Directionality and the Lexicon: Evidence from Gapping

DRAFT 1.0; September 25, 2000

Cem Bozsahin. *Middle East Technical University*

bozsahin@metu.edu.tr

> .. 'units' and 'grammatical facts' are only different names for different aspects of the same general fact: the operation of linguistic oppositions. So much so that it would be perfectly possible to tackle the problem of units by beginning with grammatical facts.
> F. de Saussure, *Cours*.

1 Introduction

The relationship between gapping (identical element deletion) and word order has been a focus of intensive research since the work of Ross (1970). In serialization of [S]ubject, [O]bject and [V]erb in a particular language, forward V gapping (deletion of identical verbs on the right) is a sign of word orders that license leftward grouping VO, and backward V gapping is a sign of rightward grouping OV (Ross, 1970, p.251):

> "The order in which gapping operates depends on the order of elements at the time that the rule applies; if the identical elements are on the left branches, gapping operates forward; if they are on the right branches, it operates backward."

Table 1
Ross's classification of Gapping

Type	Base	Pattern	
A	SVO	SVO & SVO	$\Rightarrow_{gap}$ SVO & SO (forward gapping)
B	SVO	SVO & SVO	$\Rightarrow_{gap}$ SVO & SO $\Rightarrow_{scramble}$ SOV & SO
C	SOV	SOV & SOV	$\Rightarrow_{gap}$ SO & SOV (backward gapping)
D	SOV	SOV & SOV	$\Rightarrow_{gap}$ SO & SOV $\Rightarrow_{scramble}$ *SO & SVO

The following typology emerges for the most common word orders SOV (1), SVO (2) and VSO (3) (data from (Steedman, 2000)):

(1) a. Japanese: SO & SOV but *SOV & SO

b. Ken-ga   Naomi-o,   Erika-ga   Sara-o   tazuneta
   Ken-NOM Naomi-ACC Erika-NOM Sara-ACC visit-PAST.CONCL
   'Ken visited Naomi, and Erika Sara.'

c. *Ken-ga Naomi-o tazunete, Erika-ga Sara-o

(2) a. English: SVO & SO but *SO & SVO

b. Keats eats Beans, and Chapman potatoes

c. *Chapman potatoes, and Keats eats Beans

(3) a. Irish: VSO & SO but *SO & VSO

b. Chonaic Eoghan Siobhán agus Eoghnaí Ciarán
   saw   Eoghan Siobhán and Eoghnaí Ciarán
   'Eoghan saw Siobhán, and Eoghnaí Ciarán.'

c. *Eoghan Siobhán agus chonaic Eoghnaí Ciarán

The fact that, for instance, Russian exhibits SO & SOV, SVO & SO, and SOV & SO forces an analysis of Russian as an SVO language due to universal ungrammaticality of type D in Table 1; SOV as a basic word order would derive *SO & SVO because gapping is assumed to apply before or after scrambling. Ross's conjecture that no language exhibits SO & SVO word order has been rejected by Rosenbaum (1977), which makes the appeal to typological universals for pinning down the basic word order questionable.

Lacking a universal for word order, Ross's hypothesis—that the direction of gapping depends on input phrase structure configuration—sets an agenda for lexicalist theories of grammar: the patterns of gapping in a language must originate ultimately from the lexicon if no operation is allowed to change the projection of structure from lexicon to grammar, and directionality in a language is to be specified non-redundantly in grammar-lexicon. This in turn forces a minimalist grammar to posit surface structures and categories that consistently reflect the directionality and word order emanating from the lexicon.

The issue of word order identification has been controversial even for configurational languages, due mainly to empirical significance or insignificance attributed to having certain word orders in the lexicon (or d-structure). McCawley's (1970) early proposal for English as a VSO language—based on the ease of transformations, and Pullum's (1977) universals for word order argued on mostly formal grounds, which were found to be untenable (Derbyshire, 1977; Berman, 1974). Movement-based accounts such as (Kayne, 1994) also undermine the empirical support for a surface notion like word order (cf. Greenberg's (1963) universals).

With the understanding that a putatively lexicalized word order be empirically justifiable, the issue becomes more problematic in so-called free word order languages, for different word orders serve different purposes, and it is hard to single out one of them as basic and regard others as derived. Steele (1978) argued that word orders that are morpho-syntactically distinct from the basic word order, such as in subordinate clauses of many languages, are not variations in word order. Following the same route, we look at main clauses, and consider the word order distinctions in main and subordinate clauses (as in German) to be a different matter.

We wish to argue in this paper that the issue is not the 'basic' word order in grammar but directional and categorial specificity in the lexicon. A proper way of pinning down

the word order(s) is to systematically lay out the consequences of having only in the lexicon different degrees of directionality, subject to universal directionality constraints in the grammar, and apply the usual principles of parsimony to select among the hypotheses. The process also reveals insights as to whether a language should be regarded as having scrambling, extraposition, rigid or flexible word order, or a combination of these in grammar-lexicon. Directional specificity forces certain surface constituents as a consequence of the grammar and the lexicon. In keeping with the surface constituency, we use the term subject (object) to mean surface subject (object) throughout the paper.

We present our argument in detail in a particular language, Turkish, which is generally considered to have basic SOV order and scrambling. Turkish data on gapping is provided in section 2. We formulate the hypotheses with explicitly constructed surface grammars based on Combinatory Categorial Grammar (CCG), which we describe in Section 3. Sections 4 through 7 look at the consequences of identifying Turkish in the lexicon as an SOV language, an OV/VO language, an SOV and SVO language, and a verb-final language (SOV and OSV). The first three alternatives have been entertained in the literature, and the last one is the one we propose based on our findings. In conclusion we elaborate on language-particular and general consequences of this way of theorizing about word order.

2 Gapping: Turkish Data

Studies on Turkish word order, e.g., (Enç, 1991; Erguvanlı, 1984; Erkü, 1983; Hoffman, 1995; Kılıçaslan, 1994; Turan, 1995) reflect the dominance of discourse-functional concerns for identifying the basic word orders. As these studies point out, word order shows distinct characteristics according to discourse ($\pm$definite) and semantic ($\pm$referential) properties of the object. Word order variation serves a discourse function, and word order restriction is semantic in nature. Table 2 shows the word order restrictions with non-referential objects. OSV is ungrammatical if the object is non-referential (labeled O^{-r}). Referential objects can appear anywhere, and all six variations of S, O, V are attested in main clauses. Definiteness does not seem to constrain word order as much as referentiality. Indefinite objects can appear anywhere depending on the information structure (cf. 4a–b).

(4) a. Bir kitap adam, bir   dergi   de çocuk oku-du   (indefinite O)
       a/one book man, a/one magazine conj child read-PAST
       'the man read a book, and the child, a magazine.'

    b. *kitap adam, dergi de çocuk okudu (non-referential O)

Table 2
Word order with non-referential object (O^{-r})

$SO^{-r}V$	SVO^{-r}	$VO^{-r}S$
*$O^{-r}SV$	$O^{-r}VS$	VSO^{-r}

We classify our gapping data along the semantic aspect (± referentiality) with the proviso that a competence grammar and lexicon must deliver all surface structures that the information structure requires. In other words, we will be interested in discourse functions insofar as their involvement is indispensible in the lexicon and the grammatical processes.

For ease of exposition, we use the schematic notation such as SO & SOV to indicate coordination with gapping, but in surface structure, the coordinating clitic comes after the first constituent of the rightmost conjunct e.g., (4a) and (5). This is typical of native coordinators; only 've' (and) and 'ama' (but) which are borrowed from Arabic do not behave this way (6a–b). Both kinds of coordinators allow for backward and forward gapping.

(5) Kitab-ı   adam, dergiyiyse   çocuk oku-du
    book-ACC man   magazine-ACC-conj child read-PAST
    'The man read the book, the child, the magazine.'

(6) a. Çocuk ev ödev-i-ni   yap-tı   ve tarih   çalış-tı
       child   homework-POSS-ACC do-PAST and history study-PAST
       'The child did his/her homework and studied history.'

    b. *Çocuk ödevini yaptı tarih ve çalıştı .

    c. Adam kitab-ı   ama çocuk dergi-yi   oku-du
       man   book-ACC conj child magazine-ACC read-PAST
       'The man read the book, but the child, the magazine.'

    d. Çocuk dergiyi okudu, ama adam kitabı.

We adopt a syncategorematic treatment of coordination (7). Assuming that the coordinating clitic marks the first constituent X of the rightmost conjunct as $X_{\&}$, (8) is the instance of the general schema for the surface constituents with coordinating particles (Steedman, 1990a). (9) shows an application of (8) in which we write S and O instead of surface categories of the arguments for simplicity (but our analyses do not take grammatical relations such as S and O as primitives). In examples, we refer to the general scheme of coordination (7) for ease of exposition.

(7) Coordination Scheme (&) : X & $X \Rightarrow X$

(8) Coordination with particles ($\&_p$): $X \ X_{\&} \Rightarrow X_{\&}$

(9) Adam kitab-ı , çocuk da   dergi-yi   okumuş
    man book-ACC child conj magazine-ACC   read

$$\underbrace{\text{SO}} \quad \underbrace{\text{S}_{\&}}$$
$$\underline{\qquad\qquad \text{SO}_{\&} \qquad\qquad}$$
$$\underline{\qquad\qquad\qquad\qquad\qquad}_{\&_p}$$
$$\text{SO}_{\&}$$

Table 3
Backward V gapping (referential O)

SO & SOV	OS & OSV
*SO & OSV	*OS & SOV
*SO & XVY	*OS & XVY for X,Y=S,O
*SO & VXY	*OS & VXY for X,Y=S,O

Table 3 shows the data on backward deletion of identical verbs. The rightmost conjunct in which the undeleted verb appears is verb-final. The shall show later that the ungrammaticality of bottom two rows is not due to a universal word order constraint such as type D but a universal directionality constraint in the grammar. The first row indicates that SO and OS must be treated as constituents at the surface structure, with derivations similar to (9). The second row shows that their surface categories must differ, otherwise SO & OS and OS & SO coordination would be grammatical.

Table 4
Forward V Gapping (referential O)

SOV & SO	OSV & OS
SOV & OS	OSV & SO
?SVO & SO/OS	?OVS & SO/OS
?VOS & OS/SO	?VSO & SO
??VSO & OS	

Table 4 shows the data on forward deletion of identical verbs. As evident from the first two rows, structural parallelism that we observe in Table 3—which has earlier prompted all too powerful transderivational constraints (Hankamer, 1973)—do not apply in forward gapping. It appears that the judgments can be ranked according to the position of the verb in the leftmost conjunct. All informants found verb-final leftmost conjuncts grammatical, irrespective of the surface structure of the right conjuncts. Non-verb-final left conjuncts are problematic irrespective of the right conjunct, with SVO & SO faring slightly better than others. Judgments improve when examples are provided in context, which we did only for questionable cases. For instance, VSO & OS is considered ungrammatical by the majority of the informants in null context, but less problematic in context (10). Providing intonational contours also affect judgments in borderline cases. For instance, informants who considered SVO & SO questionable considered it grammatical with falling intonation on the left conjunct and rising intonation on the right (pitch accents in (11) are shown in capitals). We assume that a competence grammar of surface structure must deliver analyses for all examples in Table 4 with problematic cases discourse-marked, so that discourse-pragmatic issues can be resolved by discourse grammar by deciding on the discourse felicity of the surface constituents.

(10)   Context: a film director wonders whether the producer has read the novel, after the producer claims that he read the screenplay:

Bence okumuş yapımcı senaryoyu, romanıysa yardımcısı
I-ADV read producer screenplay-ACC novel-ACC-CONJ assistant-POSS
'I think the producer has read the screenplay, but the novel, his/her assistant.'

(11) ADAM OKUMUŞ dergiyi, çocuk DA KITABI
      man read-PAST magazine-ACC child conj book-ACC
      'The man has read the magazine, and the child, the novel.'

Table 5
Argument Gapping, and Split Coordination (referential O)

SV & SVO	SVO & SV	
OV & OVS	OVS & OV	
OVS & SV	VSO & SV	
*SV & OSV	OSV & SV	
*SV & VSO	*OV & VOS	
*OV & SOV	SOV & OV	
VS & VSO	VO & VOS	*VX & ABC otherwise (for X=S,O)
*ABC & VX	(for A,B,C=S,O,V and X=S,O)	
SO & O V	SVO & O	SOV & O

Table 5 exemplifies forward and backward gapping of S and O. Some of these processes go under the rubric of right (left) node raising, e.g., SV & SVO and OSV & SV, but they are indistinguishable from constituent coordination with the flexible notion of surface constituency (Steedman, 1990b), hence need not be regarded as different grammatical processes. Similar to V deletion, forward gapping does not require structural parallelism but backward gapping does (cf. top six rows). As in the case of SO and OS categorial distinction in verb deletion (Table 3), SV and VS, and OV and VO must be distinguished categorially to account for the fifth row. VS and VO cannot form constituents as right conjuncts (second row from bottom). VS and VO as left conjuncts are grammatical only with coordinators that are not clitics on the right conjunct (third row from bottom). 'Ama' is ambiguous in this regard, it can be a coordinating particle as well (12).

(12) a. Yazmış adam ama okumadı kimse kitabı
          write-PAST man conj read-NEG-PAST nobody book-ACC
          'The man wrote, but nobody read the book.'

      b. Yazmış adam, okumadı ama kimse kitabı

Split coordination of O in Hungarian is what prompted Koutsoudas (1971) to regard SVO as a basic order in addition to SOV, also for languages similar to Hungarian in that respect: Russian, Modern Greek and Turkish (cf. bottom row, third column).

Non-referential objects (labeled O^{-r}) significantly constrain the possibilities in gapping and word order. Givón's (1978) universal tendency E—that topic/theme (old information) appear before new information cf. also (Clark and Clark, 1977; Gundel,

1988)—appears to hold in *O^{-r}SV in which the O^{-r}as non-definite description (either non-referential or indefinite) of new information cannot precede SV. But Table 2 shows that the contrast in grammaticality is between O^{-r}SV and all others, including O^{-r}VS, which is a case against the universal tendency. Instead of deliberating on the topichood of O^{-r}in O^{-r}SV vs. O^{-r}VS, we believe that a competence grammar should preserve this contrast of O and O^{-r}and do no more than that, in effect letting discourse-pragmatics do its work on deciding the contextual appropriateness of the word order. The contrast between VSO^{-r}and *O^{-r}SV is also crucial (13a–b). These are the cases in which the non-referential object is not adjacent to the verb. Incorporation accounts would treat these cases similarly. Moreover, as (13c) shows, non-trivial material can creep in between O^{-r}and V in O^{-r}V/VO^{-r} sequences. We will not rely on incorporation accounts of non-referential NPs.

(13) a. Okumuş adam kitap, hiç birşey bilmiyor   değil.
        read-ASP man book nothing   know-NEG-ASP not
        lit. 'The man apparently has read some books, it is not that he doesn't know anything.'

    b. *Kitap adam okumuş, hiç birşey bilmiyor değil.

    c. Adam <u>balık</u> uzun süre hiç sıkılmadan <u>tutmuş</u>, o yüzden artık   balığa çıkamadığı için   üzgün.
        Man fish   long time without bore   catch so   anymore fish-going-NEG   because sorry.
        lit. 'The man has caught fish for a long time without a bore, he is sorry that he can't go fishing anymore.'

Table 6 and Table 7 are tabulated similar to Table 3 and Table 4 for comparison. They show that O^{-r}S is not a surface constituent and that the structural parallelism asymmetry between backward and forward gapping of verbs with O is preserved with O^{-r}, e.g. *SO^{-r}& SVO^{-r}but ?SVO^{-r}& SO^{-r}. Bottom row of Table 7 shows that the object's referentiality is shared across the conjuncts (cf. first and third rows).

Table 6
Backward V gapping (non-referential O^{-r})

SO^{-r}& SO^{-r}V	*O^{-r}S & O^{-r}SV
*SO^{-r}& O^{-r}SV	*O^{-r}S & SO^{-r}V
*SO^{-r}& XVY	*O^{-r}S & XVY for X,Y=S,O^{-r}
*SO^{-r}& VXY	*O^{-r}S & VXY for X,Y=S,O^{-r}

Table 8 is the counterpart of Table 5 for O^{-r}. The main distinction is the ungrammaticality of O^{-r}SV & SV although the structural parallelism in forward gapping is still not required (cf. top three rows).

3 Surface Grammar and Lexicon: Combinatory Categorial Grammars

CCG (Ades and Steedman, 1982; Steedman, 1996; Steedman, 2000) is a theory of natural language syntax and lexicon that appeals only to surface constituency. It is a minimalist program in the sense that only the Logical Form (LF) is a level of representation;

Table 7
Forward V Gapping (non-referential O^{-r})

$SO^{-r}V$ & SO^{-r}	*$O^{-r}SV$ & $O^{-r}S$
*$SO^{-r}V$ & $O^{-r}S$	*$O^{-r}SV$ & SO^{-r}
SVO^{-r} & ?SO^{-r}/*$O^{-r}S$	$O^{-r}VS$ & ?SO^{-r}/*$O^{-r}S$
$VO^{-r}S$ & *$O^{-r}S$/?SO	?VSO^{-r} & SO^{-r}
*VSO^{-r} & $O^{-r}S$	
*SOV & SO^{-r}	*SVO & SO^{-r}

Table 8
Argument gapping and split coordination(non-referential O^{-r})

SV & SVO^{-r}	SVO^{-r} & SV	
$O^{-r}V$ & $O^{-r}VS$	$O^{-r}VS$ & $O^{-r}V$	
$O^{-r}VS$ & SV	VSO^{-r} & SV	
*SV & $O^{-r}SV$	*$O^{-r}SV$ & SV	
*$O^{-r}V$ & $SO^{-r}V$	$SO^{-r}V$ & $O^{-r}V$	
*VS & XYZ	*XYZ & VS for X,Y,Z=S,O^{-r},V	
*VO^{-r} & XYZ	*XYZ & VO^{-r} for X,Y,Z=S,O^{-r},V	
SO^{-r} & $O^{-r}V$	SVO^{-r} & O^{-r}	$SO^{-r}V$ & O^{-r}

binding conditions are predicated over it. CCG lexicon consists of lexical items with their associated syntactic and semantic types (14) (lambda notation is used in semantic representation for ease of exposition; CCG in fact makes use of less powerful—and variableless—abstraction devices such as a limited set of combinators (Steedman, 1988; Curry and Feys, 1958)).

(14) Mary := NP:$mary'$
   book := N:$\lambda x.book'x$
   reads := $(S\backslash NP)/NP$:$\lambda x.\lambda y.read'xy$

Categorial Grammar is considered a radically lexicalist grammar (Karttunen, 1989). Languages differ in their CCG specification only in the lexicon and the kinds of categorial restrictions they impose on a small set of universal rules in the grammar. Hence any structure-forming operation must originate and project itself from the lexicon without any change. It employs no empty categories or movement devices.

The landscape of CCG combinatory rules is shaped by the Principle of Directional Consistency (Steedman, 1996): All syntactic combinatory rules must be consistent with the directionality of the main functor. The simplest rules of function application thus linearize to two possibilities (15a–b), excluding (15c–d).

(15) a. Forward Application ($>$):

    X:fx/Y:x Y:a $\Rightarrow$ X:fa

  b. Backward Application ($<$):

$$Y\!:a \quad X\!:fx\backslash Y\!:x \quad \Rightarrow \quad X\!:fa$$

c. $* \ Y \quad X/Y \quad \Rightarrow \quad X$

d. $* \ X\backslash Y \quad Y \quad \Rightarrow \quad X$

What brings CCG to mildly context-sensitive power from the context-free basis of function application is the inclusion of function composition (16), type raising (17), and substitution. We are only concerned with the first two operations in this work. Composition (and substitution) is also serialized according to a principle, the Principle of Directional Inheritance (Steedman, 1996, p.42): if the category that results from the application of a combinatory rule is a function category, then the slash defining the directionality for a given argument in that category will be the same as the one(s) defining the directionality for the corresponding argument(s) in the input function(s). This principle allows four possibilities of surface composition (16a–d) and excludes e.g., (16e–f).

(16) a. Forward Composition ($>$B):

$$X/Y\!:f \quad Y/Z\!:g \quad \Rightarrow X/Z\!:\lambda x.f(gx)$$

b. Backward Composition ($<$B):

$$Y\backslash Z\!:g \quad X\backslash Y\!:f \quad \Rightarrow X\backslash Z\!:\lambda x.f(gx)$$

c. Forward Crossing Composition ($>$B$_\times$):

$$X/Y\!:f \quad Y\backslash Z\!:g \quad \Rightarrow X\backslash Z\!:\lambda x.f(gx)$$

d. Backward Crossing Composition ($<$B$_\times$):

$$Y/Z\!:g \quad X\backslash Y\!:f \quad \Rightarrow X/Z\!:\lambda x.f(gx)$$

e. $*X/Y \quad Y/Z \quad \Rightarrow X\backslash Z$

f. $*Y/Z \quad X/Z \quad \Rightarrow X/Z$

(17) a. Forward Type Raising ($>$T):

$$X\!:a \Rightarrow \quad T/(T\backslash X)\!:\lambda f.fa$$

b. Backward Type Raising ($<$T):

$$X\!:a \Rightarrow \quad T\backslash(T/X)\!:\lambda f.fa$$

There may be language-particular and universal constraints on the rules. For instance, Dutch makes use of $>$B$_\times$ to handle crossing dependencies (Steedman, 1985). English makes no use of $>$B$_\times$. Type raising is performed over argument categories ($X{=}NP,PP$ in (17)). It is schematized by variable T over the categories that can take X as an argument, e.g., functions onto S for verbs. Type raising in (17) is called order-preserving (Dowty, 1988) because it maintains word order and the dominance relationships. For instance, objects in English are backward type raised ($<$T) because of the

verbs' category *(S\NP)/NP*; forward type raising would yield *T/(T\NP)* for the object, which would look for a verb that looks for its object to the left. Non-order preserving type raising, e.g., *T|(T|X)* collapses to permutation closure and is insensitive to word order restrictions (Moortgart, 1988). Type raising and composition work together to build non-standard surface constituents from e.g. SV:

$$
\begin{array}{cccccc}
(18) & \text{John} & \text{likes} & \text{and} & \text{Mary} & \text{hates} & \text{cats} \\
& \overline{T/(T\backslash NP)}^{>T} & \overline{(S\backslash NP)/NP} & & \overline{T/(T\backslash NP)}^{>T} & \overline{(S\backslash NP)/NP} & \overline{NP} \\
& :\lambda f.f john' & :\lambda xy.likes'xy & & :\lambda g.g\ mary' & :\lambda xy.hate'xy & :cats' \\
& \multicolumn{2}{c}{\overline{S/NP:\lambda x.like'x\ john'}^{>B}} & & \multicolumn{2}{c}{\overline{S/NP:\ \lambda x.hate'x\ mary'}^{>B}} & \\
& \multicolumn{5}{c}{\overline{S/NP:\ \lambda x.and'(like'x\ john')(hate'x\ mary')}^{\&}} \\
& \multicolumn{5}{c}{\overline{S:and'(like'cats'john')(hate'cats'mary')}^{>}}
\end{array}
$$

Categorial Grammars build complex syntactic expressions from simple types *S, NP*, and *N*. Janeway (1990) argued that for verb-peripheral languages such as SOV and VSO, there is an undesirable argument ambiguity if the arguments are not decorated with case features; *S\NP\NP* verbal category might indicate SOV or OSV. $S\backslash NP_{nom}\backslash NP_{acc}$ makes the mapping of surface structure to argument structure explicit. We use the case feature in surface categories of arguments.[1]

Order-preserving operations like type raising, order-reversing operations like extraposition, and order-insensitive operations like scrambling must be distinguished categorially in the surface grammar so that the consequences of having them in the grammar-lexicon can be made explicit in terms of directionality. (19a–b) define extraposition. Backward displacement has the effect of making the argument more likely to be the topic, and forward displacement makes it less likely. Scrambling (19c) is directionally too insensitive to mark an argument on topichood. In fact, all word order restrictions disappear in presence of (19c), but more restricted versions such as *T\(T\NP)* or *T/(T/NP)* are worthy of consideration for loosely constrained flexibility in word order.

The semantics of extraposition and scrambling are rather obscure without a discourse component. We leave this issue aside (i) by noting that they are related to type raising in turning arguments into functors, and (ii) by marking the sentence with extraposed element on topic as S_{+t}(topicalized) or S_{-t}(detopicalized), in effect, categorizing it as another type of sentence which is not discourse-equivalent to *S*.

(19) a. Backward Extraposition (<XP):

$X \Rightarrow \quad S_{+t}/(S/X)$ or $S_{+t}/(S_{+t}/X)$

b. Forward Extraposition (>XP):

$X \Rightarrow \quad S_{-t}\backslash(S\backslash X)$ or $S_{-t}\backslash(S_{-t}\backslash X)$

---

c. Scrambling ($\leftrightarrow$):
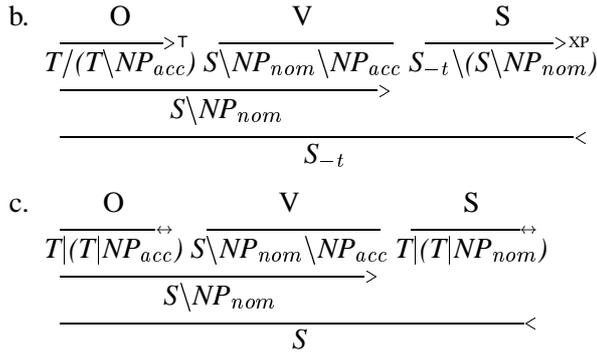
$X \Rightarrow T|(T|X)$

X is an argument category

Surface extraposition moves elements in the other direction with respect to the verb. In an SVO language like English with verbal category $(S\backslash NP_{nom})/NP_{acc}$, an extraposed (topicalized) object moves leftward and looks for the rightward-looking verb. Hence object extraposition in English yields the $S_{+t}/(S/NP_{acc})$ category (20a). Forward (backward) extraposition of subject (object) is to be distinguished from forward (backward) type raising of subject (object) in order to account for ungrammaticality of (20b) with the given interpretation (*** in a line indicates non-derivability). Backward type raising of subject in the form of $T\backslash(T/NP_{nom})$ leads to non-derivability by the universal principles of directionality; there would be no verb in the language that would look for its surface subject on the right, hence the T/NP_{nom} argument category in type raising fails. Forward extraposition of the subject as in (20b) on the other hand differs from backward-type-raising only in the argument category $S\backslash NP_{nom}$, which is directionally consistent with the verb's lexical category, and the principles of directionality in the grammar could not eliminate it. Although type raising applies freely to argument categories, surface subject extraposition is not licensed by the English lexicon.

(20) a.

$$
\begin{array}{ccc}
\text{This book} & \text{the librarian} & \text{recommends} \\
\hline
S_{+t}/(S/NP_{acc}){:}\lambda f.f\ b' & T/(T\backslash NP_{nom}){:}\lambda g.g\ l' & (S\backslash NP_{nom})/NP_{acc}{:}\lambda x.\lambda y.r'xy \\
\end{array}
$$

$$
\underset{<\text{XP}}{} \quad \underset{>\text{T}}{} \quad \underset{S/NP_{acc}{:}\lambda x.r'xl'}{\overline{\qquad\qquad\qquad\qquad\qquad}}{>\text{B}}
$$

$$
\overline{\qquad\qquad\qquad S_{+t}{:}r'b'l' \qquad\qquad\qquad}{>}
$$

b.

$$
\begin{array}{ccc}
\text{*This book} & \text{recommends} & \text{the librarian} \\
\hline
S_{+t}/(S/NP_{acc}){:}\lambda f.f\ b' & (S\backslash NP_{nom})/NP_{acc}{:}\lambda x.\lambda y.r'xy & {*}S_{-t}\backslash(S\backslash NP_{nom}){:}\lambda g.g\ l' \\
\end{array}
$$

$$
{<\text{XP}} \qquad\qquad\qquad {***}{>\text{XP}}
$$

$$
\overline{\qquad\qquad\qquad S_{-t}/NP_{acc}{:}\lambda x.r'x\ l'\qquad\qquad\qquad}{<\text{B}_{\times}}
$$

$$
\overline{\qquad\qquad {***}\qquad S_{+t}{:}\ r'b'l'\qquad\qquad}{>}
$$

Examples in (21) show for an SOV language the surface categories and directional specificity of using type raising (21a), extraposition (21b), or scrambling (21c) in the derivation of OVS word order. (21a) is ruled out because of the principle of directional consistency; an SOV language with no extraposition or scrambling could not derive OVS.

(21) a.

$$
\begin{array}{ccc}
\text{O} & \text{V} & \text{S} \\
\hline
NP_{acc} & S\backslash NP_{nom}\backslash NP_{acc} & T/(T\backslash NP_{nom}) \\
\end{array}{>\text{T}}
$$

$$
\overline{\qquad S\backslash NP_{nom}\qquad}{<}
$$

$$
\overline{\qquad\qquad {***}\qquad S\qquad\qquad}
$$

b.

$$\frac{\overline{\text{O}}}{\underset{>\text{T}}{T/(T\backslash NP_{acc})}} \quad \frac{\overline{\text{V}}}{S\backslash NP_{nom}\backslash NP_{acc}} \quad \frac{\overline{\text{S}}}{\underset{>\text{XP}}{S_{-t}\backslash(S\backslash NP_{nom})}}$$

$$\frac{\qquad\qquad\qquad}{S\backslash NP_{nom}}{}_{>}$$

$$\frac{\qquad\qquad\qquad\qquad\qquad\qquad\qquad}{S_{-t}}{}_{<}$$

c.

$$\frac{\overline{\text{O}}}{\underset{\leftrightarrow}{T|(T|NP_{acc})}} \quad \frac{\overline{\text{V}}}{S\backslash NP_{nom}\backslash NP_{acc}} \quad \frac{\overline{\text{S}}}{\underset{\leftrightarrow}{T|(T|NP_{nom})}}$$

$$\frac{\qquad\qquad\qquad}{S\backslash NP_{nom}}{}_{>}$$

$$\frac{\qquad\qquad\qquad\qquad\qquad\qquad\qquad}{S}{}_{<}$$

In the remainder of the paper, we elaborate on the choice of directionality alternatives in the grammar and the lexicon for identifying the lexical requirements of word order. These choices are interdependent due to the principles of directionality and inheritance. Type raising is not considered as part of this co-dependency because of its order-preserving property; any monotonic grammar-lexicon architecture is in principle able to license direction-preserving higher-order functions for the arguments. We classify the alternatives along four aspects:

Property 1 (LEXV) : The presumed verbal category (or categories) and its directional specificity in the lexicon. For instance, SOV is $S\backslash NP_{nom}\backslash NP_{acc}$ and OV/VO is $S|NP_{nom}|NP_{acc}$. The latter unfolds to four fully directional categories $S\backslash NP_{nom}\backslash NP_{acc}$, $S\backslash NP_{nom}/NP_{acc}$, $S/NP_{nom}\backslash NP_{acc}$ and $S/NP_{nom}/NP_{acc}$, but its unique capture in the lexicon by a single category is crucial for CCG in its attempt to build a theory of grammar *and* the lexicon. Steedman (2000) proposes the following principle as part of a theory of the lexicon:

(22) *The Principle of Head Categorial Uniqueness (HCU)*: A single non-disjunctive lexical category for the head of a given construction specifies both the unbounded dependencies that arise when its complements are in canonical position, and the unbounded dependencies that arise when those complements are displaced under relativization, coordination, etc.

This principle does not rule out multiple categories for verbs, e.g., one for main clauses and one for subordinate clauses in German. But each category assignment captures both bounded and unbounded phenomena involving the word with the given directionality options. Hence if OV and VO orders for a verb behave the same in all respects, it would have a single lexical category. This is a principle of parsimony in the lexicon in terms of its size and its learnability.

Property 2 (LEXR) : The availability of order-reversing categories in the lexicon. For instance, if we presume a rigid SVO language with object topicalization, the topicalized object is backward extraposed via an order-reversing category.

Property 3 (LEXI) : The availability of order-insensitive categories in the lexicon, i.e., scrambling (19c). This is a property that overrides the order-sensitivity of type raising

and extraposition in a monotonic relationship of grammar and the lexicon; any derivation that employs type raising or extraposition is also derivable by scrambling, hence availability of scrambling in the lexicon renders more directionally sensitive categories redundant.

Property 4 (GDIR) : Directionality options in grammar. Directionality of rules is set by universal principles, and in all cases, the grammar is fully directional. Acquisition of directionality in the lexicon is presumably aided by this full directionality (Steedman, 2000). But the principles leave a degree of freedom for directionality in the grammar, e.g., directionally harmonic $>$B and $<$B, and disharmonic $>$B$_\times$ and $<$B$_\times$, as alternatives for composition. The spectrum of choices for a particular language involves all grammatical processes in the language, but for our purposes, we will be concerned with the minimal requirements that are consistent with—or implied by—the choices for properties 1–3.

4 Turkish as an SOV Language

SOV basic word order hypothesis is the canonical position on Turkish (Erguvanlı, 1984; Erkü, 1983; Göksel, 1993; Kılıçaslan, 1994; Kornfilt, 1997). We evaluate two sub-hypotheses of SOV in terms of directionality in the lexicon: (i) SOV order without scrambling, (ii) SOV order with scrambling. The first alternative implies the following choices:

LEXV: The lexical category of the verb is $S\backslash NP_{nom}\backslash NP_{acc}$.

LEXR: Only forward extraposition $>$XP is available. If SOV is the only basic word order, movement of subject (object) to the other side of the verb is only by rightward displacement which requires reversal of directionality in the form $S\backslash(S\backslash NP)$ (assuming no free scrambling categories for this alternative).

LEXI: All order insensitive processes would be unavailable by assumption.

GDIR: All directional variants of composition (16a–d) may be available in principle. With these options, the combinatory possibilities for SO and OS surface constiuents are as follows (we write all possible categories and their combinations together to save space):

(23) a.

S		O	
(>T):	$T/(T\backslash NP_{nom})$	(>T):	$T/(T\backslash NP_{acc})$
(<T):	$T\backslash(T/NP_{nom})$	(<T):	$T\backslash(T/NP_{acc})$
(>XP):	$S_{-t}\backslash(S\backslash NP_{nom})$	(>XP):	$S_{-t}\backslash(S\backslash NP_{acc})$
	$S_{-t}\backslash(S_{-t}\backslash NP_{nom})$		$S_{-t}\backslash(S_{-t}\backslash NP_{acc})$

(>B):	$T/(T\backslash NP_{nom}\backslash NP_{acc})$
(>B$_\times$):	$T\backslash(T\backslash NP_{nom}/NP_{acc})$
(<B):	$T\backslash(T/NP_{acc}/NP_{nom})$
	$S_{-t}\backslash(S\backslash NP_{acc}/NP_{nom})$
	$S_{-t}\backslash(S_{-t}\backslash NP_{acc}/NP_{nom})$
(<B$_\times$):	$T/(T/NP_{acc}\backslash NP_{nom})$
	$S_{-t}/(S\backslash NP_{acc}\backslash NP_{nom})$
	$S_{-t}/(S_{-t}\backslash NP_{acc}\backslash NP_{nom})$

b.

O		S	
(>T):	$T/(T\backslash NP_{acc})$	(>T):	$T/(T\backslash NP_{nom})$
(<T):	$T\backslash(T/NP_{acc})$	(<T):	$T\backslash(T/NP_{nom})$
(>XP):	$S_{-t}\backslash(S\backslash NP_{acc})$	(>XP):	$S_{-t}\backslash(S\backslash NP_{nom})$
	$S_{-t}\backslash(S_{-t}\backslash NP_{acc})$		$S_{-t}\backslash(S_{-t}\backslash NP_{nom})$

(>B):	$T/(T\backslash NP_{acc}\backslash NP_{nom})$
(>B$_\times$):	$T\backslash(T\backslash NP_{acc}/NP_{nom})$
(<B):	$T\backslash(T/NP_{nom}/NP_{acc})$
	$S_{-t}\backslash(S\backslash NP_{nom}/NP_{acc})$
	$S_{-t}\backslash(S_{-t}\backslash NP_{nom}/NP_{acc})$
(<B$_\times$):	$T/(T/NP_{nom}\backslash NP_{acc})$
	$S_{-t}/(S\backslash NP_{nom}\backslash NP_{acc})$
	$S_{-t}/(S_{-t}\backslash NP_{nom}\backslash NP_{acc})$

SO & SOV is derivable by >B (24). As evident from (23), although SO and OS can have similar category, backward gapping with SO & OSV is not derivable because SO and OS impose conflicting demands on the verb: either an OSV verb (25a) or a marked SOV verb (25b). This is consistent with judgments in Table 3 about parallelism in backward V gapping.

(24)

$$
\frac{\dfrac{\overline{S}}{T/(T\backslash NP_{nom})}^{>T} \; \dfrac{\overline{O}}{T/(T\backslash NP_{acc})}^{>T} \quad \& \quad \dfrac{\overline{S}}{T/(T\backslash NP_{nom})}^{>T} \; \dfrac{\overline{O}}{T/(T\backslash NP_{acc})}^{>T} \; \dfrac{\overline{V}}{S\backslash NP_{nom}\backslash NP_{acc}}}{\dfrac{\dfrac{T/(T\backslash NP_{nom}\backslash NP_{acc})}{}^{>B} \qquad \dfrac{T/(T\backslash NP_{nom}\backslash NP_{acc})}{}^{>B}}{\dfrac{T/(T\backslash NP_{nom}\backslash NP_{acc})}{}^{\&}}}
$$
$$
\frac{}{S}^{>}
$$

(25) a.

$$
\frac{\dfrac{\overline{*SO}}{S_{-t}/(S_{-t}\backslash NP_{acc}\backslash NP_{nom})}^{<B_\times} \quad \& \quad \dfrac{\overline{OS}}{T/(T\backslash NP_{acc}\backslash NP_{nom})}^{<B} \; \dfrac{\overline{V}}{S\backslash NP_{nom}\backslash NP_{acc}}}{\dfrac{S_{-t}/(S_{-t}\backslash NP_{acc}\backslash NP_{nom})}{}^{\&}}
$$
$$
\frac{}{}^{***}{}^{>}
$$

14

b.
$$\frac{\quad\quad \text{*SO} \quad\quad}{T/(T\backslash NP_{nom}\backslash NP_{acc})}{}_{>\mathsf{B}} \quad \& \quad \frac{\frac{\quad\quad \text{OS} \quad\quad}{S_{-t}/(S_{-t}\backslash NP_{nom}\backslash NP_{acc})}{}_{<\mathsf{B}_{\times}} \quad \frac{\quad \text{V} \quad}{S\backslash NP_{nom}\backslash NP_{acc}}}{}$$

$$\frac{}{S_{-t}/(S_{-t}\backslash NP_{nom}\backslash NP_{acc})}{}_{\&}$$

$$\frac{}{\quad\quad\quad\quad\quad \ast\!\ast\!\ast \quad\quad\quad\quad\quad}{}_{>}$$

This hypothesis correctly handles the gapping behaviour of OS constituents even though OSV verb category is not available. This is provided by $<\mathsf{B}_{\times}$:

(26)
$$\frac{\quad\quad \text{OS} \quad\quad}{S_{-t}/(S\backslash NP_{nom}\backslash NP_{acc})}{}_{<\mathsf{B}_{\times}} \quad \& \quad \frac{\quad\quad \text{OS} \quad\quad}{S_{-t}/(S\backslash NP_{nom}\backslash NP_{acc})}{}_{<\mathsf{B}_{\times}} \quad \frac{\quad \text{V} \quad}{S\backslash NP_{nom}\backslash NP_{acc}}$$

$$\frac{}{S_{-t}/(S\backslash NP_{nom}\backslash NP_{acc})}{}_{\&}$$

$$\frac{}{\quad\quad\quad\quad\quad S_{-t} \quad\quad\quad\quad\quad}{}_{>}$$

As for argument gapping, $<\mathsf{B}$ predicts VS constituency in Turkish (27), which accounts for VS & VSO. Parallelism in backward gapping of SV and VS in Table 5 follows from discourse-functional differences of these constituents (28).

(27)
$$\frac{\frac{\quad \text{V} \quad}{S\backslash NP_{nom}\backslash NP_{acc}} \quad \frac{\quad \text{S} \quad}{S_{-t}\backslash(S\backslash NP_{nom})}{}_{>\mathsf{XP}}}{S_{-t}\backslash NP_{acc}}{}_{<\mathsf{B}} \quad \& \quad \frac{\quad \text{VS} \quad}{S_{-t}\backslash NP_{acc}}{}_{<\mathsf{B}} \quad \frac{\quad \text{O} \quad}{S_{-t}\backslash(S_{-t}\backslash NP_{acc})}{}_{>\mathsf{XP}}$$

$$\frac{}{\quad\quad S_{-t}\backslash NP_{acc} \quad\quad}{}_{\&}$$

$$\frac{}{\quad\quad\quad\quad\quad S_{-t} \quad\quad\quad\quad\quad}{}_{<}$$

(28)
$$\frac{\frac{\quad \text{*S} \quad}{T/(T\backslash NP_{nom})}{}_{>\mathsf{T}} \quad \frac{\quad \text{V} \quad}{S\backslash NP_{nom}\backslash NP_{acc}}}{S\backslash NP_{acc}}{}_{>\mathsf{B}_{\times}} \quad \& \quad \frac{\quad \text{VS} \quad}{S_{-t}\backslash NP_{acc}}{}_{<\mathsf{B}} \quad \text{O}$$

$$\frac{}{\quad\quad\quad\quad \ast\!\ast\!\ast \quad\quad\quad\quad}{}_{\&}$$

However, subject gapping is not predicted. VO cannot be a constituent, either discourse-marked or unmarked, under this hypothesis (29). Therefore the attested order VO & VOS (see Table 5) is not derivable.

(29)
$$\frac{\quad \text{V} \quad}{S\backslash NP_{nom}\backslash NP_{acc}} \quad \frac{\begin{array}{l}\quad\quad\quad \text{O} \\ \hline \quad NP_{acc} \\ (>\mathsf{T}): \quad T/(T\backslash NP_{acc}) \\ (<\mathsf{T}): \quad T\backslash(T/NP_{acc}) \\ (>\mathsf{XP}): \quad S_{-t}\backslash(S\backslash NP_{acc}) \\ \quad\quad\quad\quad S_{-t}\backslash(S_{-t}\backslash NP_{acc}) \end{array}}{}$$

$$\frac{}{\quad\quad\quad\quad \ast\!\ast\!\ast \quad\quad\quad\quad}{}$$

The scrambling alternative to account for VO, either in full form $T|(T|NP)$ or in more restricted form $T\backslash(T\backslash NP)$, breaks the SO and OS dependence on an OSV verbal category. Ungrammatical combinations could then be derived as follows (similarly, *OS & SOV):

(30)

$$\frac{\overline{}^{*SO} \quad \& \quad \overline{}^{OS} \quad \overline{}^{V}}{}$$

$$\frac{T/(T\backslash NP_{nom}\backslash NP_{acc}) \quad\;_{>B} \quad T/(T\backslash NP_{nom}\backslash NP_{acc}) \quad_{<B_\times} \; S\backslash NP_{nom}\backslash NP_{acc}}{}$$

$$\frac{T/(T\backslash NP_{nom}\backslash NP_{acc}) \qquad\qquad\qquad_{\&}}{}$$

$$\frac{}{S}\quad_{>}$$

We therefore conclude that SOV-with-scrambling hypothesis overgenerates, wheras the more constrained version (SOV-with-extraposition) is unable to account for backward gapping data even when full repertoire of composition is available. We show in Section 7 that it is also insufficient to account for forward gapping.

5 Turkish as an OV/VO Language

OV/VO basic word order hypothesis is implicit in Bozsahin (1998). The verb has lexical categories OVS and VOS in addition to SOV and SVO. The properties are entailed as follows:

LEXV: Lexical categories of the verb are $S\backslash NP_{nom}\backslash NP_{acc}$, $S\backslash NP_{nom}/NP_{acc}$, $S/NP_{nom}\backslash NP_{acc}$ and $S/NP_{nom}/NP_{acc}$. Unique capture of the verbal category in the lexicon is possible via underspecification, $S|NP_{nom}|NP_{acc}$. It is important to note that the non-directional slash ($|$) serves parsimony in the lexicon along the lines similar to HCU principle of Steedman (22), with the assumption that all four basic word orders exhibit the same behaviour in bounded and unbounded constructions. However, HCU does not necessitate unique capture if their behaviour is diverse. In any case, the non-directional slash ($|$) is a lexical connective, and the grammar is fully directional. Hence $|$ instantiates to either $/$ or $\backslash$ in derivations, subject to universal (grammatical) constraints on directionality.

LEXR: By LEXV, it is clear that no order-reversing operation is necessary in the lexicon, as both arguments are underspecified with respect to the verb's position.

LEXI: LEXR implies unavailability of scrambling as well.

GDIR: All directionality options are available in principle. The following surface categories emerge for SO and OS:

(31) a.

S		O	
(>T):	$T/(T\backslash NP_{nom})$	(>T):	$T/(T\backslash NP_{acc})$
(<T):	$T\backslash (T/NP_{nom})$	(<T):	$T\backslash (T/NP_{acc})$

(>B):	$T/(T\backslash NP_{nom}\backslash NP_{acc})$
(>B$_\times$):	$T\backslash (T\backslash NP_{nom}/NP_{acc})$
(<B):	$T\backslash (T/NP_{acc}/NP_{nom})$
(<B$_\times$):	$T/(T/NP_{acc}\backslash NP_{nom})$

16

b.

	O		S
(>T):	$T/(T\backslash NP_{acc})$	(>T):	$T/(T\backslash NP_{nom})$
(<T):	$T\backslash(T/NP_{acc})$	(<T):	$T\backslash(T/NP_{acc})$

(>B):	$T/(T\backslash NP_{acc}\backslash NP_{nom})$
(>B$_\times$):	$T\backslash(T\backslash NP_{acc}/NP_{nom})$
(<B):	$T\backslash(T/NP_{nom}/NP_{acc})$
(<B$_\times$):	$T/(T/NP_{nom}\backslash NP_{acc})$

For backward V gapping, this hypothesis makes the correct prediction that *SO & OSV, *OS & SOV. This follows from the fact that the grammar is fully directional although the lexicon is not; all categories in (31) are directionally specified. Although SO category $T/(T\backslash NP_{nom}\backslash NP_{acc})$ and OS category $T/(T/NP_{nom}\backslash NP_{acc})$ can match verbal category $S|NP_{nom}|NP_{acc}$ on the right, they are not conjoinable types (cf. scheme (7)).

However, the directional insensitivity of VX and XV in this hypothesis reveal the problem with parallelism in backward argument gapping (Table 5). Although SV & SVO (and OV & OVS) is derivable (32a), due to the fact that SV and VS (and OV and VO) receive the same surface categories, it wrongly predicts SV & VSO (and OV & VOS) to be grammatical. We therefore conclude that this hypothesis is inconsistent with backward gapping data.

(32) a.

$$
\begin{array}{c}
\underline{\text{S}} \quad \underline{\text{V}} \quad \& \quad \underline{\text{SV}} \quad \underline{\text{O}} \\
\underline{T/(T\backslash NP_{nom})\ S|NP_{nom}|NP_{acc}} \quad \underline{S/NP_{acc}\ NP_{acc}} \\
\underline{S/NP_{acc}}_{>B} \\
\underline{S/NP_{acc}}_{\&} \\
\underline{S}_{>}
\end{array}
$$

b.

$$
\begin{array}{c}
\underline{\text{*O}} \quad \underline{\text{V}} \quad \& \quad \underline{\text{V}} \quad \underline{\text{O}} \quad \underline{\text{S}} \\
\underline{NP_{acc}\ S|NP_{nom}|NP_{acc}} \quad \underline{S|NP_{nom}|NP_{acc}\ NP_{acc}\ NP_{nom}} \\
\underline{S|NP_{nom}}_{<} \quad \underline{S|NP_{nom}}_{>} \\
\underline{S|NP_{nom}}_{\&} \\
\underline{S}_{>}
\end{array}
$$

6 Turkish as an SOV and SVO Language

Ross (1970) claimed that Turkish must be SVO because of forward gapping. He classified Turkish as type BC (Table 1). But Koutsoudas (1971) showed that split coordination (Table 5, bottom row) requires SOV order as well. Assuming only these two orders in the lexicon, the properties are set as follows:

LEXV: Lexical categories of the verb are $S\backslash NP_{nom}\backslash NP_{acc}$ and $S\backslash NP_{nom}/NP_{acc}$. SOV and SVO can be uniquely captured using directional underspecification in the lexicon as $S\backslash NP_{nom}|NP_{acc}$.

LEXR: Only subject forward extraposition >XP is available because only subjects

move to the other side of the verb by this hypothesis; objects' position on either side is captured by the lexical verbal category $S\backslash NP_{nom}|NP_{acc}$.

LEXI: Unavailable due to LEXR.

GDIR: The following surface categories are made available by four combinatory possibilities of composition to facilitate gapping under the present assumption.

(33) a.

S		O	
(>T):	$T/(T\backslash NP_{nom})$	(>T):	$T/(T\backslash NP_{acc})$
(<T):	$T\backslash(T/NP_{nom})$	(<T):	$T\backslash(T/NP_{acc})$
(>XP):	$S_{-t}\backslash(S\backslash NP_{nom})$		
	$S_{-t}\backslash(S_{-t}\backslash NP_{nom})$		

(>B):	$T/(T\backslash NP_{nom}\backslash NP_{acc})$	
(>B$_\times$):	$T\backslash(T\backslash NP_{nom}/NP_{acc})$	
(<B):	$T\backslash(T/NP_{acc}/NP_{nom})$	
(<B$_\times$):	$T/(T/NP_{acc}\backslash NP_{nom})$	

b.

O		S	
(>T):	$T/(T\backslash NP_{acc})$	(>T):	$T/(T\backslash NP_{nom})$
(<T):	$T\backslash(T/NP_{acc})$	(<T):	$T\backslash(T/NP_{nom})$
		(>XP):	$S_{-t}\backslash(S\backslash NP_{nom})$
			$S_{-t}\backslash(S_{-t}\backslash NP_{nom})$

(>B):	$T/(T\backslash NP_{acc}\backslash NP_{nom})$	
(>B$_\times$):	$T\backslash(T\backslash NP_{acc}/NP_{nom})$	
(<B):	$T\backslash(T/NP_{nom}/NP_{acc})$	
	$S_{-t}\backslash(S\backslash NP_{nom}/NP_{acc})$	
	$S_{-t}\backslash(S_{-t}\backslash NP_{nom}/NP_{acc})$	
(<B$_\times$):	$T/(T/NP_{nom}\backslash NP_{acc})$	
	$S_{-t}/(S\backslash NP_{nom}\backslash NP_{acc})$	
	$S_{-t}/(S_{-t}\backslash NP_{nom}\backslash NP_{acc})$	

As evident from above, $>$B and $<$B$_\times$, the only combinations with forward-looking categories that look for a verbal category consistent with LEXV, predict parallelism in backward V gapping (34).

(34)

*SO	&	OS	V
$T/(T\backslash NP_{nom}\backslash NP_{acc})$ ${}_{>B}$		$S_{-t}/(S_{-t}\backslash NP_{nom}\backslash NP_{acc})$ ${}_{<B_\times}$	$S\backslash NP_{nom}|NP_{acc}$

$$S_{-t}/(S_{-t}\backslash NP_{nom}\backslash NP_{acc})$$ ${}_{\&}$

$$\underbrace{\qquad\qquad\qquad}_{***}\longrightarrow{}_{>}$$

Another prediction from OS categories is that OS & OSV is possible only with $<$B$_\times$; it is the only combinatory rule that provides an OS constituent that looks forward for a lexically licensed (SOV or SVO) verbal category; $>$B requires an OSV verbal category on the right. But this is inconsistent with parallelism in backward argument gapping (Table 5). Although SV & VSO is not allowed (35a), OV/VO indistinguishability remains, hence *OV & VOS parallelism is compromised (35b). Hence, the improvement over the

OV/VO hypothesis is not adequate enough to account for all the facts on backward gapping. As we show in the next section, this hypothesis takes unnecessary liberties in the verb's directionality for forward gapping as well.

(35) a.

*S	V	&	V	S	O

$$
\underbrace{\frac{T/(T\backslash NP_{nom})}{}^{>T} \frac{S\backslash NP_{nom}|NP_{acc}}{}}_{S\backslash NP_{acc}}{}^{>B_{\times}} \&\&\& \underbrace{\frac{S\backslash NP_{nom}|NP_{acc} \quad \frac{S_{-t}\backslash(S\backslash NP_{nom})}{}^{>XP} \frac{S_{-t}\backslash(S\backslash NP_{acc})}{}^{>XP}}{S_{-t}\backslash NP_{acc}}{}^{<B}}{}_{\&}
$$

b.

* O	V	&	V	O	S

$$
\underbrace{\underbrace{\frac{NP_{acc} \quad S\backslash NP_{nom}|NP_{acc}}{S\backslash NP_{nom}}^{<}}_{} \&\& \underbrace{\frac{S\backslash NP_{nom}|NP_{acc} \quad NP_{acc}}{S\backslash NP_{nom}}^{>} \quad \frac{S_{-t}\backslash(S\backslash NP_{nom})}{}^{>XP}}_{}}_{\substack{S\backslash NP_{nom}\\ S_{-t}}}{}^{\&}{}_{<}
$$

7 Turkish as an SOV and OSV Language

We have shown in the last three sections that obtaining 'virtual' argument cluster categories that look for OSV verbs—virtual in the sense that the grammar reveals these categories irrespective of the verb's category, when not accompanied by a verbal category of same type from the lexicon, is bound to be inadequate for backward gapping facts. We show in this section that lexicalizing OSV verb category not only accounts for backward gapping, but also for forward gapping. In fact, given the grammar-lexicon options below, argument gapping is predicted to show the contrast in Table 5 and Table 8. Word order facts outlined in Table 2 provide further support for distinguishing OSV.

LEXV: Lexical categories of the verb are $S\backslash NP_{nom}\backslash NP_{acc}$ and $S\backslash NP_{acc}\backslash NP_{nom}$. Unique capture of SOV and OSV in the lexicon is possible in set-CCG, which is strongly equivalent to CCG (Baldridge, 2000). In set-CCG, directionality is associated with a set of arguments, rather than one by one. The categories $S\backslash NP_{nom}\backslash NP_{acc}$ and $S\backslash NP_{acc}\backslash NP_{nom}$ translate to a single category $S\backslash\{NP_{nom}, NP_{acc}\}$ in set-CCG.

LEXR: Both arguments appear on the left side of the verb in the lexicon. Any displacement of the arguments, then, is rightward, hence only forward extraposition $>$XP is available.

LEXI: Unavailable due to constrained use of LEXR.

GDIR: We show in the remainder of this section that a fragment of grammar that makes use of only harmonic composition $>$B and $<$B can set lexical properties as above, and that this is the minimal requirement under the hypothesis of monotonic projection of directionality to account for backward and forward gapping, and word order.

(36) a.

	S			O	
(>T):	$T/(T\backslash NP_{nom})$		(>T):	$T/(T\backslash NP_{acc})$	
(<T):	$T\backslash(T/NP_{nom})$		(<T):	$T\backslash(T/NP_{acc})$	
(>XP):	$S_{-t}\backslash(S\backslash NP_{nom})$		(>XP):	$S_{-t}\backslash(S\backslash NP_{acc})$	
	$S_{-t}\backslash(S_{-t}\backslash NP_{nom})$			$S_{-t}\backslash(S_{-t}\backslash NP_{acc})$	

(>B):	$T/(T\backslash NP_{nom}\backslash NP_{acc})$
(<B):	$T\backslash(T/NP_{acc}/NP_{nom})$
	$S_{-t}\backslash(S\backslash NP_{acc}/NP_{nom})$
	$S_{-t}\backslash(S_{-t}\backslash NP_{acc}/NP_{nom})$

b.

	O			S	
(>T):	$T/(T\backslash NP_{acc})$		(>T):	$T/(T\backslash NP_{nom})$	
(<T):	$T\backslash(T/NP_{acc})$		(<T):	$T\backslash(T/NP_{nom})$	
(>XP):	$S_{-t}\backslash(S\backslash NP_{acc})$		(>XP):	$S_{-t}\backslash(S\backslash NP_{nom})$	
	$S_{-t}\backslash(S_{-t}\backslash NP_{acc})$			$S_{-t}\backslash(S_{-t}\backslash NP_{nom})$	

(>B):	$T/(T\backslash NP_{acc}\backslash NP_{nom})$
(<B):	$T\backslash(T/NP_{nom}/NP_{acc})$
	$S_{-t}\backslash(S\backslash NP_{nom}/NP_{acc})$
	$S_{-t}\backslash(S_{-t}\backslash NP_{nom}/NP_{acc})$

Argument cluster categories emerge as in (36). Forward directionality in composition predicts all entries in Table 3; SO and OS do not have the same category and they can look forward for only SOV or OSV verbs. Paralellism in backward argument gapping (Table 5) is also predicted to be more constrained under this hypothesis. SV and VS (and OV and VO) cannot have the same discourse-equivalent categories to go under coordination (37). Thus SV & SVO and *SV & VSO (similary for OV) are predicted. As in SOV hypothesis (Section 4), parallelism in backward gapping of SV and VS (and OV and VO) in Table 5 follows from discourse-functional differences of these constituents.

(37) a.

	S		V
(>T):	$T/(T\backslash NP_{nom})$		$S\backslash NP_{nom}\backslash NP_{acc}$
(<T):	$T\backslash(T/NP_{nom})$		$S\backslash NP_{acc}\backslash NP_{nom}$
(>XP):	$S_{-t}\backslash(S\backslash NP_{nom})$		
	NP_{nom}		

$$\frac{\qquad\qquad\qquad\qquad\qquad\qquad}{S\backslash NP_{acc}}<$$
(because OSV verbal category is available)

b.

V		S	
$S\backslash NP_{nom}\backslash NP_{acc}$	(>T):	$T/(T\backslash NP_{nom})$	
$S\backslash NP_{acc}\backslash NP_{nom}$	(<T):	$T\backslash(T/NP_{nom})$	
	(>XP):	$S_{-t}\backslash(S\backslash NP_{nom})$	
		NP_{nom}	

$$\frac{\qquad\qquad\qquad\qquad\qquad\qquad}{S_{-t}\backslash NP_{acc}}<B$$
(because SOV verbal category is available)

Backward gapping under the presence of non-referential O (labeled O^{-r}) is more constrained, as shown in Table 6 ($*O^{-r}S$ & $O^{-r}SV$; cf. OS & OSV). Mixed object referentiality such as $O^{-r}S$ & OSV or OS & $O^{-r}SV$, are also ungrammatical. Hence

OS and O^{-r}S must be distinguished. We do this by decorating the OSV verbal category $S\backslash NP_{acc}\backslash NP_{nom}$ as $S\backslash NP_{acc}^{+r}\backslash NP_{nom}$ indicating that the NP_{acc} must be referential. The other verbal category in the lexicon, $S\backslash NP_{nom}\backslash NP_{acc}$, is unmarked in terms of referentiality. This referentiality contrast between two lexicalized word orders accounts for word order facts in Table 2. OS and O^{-r}S are then distinguished as (36b) and (38a). Ungrammaticality of O^{-r}S & O^{-r}SV follows because O^{-r}S needs an OSV verb on the right, which is marked lexically as NP_{acc}^{+r} (38b). Hence configurational aspects of word order such as non-referential object's position can be captured in the lexicon without any reference to derivational structure (as would be, say, in the case of a model of human parsing being sensitive to what is currently being derived and what are its neighbours, e.g., (Pulman, 1986)).

(38) a.

$$
\frac{\dfrac{O^{-r}}{(>T): \quad T/(T\backslash NP_{acc}^{-r})} \quad \dfrac{S}{(>T): \quad T/(T\backslash NP_{nom})}}{(>B): \quad T/(T\backslash NP_{acc}^{-r}\backslash NP_{nom})} {}_{>B}
$$

b.

$$
\frac{\dfrac{O^{-r}S}{T/(T\backslash NP_{acc}^{-r}\backslash NP_{nom})} {}_{>B} \quad \& \quad \dfrac{\dfrac{O^{-r}S}{T/(T\backslash NP_{acc}^{-r}\backslash NP_{nom})} {}_{>B} \quad \dfrac{V}{S\backslash NP_{acc}^{+r}\backslash NP_{nom}}}{T/(T\backslash NP_{acc}^{-r}\backslash NP_{nom})} {}_{\&}}{***} {}_{>}
$$

Forward gapping in Table 4 and Table 5 indicate the asymmetry in gapping. Although backward gapping is sensitive to the category of the left conjunct (e.g., *SO & OSV), forward gapping does not appear to be susceptible to categorial restrictions; the category of the right conjunct does not require any parallelism with the left conjunct (e.g., OSV & SO and SOV & OS). One implication of this is that any right conjunct can be coordinated under gapping if it can be grouped into a constituent (modulo discourse conditions).

As Table 4 shows, all verb-final left conjuncts are grammatical, and non-verb-final cases are problematic (we conjecture below that the problem is related to the discourse properties of the conjuncts). In XVY & XY and XYV & XY, the verb intervenes in conjoinable XY constituent in the left conjunct, which would block the constituent condition on coordination. The left conjunct needs to reveal its conjoinable type for these cases. This operation has been used by Steedman (2000) to account for gapping in SVO and VSO languages. As forward gapping is tied to access to a (virtual) VSO or VOS verb, a requirement on this hypothesis is that an SO or OS on the right conjunct must look for VSO (VOS) verb on the left to facilitate gapping. These categories are provided only if <B is available (36), hence the minimal requirement on directionality in grammar.

We use the revealing rule in (39) (cf. (Steedman, 2000) for its semantics). In a monotonic grammar architecture, rules of this type preserve the projection of directionality from the lexicon because they are instances of the applicative system and the principles such as directional consistency and inheritance apply to them as well.

(39) Backward Decomposition (Virtual Left Conjunct Revealing) (<dcomp):

$$X \Rightarrow \quad Y{:}\theta''left \quad X\backslash Y{:}\lambda y.left$$

where Y=S/$, i.e., category onto S, e.g., S/NP_{nom}, S/NP_{acc}, $S/NP_{nom}/NP_{acc}$, $S/NP_{acc}/NP_{nom}$ etc.

Due to uniform directionality of the arguments in the lexicon ($S\backslash NP_{nom}\backslash NP_{acc}$ and $S\backslash NP_{acc}\backslash NP_{nom}$), the asymmetry in backward and forward gapping is maintained in the presence of (<dcomp), which restricts Y to be a forward-looking function. But this rule, when applied to a *right* conjunct, cannot reveal conjoinable categories that look *leftward* (as would be the case in backward gapping, which requires parallelism):

(40)

$$\underbrace{\dfrac{* \text{ SO}}{T\backslash(T/NP_{acc}/NP_{nom})}}_{<\text{B}} \quad \& \quad \dfrac{\text{OSV}}{\overbrace{\dfrac{S}{\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots}^{<\text{dcomp}}}{S/NP_{acc}/NP_{nom} \quad S\backslash(S/NP_{acc}/NP_{nom})}}$$

$$*\!*\!*\underline{\qquad\qquad\qquad\qquad}_{\&}$$

Anti-gapping (Steedman, 2000) of the kind e.g. V & SOV are not allowed either. The rightward-looking virtual category revealed by decomposition does not match the real category of the verb:

(41)

*Okudu	ama	adam kitabı almadı
read-PAST	but	man book-ACC buy-NEG-PAST

$$\dfrac{*S/NP_{nom}/NP_{acc}}{} \qquad \dfrac{\text{S}}{S/NP_{nom}/NP_{acc} \quad S\backslash(S/NP_{nom}/NP_{acc})}{}^{<\text{dcomp}}$$

$$*\!*\!*\underline{\qquad\qquad\qquad\qquad}_{\&}$$

Given the argument gapping directionality in (36) and (38), forward gapping with referential and non-referential object follows (Table 4 and Table 7). In particular, if the object is O^{-r}, $O^{-r}S$ constituency and $O^{-r}SV$ word order are not licensed, as shown in (38). If object is unmarked on referentiality, all argument clusters can look leftward for a VSO or VOS verb by this hypothesis (36), hence any *verb-final* word order in the left conjunct can reveal a conjoinable category (42a).

(42) a.

$$\dfrac{\text{SOV/OSV}}{\overbrace{S}^{}} \quad \& \quad \underbrace{\dfrac{\text{SO}}{T\backslash(T/NP_{acc}/NP_{nom})}}_{<\text{B}}$$

$$S/NP_{acc}/NP_{nom} \quad S\backslash(S/NP_{acc}/NP_{nom}) \quad{}^{<\text{dcomp}}$$

$$\dfrac{S\backslash(S/NP_{acc}/NP_{nom})}{}_{\&}$$

$$\dfrac{S}{}_{<}$$

b.

$$\dfrac{\text{OVS}}{\overbrace{S_{-t}}^{}} \quad \& \quad \underbrace{\dfrac{\text{OS}}{T\backslash(T/NP_{nom}/NP_{acc})}}_{<\text{B}}$$

$$S_{-t}/NP_{nom}/NP_{acc} \quad S_{-t}\backslash(S_{-t}/NP_{nom}/NP_{acc}) \quad{}^{<\text{dcomp}}$$

$$\dfrac{S_{-t}\backslash(S_{-t}/NP_{nom}/NP_{acc})}{}_{\&}$$

$$\dfrac{S_{-t}}{}_{<}$$

This hypothesis also predicts an asymmetry on the left conjunct. All verb-final word orders in it derive unmarked S (43a), and all non-verb-final orders derive S_{-t}, e.g., (43b–d). Hence, if the reveal rule is made sensitive to discourse functions by letting X and Y in (39) to be onto S_{-t} as well, all non-verb-final left conjuncts would be marked (but grammatical), irrespective of the category of the right conjunct (42b). This would also explain *ABC & VX in Table 5; even when ABC sequence is verb-final to yield S, VX could only give S_{-t} (37b), hence the asymmetry of XV and VX. If S_{-t} is not allowed in (39), all problematic cases in Table 5 would be ungrammatical. It remains to be seen whether this is a dialectical variation.

(43) a.
$$\frac{\frac{O}{NP_{acc}} \quad \frac{S}{NP_{nom}} \quad \frac{V}{S\backslash NP_{acc}\backslash NP_{nom}}}{\frac{\frac{S\backslash NP_{acc}}{}<}{S}<}$$

b.
$$\frac{\frac{O}{NP_{acc}} \quad \frac{V}{S\backslash NP_{nom}\backslash NP_{acc}} \quad \frac{S}{S_{-t}\backslash (S\backslash NP_{nom})}}{\frac{\frac{S\backslash NP_{nom}}{}<}{S_{-t}}<}$$

c.
$$\frac{\frac{V}{S\backslash NP_{nom}\backslash NP_{acc}} \quad \frac{S}{S_{-t}\backslash (S\backslash NP_{nom})}>XP \quad \frac{O}{S_{-t}\backslash (S_{-t}\backslash NP_{acc})}>XP}{\frac{\frac{S_{-t}\backslash NP_{acc}}{}<B}{S_{-t}}<}$$

d.
$$\frac{\frac{V}{S\backslash NP_{acc}\backslash NP_{nom}} \quad \frac{O}{S_{-t}\backslash (S\backslash NP_{acc})}>XP \quad \frac{S}{S_{-t}\backslash (S_{-t}\backslash NP_{nom})}>XP}{\frac{\frac{S_{-t}\backslash NP_{nom}}{}<B}{S_{-t}}<}$$

Split coordination is handled as in (44a). Mixed referentiality of the type $SO^{-r}V$ & O^{+r} is ungrammatical. This is enforced by having the reveal rule carry over the referentiality of the categories it reveals (44b).

(44) a.
$$\frac{\frac{\frac{SOV}{S}}{\underset{\cdots\cdots\cdots\cdots}{}<dcomp} \quad \& \quad \frac{O}{T\backslash (T/NP_{acc})}<T}{\cdots}$$
$$\frac{S/NP_{acc} \quad S\backslash (S/NP_{acc})}{\frac{S\backslash (S/NP_{acc})}{S}<}\&$$

23

b.
$$\frac{\text{SO}^{-r}\text{V}}{S^{-r}} \quad \& \quad \frac{\text{O}^{+r}}{T\backslash(T/NP^{+r}_{acc})}{}^{<\mathsf{T}}$$

$$\overline{S/NP^{-r}_{acc} \quad S\backslash(S/NP^{-r}_{acc})}{}^{<\mathrm{dcomp}}$$

$$\underline{\qquad\qquad ***\qquad\qquad}{}_{\&}$$

In summary, we consider this hypothesis to be consistent with all word order and gapping facts, and claim that it is minimal in the sense that any theory to account for these data must posit two lexical categories for the verb, otherwise the asymmetry in parallelism for backward and forward gapping cannot be maintained. As first noted by Steele (1978), SOV and OSV are usually the alternatives in a single language (also VSO and VOS). The representational status of the two verbal categories in the lexicon is orthogonal to their directional specificity. Set-CCG (Baldridge, 2000) is capable of unique capture if need be.

The contrast between two verb-final languages, Turkish and Japanese, in forward gapping is noteworthy. There is nothing in principle that will prevent a XYV language from exhibiting forward gapping: Backward directionality in composition is able to generate backward-looking constituents for XY as a right conjunct (45).[2] This is independent of the verb's directionality, and it is provided without an appeal to order-changing processes (see combinations with $>\mathsf{T}$ and $<\mathsf{T}$ in (36)). The verbal category that XY demands for forward gapping is VXY, which is a *virtual* category in any non-VSO or non-VOS language. SO conjuncts look for virtual VSO verbs by $<\mathsf{B}$ and $<\mathsf{T}$, and OS conjuncts for virtual VOS verbs by $<\mathsf{B}$ and $>\mathsf{T}$. If these combinatory possibilities are part of universal grammar, availability of forward gapping depends on whether the language taps onto these virtual categories via decomposition (available in Turkish, blocked in Japanese). But, decomposition preserves the projection of directionality from the lexicon. It is a special case of backward application.

(45) a.
$$\frac{\text{XYV}}{S} \quad \& \quad \frac{\text{XY}}{T\backslash(T/Y/X)}{}^{<\mathsf{B}}$$

$$\overline{S/Y/X \quad S\backslash(S/Y/X)}{}^{<\mathrm{dcomp}}$$

$$\underline{\qquad\qquad S\backslash(S/Y/X)\qquad\qquad}{}_{\&}$$

8 Conclusion

Patterns of gapping originate from the lexicon rather than the grammar when directionality becomes a component of representation in the lexicon. Directional specificity in the lexicon is set by a fully directional grammar which is constrained by principles of directionality. This co-dependence of grammar-lexicon directionality allows for the typological diversity of word orders in the languages, yet leads to a predictable landscape of gapping patterns. The collapse of several word order alternatives into unique gapping

---

2 It is noted earlier (fn. 1) that S and O are labels for surface categories NP_{nom} and NP_{acc}. In this example, we exploit this property to write *X* as a surface category for X.

patterns has been known for a long time, but the cause of variation has been pinned down on (surface) grammars, which we claim should be restored to the lexicon. This of course requires a more comprehensive theory of lexicon, co-extensive with theory of grammar. For example, the question as to what directionality alternatives in the lexicon are implied by grammar, or, if we claim a language to have more than one word order projecting from its lexicon, how this redundancy can be acquired by children.

Empirical facts about constituency alone reveals combinational possibilities in a surface grammar and their genesis in the lexicon. Constituents reveal the asymmetry hence carry directionality. This kind of projecting asymmetry from lexicon to grammar is consistent with (Kayne, 1994), but, as implied in this paper, it can be accounted for without an appeal to universal specifier-head-complement ordering, which requires movement to handle variation across languages and stipulating an asymmetric c-command on surface structures, which would make them a level of representation.

A traditional concept such as scrambling can then be refined to reflect its *effect* on surface grammar: collapse of directional sensitivity (for the sake of discourse functionality, style etc.). The cause is the directionality alternatives in the lexicon. Scrambling cannot maintain directional sensitivity if there is an asymmetry in forward and backward gapping. Directionally sensitive languages show an asymmetry on VX and XV either discourse-functionally or syntactically. We believe that scrambling is properly characterized as a contrast of the verb and the arguments in these aspects.

Surface extraposition presumes absence of directionally insensitive constituency and word order variation. Its availability indicates discourse-functional word order variation, which is captured at the surface structure so as to serve the discourse component. Rigidity in word order is now related to categorial specificity in the lexicon. English has rigid word order because the verb's only directionality in the lexicon is SVO. Turkish has flexible word order because the verb's lexical category corresponds to SOV and OSV (similarly, DO-IO and IO-DO basic orders for Japanese (Miyagawa, 1997)). In summary,

- Turkish is not a scrambling language, but an extraposition language with non-rigid word order. It is verb-final, not just SOV.

- English is not a scrambling language, but an extraposition language with rigid word order.

- Japanese is not a scrambling or extraposition language, but a language with non-rigid word order.

References

Ades, Anthony E. and Mark Steedman. 1982. On the order of words. *Linguistics and Philosophy*, 4:517–558.

Baldridge, Jason. 2000. Strong equivalence of CCG and Set-CCG. ms., University of Edinburgh.

Berman, Arlene. 1974. On the VSO hypothesis. *Linguistic Inquiry*, 5(1):1–38.

Bozsahin, Cem. 1998. Deriving the Predicate-Argument structure for a free word order language. In *Proceedings of COLING-ACL'98*, Montreal.

Clark, Herbert H. and Eve V. Clark. 1977. *Psychology and Language*. Harcourt Brace Jovanovich, New York.

Curry, Haskell B. and Robert Feys. 1958. *Combinatory Logic I*. North-Holland, Amsterdam.

Derbyshire, D.C. 1977. Word order universals and the existence of OVS languages. *Linguistic Inquiry*, 8:590–598.

Dixon, R.M.W. 1979. Ergativity. *Language*, 55:59–138.

Dowty, David. 1988. Type raising, functional composition, and non-constituent conjunction. In Richard T. Oehrle, Emmon Bach, and Deirdre Wheeler, editors, *Categorial Grammars and Natural Language Structures*. D. Reidel, Dordrecht.

Enç, Mürvet. 1991. The semantics of specificity. *Linguistic Inquiry*, 22:1–25.

Erguvanlı, Eser E. 1984. *The Function of word order in Turkish Grammar*. Ph.D. thesis, UCLA.

Erkü, Feride. 1983. *Discourse Pragmatics and Word Order in Turkish*. Ph.D. thesis, University of Minnesota.

Givón, Talmy. 1978. Definiteness and referentiality. In Joseph Greenberg, editor, *Universals of Human Language*. Stanford University Press.

Göksel, Aslı. 1993. *Levels of Representation and Argument Structure in Turkish*. Ph.D. thesis, SOAS.

Greenberg, Joseph. 1963. *Universals of Language*. MIT Press, Cambridge, MA.

Gundel, Jeanette K. 1988. Universals of topic-comment structure. In Edith A. Moravcsik Michael Hammond and Jessica R. Wirth, editors, *Studies in Syntactic Typology*. Benjamins, Amsterdam.

Hankamer, Jorge. 1973. Unacceptable ambiguity. *Linguistic Inquiry*, 4:17–68.

Hoffman, Beryl. 1995. *The Computational Analysis of the Syntax and Interpretation of "Free" Word Order in Turkish*. Ph.D. thesis, University of Pennsylvania.

Janeway, Roger. 1990. Unacceptable ambiguity in Categorial Grammar. In *Proceedings of the Ninth West Coast Conference on Formal Linguistics*, pages 305–316.

Karttunen, Lauri. 1989. Radical lexicalism. In Mark Baltin and Anthony Kroch, editors, *Alternative Conceptions of Phrase Structure*. Chicago University Press.

Kayne, Richard. 1994. *The Antisymmetry of Syntax*. MIT Press.

Kılıçaslan, Yılmaz. 1994. Information packaging in Turkish. Master's thesis, University of Edinburgh.

Kornfilt, Jaklin. 1997. *Turkish*. Routledge, London.

Koutsoudas, Andreas. 1971. Gapping, conjunction reduction, and coordinate deletion. *Foundations of Language*, 7:337–386.

McCawley, James D. 1970. English as a VSO language. *Language*, 46:286–299.

Miyagawa, Shigeru. 1997. Against optional scrambling. *Linguistic Inquiry*, 28(1):1–25.

Moortgart, Michael. 1988. *Categorial Investigations: Logical and Linguistic Aspects of the Lambek Calculus*. Foris, Dordrecht.

Pullum, Geoffrey K. 1977. Word order universals and grammatical relations. In Peter Cole and Jerrold M. Saddock, editors, *Syntax and Semantics 8: Grammatical Relations*. Academic Press, NY.

Pulman, Steve. 1986. Grammars, parsers, and memory limitations. *Language and Cognitive Processes*, 1(3):197–25.

Rosenbaum, Harvey. 1977. Zapotec gapping as counterevidence to some universal proposals. *Linguistic Inquiry*, 8:379–395.

Ross, John Robert. 1970. Gapping and the order of constituents. In Manfred Bierwisch and Karl Erich Heidolph, editors, *Progress in Linguistics*. Mouton, The Hague, pages 249–259.

Steedman, Mark. 1985. Dependency and coördination in the grammar of Dutch and English. *Language*, 61(3):523–568.

Steedman, Mark. 1988. Combinators and grammars. In Richard T. Oehrle, Emmon Bach, and Deirdre Wheeler, editors, *Categorial Grammars and Natural Language Structures*. D. Reidel, Dordrecht.

Steedman, Mark. 1990a. Constituency and coordination in a combinatory grammar. In Mark R. Baltin and Anthony S. Kroch, editors, *Alternative Conceptions of Phrase Structure*. University of Chicago Press.

Steedman, Mark. 1990b. Gapping as constituent coordination. *Linguistics and Philosophy*, 13:207–263.

Steedman, Mark. 1996. *Surface Structure and Interpretation*. MIT Press, Cambridge, MA.

Steedman, Mark. 2000. *The Syntactic Process*. MIT Press, Cambridge, MA.

Steele, Susan. 1978. Word order variation: A typological study. In Joseph Greenberg, editor, *Universals of Human Language*. Stanford University Press.

Turan, Ümit. 1995. *Null Versus Overt Subjects in Turkish Discourse: A Centering Analysis*. Ph.D. thesis, University of Pennsylvania.