The classic model of transformational grammar, as developed in Chomsky (1955) and summarized in Chomsky (1957)

Phrase structure rules (context free re-writing rules) create an initial phrase marker.

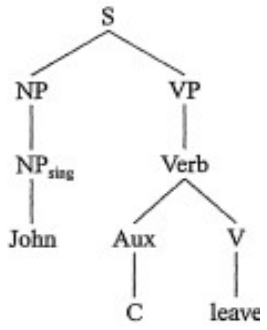
(1)

$Sentence \rightarrow NP + VP$
$VP \rightarrow Verb + NP$
$NP \rightarrow \begin{Bmatrix} NP_{sing} \\ NP_{pl} \end{Bmatrix}$
$NP_{sing} \rightarrow T + N + \emptyset$
$NP_{pl} \rightarrow T + N + S$
$T \rightarrow the$
$N \rightarrow man, ball, etc.$
$Verb \rightarrow Aux + V$
$V \rightarrow hit, take, walk, read, etc.$
$Aux \rightarrow C(M)\ (have + en)\ (be + ing)$
$M \rightarrow will, can, may, shall, must$

< I abbreviate Sentence as S>
<For ease of exposition, I add VP → Verb>

<For ease of exposition, I add NP_{sing} → John>

(2)



Transformations then sequentially alter the phrase marker. Two of them introduce a tense/agreement morpheme under C, and then attach this morpheme to the V (or to M or *have* or *be*).

(3)

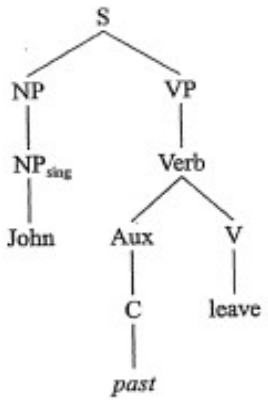
Number Transformation – obligatory
Structural analysis: $X - C - Y$
Structural change: $C \rightarrow \begin{Bmatrix} S \text{ in the context } NP_{sing} - \\ \emptyset \text{ in other contexts} \\ past \text{ in any context} \end{Bmatrix}$

(4)

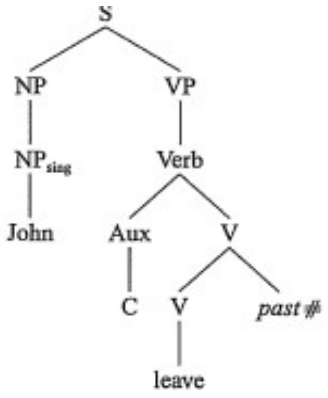
Auxiliary Transformation – obligatory:
Structural analysis: $X - Af - v - Y$ (where Af is any C or is *en* or *ing*; v is any M or V, or *have* or *be*) (29ii)
Structural change: $X_1 - X_2 - X_3 - X_4 \rightarrow X_1 - X_3 - X_2\# - X_4$

<Called by all since the mid-1960s 'Affix Hopping'>

(5)



(6)



The two transformations illustrated so far are designated 'obligatory' in the grammar, based on the empirical observation that failure to apply them results in unacceptable sentences. Other transformations are 'optional'; an acceptable sentence (ultimately) results whether they are applied or not. The following is of the latter variety:

(7) T_{not} – optional:

Structural analysis: $\begin{Bmatrix} NP - C - V \ldots \\ NP - C+M - \ldots \\ NP - C+have - \ldots \\ NP - C+be - \ldots \end{Bmatrix}$

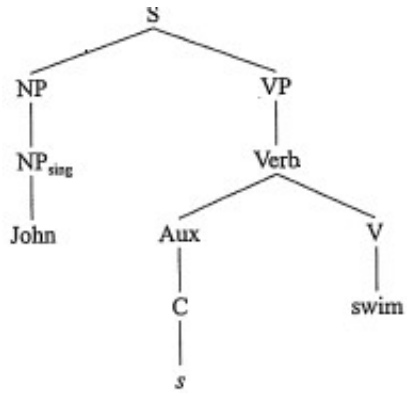
Structural change: $X_1 - X_2 - X_3 \rightarrow X_1 - X_2+n't - X_3$

If we don't apply this in a derivation beginning with (2), we ultimately generate:

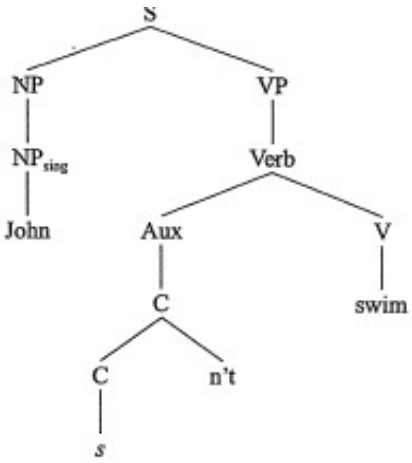
(8) John left.

Suppose we do apply it to a structure similar to the one in (5), just with a different choice of V in the phrase structure component, and a different choice of C in the Number Transformation (3). ((7) is specified as ordered after the Number Transformation. Rule ordering is an interesting topic for another occasion.)) The immediate input and output are:

(9)

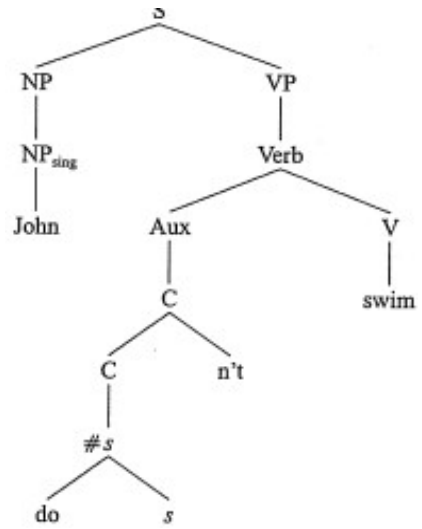


(10)



Now (4) can't apply, since *s* and V are no longer adjacent. Under these circumstances, a pair of rules (which together came to be known as 'do-support') take over, yielding (11):

(11)



(12) *Word Boundary Transformation* – obligatory:
Structural analysis: $X - Y$ (where $X \neq v$ or $Y \neq Af$)
Structural change: $X_1 - X_2 \rightarrow X_1 - \#X_2$

do – Transformation – obligatory:
Structural analysis: $\# - Af$
Structural change: $X_1 - X_2 \rightarrow X_1 - do + X_2$

Conceptually, do-support is quite simple: Insert a dummy verb *do* to support a verbal affix that is otherwise unsupported. The technical implmenetation turns out to be quite tricky. See Lasnik (2000) for extensive discussion.

So starting with the initial phrase marker underlying (9) [just like (9), but without the *s* having been inserted yet], if we apply only obligatory transformations we get (13), what Chomsky termed a 'kernel sentence'.

(13) John swims.

A variety of optional transformations were available, producing, among other things, all from the same initial phrase marker:

(14) John doesn't swim.
(15) Does John swim?
(16) Doesn't John swim?
(17) John **does** swim.

References

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Chomsky, Noam. 1957. *Syntactic structures*. The Hague: Mouton.
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