their English designations is given in (6).⁴

(6)

<i>Summary of feature combinations:</i>	
{+T, -N, -C}	old-information topic
{+T, +N, -C}	new-information topic
{+T, -N, +C}	contrastive old-information topic
{+T, +N, +C}	contrastive new-information topic
{-T, +N, -C}	non-contrastive focus
{-T, +N, +C}	contrastive focus
{-T, -N, -C}	tail
{-T, -N, +C}	contrastive tail

3. For the analysis of the few ditransitives whose accusative object precedes the dative object in canonical order see Cook (2006).

4. The three-way feature system proposed here differs from the two-term system (\pm N, \pm P) proposed by Choi (1999) in two main respects. Firstly, Choi employs a concept of topic as necessarily old information, and does not therefore have a feature \pm T. Secondly, Choi employs a feature \pm P (for prominent) which applies both to topics and contrastive focus: there is therefore no possibility of distinguishing between contrastive and non-contrastive topics. Seven of the eight terms permitted by the three-way system are employed in this paper. The one which is not is contrastive tail $\{-T, -N, +C\}$. However, as pointed out by Miriam Butt, a conceivable use for this term might be postverbal backgrounded phrases in Hindi/Urdu (Butt & King, to appear).

The features then play a crucial role, in addition to GF, in determining the contextually possible middlefield word orders, as shown in (7) and (8).

(7) Context: Wem hat Hans das Geld gegeben? [Who did Hans give the money to?]

Ich glaube, daß....

- a. [Hans]_{SUBJ} [dem Kassierer]_{OBJθ} [das Geld]_{OBJ} gegeben hat
 +T, -N, -C -T, +N, +C -T, -N, -C -T, -N, -C
- b. [Hans]_{SUBJ} [das Geld]_{OBJ} [dem Kassierer]_{OBJθ} gegeben hat
 +T, -N, -C ±T, -N, -C -T, +N, +C -T, -N, -C
- c. [das Geld]_{OBJ} [Hans]_{SUBJ} [dem Kassierer]_{OBJθ} gegeben hat
 +T, -N, -C -T, -N, -C -T, +N, +C -T, -N, -C

(8) Context: Was hat Hans dem Kassierer gegeben? [What did Hans give to the cashier?]

Ich glaube, daß....

- a. [Hans]_{SUBJ} [dem Kassierer]_{OBJθ} [das Geld]_{OBJ} gegeben hat
 +T, -N, -C ±T, -N, +C -T, +N, +C -T, -N, -C
- b. [dem Kassierer]_{OBJθ} [Hans]_{SUBJ} [das Geld]_{OBJ} gegeben hat
 +T, -N, -C -T, -N, -C -T, +N, +C -T, -N, -C
- c. % [Hans]_{SUBJ} [das Geld]_{OBJ} [dem Kassierer]_{OBJθ} gegeben hat
 +T, -N, -C -T, +N, +C -T, -N, -C -T, -N, -C

Examples (7a,b) and (8a,c) are the famous 'Lenerz data' which any account has to cover. In (7a,b), *dem Kassierer* is contrastive focus, and both object orders (OBJθ>OBJ; OBJ>OBJθ) are permitted. In (8a,c), however, *das Geld* is contrastive focus. While all speakers in this case allow the canonical order OBJθ>OBJ, as in (8a), there is variable acceptance, indicated by the percentage symbol, of the OBJ>OBJθ order in (8c). In our terms, this variability depends on whether speakers allow +C information to scramble. In (7b) and (8a), note that the initial object (*das Geld* and *dem Kassierer* respectively) can be annotated either -T or +T with no effect on the ordering. If the +T annotation is chosen, there will then be two elements which have topic status in the sentence. Note also that we have added (7c) and (8b), fronting of a non-subject topic. We are making the point here that these elements can get a +T interpretation if a speaker decides to structure the answer that way.

The constraint ranking which gives these orders, disallowing (8c), is (9).

(9) X>V_{CL} >> +T > -T >> {-N > +N, GF}

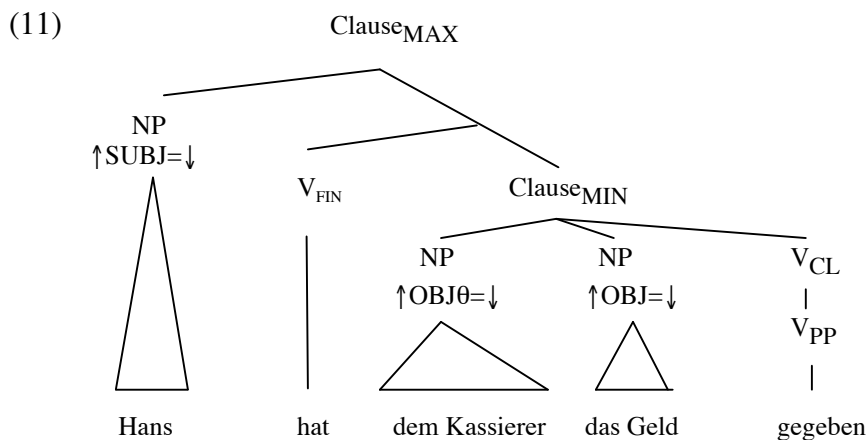
The constraint $X > V_{CL}$, which ensures the final position of the verb cluster, is highest ranked. The next-highest ranked is the constraint that topical information precedes non-topical information, followed by the equally ranked constraints $-N > +N$ and GF. The equal ranking of these last two constraints allows the two alternative object orders in (7a,b), but (8c) violates both $-N > +N$ and $OBJ\theta > OBJ$ and is therefore non-optimal. For speakers who allow the scrambling in (8c), further constraints involving $+C$ will need to be invoked. We ignore this complication here.

2.2 Front Field

In German main clause order the front field contains a single item, either a single syntactic constituent or an information unit consisting of verb and other constituents (for the information units involved see Cook 2001, and Kaplan & Zaenen 2002). The front field is followed by the finite verb and the remaining elements of the middlefield. Consider then the following examples, given the context in (10).

- (10) Context: Wem hat Hans das Geld gegeben? [Who did Hans give the money to?]
(with Hans as topic)
- a. [Hans]_{SUBJ} hat [dem Kassierer]_{OBJθ} [das Geld]_{OBJ} gegeben
 +T, -N, -C -T, +N, +C -T, -N, -C -T, -N, -C
- b. [Hans]_{SUBJ} hat [das Geld]_{OBJ} [dem Kassierer]_{OBJθ} gegeben
 +T, -N, -C -T, -N, -C -T, +N, +C -T, -N, -C
- a. [dem Kassierer]_{OBJθ} hat [Hans]_{SUBJ} [das Geld]_{OBJ} gegeben
 -T, +N, +C +T, -N, -C -T, -N, -C -T, -N, -C

An illustrative structure is given for (10a) in (11).



Note that either the topic *Hans* (10a,b) or the contrastive focus *dem Kassierer* (10c) can be selected for placement in the front field. Following ideas of Payne (2000), we handle the competition for placement in the front field as alignment with the left edge

of Clause_{MAX}. In the system proposed here, the ranking of alignment constraints then takes the form in (12).

(12) Align WH >> {Align +T, Align +C}

Highest ranked is the constraint Align WH, i.e. an interrogative WH-phrase will obligatorily occupy the front field if one is present. In the absence of an interrogative WH-phrase, the constraints Align +T and Align +C are equally ranked, allowing either a topic or a contrastive element to be fronted. The alternative object orders in (10a,b) of course follow from the middlefield linear precedence constraint rankings in (9).

The crucial role of the ±C feature in determining the eligibility of non-topic elements for front field placement can be seen examples such as (13), from Frey (2006).

(13). Context: Wo liegt Heidelberg? [Where is Heidelberg?]

- a. Heidelberg liegt [am Neckar]
 Heidelberg lies on.the Neckar
 +T, -N,-C -T, +N,-C
 'Heidelberg is on the Neckar.'
- b. #[Am Neckar] liegt Heidelberg.
 -T, +N,-C +T, -N,-C

The symbol # is intended here to indicate that (13b) is unacceptable in the given context. We can compare (13) with (14).

(14) Context: An welchem Fluss liegt Heidelberg? [On which river is Heidelberg?]

- a. Heidelberg liegt [am Neckar]
 Heidelberg lies on.the Neckar
 +T, -N,-C -T, +N,+C
 'Heidelberg is on the Neckar.'
- b. [Am Neckar] liegt Heidelberg.
 -T, +N,+C +T, -N,-C

The topic *Heidelberg* can always be placed in the front field, as in (13a) and (14a). On the other hand, it is inappropriate to place the focus *am Neckar* in the front field unless it is contrastive as in (14b), where there is a contrast with other possible rivers.

3. Information Structure and Scope

The basic claim of this paper is then that the disjunctive approach to quantifier scope in German can and should be replaced by one in which distributive quantifier scope

interpretations depend simply on information structure. The basic constraint on interpretation will be (15).⁵

(15) +T plural NPs allow distributive interpretations

In other words, only topics can have distributive scope. They can of course also be interpreted collectively.

The distributive interpretations of the examples in (1) follow straightforwardly from this constraint:

(16) a. Context: Was die Männer betrifft, wie viele von ihnen haben zwei Frauen hofiert?

[Talking about the men, how many (each) courted two women?]

[Viele Männer] _{SUBJ} haben	[zwei Frauen] _{OBJ} hofiert
+T, +N,+C	-T, -N, -C -T, -N, -C
DIST	

b. Context: Was die Frauen betrifft, wie viele von ihnen haben viele Männer hofiert?

[Talking about the women, how many were (each) courted by many men?]

[Zwei Frauen] _{OBJ} haben	[viele Männer] _{SUBJ} hofiert
+T, +N,+C	-T, -N, -C -T, -N, -C
DIST	

c. Context: Was die Männer betrifft, wie viele Frauen haben viele von ihnen hofiert?

[Talking about the men, how many women did many of them (each) court?]

[Zwei Frauen] _{OBJ} haben	[viele Männer] _{SUBJ} hofiert
-T, +N,+C	+T, -N, -C -T, -N, -C
DIST	

In (16a), the men are topic, but the question asks how many of them each courted two women. In the answer, the component *viele* ‘many’ in *viele Männer* is new and also contrastive information, since *viele* contrasts with other possible quantifiers. This is a basic information structure for (1a), in which the men have distributive scope. In (16b), we have an analogous information structure, but this time the women are the topic and the numeral *zwei* is contrastive new information. This is a basic information structure for the interpretation of (1b) in which the women have distributive scope. However, for the fronted object order there is an alternative information structure, shown in (16c), in which

5. The connection between quantifier scope interpretations and information structure, in particular topicality, has been noted in other languages. See for example van Valin (2005: 81-88) and references therein.

the subject *viele Männer* is a topic and *zwei Frauen* is a contrastive focus, the numeral *zwei* providing the answer to the question.

4. Inverse scope and prosody

For many (but not all) speakers, scope inversion, i.e. a plural NP is allowed to have distributive scope over an NP which precedes it, is possible even in the absence of displacement. The contexts are however typically quite complex. Examples are in (17).

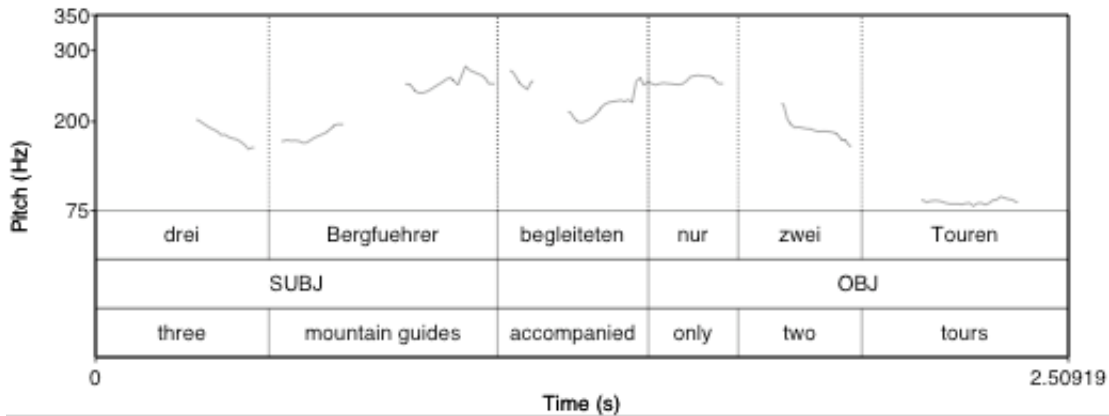
- (17) a. Context: Die Qualität der Patientenbetreuung ist normalerweise in diesem Krankenhaus sehr gut. Jeder Patient wird täglich von 3 Oberärzten besucht. Heute war es wegen des Streiks jedoch nicht so gut. [The quality of healthcare in this hospital is generally excellent. Each patient normally gets a visit by three consultants. But today, because of the strike...]

[Drei Oberärzte] _{SUBJ}	besuchten	[nur vier Patienten] _{OBJ}
three consultants	visited	only four patients
-T, -N, -C	-T, -N, -C	+T, +N, +C
DIST		
‘Only four patients were visited by three consultants.’		

- b. Context: Die Touren sind im Allgemeinen sehr gut betreut. In der Regel hat jeder Tour mindestens drei Bergführer. Gestern war das allerdings nicht so. [The tours are generally well-staffed. As a rule, every tour has at least three mountain guides. But yesterday this didn't happen...]

[Drei Bergführer] _{SUBJ}	begleiteten	[nur zwei Touren] _{OBJ}
three mountain guides	accompanied	only two tours
-T, -N, -C	-T, -N, -C	+T, +N, +C
DIST		
‘Only two tours were accompanied by three mountain guides.’		

It is clear that in the given contexts these are utterances about patients and about tours, respectively. The contexts here make the patients/tours into contrastive new topics, which should normally occupy the front field. The motivation for the word order observed in (17a,b) appears to be to place new information late, but this is at the cost of placing a “tail” in the front field. This breach of the normal constraints is however prosodically marked. Such examples are associated with a special contour, as demonstrated in the following trace for (17b).



This contour may have affinities with the so-called 'hat contour', known to exist in other kinds of scope inversion examples (cf. Jacobs 1984, 1996; Büring 1997; Krifka 1998; Molnár & Rosengren 1996). However native speaker intuitions suggest that it may not be identical. We leave a fuller investigation of this issue to further research.

Scope inversion with the indicated prosodic contour is not restricted to subject-object orders. It can also occur in object-subject orders in similar kinds of context.

- (18) Context: In den USA haben alle Doktoranden zwei Betreuer. Wir haben es in unserem Institut leider nicht so gut. [In the USA all PhD students have two supervisors. In our institute, we're not so fortunate...]

[Zwei Betreuer] _{OBJ}	haben	[nur vier Studenten] _{SUBJ}
two supervisors	have	only four students
-T, -N, -C	-T, -N, -C	+T, +N, +C
DIST		
‘Only four students have two supervisors.’		

Here again, the front field is occupied by a tail. It should be noted that from an information-structure point of view, as well as prosodically, example (18) is quite different to (16c). Both however involve a subject having distributive scope over a preceding object.

5. Semantic Representation

In this section, we consider the semantic representation of distributive scope. First of all, we follow in particular Steedman (2006) in allowing predicates to take set entities as arguments, and in taking indefinite noun phrases to denote generalized quantifiers which contain underspecified skolem terms *skolem*'*p*, where *p* is any property. Skolem functions map properties to entities which have that property, such that these entities are

dependent on any universal quantifier in whose scope they occur.⁶ The underspecified representation of an indefinite noun phrase like *viele Männer* ‘many men’ will then be $\lambda p.p(\text{skolem}'man'; \text{many}')$, denoting the set of properties which the set(s) of many men picked by the skolem term have. If a skolem term is specified outside the scope of a universal quantifier, it simply picks a constant set. Once specified, the underspecified term *skolem'man'* is converted in this case simply to sk_{man}' , representing the constant set picked by the skolem term. However, if a skolem term is specified within the scope of a universal quantifier which binds the variable w , its representation becomes $sk^{(w)'}_{man}'$. That is, the skolem term in this case picks a different set of men for each value of the variable w . Skolem terms are a natural way to characterise the underspecified nature of the interpretation of indefinites, which depending on context either denote constant sets, corresponding to traditional “wide scope” readings, or have dependent denotations when outscoped.

Within this system, a collective reading of (19a) will have, ignoring tense and assuming saturation of the object argument first, the underspecified semantic representation (19b). There are no universal quantifiers in (19b), so when the skolem terms are specified, they will denote constant sets as in (19c). If desired, (19c) can be simplified by lambda conversion to (19d).

- (19) a. [Viele Männer]_{SUBJ} haben [zwei Frauen]_{OBJ} hofiert
 b. $\lambda p.p(\text{skolem}'man'; \text{many}')(\lambda x.\text{court}'(\text{skolem}'woman'; \text{two}')x)$
 c. $\lambda p.p(\text{sk}_{man}'; \text{many}')(\lambda x.\text{court}'(\text{sk}_{woman}'; \text{two}')x)$
 d. $\text{court}'(\text{skwoman}'; \text{two}')(\text{skman}'; \text{many}')$

Since *court'*, like all predicates, takes set entities as its arguments, this naturally represents the collective reading in which many men as group court two women as a group.

In order to derive the distributive readings, we then assume the optional application of a distributivity operator D to the semantic representation of the NP which has wide scope.⁷ The underspecified representation of the distributive subject/topic interpretation of (20a) will then be (20b), exactly the same as (19b).

6. Winter (1997, 2001), following Reinhart (1997) has a similar analysis of indefinites in terms of choice functions, which he states as equivalent to skolem functions of arity zero. We simplify the representation of the cardinality of the sets picked out by skolem terms: a term *skolem'man'; many'* will be considered to pick sets whose cardinality is *many'*, however *many'* is defined.

7. Note that we doubt whether it is best to follow Steedman (2006) in taking quantifier distributivity in these kinds of examples to be based on multiple lexical representations of the predicate. This seems inappropriate when all arguments and indeed adjuncts can in principle scope over each other. See also Winter (1997, 2001) for arguments that both NP and predicate distributivity are in principle necessary.

(20) a. Viele Männer]_{SUBJ} haben [zwei Frauen]_{OBJ} hofiert

b. $\lambda p.p(\text{skolem}'\text{man}'; \text{many}')(\lambda x.\text{court}'(\text{skolem}'\text{woman}'; \text{two}')x)$

Specification of the subject/topic skolem term and application of the distributivity operator will however in this case yield (21a), which, when the function of the distributivity operator is spelled out, will be equivalent to (21b). What the distributivity operator does is to state that all properties to which the denotation of the NP applies are properties which hold of every individual member of the sets which have those properties. The distributivity operator therefore introduces a universal quantifier which will have an effect on the interpretation of any skolem term in its scope. Subsequent specification of the object skolem term in (21c) in the scope of the universal quantifier yields the interpretation in which there are separate sets of two women depending on each individual man. If desired, (21c) can again be simplified to (21d).

(21) a. $D(\lambda p.p(\text{sk}_{\text{man}'}; \text{many}')(\lambda x.\text{court}'(\text{skolem}'\text{woman}'; x)))$

b. $\lambda p.p(\text{sk}_{\text{man}'}; \text{many}')(\lambda x.\forall w[w \in x \rightarrow \text{court}'(\text{skolem}'\text{woman}' \text{two}')w]^{\{w\}})$

c. $\lambda p.p(\text{sk}_{\text{man}'}; \text{many}')(\lambda x.\forall w[w \in x \rightarrow \text{court}'(\text{sk}^{(w)}\text{woman}'; \text{two}')w]^{\{w\}})$

d. $\forall w[w \in \text{sk}_{\text{man}'}; \text{many}' \rightarrow \text{court}'(\text{sk}^{(w)}\text{woman}'; \text{two}')w]^{\{w\}}$

It will be noted that (20b) is already in the right format to conform to a structured meaning approach (Krifka 1991) in which sentence meanings are partitioned into two discourse components, one of which applies to the other. Here the partition is, in our terms, +T(-T), i.e. the semantic representation of the topic is applied to the semantic representation of the non-topical material.⁸ In order to derive the reading in which an object/topic has distributive scope, we need to manipulate the logical form so that the semantic representation of the object as topic applies to the semantic representation of the remainder of the sentence. To do this, we follow the higher order unification idea of Pulman (1997). In order to get the underspecified representation in (19b, 20b) into the right format, the equations in (22a, b) have to be solved.

(22) a. $+T(-T) = \lambda p.p(\text{skolem}'\text{man}'; \text{many}')(\lambda x.\text{court}'(\text{skolem}'\text{woman}'; \text{two}')x)$

b. $+T = \lambda q.q(\text{skolem}'\text{woman}')$

In (22a), the left-hand side of the equation specifies that we need a +T(-T) partition, and the right hand side of the equation is the underspecified representation which has already been computed from the semantic components of the sentence. Equation (22b) specifies that the topical information can be identified with the semantic representation of the object, *two women*. The solution to these equations is (23), which is now in the right +T(-T) format for the object to be interpreted as topic.

8. Technically it is the semantic representation of the element marked +T which applies to the semantic representation of the element marked -T. We simplify the notation here by writing the partition as +T(-T).

$$(23) \quad +T(-T) = \lambda q.(q(\text{skolem}'\text{woman}'; \text{two}')(\lambda y.\text{court}' y(\text{skolem}'\text{man}'; \text{many}')))$$

We can now apply skolem specification and the distributivity operator as before, but this time to the representation of the object. This gives (24a), which is equivalent to (24b) after the function of the distributivity operator is spelled out.

$$(24) \quad \text{a. } D(\lambda p.p(\text{sk}_{\text{woman}'; \text{two}'}))(\lambda y.\text{court}' y(\text{skolem}'\text{man}'; \text{many}'))$$

$$\text{b. } (\lambda p.p(\text{sk}_{\text{woman}'; \text{two}'}))(\lambda y.\forall w[w \in y \rightarrow \text{court}' w(\text{skolem}'\text{man}'; \text{many}')] \{w\})$$

Further specification of the subject skolem term now yields the representation (25a) in which we must pick a distinct set of many men for each woman. This simplifies to (25b) if desired.

$$(25) \quad \text{a. } (\lambda p.p(\text{sk}_{\text{woman}'; \text{two}'}))(\lambda y.\forall w[w \in y \rightarrow \text{court}' w(\text{sk}^{(w)}_{\text{man}'; \text{many}'})] \{w\})$$

$$\text{b. } \forall w[w \in \text{sk}_{\text{woman}'; \text{two}'} \rightarrow \text{court}' w(\text{sk}^{(w)}_{\text{man}'; \text{many}'})] \{w\}$$

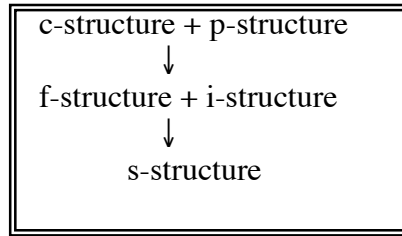
The view we have adopted here of the information-structure partitioning of semantic representations fits in well with a standard Glue approach which derives underspecified s-structure representations from f-structure predicate-argument structures. Note that in principle, the Glue approach allows the arguments of the predicate to be saturated in either order. Regardless of which order is chosen, higher order unification will be able to derive a correct $+T(-T)$ partition from the underspecified source, and distributive scope will follow (optionally) from this partition. This approach does not tie informational partitions directly to surface structure, as in Steedman (1996). We expect that the flexibility which arises will be required in principle since distributivity and i-structure features are not generally subject to syntactic island constraints.⁹

6. Mapping

In order to simplify the number of mappings between different levels, we propose essentially three levels.

9. In particular, arguments that focus partitions are not in general subject to island constraints are given in Pulman (1997). We also note that, according to the native speaker intuitions of both authors of this paper, quantifier distributivity too is not subject to island constraints (contra Ruys 1992, Winter 2001). Our intuitions thus correspond to those reported in Abusch (1994), Geurts (2002) and Kempson & Meyer-Viol (2004).

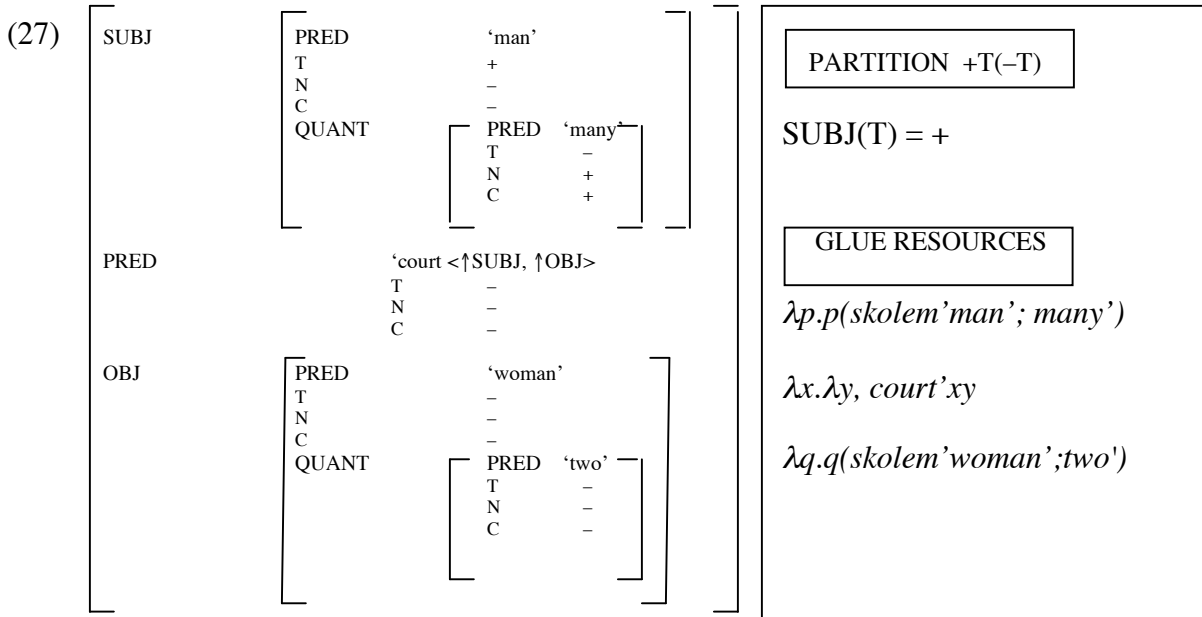
(26)



The most important notion which this diagram represents is the notion that i-structure information, in the form of i-structure features associated with individual predicates, can be amalgamated with f-structure. The position of i-structure information in the LFG architecture has been and remains subject to much debate, see especially King & Zaenen (2004). However, the amalgamation of i-structure and f-structure information ties together on the one hand the resources needed to construct a complete underspecified semantic representation, and on the other hand the i-structure information which will partition it.

Within the LFG-OT approach adopted here, f-structure and i-structure together will form the input to OT constraints which determine optimal c-structures and prosodies. Note that the prosody which is associated with scope inversion in (17) and (18) must then outrank the highly ranked constraints which disallow an initial tail. We leave however the details of the prosodic interactions for future research.

As an illustration of an amalgamated f-structure and i-structure, consider (27), which corresponds to (16a), using English names for the predicates involved and omitting tense.



The f-structure on the left contains the standard information that *many men* is subject, *two women* is object, and *court* is the main predicate. This information provides the resources needed for a Glue-based approach to semantic interpretation, as schematically shown in the box to the right, in which the representation of the predicate can combine in either

order with the representations of the subject and object. We are then left with an underspecified semantic representation such as that in (19b) and (20b). The i-structure annotations associate values of $\pm T(\text{opic})$, $\pm N(\text{ew})$, $\pm C(\text{ontrastive})$ with each f-structure containing a predicate value.¹⁰ Most importantly, the association of the feature +T with the f-structure of the subject will yield the equation $\text{SUBJ}(T) = +$. We assume that this implies that a +T(-T) partition must be created in which the +T information is equated with the semantic representation of the subject. Higher order unification will then partition the original semantic representation into the (still underspecified) +T(-T) format.

With the representation in this format, there are two possibilities. Either the distributivity operator is applied to the +T term, in which case we will derive an interpretation in which the subject has quantifier distributivity. Or the distributivity operator is not applied, in which case we achieve a collective interpretation. We assume that the application (or not) of the distributivity operator in German will depend on wider contextual factors.

7. Non-canonical predicates and topical objects

With verbs with regular THEME objects and AGENT subjects (canonical argument structure), the scope inversion examples of section 4 are slightly more accessible when the following argument is subject. Thus, (28) – in which the context is set up so as to force a distributive reading of the subject – is slightly more accessible than (29), in which the context is designed to force a distributive reading of the object. We use # to signal this here.

10. This notation obviates an objection made by King (1993) to locating information structure values within f-structure representations: the information structure attributed to the main predicate of the sentence will not in our system spread to its arguments. An alternative might be to invoke the subsumption approach of Kaplan & Zaenen (2002) in which information can be shared between f-structures on a partial rather than equal basis. Such an approach would involve, rather than a set of features, a set of paths linking f-structures representing topical, new and contrastive information to the basic f-structure information for the sentence. We do not exclude this approach, but observe that the feature notation adopted fits naturally with the higher order unification approach in which information structure feeds into articulations at the level of logical form. We speculate that the employment of independent f-structures to represent i-structure information might be most appropriate in cases where long-distance extractions are involved, and where island-constraints apply to the f-structure paths created. However, this is a large issue which is beyond the scope of this paper.

- (28) Context: Alle Professoren wurden aufgefordert, ihre besten fünf Studenten für einen Preis zu empfehlen. Viele hatten Schwierigkeiten, überhaupt 5 Studenten zu empfehlen. Die meisten Professoren schlugen nur einen Studenten vor [All professors were requested to put forward their 5 best students for a prize. A lot had difficulty finding 5 students to recommend. Most professors just suggested one student.]

[5 Studenten]_{OBJ} schlugen [nur 4 Professoren]_{SUBJ} vor
Only 4 professors suggested 5 students

- (29) Context: Die Qualität der Schwangerenbetreuung in Stuttgart ist sehr gut. Jede Frau hat Anspruch auf zwei Hebammen. In Frankfurt haben die Frauen es leider nicht so gut. [The quality of care for pregnant women is very good in Stuttgart. Every woman has access to two midwives. In Frankfurt the women don't have it so good]

#[2 Hebammen]_{SUBJ} betreuen [nur 4 Schwangere]_{OBJ}
2 midwives look after only 4 pregnant women

In our account, this tendency can be seen to reflect the fact that (agentive) subjects are the default candidate for topic status (cf. Reinhart 1981).

Thematically non-canonical verbs can be seen as providing support for our topic-analysis of distributivity since we claim that EXPERIENCER objects can acquire topic status more easily than theme objects. With respect to this claim, we consider here psych verbs with STIMULUS subject and EXPERIENCER object. It is striking that with EXPERIENCER objects, it is far easier to have object distributivity in situ (inverse scope) than was the case with THEME object verbs above. Examples (30) and (31) have dative and accusative EXPERIENCERS respectively.

- (30) Context: Man muss dem Jugendamt melden, wenn im Kindergarten ein Kind 5 oder mehr Unfälle in einem Monat hat. In den letzten Monaten mussten immer mehr Meldungen an das Jugendamt erfolgen. In diesem Monat war es besonders schlecht [You have to inform the Youth Services if a child has five or more accidents a month in the Kindergarten. In the last months we had to make more and more announcements to the Youth services. It was especially bad this month]

[5 Unfälle]_{SUBJ} sind sogar [10 Kindern]_{DAT OBJ} zugestoßen
5 accidents happened to 10 children this month

- (31) Context: Jedes Jahr werden von den Designern neue Farben entwickelt. Die Farben werden einem Team von Gutachtern präsentiert. Normalerweise ist jedes Mitglied des Gutachterteams von ca. zwei Farben angewidert. Dieses Jahr haben die Entwürfe den Gutachtern besser gefallen. [Every year new colours are developed. The colours are presented to a panel of judges. Normally, every judge is repulsed by around 2 colours. This year, the designs appealed to the judges more.]

[2 Farben]_{SUBJ} haben nur [4 Gutachter]_{ACC OBJ} angewidert
2 colours only repulsed 4 judges

There is a further contrast between the THEME object and the EXPERIENCER object verbs: the reading in which a subject distributes over a preceding object is much 'more difficult'

to obtain with these verbs than with the agentive subject in (28) above. We indicate this again using #.

- (32) Context: Die Ingenieure der verschiedenen Abteilungen der Firma kommen manchmal auf die gleichen Ideen für neue Lösungen. Dann gibt's immer Ärger. Erfreulicherweise hatten wir in letzter Zeit nicht so viel Ärger. [Engineers from different departments sometimes come up with the same idea for new solutions. Then there's always trouble. Fortunately there hasn't been so much trouble recently.]

#[Mehreren Ingenieuren]_{DAT OBJ} sind nur [2 Ideen]_{SUBJ} eingefallen
Only two ideas occurred to several engineers.

- (33) Context: Wenn mindestens fünf Eltern sich beschweren, machen wir uns Sorgen über die Qualität unserer Produkte. Laut Firmenrichtlinien müssen die Produkte dann vorübergehend aus dem Verkauf genommen werden. Die Qualität unserer Produkte ist sehr gut. [If at least five parents complain then we worry about the quality of a product. According to firm guidelines we have to temporarily withdraw it from sale. The quality of our products is very good]

#[Fünf Eltern]_{ACC OBJ} beunruhigten bislang nur [4 Produkte]_{SUBJ}
So far only 4 products have disturbed five parents.

The observation that thematic properties of a predicate affect scope has been made before (cf. Pafel 2006:70-74). It has, however, not previously been attributed to information structuring but has merely been stated as an extra 'factor' influencing scope. Under our analysis the facts fall out in the following way. The most typical topics are AGENTS (hence also typical animate/human) and thus, topic very often corresponds to subject. With a predicate with an AGENT argument, some contextual motivation is required for treating a non-agentive role as topic. Thus, when a THEME is topic, as in (29), some prosodic, contextual or syntactic support (or a combination thereof) is required. In the absence of an AGENT, as in the case of the STIMULUS-EXPERIENCER verbs in (30)-(31), the next highest role, namely the EXPERIENCER, is the most typical topic. Note again that this will often be an animate argument.¹¹ Under the disjunctive approach to scope discussed in Section 1, such facts are mysterious since that account predicts that a subject can always scope over a lower GF irrespective of linear order yet this is a dispreferred option for EXPERIENCER object psych verbs.

The availabilities of readings available with the three different types of predicates discussed here are summarised in table (33), in which *D* denotes 'distributes over'.

11. The higher a thematic role is in the thematic hierarchy, the more suitable a candidate for topic status it is. This is, of course, indirectly linked to animacy since high thematic roles such as agent, experiencer, beneficiary are typically animate. We do not, however, wish to augment the constraint set in (9) with a separate constraint concerning the linearization of animate arguments before inanimate ones since we believe any effects seemingly associated with alignment of animate arguments to be an epiphenomenon of the +T > -T constraint given in (9).

(34)	SUBJ > OBJ order	OBJ > SUBJ order
agentive subject theme object verb	OBJ D SUBJ available but needs some contextual and/or prosodic support, viz. (29), because THEME object is not the most typical topic	SUBJ D OBJ readily available, viz. (28) because AGENT subject is a typical topic
Stimulus subject Dat Experiencer Object	OBJ D SUBJ very easily available, (viz. 30), because EXPERIENCER is a fairly typical topic.	SUBJ D OBJ not readily available, viz. (32), because STIMULUS subject is not a typical topic. EXPERIENCER would be a more typical topic.
Stimulus subject Acc Experiencer Object	OBJ D SUBJ very easily available, (viz. 31), because EXPERIENCER is a fairly typical topic.	SUBJ D OBJ not readily available viz. (33), because stimulus subject is not a typical topic. EXPERIENCER would be a more typical topic

Conclusion

In this paper, we have provided a detailed analysis of quantifier scope phenomena in German in which distributive scope is directly linked to topicality. The analysis is framed in a streamlined view of the mapping between f-structure and s-structure in which information structure is amalgamated featurally with basic f-structure representations, and in which the s-structure derived compositionally from the basic f-structure representation is then partitioned into information structure components by higher order unification. The optional application of a distributivity operator to these partitioned meanings then derives the association between scope and topicality.

One of the major advantages of this approach is that it obviates the need for a disjunctive analysis based on grammatical relations and linear precedence. However, it also accounts for the varying availability of different scope readings when standard and non-standard predicates are taken into consideration. All the factors which have been implicated in the availability of distributive scope readings in addition to grammatical relations and linear precedence, e.g., higher animacy and thematic role status, fall naturally into place under the heading of topicality.

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