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Work Order, Negation, and Negative Polarity in Hindi

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Abstract. In Hindi certain word order possibilities that are grammatical in non-negative sentences become ungrammatical in the presence of sentential negation. In movement-based accounts of such negation-induced word order constraints, the restricted word order has been argued to provide evidence that negative polarity items (NPIs) in Hindi are licensed at LF and S-structure while in English NPI licensing occurs at S-structure. I argue for a non-movement-based, uniformly monostratal (S-structure) account for the word order facts in Hindi, cast in the multimodal categorial grammar framework. The NPI licensing issue is dealt with independently following Dowty's monotonicity marking analysis.

Key words: multimodal categorial grammar, negation, negative polarity, word order, Hindi, Urdu

1. Introduction

This paper presents a uniform treatment of two phenomena in Hindi: word order constraints imposed by sentential negation, and a point of difference between Hindi and English negative polarity items (NPIs). I develop a theory couched in multimodal categorial grammar (see e.g., Moortgat, 1997), which, I argue, has several advantages over existing accounts.

The structure of the paper is as follows. Section 2 presents the word order and NPI facts, and Section 3 discusses two transformational analyses of the related issue of NPI licensing, and points out some problems with these. Sections 4 and 5 present an alternative, monostratal account set in categorial grammar for the word order and negative polarity problems, and Section 6 concludes the paper.

2. Constraints on Word Order

Mahajan (1988) discusses the various ordering possibilities for a sentence with an intransitive or transitive verb and negation. Although he presents examples of both intransitive and transitive verbs, we will consider only transitive verbs here since the facts for these subsume those for intransitives. Let us first look at a representative set of acceptable and unacceptable sentences with a transitive main verb and its arguments, an auxiliary verb, and negation (I do not consider all possible word

orders here due to space limitations). Although the facts presented below are based on Mahajan's, the generalizations I give are my own.

The canonical word order for sentences with a transitive main verb, negation, and auxiliary verb is Subj(ect), Obj(ect), Neg(ation), V(erb), Aux(iliary), as example (2.1) shows.

(2.1) raam roṭii nahĩĩ khaataa thaa
Ram bread not eat was
'Ram did not (use to) eat bread.'

The constraints on word order in such a sentence are discussed below, with examples justifying each claim.

FACT 2.1
The main verb and negation form a cluster; in this cluster word order is free, but Subj, Obj, Aux cannot appear between the main verb and negation.

This generalization follows from examples (2.2). Examples (2.2a) shows the canonical Neg-V order and (2.2b) the V-Neg order. Examples (2.2c–e) show that Obj, Subj, and Aux cannot intervene between Neg and V; and (2.2f–h) show the same for the V-Neg order (all these sentences are intended to be cases of sentential negation, not constituent negation, and we assume that no special prosodic contour is employed).

(2.2) (a) raam roṭii nahĩĩ khaataa thaa
Subj Obj Neg V Aux

(b) raam roṭii khaataa nahĩĩ thaa
Subj Obj V Neg Aux

(c) *raam nahĩĩ roṭii khaataa thaa
Subj Neg **Obj** V Aux

(d) *roṭii nahĩĩ raam khaataa thaa
Obj Neg **Subj** V Aux

(e) *raam roṭii nahĩĩ thaa khaataa
Subj Obj Neg **Aux** V

(f) *raam khaataa roṭii nahĩĩ thaa
Subj V **Obj** Neg Aux

(g) *roṭii khaataa raam nahĩĩ thaa
Obj V **Subj** Neg Aux

(h) *raam roṭii khaataa thaa nahĩĩ
Subj Obj V **Aux** Neg

FACT 2.2
The auxiliary verb cannot precede the Neg-V (or V-Neg) cluster and must immediately follow the Neg-V (or V-Neg) cluster.

Examples (2.3a,b) show that the auxiliary verb cannot precede the Neg-V or V-Neg cluster. Examples (2.3c,d) show that Aux must be adjacent to the Neg-V

cluster (i.e., neither Subj nor Obj may intervene between the Neg-V cluster and Aux); and examples (2.3e,f) show the same for the V-Neg cluster.

(2.3) (a) *raam roṭii thaa nahĩĩ khaataa
Subj Obj Aux Neg V
(b) *raam roṭii thaa khaataa nahĩĩ
Subj Obj Aux V Neg
(c) *raam nahĩĩ khaataa roṭii thaa
Subj Neg V **Obj** Aux
(d) *roṭii nahĩĩ khaataa raam thaa
Obj Neg V **Subj** Aux
(e) *raam khaataa nahĩĩ roṭii thaa
Subj V Neg **Obj** Aux
(f) *roṭii khaataa nahĩĩ raam thaa
Obj V Neg **Subj** Aux

FACT 2.3
Modulo the above constraints, word order of subject and object is free.

Examples (2.4) are a representative sample illustrating the above generalization.

(2.4) (a) raam roṭii nahĩĩ khaataa thaa
Subj **Obj** Neg V Aux
(b) roṭii raam nahĩĩ khaataa thaa
Obj **Subj** Neg V Aux
(c) roṭii nahĩĩ khaataa thaa raam
Obj Neg V Aux **Subj**
(d) raam nahĩĩ khaataa thaa roṭii
Subj Neg V Aux **Obj**
(e) nahĩĩ khaataa thaa raam roṭii
Neg V Aux **Subj** **Obj**
(e) nahĩĩ khaataa thaa roṭii raam
Neg V Aux **Obj** **Subj**

In sum, the main observations are that V and Neg form an inseparable cluster in which internal order is free, the Aux must appear to the immediate right of this cluster, and Subj and Obj may occur in any order outside this Neg-V-Aux cluster.

In the next section I first summarize Mahajan's barriers-based account of these word order facts and the apparently related NPI facts, and then Bhandari's (1998) minimalist treatment of Hindi and English NPI licensing. I then show that neither of these provides a satisfactory account.

3. Subject vs. Non-subject NPIs in Hindi and English

3.1. MAHAJAN ON WORD ORDER AND NEGATION

Mahajan (1988, 1990) has argued as follows. The direct object (DO) *sabzii*, 'vegetables', in (3.1a) cannot be scrambled from its canonical position to the right of the main verb *khaatii* when negation is present, as in (3.1b), but can be without the negation (see (3.1c)). (Abbreviations used hereafter: acc = accusative; emph = emphatic; encl = enclitic; erg = ergative; fem = feminine; fut = future; imp = imperfect; masc = masculine; neg = negation; onom = onomatopoeia; part = participle.)

(3.1) (a) siitaa sabzii nahĩĩ khaat-ii thii
Sita(fem) vegetables neg eat-imp-fem be-past-fem
'Sita did not use to eat vegetables.'

(b) *siitaa t_i nahĩĩ khaat-ii sabzii$_i$ thii
Sita(fem) neg eat-imp-fem vegetables be-past-fem
'Sita did not use to eat vegetables.'

(c) siitaa t_i khaat-ii sabzii$_i$ th-ii
Sita(fem) eat-imp-fem vegetables be-past-fem
'Sita used to eat vegetables.'

In (3.1a), "negation is adjoined to the right of the VP and V to AGR to I raising in Hindi gives the relevant word order" (Mahajan, 1990, pp. 337). (3.1b) above is ruled out by assuming that negation must raise at LF to adjoin to a finite IP for independent reasons; the DO, scrambled to a position below IP, is then a barrier to this LF movement since "adjunction to a maximal projection creates a barrier for any further extractions from within that maximal projection" (Mahajan, 1990, pp. 338–339).

Now consider these examples (also due to Mahajan (1990)), and the simplified tree diagrams for (3.2b) and (3.2c) below:

(3.2) (a) siitaa t_i nahĩĩ khaat-ii th-ii sabzii$_i$
Sita(fem) neg eat-imp-fem be-past-fem vegetables
'Sita did not use to eat vegetables.'

(b) *koi-bhii t_i nahĩĩ khaat-aa sabzii$_i$ th-aa
anyone(masc) neg eat-imp-masc vegetables be-past-masc
(Lit.) 'Anyone did not use to eat vegetables.'
(Intended) 'No-one used to eat vegetables.'

(c) koi-bhii t_i nahĩĩ khaat-aa th-aa sabzii$_i$
anyone(masc) neg eat-imp-masc be-past-masc vegetables
'Anyone did not use to eat vegetables.' (='No-one used to eat vegetables.')

According to Mahajan, (3.2a) is allowed because the DO is adjoined higher than I (to IP) and thus is not a barrier to LF movement of negation as it adjoins to IP above the scrambled DO. (3.2b) is ruled out as in the case of (3.1b), but (3.2c)'s grammaticality is taken to indicate that negative polarity items (NPIs) in Hindi

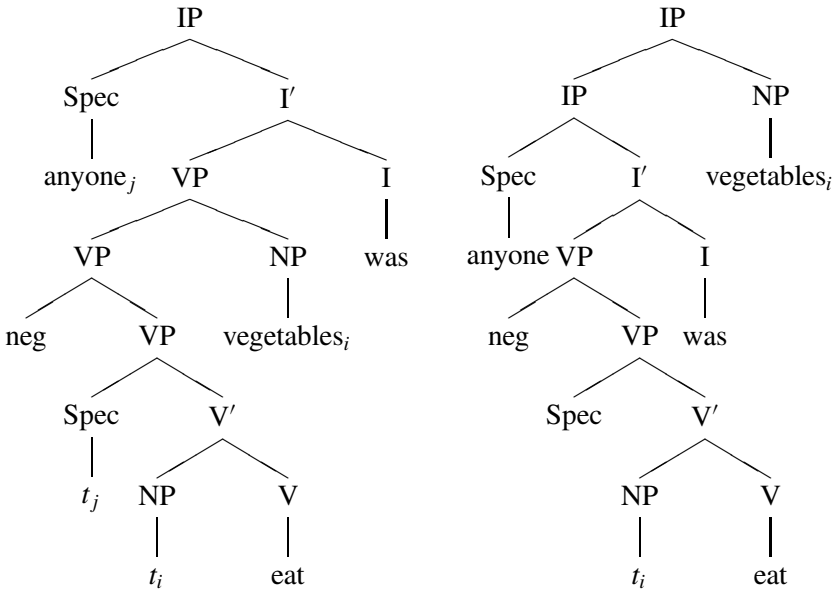


Figure 1. Mahajan's Barriers-based licensing account.

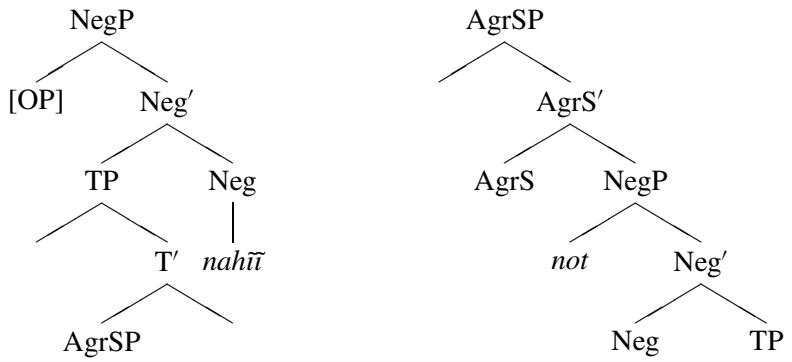
must be licensed at LF, since both the scrambled DO and negation adjoin to IP (the former at S-structure, and the latter at LF), as shown in Figure 1 (adjunction by negation at LF is not shown in Figure 1(b)).

Similarly, in the case of the transitive verb constructions given earlier, the subject and/or object may scramble to the right of the main verb and the auxiliary, and the ungrammatical possibilities are ruled out as in the case of (3.1) and (3.2).

However, there is a problem in this analysis regarding the connection between word order variation and NPI licensing. Mahajan (1990) proposes that NPIs must be c-commanded by negation and that there must not be any intervening barriers between negation and the NPI. This condition applies at both LF and S-structure in English, while in Hindi it applies only at LF. These different licensing conditions in Hindi versus English are ascribed to a parametric difference. Under this view, (3.2b,c) are taken to indicate that LF is the relevant licensing condition on NPIs in Hindi. However, consider examples (3.1b) and (3.2b); together, these show that the negated sentence is ungrammatical irrespective of whether the subject is an NPI or not, so the argument that (3.2b) is bad because the subject is an NPI is not convincing – the ungrammaticality could be more straightforwardly argued to be due to the barrier to negation's (LF-)movement. Pursuing this idea, I argue below that the Hindi word order constraints and negative polarity licensing are independent issues.

3.2. BHANDARI AND OTHERS ON THE ASYMMETRY PROBLEM

Two other proposals present different analyses of the asymmetry problem (although these do not discuss the word order issue): Bhandari (1998) proposes a Minimalist (Chomsky, 1995) solution whereby licensing occurs purely at LF. Hindi negation projects a functional projection NegP and the negation head selects for Tense Phrase (TP). The difference between English and Hindi subject NPI licensing is due to the fact that the functional projection Agreement Subject Phrase (AgrSP) lies below TP in Hindi, but immediately above NegP in English, as shown below. Since Neg c-commands SpecAgrSP in Hindi but not in English, subject NPIs are allowed in Hindi but not in English.



(a) Functional Projections in Hindi (b) Functional Projections in English

Figure 2. Bhandari's Minimalist account of NPI licensing.

Vasishth (1997) presents a purely S-structure account of the asymmetry problem where NegP plays a crucial role in NPI licensing. Here, Brody's (1995) representational chains and Haegeman's Neg-criterion (Haegeman, 1995) are the licensing mechanisms. All these analyses make several problematic assumptions, which I discuss next.

3.3. PROBLEMS WITH EXISTING ANALYSES

3.3.1. *No NegP in Hindi*

Mahajan (1988) has shown that Hindi negation cannot project a functional projection, so any account, such as Bhandari's or Vasishth's, both relying on functional projections, will first have to demonstrate that these are in fact sufficiently motivated in Hindi.

Mahajan's argument against NegP as a functional projection is that, given the fact that the main verb can move past negation, as in (3.3), we have to assume that the head movement constraint (Travis, 1984) is not violated when the verb moves. This means that negation is not a head.

(3.3) (a) raam aayaa nahĩĩ
Ram came neg
'Ram didn't come.'

(b) raam t_i nahĩĩ aayaa_i
Ram neg came
'Ram didn't come.'

3.3.2. *No Motivation for LF-based NPI Licensing in English*

Culicover (1981), Laka (1994), and May (1977) have shown that NPI licensing in English is an S-structure phenomenon. Consequently, Bhandari's Minimalist analysis, which carries out English NPI licensing to LF, is hard to motivate.

Two of the arguments against LF licensing of NPIs come from quantifier lowering (QL) and reconstruction. May (1977) (also see Lasnik, 1999, pp. 18–19) has shown that quantificational elements like NPIs cannot be regarded as undergoing the kind of QL that *some* undergoes in *some politican is likely to address John's constituency*. The reason is that if QL were to occur in the case of NPI *any*, the sentence *anyone is unlikely to address the rally* would be wrongly predicted to be grammatical, since the subject NPI could lower at LF to a position below the negative element *unlikely*. Laka (1994, p. 123) also argues that reconstruction (see Chomsky, 1977; Riemsdijk and Williams, 1986) cannot allow LF licensing of NPIs since reconstruction would incorrectly predict *anybody wasn't arrested by the police* to be grammatical, as well as preposed VPs like *buy any records is what she refused to do*.

3.3.3. *The Role of Downward Monotonicity*

The accounts of Mahajan, Bhandari, and Vasishth do not refer to the role of downward monotonicity in NPI licensing. Of course, in these analyses, the reliance on negation outscoping the NPI in question involves an assumption regarding some salient property of negation, and this might well be downward monotonicity. In this paper, I take the role of downward monotonicity in NPI licensing to be central, at least in English and Hindi (see Ladusaw (1979) and Vasishth (1998)), in a manner which will presently become clear.

3.4. DESIDERATA FOR A THEORY OF NPI LICENSING

To summarize the above discussion, existing analyses of the subject-object NPI asymmetry in Hindi and English have the problems that (i) the functional projection NegP is not motivated for Hindi, (ii) English NPI licensing cannot happen at LF, and (iii) the role of downward monotonicity in NPI licensing needs to be taken into account. In response to these issues, I present in Section 6 an alternative analysis of NPI licensing based primarily on Dowty's work (Dowty, 1994).

Next, we turn to the new treatment of word order and negation proposed in this paper.

4. Multimodal Categorial Grammar

Categorial Grammar (CG) is a monostratal, strictly lexical framework for linguistic theory, a characteristic feature of which is the close interaction between the syntax and semantics of linguistic objects. Categorial type-logics (see Carpenter (1997) and Moortgat (1997) for their relation to categorial grammar) build up complex syntactic units from atomic lexical entries using logical derivations. In this paper, I use the multimodal calculus with selective permutation and structural modalities. Given certain empirical facts, the aim is to build a deductive system allowing the composition of form and meaning, treating the grammar as a system of logic, i.e., a system for reasoning about structured linguistic resources. The underlying idea is that the lexicon contains all the information needed for building up grammatical sentences, and the combination of words to form sentences is effected by means of a set of logical inference rules. Below, I give a brief overview of the way the system is built up. For a more detailed discussion, see Moortgat (1997).

DEFINITION 4.1 (Types)
Given a finite set $\mathcal{B}$ of basic types (e. g. $\mathcal{B} = \{s, np, iv, \ldots\}$) the set of types is defined recursively like this:

$$\mathcal{T} ::= \mathcal{B} \mid \mathcal{T} \backslash \mathcal{T} \mid \mathcal{T} / \mathcal{T} \mid \mathcal{T} \multimap \mathcal{T} \mid \Diamond \mathcal{T} \mid \Box^{\downarrow} \mathcal{T}$$

In addition to these, the Gentzen sequent system requires that for every kind of n-ary *logical* connectives, there be an n-ary *structural* connectives. For example, for the unary logical connectives $\Diamond$ and $\Box^{\downarrow}$, we have the structural connective $(.)^{\Diamond}$.

DEFINITION 4.2 (Structures)
A structure $\mathcal{S}$ is defined as follows:

$$\mathcal{S} ::= \mathcal{T} \mid \langle \mathcal{S}, \mathcal{S} \rangle \mid \{\mathcal{S}, \mathcal{S}\} \mid (\mathcal{S})^{\Diamond}$$

Object-level statements are expressed by sequents $\Gamma \vdash A$, where $\Gamma \in \mathcal{S}$ and $A \in \mathcal{T}$. In $\Gamma \vdash A$, Γ is the ANTECEDENT, A is the SUCCEDENT; we read $\Gamma \vdash A$ as "A may be proven from Γ". So, for example, the sequent $\Gamma_1, \Gamma_2, \Gamma_3, \ldots \vdash A$ amounts to saying that the Γ_i's can be concatenated to give an expression of category A. A simple linguistic example would be *mary sleeps* $\vdash s$, where *mary* has type s/vp and *sleeps* has type vp, so that the sequent looks like $s/vp \;\; vp \vdash s$.

DEFINITION 4.3 (Multimodal Type Logic)
The logic we use is made up of three parts, corresponding to the three structural connectives: a calculus that treats $\langle ., . \rangle$ as associative, one that treats $\{., .\}$ as associative and commutative, and one for the unary connective $(.)^{\Diamond}$. In addition the following Axiom schema is used:

$$\frac{}{A \vdash A} Ax$$

The linguistic motivation for choosing these components is that we need control over permutation for the partly rigid versus free word order in Hindi: we need to account for word order freedom within the Neg-V cluster, the rigid word order for the Neg-V-Aux cluster, and the partially free word order of Subj and Obj (i.e., the fact that Subj and Obj cannot appear within the Neg-V-Aux cluster, but are otherwise freely permutable).

$\Gamma[A]$ in the rules below means that the material A in square brackets is some sub-structure (respecting structural bracketings) of the left-hand side Γ of a sequent. We will use the $\Box^{\downarrow}$ modality to handle the word order facts. The basic idea is that sequents are in general permutable, but any types marked with the $\Box^{\downarrow}$ (and the $(.)^{\Diamond}$ structural marking) do not allow permutation outside the 'boxed' ($\Box^{\downarrow}$'ed) type.

DEFINITION 4.4 (**L**)
The associative Lambek calculus makes up the part of the logic which is associated with the structural connective $\langle ., . \rangle$ and the logical connectives / and \. It has the following inference schemata:

$$\frac{\Gamma[\langle\langle \Delta_1, \Delta_2\rangle, \Delta_3\rangle]}{\Gamma[\langle \Delta_1, \langle \Delta_2, \Delta_3\rangle\rangle]}\ \mathit{Assoc}$$

$$\frac{\Delta \vdash A \quad \Gamma[B] \vdash C}{\Gamma[\langle B/A,\ \Delta\rangle] \vdash C}\ /L \qquad \frac{\langle \Gamma,\ A\rangle \vdash B}{\Gamma \vdash B/A}\ /R$$

$$\frac{\Delta \vdash A \quad \Gamma[B] \vdash C}{\Gamma[\langle \Delta,\ A\backslash B\rangle] \vdash C}\ \backslash L \qquad \frac{\langle A,\ \Gamma\rangle \vdash B}{\Gamma \vdash A\backslash B}\ \backslash R$$

Associativity will be left implicit and $\langle A, B, C, \ldots\rangle$ is used as a convenient shorthand.

DEFINITION 4.5 (**LP**)
The Lambek calculus with permutation **LP** is simply **L** with an added rule of Permutation that affects (sub)structures of the form {., .}, and rules for the logical connective $\multimap$, namely:

$$\frac{\Gamma[\{\{\Delta_1, \Delta_2\}, \Delta_3\}]}{\Gamma[\{\Delta_1, \{\Delta_2, \Delta_3\}\}]}\ \mathit{Assoc}$$

$$\frac{\Gamma[\{\Delta_2, \Delta_1\}] \vdash C}{\Gamma[\{\Delta_1, \Delta_2\}] \vdash C}\ \mathit{Permute}$$

$$\frac{\Delta \vdash A \quad \Gamma[B] \vdash C}{\Gamma[\{\Delta,\ A \multimap B\}] \vdash C}\ \multimap L \qquad \frac{\{\Gamma,\ A\} \vdash B}{\Gamma \vdash A \multimap B}\ \multimap R$$

Permutation is also compiled away in the Gentzen presentation by treating sequents as multisets.

With the inference rules involving the directionally insensitive connective $\multimap$, and treating the sequents as multisets, we now allow the argument A of a functor like $A \multimap B$ to appear to the left or right of the functor; this contrasts with our directional slashes in **L**, where $A \backslash B$ requires its argument A to be to its left.

DEFINITION 4.6 (Modalities)
The unary modal operators $\Diamond$ and $\Box^{\downarrow}$, which are related to each other by $\Diamond A \vdash B \dashv\vdash A \vdash \Box^{\downarrow} B$ (see Moortgat, 1997), are added to the deductive system via the following rules:

$$\frac{\Gamma[(A)^{\Diamond}] \vdash B}{\Gamma[\Diamond A] \vdash B}\ \Diamond L \qquad \frac{\Gamma \vdash A}{(\Gamma)^{\Diamond} \vdash \Diamond A}\ \Diamond R$$

$$\frac{\Gamma[A] \vdash B}{\Gamma[(\Box^{\downarrow} A)^{\Diamond}] \vdash B}\ \Box^{\downarrow} L \qquad \frac{(\Gamma)^{\Diamond} \vdash A}{\Gamma \vdash \Box^{\downarrow} A}\ \Box^{\downarrow} R$$

With this brief introduction to the underlying framework, we turn to the empirical issues discussed above.

4.1. GETTING THE RIGHT WORD ORDER

We can capture the word ordering facts by defining the lexicon as follows.

(4.1) (a) *nahĩĩ* 'not', $vp \multimap \Box^{\downarrow} vp$
(b) *siitaa* 'Siitaa', np
(c) *sabzii* 'vegetables', np
(d) *khaatii* 'ate', $np \multimap np \multimap s$
(e) *thii* 'had', $vp \backslash \Box^{\downarrow} vp$

Some of these entries need explanation. The syntactic category of the negative *nahĩĩ* is lexically specified as in (4.1a); vp is an intransitive or transitive verb phrase. The non-directional implication $\multimap$ indicates that the VP argument for negation may occur either to the left or the right of the negation. The result category $\Box^{\downarrow} vp$ ensures that after the verb and negation have combined together, nothing may intervene between them. In (4.1d), the lexical entry for *khaatii*, 'ate', says that it needs two nps as arguments in order to form an s, but that the ordering is free: the nps can occur before or after the verb (I ignore agreement issues here for expository purposes). The entry for the auxiliary verb *thii*, on the other hand, says that it needs some kind of verb to its immediate left in order to form a $\Box^{\downarrow}$'ed category of the same type, the $\Box^{\downarrow}$ ensuring that no argument of the verb can appear inside the cluster of negation-verb-auxiliary.

Let us work through a derivation to see how this works. In the following discussion, $np \multimap np \multimap s$ is abbreviated as tv. The sentence we derive is (3.1a).

First, we replace the lexical items with their syntactic types (the derivation is read from the bottom up). After that, the $\multimap L$ rule applies: the negation functor

consumes its transitive verb argument, resulting in a $\Box^{\downarrow}tv$ category. Next, the $\Box^{\downarrow}tv$ is reduced to tv by the rule $\Box^{\downarrow}L$ and can now serve as an argument to the auxiliary $tv\backslash\Box^{\downarrow}tv$. Then, the auxiliary "consumes" the verb, and we again get a boxed category, $\Box^{\downarrow}tv$, which can be reduced to tv as shown above using the $\Box^{\downarrow}L$ rule. After expanding tv to $np \multimap np \multimap s$, we apply the rule $\multimap L$ twice to obtain axioms.

The entire derivation is shown below:

$$\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{}{tv \vdash tv}\,Ax \qquad \dfrac{\dfrac{\dfrac{\dfrac{}{np \vdash np}\,Ax \quad \dfrac{}{np \vdash np}\,Ax \quad \dfrac{}{s \vdash s}\,Ax}{\{np,\ np,\ np \multimap np \multimap s\} \vdash s}\,\multimap L \text{ twice}}{\{np,\ np,\ tv\} \vdash s}}{\{np,\ np,\ (\Box^{\downarrow}tv)^{\Diamond}\} \vdash s}\,\Box^{\downarrow}L}{\{np,\ np,\ (\langle tv,\ tv\backslash\Box^{\downarrow}tv\rangle)^{\Diamond}\} \vdash s}\,\backslash L}{\{np,\ np,\ (\langle(\Box^{\downarrow}tv)^{\Diamond},\ tv\backslash\Box^{\downarrow}tv\rangle)^{\Diamond}\} \vdash s}\,\Box^{\downarrow}L}{\{np,\ np,\ (\langle(\{tv \multimap \Box^{\downarrow}tv,\ tv\})^{\Diamond},\ tv\backslash\Box^{\downarrow}tv\rangle)^{\Diamond}\} \vdash s}\,\multimap L}{\textit{siitaa}\ \ \textit{sabzii}\ \ ((\textit{nahĩĩ}\ \ \textit{khaatii})^{\Diamond}\ \ \textit{thii})^{\Diamond} \vdash s} \tag{4.2}$$

The derivation detailed above illustrates how we can account for the word order facts using these strictly lexically driven deductions. The ordering of negation with respect to the main verb is free, but the auxiliary verb must appear to the right of the result of the combination of the verb with negation. Thereafter, the arguments of the verb may combine in any possible permutation. The ungrammatical derivations are ruled out by the fact that any structural marking using $(.)^{\Diamond}$ other than the ones shown in the above example will lead to a failure in derivation, modulo the refinement discussed next.

One kind of unwanted derivation allowed by the system as set up above is the following. Recall the ungrammatical sentence (3.1b):

(4.3) *Siitaa nahĩĩ khaatii **sabzii** thii
Sita neg eat vegetables was
'Sita did not use to eat vegetables.'

We can actually derive this ungrammatical sentence with the structural marking shown below (in the following derivation, $tv = np \multimap np \multimap s$ (transitive verb); and $iv = np \multimap s$ (intransitive verb)):

$$\dfrac{\dfrac{\dfrac{}{np \vdash np}\,Ax \quad \dfrac{\textit{derivable}}{\{np,\ (\langle(\{iv \multimap \Box^{\downarrow}iv, \boxed{iv}\})^{\Diamond},\ iv\backslash\Box^{\downarrow}iv\rangle)^{\Diamond}\} \vdash s}}{\{np,\ (\langle(\{iv \multimap \Box^{\downarrow}iv, \boxed{tv,\ np}\})^{\Diamond},\ iv\backslash\Box^{\downarrow}iv\rangle)^{\Diamond}\} \vdash s}\,\multimap L}{\textit{siitaa}\ \ ((\textit{nahĩĩ}\ \ \textit{khaatii}\ \ \textit{sabzii})^{\Diamond}\ \ \textit{thii})^{\Diamond} \vdash s} \tag{4.4}$$

Notice that the transitive verb can first combine with one of its arguments (the lower material enclosed in a box in the derivation above), and then can combine with negation as an intransitive verb (the higher element enclosed in a box). The way to prevent this is to ensure that negation looks for a *lexical verb*, i.e., a verb with none of its arguments satisfied. Since we are working in a multimodal system, this constraint can be incorporated straightforwardly. Instead of having only one modal operator $\Box^{\downarrow}$, we can also have a second one, say $\Box^{\downarrow}_{lex}$, which is defined similarly to $\Box^{\downarrow}$. We then mark a lexical verb with this new modal operator $\Box^{\downarrow}_{lex}$, and alter the lexical entries as shown below.

The revised lexical entries are as follows:

(4.5) (a) *nahĩ̃* 'not', $\Box^{\downarrow}_{lex} vp \multimap \Box^{\downarrow} vp$

(b) *khaatii* 'ate', $\Box^{\downarrow}_{lex}(np \multimap np \multimap s)$

5. Constraining NPI Licensing

Since the present account of NPI licensing relies on the notion of downward monotonicity, I begin by defining this term. We then move on to a discussion of Dowty's reformulation of Monotonicity Logic, and its use in our analysis of Hindi NPIs.

Ever since Barwise and Cooper (1981), noun phrases (NPs) have been treated as generalized quantifiers, that is, as (higher order) set-theoretic entities consisting of collections of sets. Moreover, certain quantified NPs, such as *few N* and *at most n N*, happen to have the set-theoretic property of being closed under subsets: given a universe U, sets X and Y, and a (generalized) quantifier Q, if $X \in Q$ and $Y \subseteq X \subseteq U$, then $Y \in Q$. Such quantifiers are known as *downward entailing* or *monotone decreasing* (Barwise and Cooper, 1981).

Monotone decreasing quantifiers contrast with *upward entailing* or *monotone increasing* quantifiers such as *every N*, and *at least n N* which have the property of being closed under *super*sets. In set-theoretic notation, upward entailment amounts to the following statement: if $X \in Q$ and $X \subseteq Y \subseteq U$, then $Y \in Q$.

As an example of downward entailing expressions, consider the sentence *few men ran* which contains the downward entailing quantifier *few men*. Given the truth of this expression, we can conclude that the expression *few men ran slowly* must also be true. Here, the set of slow runners is in general a proper subset of the set of runners. The converse, however, is not true. That is, given that *few men ran slowly* is true, we cannot conclude that *few men ran* must also be true. In other words, we cannot reason from a set such as one characterizing the property of running slowly to one of its supersets, which in this case is the set characterizing the property of running.

One can treat a determiner as a two-place relation which takes the noun and the verb phrase as arguments. In such a case, one can then speak of downward and upward monotonicity applying independently to both the first and second arguments of the determiner. For example, the generalized determiner *every* can be regarded as taking two arguments, a first argument, such as *woman*, with which

it forms an NP, *every woman* and a second argument, such as the verb phrase *is running*, to form the sentence *every woman is running*. As the reader can verify, *every* happens to be downward monotone in its first argument, but upward monotone in its second argument: *every woman is running* entails *every tall woman is running* but not *every woman is running in the park*.

Dowty's Monotonicity Logic, discussed below, relies on the notion of downward monotonicity as defined above.

5.1. DOWTY'S REFORMULATION OF MONOTONICITY LOGIC

The main goal in Dowty (1994) is to try to answer the question: why do NPIs exist? His answer is that NPIs and negative concord (NC) facilitate natural language semantic processing and inference by explicitly marking downward monotone contexts (cf. Israel, 1998). Since in this paper I am not concerned with the above question, but rather with the English-Hindi NPI licensing asymmetry discussed earlier, I present a highly abbreviated account of Dowty's theory, discussing only those elements that are relevant to our discussion.

Dowty begins by presenting a linguistically more suitable version of Sánchez-Valencia's (1991) Natural Logic (but cf. Bernardi, 1999). Lexical items are assumed to have monotonicity marking as indicated by the recursive definition for syntactic categories and types.

(5.1) (a) NP (= type e), S (= type t) and CN (= type (e, t)) are (primitive) categories.
(b) If A and B are any categories, so are A/B and $A\backslash B$.
(c) If A/B is a category, so are A^+/B^+, A^+/B^-, A^-/B^+, and A^-/B^-.
(d) If $A\backslash B$ is a category, so are $A^+\backslash B^+$, $A^+\backslash B^-$, $A^-\backslash B^+$, and $A^-\backslash B^-$.

For complex categories, the monotonicity marking on the result category of a functor is the complex category's marking.

(5.2) (a) $(A/B)^+ =_{def} (A^+/B)^+ =_{def} (A^+/B)$
(b) $(A/B)^- =_{def} (A^-/B)^- =_{def} (A^-/B)$

Most lexical categories appear in two formulations but with the same semantic interpretation. For example, $eat \in (NP^+\backslash S^+)/NP^+$ and $eat \in (NP^-\backslash S^-)/NP^-$. Upward and downward monotone functors, however, are special. They are constrained to appear as shown below (with similar definitions for $A\backslash B$):

(5.2) (a) Upward monotone functors appear in a pair of categories of the forms A^+/B^+ and A^-/B^-.
(b) Downward monotone functors appear in a pair of categories of the forms A^+/B^- and A^-/B^+.

Furthermore, NPIs are specified to have only negative monotonicity marking (with a similar statement for $A\backslash B$):

(5.4) NPIs appear in a category of the form A^-/B^- (or C^-).

Finally, a well-formed non-embedded sentence is defined as follows:

(5.5) If ϕ is of category S^+, ϕ is a well-formed non-embedded sentence.

In the following subsections, I show how this system, with some modifications, allows a straightforward treatment of the English-Hindi NPI asymmetry problem.

5.2. SUBJECT NPIS IN ENGLISH

As discussed earlier, polarity reversing elements like negative quantifiers, e.g., *nobody*, only have the entry S^+/VP^- or S^-/VP^+ for the subject position and $TV^-\backslash VP^+$ or $TV^+\backslash VP^-$ for the object position.

On the other hand, NPIs like *anyone* have only the entries S^-/VP^- and $TV^-\backslash VP^-$ for subject and object positions, respectively. The downward monotonicity constraints on NPIs are then enforced in an obvious way: **Anyone didn't come* is correctly ruled out, while *Nobody came*, *John didn't see anyone*, and *Nobody saw anything* are allowed, as shown in Derivations A, B, C, D, respectively.

I illustrate the way this works using Derivation A below. The other derivations proceed in a similar fashion.

$$\dfrac{\dfrac{\dfrac{}{vp^+ \vdash vp^+}\,Axiom \quad \dfrac{\dfrac{}{vp^- \vdash vp^-}\,Axiom \quad \dfrac{FAIL}{s^- \vdash s^+}}{s^-/vp^- \;\; vp^- \vdash s^+}\,/L}{s^-/vp^- \;\; vp^-/vp^+ \;\; vp^+ \;\; \vdash s^+}\,/L}{anyone \quad didn't \quad come \vdash s^+}$$

Derivation A

Derivation A shows the final monotonicity marking on the lexical items; let us unpack the derivation to show how we got there. Only the lexical entries for *anyone* and *didn't* have fixed monotonicity markings; the one for *come* is underspecified and could be VP^+ or VP^-. *Anyone* must have the entry S^-/VP^-, since it is an NPI (see (5.4)), and *didn't* must either be VP^+/VP^- or VP^-/VP^+, since it is a polarity reversing functor (see (5.3b)). Since *anyone* is the main functor, for the derivation to be legal, its argument, to its immediate right, is determined to be of the form VP^-. In order for this to happen, VP^-/VP^+ is chosen for *didn't* (this is because the result category in VP^-/VP^+ is VP^-). Now, since *come* is underspecified for monotonicity marking, it can serve as an argument for *didn't*, i.e., VP^-/VP^+, with a positive marking and will therefore be instantiated as VP^+. When *didn't* (VP^-/VP^+) combines with VP^+, the result is a VP^-, which can serve as an argument for the main functor S^-/VP^- to yield S^-. But this leads to a failure because of (5.5).

The other examples given below are self-explanatory.

$$\dfrac{\dfrac{\dfrac{}{vp^- \vdash vp^-}\,Axiom \quad \dfrac{}{s^+ \vdash s^+}\,Axiom}{s^+/vp^- \;\; vp^- \vdash s^+}\,/L}{nobody \quad came \vdash s^+}$$

Derivation B

$$\dfrac{\dfrac{\dfrac{}{tv^- \vdash tv^-}\,Axiom \quad \dfrac{\dfrac{}{vp^- \vdash vp^-}\,Axiom \quad \dfrac{\dfrac{}{vp^+ \vdash vp^+}\,Axiom \quad \dfrac{}{s^+ \vdash s^+}\,Axiom}{s^+/vp^+ \;\; vp^+ \vdash s^+}\,/L}{s^+/vp^+ \;\; vp^+/vp^- vp^- \vdash s^+}\,/L}{s^+/vp^+ \;\; vp^+/vp^- \;\; tv^- \;\; tv^- \backslash vp^- \;\; \vdash s^+}\,\backslash L}{John \;\; didn't \;\; see \;\; anyone \vdash s^+}$$

Derivation C

$$\dfrac{\dfrac{\dfrac{}{tv^- \vdash tv^-}\,Axiom \quad \dfrac{\dfrac{}{vp^- \vdash vp^-}\,Axiom \quad \dfrac{}{s^+ \vdash s^+}\,Axiom}{s^+/vp^- \;\; vp^- \vdash s^+}\,/L}{s^+/vp^- \;\; tv^- \;\; tv^- \backslash vp^- \;\; \vdash s^+}\,\backslash L}{nobody \;\; saw \;\; anything \vdash s^+}$$

Derivation D

5.3. HINDI NPIS

Hindi NPIs like *koii-bhii* are derived from the existential quantifier *koii*, 'some, a', by the suffixation of the focus particle *-bhii*, 'also/even' (see Lahiri (1998), and Lee and Horn (1995)). *Koii* displays the same quantifier scope ambiguity as in English in conjunction with, e.g., a universal quantifier or negation ($X > Y$ means X outscopes Y):

(5.6) (a) sab logõ-ne kisii-ko maaraa
all people-erg someone-acc beat
'Everyone beat someone.' $\forall > \exists$ or $\exists > \forall$

(b) koi nahĩĩ aayaa
someone neg came
'Someone didn't come.' $\exists > \neg$ or $\neg > \exists$

However, when *-bhii* is suffixed, the polarity sensitive item is obtained.

(5.7) (a) *koii-bhii aayaa
anyone came
'Anyone came.'

(b) koii-bhii nahĩĩ aayaa
anyone neg came
'No-one came.' $\neg > \exists$

I assume here that NPIs like *koi-bhii* are lexically of a lower type, NP^-, than the generalized quantifier *koii* or *kisii* (which have the type S^-/VP^- in subject position), thereby ensuring that NPIs are never the main functors and must appear in the scope of negation. This lower type allows them to appear more liberally, both in subject and object positions.

Support for treating *-bhii* marked NPIs as more liberal in nature comes from the fact that *-bhii* allows a wide range of NPIs to appear in many more licensing environments than that NPI might otherwise appear in (see Vasishth, 1998).

For example, *uf karnaa*, 'to express distress', is an NPI that appears only in strongly negative or antimorphic contexts,[1] i.e., in the scope of negation, and not in other negative contexts like the monotone decreasing NPI licensor *few people* and the anti-additive licensor[2] *if . . . then*.

(5.8) (a) #gaṇit-mẽ fel hone-par **kam-hii** vidyaarthii *uf*
mathematics-in fail become-on few-encl students onom
kartee haĩ
do are
'It matters to few students if they fail in mathematics.'

(b) **#agar** tum-ne injekshan lagne-par *uf* *kii* to mai
if you-erg injection apply-on onom do then I
tum-he ḍarpok samjhuun-gaa
you-to coward consider-will
'I'll consider you a coward if you make even a sound when you get the injection.'

(c) us-ne sab-kuch bec ḍaalaa lekin vimlaa-ne *uf* **naa**
(s)he-erg everything sold gave but Vimla-erg onom not
kii
did
'(S)he sold off everything, but Vimla didn't show even the slightest distress.'

However, suffixing *-bhii* to *uf karnaa* transforms it into a weak NPI:

(5.9) (a) gaṇit-mẽ fel hone-par **kam-hii** vidyaarthii
mathematics-in fail become-on few-encl students
uf-bhii *kartee* haĩ
onom-even do are
'It matters to few students if they fail in mathematics.'

(b) **agar** tum-ne injekshan lagne-par *uf-bhii* *kii* to mai
if you-erg injection apply-on onom-even do then I
tum-he ḍarpok samjhuun-gaa
you-to coward consider-will
'I'll consider you a coward if you make even a sound when you get the injection.'

(c) us-ne sab-kuch bec ḍaalaa lekin vimlaa-ne *uf-bhii*
(s)he-erg everything sold gave but Vimla-erg onom-even
naa *kii*
neg did
'(S)he sold off everything, but Vimla didn't show even the slightest distress.'

Assuming, then, that NPIs like *koi-bhii* are of a more liberally occurring type, NPI licensing in Hindi proceeds as shown in Derivation E for the sentence *kisii-ne-bhii kuch-bhii nahĩ̃ khaayaa*, literally, 'anyone anything not ate' (='nobody ate anything'), where two NPIs occur, one in subject position, and the other in an object position. (tv^+ abbreviates $np^- \multimap vp^+$, which expands to $np^- \multimap np^- \multimap s^+$.). In this and subsequent derivations, for ease of exposition I ignore the modalities etc. introduced earlier for controlling word order.

$$\dfrac{\dfrac{\dfrac{}{np^- \vdash np^-}\ Axiom \quad \dfrac{}{np^- \vdash np^-}\ Axiom \quad \dfrac{}{s^+ \vdash s^+}\ Axiom}{np^-\ \ np^-\ \ tv^- \multimap tv^+\ \ tv^-\ \ \vdash s^+}\ \multimap L \textit{ three times}}{\textit{kisii-ne-bhii}\ \ \textit{kuch-bhii}\ \ \textit{nahĩ̃}\ \ \textit{khaayaa} \vdash s^+}$$

Derivation E

5.4. An advantage of this analysis: wider coverage

This licensing mechanism generalizes to licensors of differing strengths. E.g., consider the monotone decreasing NPI licensor *kam-hii log*, 'few-encl people', and the anti-additive licensor *agar ... to*, 'if ... then' (see Vasishth (1998) for details of NPI licensing in the scope of these and other licensors). Assigning the type (s^+/vp^-) to *kam-hii log*, 'few people', and $s^+ \multimap s^-$ to *agar*, we get the correct possibilities for *kam-hii log kuch-bhii khaayenge*, literally, 'few people anything will-eat', ('few people will eat anything'), and *agar koi-bhii kuch-bhii maange*, literally, 'if anyone anything wants ...' ('if anyone wants anything ...').

$$\dfrac{\dfrac{\dfrac{}{np^- \vdash np^-}\ Axiom \quad \dfrac{}{vp^- \vdash vp^-}\ Axiom \quad \dfrac{}{s^+ \vdash s^+}\ Axiom}{s^+/vp^-\ \ np^-\ \ np^- \multimap vp^-\ \ \vdash s^+}\ \multimap, /E}{\textit{kam-hii log}\ \ \textit{kuch-bhii}\ \ \textit{khaayenge} \vdash s^+}$$

Derivation F

$$\dfrac{\dfrac{\dfrac{}{np^- \vdash np^-}\ Axiom \quad \dfrac{}{np^- \vdash np^-}\ Axiom \quad \dfrac{\dfrac{}{s^- \vdash s^-}\ Axiom \quad \dfrac{}{s^+ \vdash s^+}\ Axiom}{s^+ \multimap s^-\ \ s^- \vdash s^+}\ \multimap}{s^+ \multimap s^-\ \ np^-\ \ np^-\ \ np^- \multimap vp^-\ \ \vdash s^+}\ \multimap \textit{ twice}}{\textit{agar}\ \ \textit{koi-bhii}\ \ \textit{kuch-bhii}\ \ \textit{maange} \vdash s^+}$$

Derivation G

The direction-sensitive slash in the lexical entry for *kam-hii log* rules out the word order variations shown in (5.4a,b) below, while the non-directional implication for *agar* allows the possibility of scrambling, as shown in (5.4c–e).

(5.10) (a) *kuch-bhii khaaenge kam-hii log
anything will-eat few-encl people
'...'

(b) *kuch-bhii kam-hii log khaaenge
anything few-encl people will-eat
'...'

(c) kuch-bhii maange koii-bhii agar
anything asks anyone if
'If anyone asks for anything ...'

(d) kuch-bhii maange agar koii-bhii
anything asks if anyone
'If anyone asks for anything ...'

(e) kuch-bhii agar maange koii-bhii
anything if asks anyone
'If anyone asks for anything ...'

Existing transformational accounts only discuss NPI licensing in the context of negation, not these other licensing contexts. It remains to be seen whether a transformation-based theory could adequately cover data such without introducing new constraints and mechanisms; the present treatment has the advantage that itrequires no extra machinery to handle the word order variation discussed above.

6. Concluding Remarks

This treatment of word order variation constrained by negation, and of NPI licensing has several advantages over a purely or partly LF-based, transformational account: (i) negation-constrained word order variation is treated independently of the negative polarity facts, as I have argued it should be, and word order variation is constrained lexically; (ii) a monostratal theory is developed in which NPIs are licensed due to the downward monotone property of their licensors, not mere c-command by the licensor; and (iii) diverse licensing facts can be captured easily in this analysis.

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Notes

[1] These are linguistic elements that satisfy the following definition:
An element X is antimorphic iff the following are logically valid:
X (VP_1 or VP_2) ↔ (X VP_1 and X VP_2)
X (VP_1 and VP_2) ↔ (X VP_1 or X VP_2)
English and Hindi have only one such antimorphic licensor: the negation marker. See Wouden (1997) for further details.

[2] These are linguistic elements that satisfy the following definition:
An element X is anti-additive iff the following is logically valid:
X (VP_1 or VP_2) ↔ (X VP_1 and X VP_2)
English and Hindi have several such licensors, such as the conditional. See Wouden (1997) for further details.

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