Parasitic Trees

Pieter Muysken
Universiteit van Amsterdam

PARASITIC TREES

PIETER MUYSKEN

UNIVERSITEIT VAN AMSTERDAM

In this note I propose a formalism to account for phrasal 'percolation' that:
   (a)   specifies its formal character and the conditions to
         which it is subject;
   (b)   allows for a more principled parametrized description
         of percolation of natural languages.*

The notion implicit in the formalism is that of a well-formed subtree or 'parasitic tree'. Hence the title of this paper. On a subset of the nodes (defined in terms of the features $+N$, $+V$) of the 'major trees' or 'lexical projections', we find a path, or a network of paths, of nodes defined in terms of minor features, such as 'objective case', 'tense', etc. The geometry of the path is subject to parameteric variation.

In section 1 I will present an informal account of phenomena commonly captured under the notion of percolation, discuss some of the definitions of percolation found in the generative literature, and present some of the issues which arise with respect to the notion. Section 2 contains a description of two rather different systems of percolation, that of Amharic and that of Quechua. In section 3 I give a semi-formal definition of percolation trees, both the part of the definition that is universal, and the parametrized part. Section 4 is dedicated to a discussion of the locality principles governing percolation trees, and section 5 to some further issues: (a) the relation between the parametric

PIETER MUYSKEN

specification of headedness in the morphology of a language, and the type of percolation found; (b) the question of whether agreement can be reduced to percolation; (c) a discussion of 'strong' percolation in German noun phrases; (d) a reformulation of the Case filter in terms of the well-formedness of the percolation tree; Section 6 finally presents some conclusions.

1. Percolation

Here I will only discuss percolation in noun phrases, leaving aside the problems emerging with respect to percolation within the word (cf. Selkirk, 1982) for some discussion and references and to percolation in other phrasal projections such as clauses. To the latter I will briefly return in the conclusion to this paper. Safir (1982:424) limits percolation to sub-maximal projections:

If X^m is a maximal projection of X, and X^m has the feature $[\alpha F]$, then for all SPEC X^n, $n \leq m$, X^n and SPEC X^n are also $[\alpha F]$.

The general consensus, however, at least with respect to NPs, is that percolation accounts for the implication between the following two principles (Chomsky, 1981:49):

(1) $*[_N \alpha]$, where α includes a phonetic matrix, if N has no Case

(2) *NP if NP has phonetic content and has no Case

Thus Case is both a feature of the NP node and of the head N, and percolation establishes the feature correspondence between these two nodes. Rouveret & Vergnaud (1980:102) to whom the insight in the relation between (1) and (2) is due, extend the notion of percolation to include the determiner and the modifiers of the head noun.

In Safir, Chomsky and Rouveret & Vergnaud the idea is implicit that percolation is downward. In Gazdar & Pullum (1982) the idea is explored that percolation is upward, really the same thing as projection from a lexical category, and thus percolation falls under the X-bar theory:

(3)
$$[\alpha F]$$
$$|$$
$$[\alpha F]$$

Here $[\alpha F]$ can be $[\underline{+}N]$ as well as $[\underline{+}accusative]$.

In some sense, however, both the upwards and the downwards notions of percolation are beside the point: needed is a well-defined path between the NP-node and a lexical element. Gazdar & Pullum explicitly, and Chomsky and Rouveret & Vergnaud implicitly assume that it is the head noun that is the lexical element that is marked for Case. Notice, however, that (1) and (2) do not require it to be the head, in that (2) does refer to "phonetic

PARASITIC TREES

content", and this may be something else than the head. Consider, for instance, Dutch noun phrases, as in (5), contrasted with the English equivalents in (4):

(4) a. a black one (e.g. horse)
    b. the black one
    c. *a black
    d. *the black

(5) a. het zwarte paard   'the black horse'
    b. een zwart paard   'a black horse'
    c. *een zwarte paard
    d. het zwarte   'the black one'
    e. ?een zwarte   'a black one (Neuter)'
    f. *een zwart

In English, adjectives are not marked for Case, and the head N must normally be filled by a dummy element such as 'one'. In Dutch, however, adjectives are marked for Case (as is indirectly expressed by the agreement system. In neuter noun phrases which are indefinite, no element appears on the adjective, as in (5b). But here the equivalent NP without a head noun, as in (5f), is ungrammatical. (5d), the definite phrase is perfectly grammatical, while (5e) may be, even though indefinite neuter adjectives don't carry -e. This array of facts is easily explained if the adjective inflection in Dutch is an expression of Case, so that in (5d) there is a well-formed percolation path between the NP and some lexical element. In section 5d we will return to this issue, proposing a new definition of the Case filter, which can handle facts such as these and the ones presented in the next section.

2. Two percolation systems: Amharic and Quechua

    In the previous section we considered primarily percolation to the lexical head of a projection. Here we will briefly describe data in which not the main projection line, but rather either the line of left-most nodes or the line of rightmost nodes is involved in percolation. Consider the following data from Amharic (cf. Bach 1970; Obolensky et al., 1964):

(6) a. lij - u - n   'the child (acc.)'
        child DEF AC
    b. tilliḳ - u - n ḳonjo lij 'the big and beautiful child'
        big   DEF AC beaut. child
    c. tilliḳ - inna ḳonjo yə - honə - w - in lij
        big   and beaut. REL be   DEF AC child
        'the/a child that is big and beautiful'

    In (6a) it is the lexical head itself, the only element in the NP, which is marked for definiteness and Case, features of the NP as a whole. In (6b) it is the leftmost of the two prenominal adjectives. In (6c) it is the (prenominal) relative clause that is marked. Thus a general observation would be:

PIETER MUYSKEN

(7) In Amharic, accusative Case and Definiteness percolate
     along the left-most nodes in a projection (unless this
     would mean entering a different Case assignment domain).

Here I am assuming that the relative involves a different Case
assignment domain, and hence cannot be part of the percolation path.
In section 4 this restriction will be made more precise and more
general.

In contrast with Amharic, Quechua presents a case where
percolation of Case markers follows the right-most branch in the
tree. Compare the examples in (8) (some of which were discussed in
a slightly different framework, to which we will return below, in
Muysken (1981):

(8) a. xwan - ta   'Juan (acc.)'
        Juan   AC

    b. hatun wasi - ta   'a big house (acc.)'
        big   house AC

    c. pay wasi - ta ruwa - sqa - n - ta yacha - ni
        he house   AC build NOM   3   AC know   1
        'I know that he built a house'

    d. hamu - nqa chay - ta yacha - ni
        come   3FU that   AC know   1
        'I know that he will come'

    e. wasi hunt'a - ta riku - ni
        house full   AC see   1
        'I see a full house'

    f. [$_{NP}$[$_{AP}$ allin - ta]pro] riku - ni
              good   AC   see   1
        'I see the good one'

    g. [$_{NP}$[$_{S'}$ runa hamu - q - ta]e] riqsi - ni
               man come   AG AC   know   1
        'I know the man who is coming'

    h. [$_{NP}$[$_{NP}$ pay - pa - ta]pro] riku - ni
               he   GEN AC   see   1
        'I see his (one)'

Again, discussing these examples one by one, we see that in (8a)
and in (8b) the head noun receives the Case marking. I claim that
this is not due to its being the head, however, but to its right-
most position. In (8c) and (8d) there are two examples of Case
marked clauses, and here the Case is expressed on the rightmost
element again: in (8c) on the nominalized verb and in (8d) on a
lexical complementizer, /chay-ta/, 'that (acc.)'.

While almost all adjectives in Quechua occur in prenominal
position, and will not be marked for Case, there is one adjective
/hunt'a/ 'full', which occurs post-nominally; notice that in (8e),
it is this adjective, and not the head noun, which is marked for

PARASITIC TREES

the Case of the NP. The data is (8f), (8g), and (8h) also strongly support the conclusion that it is simply the rightmost lexical element that must receive Case. In (8f) we have a situation parallel to (5): since the noun is absent, the adjective carries the case. In (8g) it is a so-called 'headless relative': again, since (normally rightmost) head is part of the relative clause itself, the clause is marked for the case of the whole NP. In (8h) the pre-nominal possessive phrase, itself marked genitive Case, also carries accusative Case marking, corresponding to the Case of the whole NP.

Now these examples would be quite transparent if accusative /-ta/ were simply a clitic, slapped on to whatever lexical material appears in the NP. In Muysken (1981) and Muysken & Lefebvre (forthcoming), however, a number of arguments are given that /-ta/ is a real affix, generated by the word formation rules of the lexicon. Thus, a different analysis is called for. The solution presented in Muysken (1981) was in terms of morphological control, where an element of morphology of a head could control the features of an abstract position:

(9)

$$X^{max}_i$$
$$ABSTR$$
$$\alpha F$$
$$X + \alpha F$$
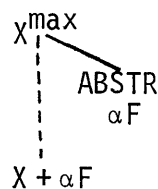
Now in (9) the abstract position could be a COMP position, a CASE position or INFL. Notice that in this theory case on an AP (as in (8f) would have to look further than the A^{max} boundary to control the Case on the higher NP. It turned out that the locality conditions for the various cases in (8) were difficult to state.

A second problem is that to make morphological control work, Case had to be an abstract position and could not be thought of as a feature on the head. This creates a principled division between Case feature percolation languages and abstract CASE position languages, a division which is not necessary under the present proposal.

A third problem is that the morphological control analysis works well for Quechua (if the first and second problem are solved), but is not attractive for Amharic. Positing a right-most abstract CASE position in Quechua had some plausibility in terms of the typology of the language (which has a rightmost COMP as well, with which the CASE position could be identified or associated), but a leftmost Definite/Accusative abstract position for Amharic makes much less sense.

For these reasons I prefer an analysis in terms of a para-metrized percolation system, the form of which I will specify in the next section.

PIETER MUYSKEN

## 3. A (semi) formal definition of percolation trees.

Now that we have surveyed some 'exotic' cases of percolation, after discussing its definition for French and English, I will try to give a precise definition of a percolation tree in which it is possible to separate the universal aspects from the particular ones (Zwicky & Isard, 1963)

(10) A percolation tree for the feature [αF] is defined as a set of labelled nodes such that:

a. each node is labelled (±N, ±V);

b. each node is a term in a finite set of ordered pairs (n, n-1), (n-1, n-2) . . . . (2, 1), where $1 < j \leq n$, such that
   (I) j directly dominates $j-1$;
   (II) the dominance relationship (j+1, j)(j, j-1) is transitive;
   (III) node 1 is 'lexical' (here: dominates a phonetic matrix).

c. each node is labelled [αF].

This definition simply states that there is a path from the top node (e.g. NP) to some lexical element, defined on the major projection tree. How this path is defined is subject to parametric variation. In languages which show Case on the noun and adjective and possibly also the determiner are defined by (11):

(11) Each node in the path is (+N, αV].

This gives a series of parallel paths, as in:

(12)
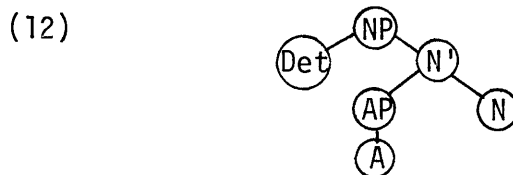
Since all the circled nodes share the feature [+N], they all participate in the definition of the percolation path.

Other languages may only show the feature percolated on the head. These languages fall under (13):

(13) Each node in the path is [αN, βV].

Given **X'** theory and the locality principles that we will refer to below, it will be the head that will be marked for the feature percolated.

The percolation systems discussed in the previous section would fall under principle (14), added to the definition in (10):

(14) Given an ordered pair (j, j-1) and a node q such that (j, q), then the node $j-1$ is ordered to the left (Amharic) or right (Quechua) of q.

PARASITIC TREES

This type of left-right specification is not characteristic of tree definitions in syntax, but frequent in morphology and phonology. Below we will explore the consequences of that observation.

4. Locality principles for percolation trees

The definitions for percolation trees given in (10)-(14) above limit the trees as to the types of nodes that may be involved in the tree and/or as to the direction of branching involved. No specification is given on how long the percolation path can be. In (15) I present again in schematic form the three 'non-local' cases of percolation discussed in (8) for Quechua:

(15)   (8f)$\bullet$ (8g) $\bullet$ (8h) $\bullet$

$\bullet$ AP $\bullet$ S' $\bullet$ NP + gen

$\bullet$ $\bullet$ $\bullet$
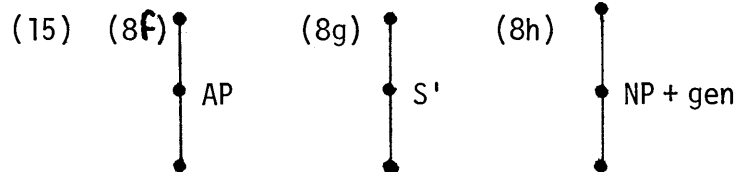
Clearly, then, percolation can involve more than one projection or or maximal boundary. What these three cases have in common, however, is that the intervening maximal node can not be marked for accusative, while being part of an accusative percolation path. We will generalize this insight into the following restriction:

(16)   (UNIVERSAL)   In a percolation tree 1...n for feature [αF], no node j may be governed for feature [αF].

Hence Case percolation can't enter into a domain to which the same feature is assigned independently, etc. The general statement in (16) explains an asymmetry between 'double' case marking in subject and in object positions. In (8h) we had a genitive combined with accusative, but a genitive combined with a nominative is ungrammatical:

(17)   *xwan - pa - Ø sumaq - mi
       Juan   GE nom beaut. AF
       'John's is beautiful'

This asymmetry can be explained if we assume:

(18)   genitive = (assigned by AGR, nominal context)
       accusative = (assigned by V, verbal context)
   nominative = (assigned by AGR, verbal context)

Genitive and accusative can be combined because they do not share any features, and thus the percolation in (8h) is licensed by (16). Nominative and genitive share a feature, and therefore cannot be combined.

Besides these empirical consequences the principle in (16) has the added attraction that it may be the general locality principle which holds for the Binding theory. Suppose that the

206

PIETER MUYSKEN

relevant notion domain is expressed in terms of indexes on nodes, then anaphors have to be related to antecedents within a given domain, along a uniformly indexed path, as in (19).

(19)

Antecedent
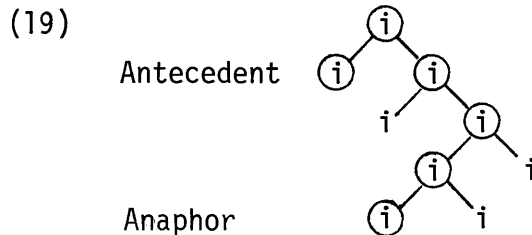
Anaphor

Now the path between antecedent and anaphor is 'licensed' by all intervening nodes having the same index, assigned by the SUBJECT. The equivalent of (19) (which I do not need to draw here) in which not all nodes have the same index does not license a antecedent-anaphor path. If we can abstract here from the difference between features and indexes, on a more abstract level the locality condi-tions for antecedent-anaphor relations and for Case percolation are the same.

5.1 Morphological headedness and the left/right distinction.

Williams (1981) has proposed that in morphology the affix that determines the category of the resulting complex word is the head of the word. Since in Quechua all affixes are suffixes, we can then say that the morphology is right-headed. 'Head' then can be defined perhaps in terms of right-left distinctions. It is tempting to say that percolation in Quechua, since it involves morphological features, is right-branching, 'right-headed', in the same way as affixation.
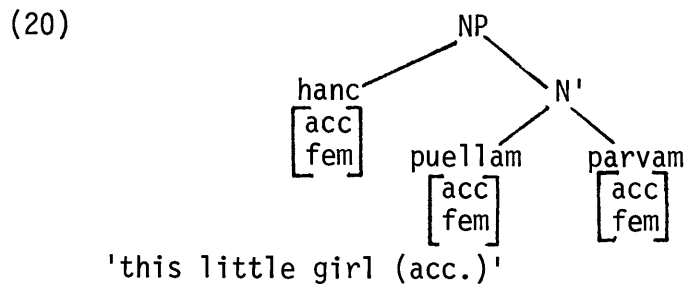
This type of observation would gain support if we would find that left-percolating languages such as Amharic would be character-ized by prefixes as heads and left-headed compounds. This is only partially the case, however.

If it were true in general, and if Amharic's being a partial counter-example would be due to its mixed Semitic/non-Semitic lexical heritage, we could plausibly regard cases of left/right percolation as extensions of morphological tree-building principles into the phrase structure component. This parametrized possibility of extending principles from one component to another was discussed in Muysken (1982).

5.2 Can the effects of agreement be reduced to percolation?

Since in (11) I defined a type of percolation tree in which all [+N] nodes, including adjectives, determiners, and nouns, could form percolation paths for a given feature such as Case, we may ask ourselves whether the phenomenon of agreement within NP can be reduced to a condition on parallel percolation paths. Consider a noun phrase such as (20):

PARASITIC TREES

(20)

```
                        NP
              hanc            N'
             [acc]
             [fem]    puellam      parvam
                      [acc]        [acc]
                      [fem]        [fem]
```

'this little girl (acc.)'

Quite easily, this structure could be described as containing three percolation paths, each of them of the form in (21):

(21) $\begin{bmatrix} +N \\ \alpha F \end{bmatrix}$ Det, Adj, N = +N

      $\begin{bmatrix} +N \\ \alpha F \end{bmatrix}$
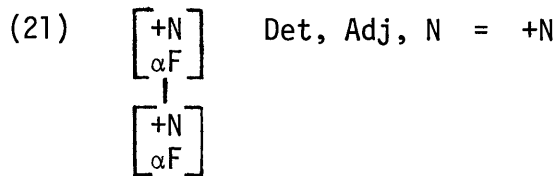
Now, of course, these paths will converge, and agreement can be described in terms of a principle such as (23):

(22) A node may not be specified for $[\alpha F]$ and $[-\alpha F]$ at the same time.

This princple accounts for the ungrammaticality in (23):

(23)   *hanc   puella,   since   *NP
     acc   nom   acc
     fem   fem   nom

I will assume that similar cases in other languages, such as the Dutch case discussed in example (5) and the German case to be discusssed below, can be handled in the same way.

5.3 'strong' percolation in German NPs.

There is a classical problem in German morphology having to do with the distribution of -er inflections in masculine NPs (and equivalent cases in feminine and neuter NPs). The relevant pattern is as in (24) (cf. Milner & Milner, 1972):

(24)   a.   der hohe Baum   'the high tree (nominative)'
       b.   ein hoher Baum   'a high tree'
       c.   *der hoher Baum
       d.   *de? hoher Baum

Assume now that there are lexically determined affixation possibilities: the definite article can take -r, and the indefinite one cannot. Then with the assumptions in (25), the patterns in (26), which correspond to (24) are predicted:
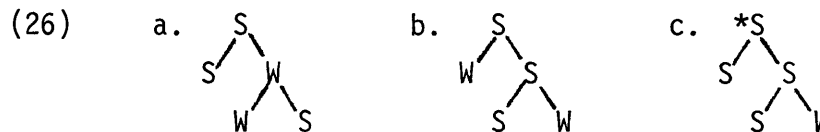
(25)   i.   inflection of the type -r is strong, i.e.
           -r counts for branching
     ii.   the feature strong is projected on the tree

PIETER MUYSKEN

(25) iii. the sister of a strong node is weak, hence

```
     *X
    /   \
   S     S
```

    iv. in a tree where j dominates $j-1$, $j-1$ is strong
iff it is a branching left daughter, otherwise
a right daughter

(26)   a.   b.   c.

```
   a.  S            b.  S            c.  *S
      / \              / \              / \
     S   W            W   S            S   S
        / \              / \              / \
       W   S            S   W            S   W
```

Now the type of conditions on percolation found in (25) are strongly
reminiscent from the phonological theory of stress patterns as
found in numerous recent publications. Just as in the case of
Quechua, then the particular form percolation takes results from
the extension of principles from one component of the grammar
to another one.

In German most adjectives have some form of inflection (-er,
-en, -e, -em, -es). Rare adjectives like lila 'violet', however,
pattern like the Dutch case in (5):

(27) a. ein lila Kleid   'a violet dress'
     b. ein lilanes Kleid   'a violet dress' (informal)
     c.*ein lila   'a violet (one)'
     d. ein lilanes   'a violet (one)'

Inflection is optional when the noun is present (and preferred in
informal styles), but obligatory when the noun is absent. This
example supports the analysis of Dutch and Quechua given in (5)
and (8).

5.4 The Case filter.

It has become clear from the discussion so far that the Case
filter has to be revised somewhat, to accommodate (5), (8) and
(27). Crucial is that there is a well-defined percolation path:

(28)   *NP, where NP contains phonetic material and no
well-formed percolation path relating the category
node and some lexical element specified for Case.

While Rouveret & Vergnaud assumed that this lexical element
was the noun, we have adduced evidence that any element specified
in the language itself as a Case carrier can fulfill the required
function, if conditions on the well-formedness of the percolation
path have been met.

6. Concluding remarks

I have tried to give an account of percolation in noun
phrases in terms of parameters for percolation subtree construction,
an account which is somewhat more precise than previous ones,

209

PARASITIC TREES

which allows us a way to describe differences between percolation systems, and which allows us to state the locality principle that holds for it precisely. Somewhat more tentatively, I have suggested that there might be a relation between percolation parameters and the components of phonology and morphology, and that NP agreement can be seen as the result of converging percolation paths.

To keep the discussion precise, I have limited myself to NP-internal percolation. It is tempting to extend the discussion to the percolation of Tense in clauses, and particularly to investigate the phenomenon of Aux in second clausal position, that we find in many languages, in terms of left-branching percolation in the clause.

FOOTNOTE

* I am grateful to Henk van Riemsdijk for support with respect to the model proposed, and for observations concerning German strong percolation. The analysis of Quechua Case owes much to Claire Lefebvre's work in this area. The relevance of the Amharic facts was pointed out by Emmon Bach. The German lila example is due to Armin Mester. None of these people is responsible for misunderstandings and errors in interpretation that remain.

REFERENCES

E. Bach (1970) 'Is Amharic an SOV language?' Journal of Ethiopian Studies (8) 1:9-20.

N. Chomsky (1981) Lectures on Government and Binding, Foris: Dordrecht.

G. Gazdar & G. Pullum (1982) 'Heads and Phrase Structure Grammar. In T. Hoekstra, H.v.d. Hulst & M. Michael Moortgat (eds.) The Scope of Lexical Rules. Foris, Dordrecht.

J. A. Milner & J. Milner (1972) "La morphologie du groupe nominal en allemand.' DR LAV-2

P. Muysken (1981) 'The Theory of Morphological Control'. V. Burke and J. Pustejovsky (eds.) Proceedings of the Northeastern Linguistic Society XI (Ithaca, New York Meeting). GLSA, Amherst.

P. Muysken (1982) 'Parametrizing the notion 'head'. Presentend at GLOW. Paris. To appear in The Journal of Linguistic Research.

P. Muysken & C. Lefebvre (forthcoming) Quechua Nominalizations.

S. Obolensky et al. (1954) Amharic Baisc Course. Foreign Service Institute: Washington D.C.

A. Rouveret & J. R. Vergnaud (1980) 'Specifying Reference to the Subject.' Linguistic Inquiry (11)1, 97-202.

210

PIETER MUYSKEN

K. Safir (1982) 'Inflection and Word Order' The Linguistic Review 1(2).

L. Selkirk (1982) The Syntax of Words. MIT Press: Cambridge.

E. Williams (1981) 'On the Notions 'Lexically Related' and 'Head of a Word'. Linguistic Inquiry (12)2, 245-274.

A. M. Zwicky & S. Isard (1963) Some aspects of tree theory. ms. The Mitre Corporation.