MODULARITY AND TRANSLATION IN STRUCTURALIST AND GENERATIVE PHONOLOGY

(1) purpose
   a. to show that modularity and its consequence, translation, is a fundamental piece of linguistic thinking in the 20th century that is shared by structuralist and generative approaches to language.
   b. trace back its various manifestations and implementations.
   c. evaluate current practice, namely in OT, in this light.
   d. define the desiderata for a modularity-compatible interface theory: Direct Interface.

[this talk is a piece of Scheer forth a]

(2) origins of modularity
   a. phrenology: Franz-Joseph Gall (1758-1828)
   b. Standard model of Cognitive Science developed in the 50s psychology, philosophy, anthropology, neuroscience, computer science, artificial intelligence, linguistics, cybernetics etc.
      Gardner (1985)
   c. Chomskyan linguistics is the application of the cognitive science programme that was laid out in the 50s to a specific area of cognitive activity.

(3) what is modularity?
   a. modularity is the idea that cognitive computation is specialized, rather than all-purpose
   b. the mind/brain is made of a number of computational units that
      - can only carry out a very narrowly defined task
      - are insensitive to eventual teleological goals of the global system
      - work only with a specific vocabulary (domain specificity)
   c. of course modules network, and a necessary condition of intermodular communication that follows from domain specificity is translation: a given module can understand only its own vocabulary.
looking at
  a. two specific modules and their communication:
     morpho-syntax and phonology
  b. only one of the two channels of intermodular communication:
     representational
     i.e. the insertion of objects into the linear phonological string that is the input to
     phonological computation: these objects are carriers of morpho-syntactic
     information.
     Objects that have been used:
     1. juncture phonemes (structuralism)
     2. hash marks # (SPE)
     3. autosegmental trees (prosodic constituency)
  c. the other channel is left unconsidered here:
     procedural communication
     i.e. cyclic derivation, today called derivation by phase (Chomsky 2000 et passim).
     Traditional representative in phonology: Lexical Phonology.

our focus today
  a. modularity
     - to which extent is it/was it a conscious concern for linguists?
     - who violates it?
  b. translation
     - what do carriers of morpho-syntactic information look like?
     - in which way are they different (local/linear vs. arboreal)?
     - the diacritic issue: for the time being, all carriers are phonological aliens, i.e.
       items that are not part of the proprietary phonological vocabulary.

1. American Structuralism: Level Independence

two ontologically distinct areas
  fieldwork-based discovery procedure:
  a. only bottom-up: phones → phonemes → morpho-phonemes → phrases
  b. information that does not exist yet cannot be used
  c. ==> morpho-syntactic information must not be used in phonology
     cf. (7)

Level Independence: morphological information must not be used in phonology
  b. "One of the essential characteristics of the American descriptivists' phonemic level, a consequence
     of their theory of discovery procedures, was its autonomy from syntax, semantics, and
     morphology. One was supposed to be able to do a phonemic transcription which did not refer to
     higher levels of analysis. Indeed, according to the theoreticians, one was supposed to be able to do
     a phonemic analysis without having a clue as to the higher structure of an utterance. In the case of
     juncture, the phonemic transcription could not refer to the fact that nitrate is a compound
     consisting of two words, while nitrate is one single morphological unit. One could not account for
     phonetic distribution in terms of morphology and syntax." Aronoff (1980:30)
  c. "The American descriptivists believed that junctures were phonemes because they
     had to" Aronoff (1980:30)
but of course numerous phenomena require morpho-syntactic information. This, however, is not the "official" reason for the existence of juncture phonemes.

a. argument for juncture phonemes: **phoneme economy**
   the best phonology is the one that uses the smallest number of phonemes. According to Harris (1951:79f), the raison d'etre of juncture is to "reduce the number of phonemes, and simplify the statement of restrictions upon the environments in which they occur."
   example: German (Moulton 1947)
   monster-minimal pairs of the (nitrate - night rate kind) establish three phonemes, cf. (9), (10)

b. - aspiration: ich antworte: Terrassee vs. ich antwartete Rasse
   - the glottal stop: den Bauer kennen vs. den Bau ßerkennen
   - /ç/ and /χ/:
     Kuh-chen vs. Kuchen

c. three for the price of one:
   /ç/, /χ/, /aspiration/ against only /+/
   /ich antworte: +Terrasse/
   /den Bau +ßerkennen/
   /Kuh+chen/

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(9) monster-minimal pairs because of the prohibition to use morphological information
a. nitrate vs. night rate
b. [t] is aspirated in nitrate but not in night rate, hence aspiration is a phoneme

(10) selling morphology for phonology
Moulton (1947): juncture phonemes because of economy
a. Moulton was not the inventor of juncture phonemes, but his article is always quoted in this context

b. German: aspiration is a phoneme
1. dieses Kabinett [dlizæskhabˈnet] "this cabinet"
   vs.
   diese Skandale [dlizæskædaɬa] "these scandals"
   the portion [dlizaska] is identical except for aspiration

2. ich antworte: Terrasse [dlɛɾtsətʰˈteraɕə] "I answer 'terrace'"
   vs.
   ich antwortete: Rasse [dlɛɾtsətʰˈraɕə] "I answered 'race'"

c. "/p t k/ are aspirated after a pause, but unaspirated after any segmental phoneme"
   "there are places within an utterance where /p t k/ behave as if they were preceded by a pause" (Moulton 1947:220)
   ==> "pause" is represented by a segmental phoneme, "open juncture" /+/

d. /+/ produces allophonic variation: "at the beginning or end of an utterance it appears as a pause of brief duration or, in free variation with this, as zero"
   (Moulton 1947:220)

ich antworte: Terrasse "I answer 'terrace'" = /+ïx ʔantvort+teʰrəs+/
vs. ich antwortete: Rasse "I answer 'terrace'" = /+ïx ʔantvortetʰraʃ+/

e. as it stands, the juncture solution is not any more appealing than the solution based on aspiration. Perhaps it is even worse because it introduces a new concept. But there are 2 more relevant phenomena.

f. the glottal stop is a phoneme
den Bauer kennen [deen"bau German loan word] "to know the farmer" - glottal stop impossible vs.
den Bau erkennen [deen"bauer, German loan word] "to recognize the building" - glottal stop possible

Arbeiter suchen ["arbeit, German loan word] "to look for workers" - glottal stop impossible vs.
Arbeit ersuchen ["aarbeit, German loan word] "to request work" - glottal stop possible

g. den Bauer kennen /+deen"bau, German loan word+/ "to know the farmer" vs.
den Bau erkennen /+deen"bauer, German loan word+/ "to recognize the building"

==> "vowels show an allophone with glottal stop after /+, but without glottal stop after all other segmental phonemes" (Moulton 1947:223)

h. ich-Laut, ach-Laut
[ç] / front V, C/ [x] / non-front V, C/
Kuchen [kuç, German loan word] "cake" vs. Kuhchen [kuuç, German loan word] "little cow"
tauchen [tawç, German loan word] "to dive" vs. Tauchen [tawç, German loan word] "little rope"
da China so groß ist [daaciinasoog, German loan word] "since China is so large"

 ==> /+kuuç, German loan word+/ vs. /+kuuç, German loan word+/ [x] appears after non-front vowels, against [ç] after all other segmental phonemes, including the juncture /+/ 

i. the argument: economy
you get three for one: /ç/, /ç/, /aspiration/ against only /+

(11) accidental coincidence of juncture phonemes with morpho-syntactic divisions
a. juncture phonemes are phonemes, hence must have a non-restricted distribution
1. therefore the occurrence of juncture phonemes cannot be restricted to morpho-syntactic divisions.
2. way out: "accidental" coincidence of juncture and morpho-syntactic divisions: fortunately aspirated voiceless stops also occur morpheme-internally (the distribution is like in English: word-initially and in pre-tonic position):
Papier = /+pa+pir+/ 
Laten = /+la+terne+/ 

b. other example:
Harris (1951:87f)
- German has final devoicing, hence /d#/ → [t] 
- therefore Teil "part" = /d#ajl/

==> economy: /p,t,k/ can be eliminated altogether

c. different views on whether juncture phonemes may/must not coincide with morpho-syntactic divisions, cf. (12).
do juncture phonemes necessarily match some morpho-syntactic division?

a. rather yes:
"if some peculiar phenomenon is predictable […], and if its successive occurrences seem to mark fairly well the borders between phonological words, then that phenomenon is junctural. […] A juncture phoneme is then a grouping of such phenomena which makes for unambiguous and simple linear transcription. If this last statement seems arbitrary, it is no more so than is, for me, the definition of any kind of phoneme." Hockett (1949:35f)

b. rather yes:
"the great importance of junctures lies in the fact that they can be so placed as to indicate various morphological boundaries." Harris (1951:87)
but this is not a necessary condition.

c. no:
"there is one potential source of error which ought to be avoided. Juncture phonemes are not recognized in order to show grammatic boundaries of one or another kind - say boundaries between words. It often happens that grammatic boundaries fall at open junctures, particularly grammatic word boundaries" (Hockett 1955:172).

boundary abuse

juncture phonemes in the middle of morphemes – a disaster

cf. (14), (15)

a. licence to print money:
the existence of juncture is exclusively defined by its effect, and its effect is attributed to its existence.

b. ☺ this makes happy phonologists ☺
since they have an explanation for everything and its reverse: juncture, which comes at no cost since you cannot hear it.

c. example: Hill (1954)
lat labra > Italian labbra
because of juncture: /lab+ra/
gemination is due to juncture because "no explanation […] is as simple as postulating the sequence /-b + r-/ […] where the juncture resulted in a lengthening of the preceding consonant"

Boundary abuse (structuralist): juncture in the middle of morphemes abandon of morpho-syntactic and phonetic control over juncture overview: Aronoff (1980:31f)

a. juncture phonemes where "juncture" is meaningless

b. since there were no phonetic consequences of /+/, any phenomenon could be ascribed to the existence of a juncture phoneme at no cost.
While Moulton (1947) still consistently inserts a /+/ at every beginning and every end of an utterance, thereby reflecting the corresponding boundaries, e.g. Trager (1962) and Hill (1954) later only use /+/ when some segmental effect requires explanation because it deviates from what is expected.

Harris (1951:87f)
- German has final devoicing, hence /d#/ → [t]
- therefore Teil [tajl] "part" = /d#ajl/
===> economy: /p,t,k/ can be eliminated altogether
but Harris is inconsistent: he writes "that phonemic junctures are used for segments which occur only at morpheme (or other) boundary" Harris (1951:241)
d. according to Harris (1951:79f), the raison d'être of juncture is to "reduce the number of phonemes, and simplify the statement of restrictions upon the environments in which they occur." Hence, juncture phonemes do not need to comply with any requirement other than acting as an environment for the prediction of allophones.

e. Trager (1962:19f)
"most places where /+/ occurs also indicate the end of a word, but in some instances it is only the end of a morpheme that is present, as in shyness /šáynis/; while in still others there is not even a morpheme-end, as in the pronunciation of center as /sén+tar/. Moreover, there are word sequences without /+/: postman may be /pówsmən/ as well as /pówst+ən/."

f. Hill (1954:440)
"a juncture phoneme existed [in Latin], that it could determine syllable division, and that it could determine word boundaries but was not necessarily in one-to-one correspondence with them".

g. Trager (1962:17)
"transition phonemes occur only after a sequence of phonemes, and cannot and do not exist at the beginning of an utterance. There is nothing, phonemically speaking, before the beginning."

h. typical analysis: Latin by Hill (1954)
  1. He "define[s] juncture […] as a lengthening of the preceding phoneme by one half-unit, where a full unit is equal to the average length of a sound as member of a phoneme." Hill (1954:440)
  2. lat labra > Italian labbra
  gemoniation is due to juncture because "no explanation […] is as simple as postulating the sequence /-b + r-/ […], where the juncture resulted in a lengthening of the preceding consonant"
  3. the juncture phoneme is exclusively defined by its effect, and its effect is attributed to its existence. ☺ this makes happy phonologists ☺

(15) structuralist voices against boundary abuse
  a. Wells (1947:107) writes that "linguists find themselves tempted to institute 'junctures' simply as notational devices for reducing the number of phonemes." In his view, "juncture, whenever it occurs, is a morpheme - though often with no detectable meaning" (page 108).
  b. Pike (1947) argues against morphology-independent placement of juncture in regard of the few words that Moulton (1947) presents in support of such practice (Theater as /+te+ater+/ and so forth, see Moulton 1947): "one should hesitate to allow a small residue of words of foreign origin to prevent a general formulation".

1 Trager does not indicate why this particular pronunciation requires juncture. The transcriptions in slashes are approximate because my computer is not able to restore the multiple diacritics on all sides of the basic symbols that structuralist phonetic records mention.
(16) summary: correct solution for the wrong reasons
   a. structuralist interface theory was enforced by level independence: no morpho-
      syntactic information can be used in phonology. Hence it must be translated and
      projected onto phonology in the form of a truly phonological category.
   b. since the only phonological units of structuralist phonology are phonemes, the
      morpho-syntactic information had to come down to phonology in this coat.
   c. structuralists were honest: they were ready to take the consequences of the fact
      that their carriers of morpho-syntactic information are phonemes:
      1. they must have free distribution
      2. they must have a phonetic correlate
      (this debate was not mentioned above for lack of space and time…)
   d. ==> this is exactly the correct method
      whatever your domestic theory, higher level information must be translated into
      objects of this theory. This makes the domestic phonological theory falsifiable at
      the interface.

(17) evaluating a phonological theory on the grounds of the predictions that it makes at the
interface
   a. evaluating whether phonemes are correct carriers of morpho-syntactic information
      would have led to the falsification of phonemes as the basic units of phonology
   b. because
      1. the only phonological units that morpho-syntactic information can incarnate in
         are phonemes (there are no other units)
      2. the incarnation into phonemes has disastrous consequences:
         the presence of juncture phonemes in the middle of morphemes
      3. ==> falsification of phonemes at the interface
         there must be phonological units into which morpho-syntactic information can
         incarnate, but which are different from phonemes.
   c. Test-Your-Theory Recipe
      how to test your phonological theory at the interface
      take its basic units, make them the output of translation and look at the kind of
      predictions that are made.

2. SPE: boundaries, the generative version on juncture

(18) [-segment] segments
   a. phonology is a linear string of segments, and segments are made of features.
      Hence boundaries must be segments. They are segments that lack any phonetic
      manifestation.
   b. feature [+segment]
      [+segment] = regular segments /e/, /p/ etc.
      [-segment] = boundaries
      "Boundary features do not have universal phonetic correlates, except perhaps for
      the fact that word boundaries may optionally be actualised as pauses." (Chomsky
      & Halle 1968:364)
   c. three different boundaries:
      #, +, =
d. as all other segments, they are made of features:

[±word boundary (WB)]
[±formative boundary (FB)]
# [+WB, -FB]
+ [-WB, +FB]
= [-WB, -FB]

(Chomsky & Halle 1968:66f)

[+WB, +FB], the fourth logical possibility, is not addressed in SPE.

(19) a universal mapping algorithm distributes #s
a. exhaustive translation of morpho-syntactic structure into linear boundaries
b. # is inserted at the beginning and at the end of each major category, i.e. noun, verb, adjective, and also on each side of higher constituents that dominate major categories, i.e. NPs, VPs, sentences etc. (Chomsky & Halle 1968:12f,366ff).

c. morpho-syntactic and phonological representations of the sentence
"we established telegraphic communication"

1. morpho-syntactic structure and phonological terminals

```
[S#
 [NP#[N# we #]]#
 [VP#[V'#[V# establish #] past #]#
 [NP#[A#[N# tele+graph #] ic#] [N#[V# communicate #] ion #]]#
 ]#
```

2. phonological result of the translation

```
### we ###### establish # ed ##
## telegraph # ic ###### communicate # ion ######
```

(20) SPE translates only part of the morpho-syntactic information that is used by phonology
a. morpho-syntactic structure is translated (into #s)
b. labels of morpho-syntactic structure are also translated: N,V,A

=== violation of modularity ===

c. the input to phonological computation is a bracketed and labelled string
[where brackets represent cycles/phases, another violation of modularity: phonology cannot parse brackets]:
ex. theatricality (Chomsky & Halle 1968:88f)

```
[[[theatr]N ic + al]A i + ty]N
```
d. phonology must
- read brackets, but phonological rules cannot make reference to brackets
- read labels, and phonological rules can make reference to labels
e. labels are what is known as morphological diacritics in SPE:
"palatalize velars before e, but only if this e is the dative singular marker"
3. Pyle (1972): the bankruptcy of boundaries

(21) Pyle (1972) applies the Recipe to SPE-type boundaries
   a. recall the Test-Your-Theory Recipe
      how to test your phonological theory at the interface
      take its basic units, make them the output of translation and look at the kind of
      predictions that are made
   b. structuralism:
      phonemes are disqualified
      - as carriers of morpho-syntactic information
      - as exclusive phonological units
      because they make wrong predictions at the interface
   c. Pyle (1972):
      boundaries are not segments - pretending they are makes absurd predictions.
      segments (including [-segment] segments) are therefore disqualified
      - as carriers of morpho-syntactic information
      - as exclusive phonological units

(22) boundaries need special provisions that are not necessary for regular segments
   - what about boundary epenthesis ?
   - what about boundary metathesis ?
   - what about boundary clusters created by the erasure of a morpheme?

a. \[ X \rightarrow Y / A \_ B \]
   boundaries should be able to instantiate any of the four objects A,B,X,Y
b. \[ X,Y: \text{boundary mutation rules (cf. above)} \]
   \[ \# \rightarrow + \]
   \[ \# \rightarrow \emptyset \]
c. what about boundary epenthesis ?
   \[ \emptyset \rightarrow \# / A \_ B \]
   1. possible answer: morpho-syntax (#) and the lexicon (+) distribute boundaries
      only at higher level divisions. There is a general ban on morpheme-internal
      boundaries.
   2. \[ \Rightarrow \text{there could still be epenthesis at morpheme and word boundaries.} \]
d. what about boundary metathesis ?
   \[ +C \rightarrow C+ / A \_ B \]
   this would transport a boundary inside a morpheme and thus be ruled out by the
   same ban on morpheme-internal boundaries.
e. what about boundary clusters created by the erasure of a morpheme:
   \[ B \rightarrow \emptyset / A \_ C \]
   hence \[ A+B+C \rightarrow A++C \]
   boundary clusters are reduced by general conventions in SPE: # to maximally two,
   + to maximally one.
f. conclusion:
   special provisions need to be made for boundaries, but not for regular segments.
   Pretending that boundaries are just a little peculiar kind of segments is a trick.
g. the same point is made by Szpyra (1989:11) and Rotenberg (1978):

"In order to implement [this solution, i.e. the fact of setting up ad hoc boundaries] […] one quickly finds the need for a great deal of theoretical machinery to place boundaries, to delete most of them when they pile up, and to ignore the rest of them when they get in the way. All of this comes from assuming that boundaries exist as items of vocabulary on a par with the others." Rotenberg (1978:16f)

(23) boundaries cannot be transformed into real segments  
   a. in SPE, anything can be transformed into anything  
      so what about  
      \[ + \rightarrow p / C\_C \quad /\text{dog}\_s/ \rightarrow [\text{dogas}] \]
      \[ p \rightarrow \# \]
      b. this of course is absurd.

(24) boundaries are "invisible", but /p/ is not  
   a. in SPE, rules are supposed to apply irrespectively of boundaries unless a specific boundary condition is mentioned in their structural description. Chomsky & Halle (1968:364ff)  
   b. hence, any rule that applies to the string XYZ also applies to X+YZ, XY+Z and X+Y+Z.  
   c. if boundaries are not any different from regular segments, the latter should also be able to be "invisible" at times.  
      But of course, there is no rule in natural language that ignores, say, /p/s unless a /p/ is explicitly mentioned in its structural description.

4. Conclusion by the late 70s: boundaries are corrupt, so let's abandon translation

(25) boundaries are discredited – what's the alternative?  
   a. discredit of boundaries  
      - cf. Pyle (1972)  
      - boundary zoo, cf. (27)  
      - boundary abuse (generative version), cf. (28)  
   b. throwing out the baby (translation) with the bathwater (boundaries)  
      1. conclusion: boundaries need to be done away with  
      2. what should they be replaced with?  
         Direct Syntax, i.e. direct reference to morpho-syntactic categories in phonological rules, e.g.  
         "A \rightarrow B / when belonging to an adjunct/ to an NP/ when c-commading C".  
         Cf. (26)  
      3. =>> abandon of translation  
   c. a logical alternative that was not considered:  
      boundaries are wrong, but translation is correct  
      1. we need different phonological units that morpho-syntactic information can incarnate in.  
      2. =>> there must be phonological units beyond segments…  
         [just as there had to be phonological units beyond phonemes]
### Pyle's (1972) & Hyman's (1978) solution: Direct Syntax

**a. Pyle (1972)**

Advocates a transderivational mechanism whereby phonological rules "can look back in the derivation" and thereby detect the phonologically relevant morphosyntactic structure even though it had already been erased at an earlier derivational stage. This operation of course violates the basic principle of ordered rule application.


Propose Direct Syntax in a reaction on boundary abuse: "the abuses seen in such works as Stanley (1973), where boundaries are unnecessarily proliferated" (Hyman 1978:459)

**c. Hyman et al. propose to eliminate +**

All cases where + is claimed to be phonologically active that "we have investigated have either used the + boundary when the # boundary would have done as well, or have used the + boundary diacritically, and could just as well have used ad hoc boundaries such as $, % or † or referred directly to the morphemes involved" (Hyman 1978:459)

In replacement of +, Hyman (1978:459) proposes to write rules that make direct reference to the particular morphemes involved.

### boundary zoo

typology and strength of boundaries

**a. juncture/ boundary typology has always existed:** cf. structuralism, Chomsky et al (1956) (internal, external), SPE (#, +, =).

**b. in post-SPE times, this inventory becomes a true boundary zoo. Its members are usually ranked on a scale of boundary strength.**

**c. some examples (in decreasing strength)**

1. **Basbøll (1975) (also Basbøll 1981a)**
   - In general, no particular language: 5 different boundaries
     - ###, ##, #, +, $

2. **McCawley (1968:57ff)**
   - For Japanese: 6 different boundaries
     - $, #, †, :, &, *

3. **Stanley (1969)**
   - For Navaho: 7 different boundaries
     - #, =, *, †, !, ", +, -

   - For Modern Greek
     - More than three different boundaries needed

5. **Loporcaro (1999) and Bertinetto (1999)**
   - For Italian dialects: 13 different boundaries
     - Numerals are assigned to boundaries that represent increasing morphosyntactic distance on a scale from -6 to +6, hence yielding a zoo of 13 different diacritics, which are not named anymore but just referred to with their integer.
Boundary abuse (generative):
- attempts at restricting the arbitrary proliferation of boundaries
- a kind of self-applied hygienic use of boundaries

a. timid attempts at defining criteria that restrict the distribution of boundaries:

b. Basbøll: boundaries are "last resort" and should be disallowed in presence of a solution that does not recur to them.
   Basbøll (1978b:164f): no boundaries if they lead to a more complicated formulation of the rule.

c. example (Basbøll 1975:115, 1978b:154):
   SPE and Selkirk (1972,1974) use = only in learned vocabulary.
   French /in-légal/, /con-mémoratif/ → [illégal, commémoratif] = must be different from + because nasal loss and ensuing compensatory lengthening occur only in learned vocabulary.
   [abstracting away from the fact that there could be no synchronic activity in these words at all - they could be just one single lexical entry]
   Basbøll thus suggests to replace = by the feature [+learned].

d. Basbøll (1975:128): three criteria
   1. productivity
      productive affixes come with a boundary, unproductive affixes lack any boundary.
   2. boundaries can only be posited on the grounds of at least two phonological effects.
   3. no boundaries in roots
      only affixes can bear boundaries - roots cannot. Either the same affix always come with the same boundary, or there is no boundary at all.
      A particular root may not be retrieved from the lexicon with a given boundary. This is against Hoard (1973) who proposes a lexical recording /dhadh#/ for this particular word in Sanskrit.
      Devine & Stephenson (1976:301) point out the generally tacit assumption according to which boundaries are a property of affixes, rather than of roots. This is natural: ruling out boundaries from individual roots only reflects the insight that they represent morpho-syntactic, not lexical or phonological information.

e. Kenstowicz & Kisseberth (1977:105ff) boundary strength must be consistent on the phonological and the morpho-syntactic side.
   A boundary hierarchy established on phonological grounds must not fall foul of morpho-syntactic criteria: e.g. derivational boundaries are stronger than inflectional boundaries.
5. Foundations of Prosodic Phonology: Indirect Reference

(29) Prosodic Phonology and Indirect Reference

a. Indirect Reference is the spine of Prosodic Phonology
b. Indirect Reference
phonological processes have no access to morpho-syntactic categories. They can
only make indirect reference to morpho-syntactic information.

===> exactly the programme of modularity and Cognitive Science

===> but curiously enough, no reference whatsoever to either, despite the
contemporarity with Fodor (1983)

c. what phonology makes reference to is thus the result of a translational process.
d. the output of translation is an autosegmental arboreal structure, the Prosodic
Hierarchy.
e. ===> cultural break
output of translation
- in structuralism and SPE: LOCAL
- in Prosodic Phonology: DOMAINS, i.e. NON-LOCAL

f. the nature of the output of translation merely follows the evolution of phonological
theory:
- phonemes when the basic currency are phonemes
- segments when the basic currency are segments
- trees when the basic currency are trees

(30) critical properties of the translational process

a. translation is a computational process (so-called mapping rules):
   it transforms the output of morpho-syntactic structure into units that are legible by
   the phonology
   ===> prosodic constituency
b. mapping is a computational process that is distinct from
   - morpho-syntactic computation
   - phonological computation
c. but which is polyglot (a Big Brother): it can read and parse both morpho-syntactic
   and phonological vocabulary.
   Jackendoff (2002:220ff) calls this "bi-domain specificity"
d. mapping (= translation) cannot be done in either morpho-syntax or phonology, it
   must be done in modular no-man's land:
   ===> a Translator's Office
(31) general architecture of Prosodic Phonology

6. Conflict between Direct Syntax and Prosodic Phonology decided by non-isomorphism

(32) Direct Syntax vs. Prosodic Phonology
   a. Direct-Syntax approach
      1. why should reference to morpho-syntactic structure be indirect?
      2. why should phonology be burdened with several extra layers of arboreal structure and an extra mapping mechanism?
      3. isn't this redundant?
   b. Direct-Syntax literature
      Competition of direct syntax approaches and Prosodic Phonology in the special issue of the Phonological Yearbook edited by Kaisse & Zwicky (1987).

(33) non-isomorphism
   a. basic argument against direct-syntax which has been repeated over and over again: [Selkirk 1981 [1978], Nespor & Vogel 1986: all through the book, 4f,34ff,124ff etc., Vogel & Kenesei 1990, Nespor et al. 1996 etc.]
   b. non-isomorphism is SPE's Readjustment
      the claim that some phonological rules make reference to information that is not contained in the morpho-syntactic structure. That is, to domains that do not represent any single node on the morpho-syntactic side.
c. classical example from SPE (p.371) that runs all through the literature  
mismatch of phonological and morpho-syntactic domains  
there is no syntactic node that contains exclusively [that caught the rat], which  
however is a discrete intonational unit in phonology  
1. syntactic structure: nested  
   This is [the cat that caught [the rat that stole [the cheese]]]  
2. structure that is treated by phonology: flat  
   [This is the cat] [that caught the rat] [that stole the cheese]  
d. readjustment is an operation that flattens (SPE: "sister-joins") nested syntactic  
structure.

(34) argument against Direct Syntax  
a. in some cases, the domains to which phonology makes reference cannot be  
predicted from syntactic information and must first be created: we need a parallel  
domain structure in phonology, the Prosodic Hierarchy, and its construction  
worker, mapping rules.  
b. the input to mapping rules is certainly morpho-syntactic structure, but not only:  
mapping rules make sovereign decisions how to build phonological domains that  
do not rely on the morpho-syntactic input.  
=== cf. the Black Box under (31)

(35) non-isomorphism evaporates when boundaries are used  
a. cat-rat-cheese has a straightforward analysis when boundaries are used instead of  
domains:  
   every CP starts a new intonational unit  
b. hence if phonological rules make reference to boundaries rather than to domains,  
there is no argument at all.  
c. in this case the prosodic constituency and the mapping mechanism are redundant.

7. Local (boundaries) vs. non-local (domains) intervention

(36) local vs. non-local intervention – a cultural break  
a. since the 19\textsuperscript{th} century through structuralist juncture phonemes and SPE-style  
   boundaries, the objects inserted into phonology are  
== local  
b. arboreal domains such as prosodic constituency are  
== domain-based, i.e. non-local
(37) difference
carrier of morpho-syntactic information that is inserted: £
regular pieces of morphemic information: [piece X]
   a. local: £ is inserted at morpho-syntactic divisions
   non-local: £ dominates several pieces
   
   [piece 1] £ [piece 2] £ [piece 3]    [piece 1] [piece 2] [piece 3]

b. domain-based
   1. a number of pieces of the linear string are spanned by a domain
   2. labelled clusters are created: an individual piece belongs to a domain (a £)
   3. ==> by contrast on the local option, a piece cannot belong to a boundary (to a £)

c. local
   1. a boundary has a linear location: it follows some piece, and precedes some other piece
   2. domains cannot intervene between two pieces: they are made of pieces, but they are not defined in a linear precedence relation with the items that they dominate.

(38) the discussion that has never taken place

a. since non-isomorphism evaporates if boundaries are used, the question why domains are better than boundaries is absolutely critical for Prosodic Phonology.
b. the issue is rarely discussed in the PP literature at all, it is absent since (and including) Nespor & Vogel (1986), where domain-based intervention is taken for granted without comment or argument.
c. the diacritic argument
   is the only serious argument that was made in the early PP literature (i.e. before 1986): boundaries are wrong because they are diacritics, cf. (39).
d. No Diacritics ! - No diacritics ?
   1. nobody doubts that # is a diacritic
   2. nobody doubts that the output of translation must not be diacritic
   3. but nobody has even tried to evaluate whether the Prosodic Hierarchy is a diacritic: its "truly phonological" character was taken for granted (and advertised) without argument or discussion.
   4. the Prosodic Hierarchy is just as much a diacritic as #s, if an autosegmental diacritic.
   What has happened is that a linear diacritic was replaced by an autosegmental diacritic on the grounds of the argument that diacritics are wrong.
Scheer (2008, forth a)
Cf. (40).
e. the Prosodic Hierarchy is a child of autosegmentalism, cf. (41)
   The real reason for abandoning local = linear boundaries in favour of non-local
   domains is the autosegmentalisation of all areas of phonology in the early 80s: the
   interface could not stand back. Elisabeth Selkirk is explicit about this, cf. (41).
   - linear is ugly
   - domain-based is beautiful
   ===> we are just in the same perspective as before: every period has its own basic
   phonological units (phonemes, segments, domains), and the output of translation is
   cast in whatever is the basic currency of the period.

(39) arguments raised against boundaries
rare in the early PP literature, absent since (and including) Nespor & Vogel (1986).
   a. the diacritic argument
   Rotenberg (1978:16ff, chapter "Against Boundaries"), Selkirk (1980a), Booij
   nothing new: Pyle (1972) has provided the relevant arguments:
   1. overgeneration: anything and its reverse can be described
   2. diacritics are not linguistic objects (they are not just a peculiar kind of
   segments): p can become f, but not #.
   Except in Selkirk's work (Selkirk 1981 [1978], 1980a,b, esp. 1984), the older
   juncture/ boundary/ SPE interface literature is almost completely absent from the
   PP literature.
   [e.g. Chomsky et al. (1956), Sag (1974), Basbøll (1975,1978a,b,1981a,b),
   (1978), Strauss (1979), Anderson (1974)]
   b. domains have an independent motivation: stress, rhythm, music
   Selkirk (1980a:126ff,1984:8ff)
   1. boundaries serve only interface purposes, while autosegmental structure can
   cover both domestic phonological properties (i.e. which exist independently of
   any interface issue) and interface information.
   2. Selkirk (1986) (following Nespor & Vogel 1986 and the rest of the PP
   literature) abandons the ambition to melt all empirical properties at stake into
   one single set of representations: stress and rhythm are represented by the grid,
   and the grid is derived by a second mapping from prosodic constituency. This
   also follows Hayes' (1984:65,69) suggestion (which has become mainstream)
   that rhythm is only an accidentally linguistic property and lies outside of the
   grammar.
   3. unifying stress/ rhythm and interface information has become a handicap as it
   was understood that both empirical events do not behave alike: namely Inkelas
   ===> we are dealing with two independent empirical objects, so they must not be
   unified - everybody agrees on that today.
   c. non-arguments:

"in the theory of prosodic phonology, grammatical boundaries can be dispensed with in
phonological representations." Booij (1983:268)

[also Selkirk (1981 [1978]:136ff)]
this is certainly true, but does not tell us why PP should be preferred in the first
place.
(40) the Prosodic Hierarchy is the modern continuation of boundaries
   a. Vogel & Kenesei (1990:344) review the arguments in favour of Indirect Reference, the heart of Prosodic Phonology. One point they make is a historical one: all interface theories have been indirect thus far, so there is probably something to this approach. They namely single out SPE as a predecessor of Indirect Reference.

   "Working within the SPE framework, Selkirk [1972] modifies the original proposal by showing that at least in certain types of phonological phenomena, interaction between the two components is only indirect. Word boundaries (#'s) inserted into a string on the basis of syntactic structure determine where external sandhi rules apply. Phonological rules thus do not directly 'see' syntactic structure, but rather access only strings of segments and boundaries." Vogel & Kenesei (1990:344)

   Hence the equivalence between #s and the modern prosodic arborescence.

   b. The same line of reasoning is found in the overview article by Inkelas & Zec (1995): they call p-structure the level of representation that mediates between morpho-syntact and phonology and explicitly identify boundaries as the ancestor of its more recent prosodic incarnation:

   "An early version of p-structure was proposed in SPE and developed in subsequent work (Selkirk 1972,1974; Rotenberg 1978). According to this view, domains of phonological rules are expressed in terms of phonological boundary symbols, generated by rules. […] Far more constrained is the 'prosodic' view of p-structure. Under this view, p-structure occupies a level with its own hierarchical organization and a high degree of autonomy." Inkelas & Zec (1995:537f)

   Thus prosodic constituency is but a more advanced version of boundaries.

   c. prosodic constituency and boundaries share the following properties
      1. they are the output of the translational process that is operated in the Translator's Office.
      2. buffer: their exclusive purpose is to store extra-phonological information in the phonology.
      3. they are absent from domestic phonology, i.e. from processes that do not appeal to any extra-phonological information.
      4. their choice and names are arbitrary: "," #", "omega"
      5. pointing out that prosodic constituents represent certain stretches of the linear string which coarsely correlate with morpho-syntactic divisions does not make omegas and phis less arbitrary. This only shows that their only purpose is to replicate morpho-syntactic structure in phonology.
      The same may be said about boundaries - and actually has been said about boundaries (by McCawley 1968): + and # represent two different boundary strengths, the latter dividing larger chunks of the linear string.
d. conclusion
1. "#'s" and "omegas" have the same status: they are non-phonological intruders in the phonological world whose only purpose is to stock extra-phonological information.
2. They are necessary in order to fulfil the promise of Indirect Reference.
3. For some strange reason, though, boundaries are stigmatised as arbitrary diacritics, while prosodic constituency is sold as a "truly phonological object" (e.g. Selkirk 1984:32,409f, Nespor & Vogel 1986:27ff,110ff).
   For example, Nespor & Vogel (1986:3) call boundaries "pseudo-phonological terms" and argue that phonology should only be able to refer to truly phonological objects (just as syntax can only make reference to truly syntactic objects).

(41) Domains are a child of autosegmentalism
   in fact it is an autosegmentalised version of the SPE interface theory.
   a. In the early 80s when phonology was progressively autosegmentalised in every area, Selkirk clearly identifies the motivation for abandoning boundaries in favour of domains:
      if everything is autosegmental, so must the interface be, hence we must eliminate ugly linear boundaries and build some autosegmental, i.e. arboreal structure instead.
      "the syllables of phonological representation are arranged in some kind of hierarchical organization. [...] By 'hierarchical organization' we mean, very roughly speaking, the organization of the units of phonological analysis into layers, vertically arranged on the same plane. [...] This conception of phonological representation as having its own hierarchical structure(s) demands a radical rethinking of the relation between syntax and phonology. [...] Thus the interpretation question - the question of the mapping between phonological representation and syntactic representation - takes on a much greater importance than in the standard theory, and has an entirely different quality to it. It must be viewed as a characterization of the relation between the syntactic hierarchy, on the one hand, and the phonological hierarchy (or hierarchies), on the other." Selkirk (1984:7f)
      Therefore,
      "the junctural properties of sentences should be somehow represented 'suprasegmentally' rather than as the segmental boundaries of the standard theory. [...] Thus the theory of phonological representation that we will advocate here eliminates segmental boundary elements altogether." Selkirk (1984:8)
   b. already in Nespor & Vogel (1986), the transition with linear SPE plays no role anymore: domains are taken for granted. The later PP literature does not examine this question anymore.
      For over 20 years PP stands unchallenged as the generative interface theory. The success may be appraised when considering that the units of PP - the phonological word, the phonological phrase etc. - have become descriptive categories in everyday conversation of phonologists.
(42) what is a diacritic? Definition.

**A diacritic is a non-native object in module X: it is only used when information from outside of X is processed. It is absent from events that do not appeal to extra-Xal information.**

a. common to all carriers of morpho-syntactic information, i.e.
   - juncture phonemes
   - hash marks #
   - prosodic constituency, i.e. omegas, phis
is that they are systematically absent from phonological processes that do not use extra-phonological information (such as, say, a palatalisation):
   - they only enter the scene when extra-phonological information plays a role
   - and their exclusive function is to carry this information (they act like a buffer that stores and unstores information).
   => they are diacritics, i.e. phonological aliens.

b. a non-diacritic is thus an object that exists in phonology anyway, even in absence of any appeal to extra-phonological information.

(43) summary:
the local baby and the diacritic bathwater
a. boundaries are **diacritic AND local**

b. they were eliminated on the grounds of their diacritic character (just in order to be replaced by another diacritic).

c. the locality of intervention went down the drain with SPE-type boundaries: locality was eliminated by the diacritic character of its host.
   => this is why the question of locality was never discussed.

d. the diacritic issue and the locality of intervention are perfectly independent, though:
   1. what would a non-diacritic local carrier of morpho-syntactic information look like?
   2. what would a non-diacritic carrier look like at all, local or not?

(44) coming back to the absolutely critical **non-isomorphism**…

a. non-isomorphism is not a fact about language, but a fact about the domain-based prism that everybody took for granted without discussion.

b. there is no such thing if intervention is local:
   recall the cat-rat-cheese example: a new intonational domain begins at every CP.

c. a good and a bad reason for Indirect Reference
   1. the bad reason was rehearsed over and over again: **non-isomorphism**, a non-argument.
   2. the good reason was completely absent from the discussion with Direct Syntax: **modularity**.
   Even though the generative enterprise is built on the modular assumption, and even though modularity was contemporary in Cognitive Science, cf. Fodor (1983).
   => little communication between phonology and Cognitive Science/ the philosophical foundations of the generative idea, which are reserved for intro classes, but then play little, if any operational role in theory design.
d. Prosodic Phonology did exactly the right thing:
   - introducing Indirect Reference as a major principle of interface architecture
   - installing a Translator's Office and mapping rules
   but for the wrong reason (non-isomorphism).

(45) so let's have the debate that has never taken place:
   is representational intervention in phonology local or domain-based?
   **argument 1: domains are fake**
   a. prosodic domains are the only tree structure in linguistics that is a projection of
      nothing.
   b. trees are bottom-up constructions, i.e. where the (lexical) properties of the
      terminals determine the properties of the tree: syllable structure, morpho-syntactic
      structure etc.
   c. this is also true for the two lowest levels of the Prosodic hierarchy, syllables and
      feet, but not for higher layers, i.e. from the Prosodic Word on, cf. (47).
   d. domains as carriers of morpho-syntactic information
      - are not
      - and could not possibly be
      projections of phonological terminals: their purpose is precisely to introduce
      information that is **independent** from phonological matters, and which shapes
      phonological events.

(46) argument 2:
   local objects can be non-diaccritic, domains are necessarily diaccritic
   a. a non-diaccritic is an object that exists in phonology anyway, i.e. in processes that
      do not use extra-phonological information.
      ==> it is piece and parcel of the regular and proprietary phonological vocabulary,
      i.e. that one that defines the domain-specificity of phonology in the modular sense.
   b. what are the candidates?
      1. melodic primes: features
      2. syllabic units: x-slots, syllables etc., to the extent that they are part of the
         phonological vocabulary that is parsed by phonological computation. There is
         debate among phonologists regarding this issue:
            - 70s, early 80s and OT (Richness of the Base): no structure in the lexicon
            - mid-80s (Government Phonology, but also elsewhere, i.e. Rubach 1986
              etc.): structure is (may be) recorded in the lexicon.
   c. domains of the Prosodic Hierarchy (except syllables and feet, cf. (47))
      1. cannot be recorded in the lexicon: they are the result of online computation
      2. cannot be the projection of phonological units (cf. argument 1)
   d. ==> domains cannot be non-diaccritic carriers of morpho-syntactic information for
      principled reasons.
(47) the Prosodic Hierarchy does not include syllables and feet
   a. the four higher levels serve no other purpose than the interface
   b. they have no other definition than the one provided by the structural description of phonological rules that are sensitive to morpho-syntactic information.
   c. Syllables and feet, however, are independently motivated: the former is a bottom-up construction based on the sonority of its terminal elements, the segments, while the latter is a function of stress. Neither the sonority of segments, which is recorded in the lexicon, nor the distribution of stress relies in any way on any structural description of some phonological rule.
   d. ==> if there were no interface, syllables and feet would still exist, but the four higher levels of the Prosodic Hierarchy would not.
   Syllables and feet exist for truly phonological reasons, and only for those reasons.
   e. the syllable and feet owe nothing to mapping rules, hence they do not store any morpho-syntactic information:

   ”The phonological word is the lowest constituent of the prosodic hierarchy which is constructed on the basis of mapping rules that make substantial use of nonphonological notions.” Nespor & Vogel (1986:109)

Selkirk (1986:385) and Rice (1990:292 note 3) also point out this fact (see also Chen 1990:36).

8. Appendix to the absence of modularity in the discussion: interactionism

(48) classical picture
   - SPE
   - syntax until minimalist Derivation by Phase (Uriagereka 1999, Chomsky 2000 et passim)
   a. - inverted T
      - PLUS the proviso "ALL concatenation before ALL interpretation"

```
  syntax
     /    \
     |    |
     PF   LF
```

b. consequence: brackets in the string that is parsed by phonological computation.
   ex. theatricality (Chomsky & Halle 1968:88f)
   [[[theatr]N ic + al]A i + ty]N

c. brackets of course are diacritics, and phonology cannot read them: they are invisible.
   ==> brackets are a violation of modularity
Lexical Phonology introduces interactionism

a. interactionism is the idea that
   - concatenation and (phonological) interpretation are interspersed
   - it respects the inverted T, but does away with the additional proviso.

```
underlying representations: underived roots

    stratum 1
    /\ morphology               /\ phonology
    |           stratum 1          |
    | phonology              phonology

    stratum 2
    /\ morphology               /\ phonology
    |           stratum 2          |
    | phonology              phonology

    stratum n
    /\ morphology               /\ phonology
    |           stratum n          |
    | phonology              phonology

Output: words
(i.e. that have a meaning and a pronunciation)
```

b. under the label Derivation by Phase, interactionism today is the spine of minimalist syntax and within this frame has acquired a new quality: derivation by phase is the instrument that unburdens workbench memory by cutting the derivation of a whole sentence into pieces.
Shaping grammatical theory according to extra-grammatical conditions of cognitive/branal implementation is indeed the motor of minimalist thinking.

c. consequence:
   brackets disappear: the input to phonological computation is only one cycle/phase at a time, and the input string does not contain any brackets.

(50) cyclic derivation and interactionism

a. cyclic derivation (inside-out derivation)
   interpretation follows morpho-syntactic structure, i.e. from the most to the least embedded piece
   1. is a fundamental property of generative linguistics
   2. a genuinely generative idea: absent from linguistic thinking before Chomsky et al. (1956:75)

b. interactionism
   is the only way to make cyclic derivation compatible with modularity
(51) anti-interactionism
Halle & Vergnaud (1987a et passim)
   a. reaction of orthodox generative phonology against Lexical Phonology
   b. goal: to restore
      - SPE in general
      - the additional proviso "ALL concatenation before ALL interpretation" in
        particular
   c. discussion around (anti-)interactionism in the late 80s, early 90s
      anti-interactionist literature: Sproat (1985), Halle & Vergnaud (1987a,b), Szpyra
   d. today interactionism is virtually consensual in generative quarters,
      including Morris Halle, who is engaged in interactionist Distributed Morphology.

(52) modularity could have decided
   a. modularity could have decided the debate in favour of interactionism
   b. but curiously is entirely absent from the literature, pro-and anti-interactionist alike

9. OT: systematic and largely unreflected violation of modularity

(53) OT and its **scrambling tropism**
    (Scheer forth b,c)
    a. **scrambling tropism**
       the tendency for indifferentiation:
       1. there is only one big constraint hierarchy where everything is interspersed
          - phonetic constraints
          - phonological constraints
          - morphological constraints
          - even syntactic constraints, cf. MOT Russell (1997, 1999)
          - the lexicon (Richness of the Base)
          - static properties of phonology
          -- parameters
          -- definition of inventories
       2. extension of the parallel claim to intermodular relations
          anti-cyclicity, cf. (54)
          ==> "derivational" versions of OT, i.e. DOT and Stratal OT, take exception.
       3. the same constraint may accommodate phonological and morphological
          instructions
          cf. Yip (1998) below
b. a (the?) driving force behind OT's scrambling tropism: the commitment to non-serial computation

Kingston (2007) on the scrambling with phonetics:
there is a causal relationship between parallel computation and the scrambling tropism: OT scrambles everything because it is committed to parallel computation.

1. a serial worldview allows for doing phonology first, and then phonetics
2. extending the parallel ambition to intermodular communication causes scrambling

"[r]eplacing serial derivation by parallel evaluation removes the barrier to phonetic constraints being interspersed among and interacting with phonological constraints. […] Future research will determine whether phonological and phonetic constraint evaluation are a single, integrated process, as advocated by Steriade and Flemming or instead sequential, as advocated by Zsiga" (Kingston 2007:432).

(54) anti-cyclicity
rejection of cyclic (inside-out) interpretation because of its serial character (e.g. Kager 1999:277)
a. a category mistake:
OT's commitment to parallel computation concerns phonological computation, not computation among modules.
It is perfectly possible to have strictly parallel computation in the phonological module while having serial intermodular communication: this is the position of DOT and Stratal OT.
OT and other approaches which reject cyclicity "have taken it for granted that cyclic phonology, like rule ordering, is derivational and that this is sufficient reason to look for alternatives to cyclicity. […] In this paper, I reject the presupposition underlying these approaches, contending that there is an important distinction between rule ordering and phonology-morphology interleaving." Orgun (1999:250)
b. trying to do away with cyclic derivation is throwing a fundamental insight of generative thinking over board.
c. Orgun (1999:248ff) provides a well-documented survey of objections that have been raised against cyclicity because of its derivational character and its interactionist result.
d. anti-cyclic voices are typically anti-generative:
beyond OT, cyclicity has also been under fire from Declarative Phonology (Cole & Coleman 1992) because of its derivational character. Charges against interactionism have been led from the quarters of "Cognitive" Grammar and connectionism (Goldsmith 1993, Lakoff 1993, Karttunen 1993, all in the same book), as well as for reasons of cognitive and computational plausibility (Sproat 1992).
e. means to circumvent cyclicity
i.e. alternative means of intermodular communication
- parallel mini-grammars (co-phonologies, interface constraints)
- Interface Constraints
- Output-Output faithfulness
result of the scrambling tropism:
constant, systematic and largely unreflected violation of modularity
a. doing mapping in the phonology (instead of in modular no-man's land):
   1. mapping is done by ALIGN and WRAP constraints
   2. ALIGN and WRAP constraints make constant reference to morpho-syntactic
      structure and labels
   3. but are located in the phonological constraint ranking, i.e. interspersed with
      truly phonological constraints.
b. reference to untranslated morpho-syntactic information
   1. ALIGN and WRAP constraints
   2. interface constraints
      make direct reference to designated morphological categories in the body of
      phonological constraints.
      - example: FAITH-root and FAITH-affix
      - even reference to individual morphemes is not a problem
      - revival of the SPE-practice of adding morphological diacritics to rules.
      cf. (56)
c. constraints whose formulation combines phonological and morphological
   instructions are commonplace (see Yip 1998 on this issue)
   "These results make it hard to identify a clear dividing line between morphology and phonology. What is more, they go much further to blur the distinction than does the interleaving of phonology and morphology found in lexical phonology. In lexical phonology, each component has its own character: the entities are different, and the rules are different. In Optimality Theory, this is not necessarily the case. Alignment is the most striking example. Alignment appears to play a role in pure morphology, in pure phonology, and at the interface." Yip (1998:219)
d. representational continuity with morphology
in the spirit of Declarative Phonology
   1. Oostendorp's (2006a,b,2007) Coloured Containment
      faithfulness used for the comparison of morphological and phonological
      structure
      FAITH thus extends to
      - input-output
      - output-output
      - base-reduplicant
      ==> permanent accessibility of morphological structure during phonological
      computation
      direct application of Declarative Phonology, i.e. HPSG, where modularity is
      denied anyway.

(56) Interface Constraints
direct reference to designated morphological categories in the body of phonological
constraints
a. the formulation of constraints is purely phonological, but constraints are
   supplemented with a diacritic that identifies the particular morphological category
to which the constraint applies.
b. example  
Kager's (2000:146f) treatment of class 1 vs. class 2 affixes in Dutch.  
Class 1 affixes are attached lower in the tree than class 2 affixes. The attachment of affixes in the tree, however, is governed by constraints, and Kager proposes one that prevents class 1 affixes (such as -eer, -iteit) from attaching to higher positions:

"NonRecStem: No Stem (affixed by -eer, -iteit etc.) immediately dominates a Stem."

c. Anttila (2002:2) provides a rather well-fed list of all the large variety of particular morphological categories to which Interface Constraints have made reference (with associated literature).

1. Typical are more general categories such as roots, affixes, nouns, verbs, lexical vs. functional morphemes and affix classes  
2. but the possibility of reference to individual morphemes has also been entertained (e.g. Raffelsiefen 1996:207f, Hammond 1995, Russell 1999).  
3. all constraints families may make reference to designated morphological categories: faithfulness, markedness, alignment.

(57) the scrambling tropism and PDP-cherry picking  
the scrambling tropism is the D of PDP  
Parallel Distributed Processing  
the D is the antithesis of modularity and the backbone of empiricist connectionism:  
a. neurons have no colour  
they only react on activation levels, hence cannot parse, or distinguish between, symbolic objects  
b. therefore computation must be non-symbolic or "content-free":  
the only thing that is manipulated are connection weights.  
Only the following things are relevant for the brain and hence for the mind  
- neurons  
- synapses  
- connection weights  
either in their biological or their artificial (i.e. computer-based version that is supposed to mimic the biological reality) version.  
c. neurons are all-purpose computational units that are able to perform any computation on the grounds of any type of information submitted. This is why connectionist computation is called distributed.  
=> nothing is specialized in the mind/brain

(58) twofold genetic endowment of OT  
a. rationalist  
- Chomskyan linguistics  
- Standard Cognitive Science  
b. empiricist connectionism  
[cf. (59) for other linguistic outgrowths]  
1. Paul Smolensky has actively participated in the development of PDP (Rumelhart et al.1986), which evolved into connectionism.  
e.g. Smolensky 1986, 1987, 1988, 1991)  
2. this is where the idea of parallel computation was born.  
3. Harmonic Serialism  
is derivational, but entertained by Prince & Smolensky (1993)
(59) other applications of connectionism to linguistics/phonology

a. Harmonic Phonology
(probably generative, but initiating John Goldsmith's move to non-generative empiricist quarters)
on the same track as Harmonic Serialism: the successive application of rulesprogressively increases harmony,
but the well-formedness of representations is measured in gradient, rather than in categorical terms.
b. Harmonic Grammar
(generative ??)
most closely related to the interests of Cognitive Science: it is based on weighted constraints, which like Goldsmith's gradual well-formedness are a direct transcription of the central connectionist notion of connection weight (and the activation level of neurons which defines their output).
In this perspective, the relationship between constraints is one of lesser or greater prominence, rather than of strict dominance: less important constraints can league together and outrank a more important constraint on account of their cumulated weight.
Legendre et al. (1990), Smolensky & Legendre (2006)
c. "Cognitive" Grammar\(^2\)
(anti-generative, anti-rationalist, neo-behaviourist)
denies the existence of the distinction between computation and storage:
1. in the connectionist perspective, the "experience" of a neural network – the equivalent notion of memory – is acquired when the patterns of connectivity change: neurons may develop new connections (synapses), may lose old connections, or modify the strength (weight) of existing connections (the two former are often viewed as a special case of the latter). The computational units themselves have no variable behaviour that contributes to the properties of the whole, which is exclusively determined by the connective network (see e.g. Stillings et al. 1995:114ff on connectionist models of memory).
2. Langacker's (1987 Vol.1:42) "rule/list fallacy". The phonological offspring of this line of thought is represented by exemplar- and usage-based approaches in general, and by Joan Bybee in particular, who writes that "[I]linguistic regularities are not expressed as cognitive entities or operations that are independent of the forms to which they apply, but rather as schemas or organisational patterns that emerge from the way that forms are associated with one another in a vast complex network of phonological, semantic, and sequential relations." Bybee (2001:20f).

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\(^2\) I use quotation marks in order to refer to the framework that was founded by Ronald Langacker because the label which was chosen fallaciously suggests that this theory has a copyright on cognitive aspects of grammar, and that anything which is non-Langackerian must be non-cognitive. What about calling a particular theory of, say, biology, "scientific biology", or some semantic theory "meaning semantics"?
cherry-picking in the empiricist/connectionist toolbox

a. connectionist headlines and Prince & Smolensky's (1993: ch.10.2) cherry-picking headline

<table>
<thead>
<tr>
<th></th>
<th>P&amp;S</th>
</tr>
</thead>
<tbody>
<tr>
<td>parallel computation</td>
<td>accept</td>
</tr>
<tr>
<td>anti-symbolism, cf. (61)</td>
<td>explicitly reject</td>
</tr>
<tr>
<td>behaviourist acquisition</td>
<td>explicitly reject</td>
</tr>
<tr>
<td>&quot;knowledge of language can be empirically acquired through statistical induction from training data&quot; (Prince &amp; Smolensky 1993:217)</td>
<td></td>
</tr>
<tr>
<td>no difference between computation and storage</td>
<td>no explicit statement</td>
</tr>
<tr>
<td>distributed processing, i.e. anti-modularity</td>
<td>no explicit statement</td>
</tr>
</tbody>
</table>

b. OT rejects basically all tenets of connectionism save one, parallel computation.

c. does parallel lead to distributed computation?

there is reason to believe that the P in PDP seeds the D, which is anti-modular. Cf. (53)b = Kingston on the scrambling of phonetics and phonology.

d. the D is influencing OT practice and constantly gains ground: we assist a creeping dissolution of modular contours.

1. without discussion/comment on the modular issue
2. without this following from any tenet of OT

e. conclusion

1. parallel computation has probably entered the generative paradigm with some more empiricist luggage than Prince & Smolensky thought it would or should.
2. the question is whether a theory can be designed that holds up
   - the modular
   - and rationalist, anti-empiricist
   core of generative grammar while implementing constraint-based and parallel computation.

(61) OT's conciliatory position regarding the symbolic issue:

a. grammar is symbolic, connectionism is an intermediate level of analysis between the brain and grammar.

b. this conciliatory position that rejects reductionism (the denial of the mind as an independent level of analysis) where the connectionist level mediates between the mind and the brain is defended by Paul Smolensky since his earliest work (Smolensky 1986, 1987, 1988, 1991) and up to the present day (Smolensky & Legendre (2006)).
10. Conclusion: modularity and non-diacritic translation please

(62) desiderata for the representational channel of the communication between morpho-syntax and phonology

a. there IS an interface
   = modularity: we are in presence of two distinct ontological areas that work on distinct vocabulary
b. hence there IS translation

c. No Diacritics!
   the output of translation must not be diacritic
   carriers of morpho-syntactic information in phonology must be pieces of the proprietary vocabulary that phonology can understand, parse and compute.
   This vocabulary does not include
   - +, #
   - omegas, phis

d. representational intervention must be local (rather than domain-based)
   ==> what we are looking for is a non-diacritic boundary.

e. this is what I call Direct Interface:
   no mediation – buffer – between morpho-syntax and phonology whose only function is to store and release information. The carrier IS already a piece of phonology.
   Direct Interface is theory-neutral.

(63) benefits of Direct Interface

a. competing phonological theories can be judged according to their behaviour at the interface
   1. different phonological theories propose different vocabulary
   2. this vocabulary makes predictions that define what a possible interface event is
   No such comparison is possible if differences among individual theories are neutralized at the interface by a uniform buffer-vocabulary.

b. the Direct Effect
   1. sleepers
      inserting a diacritic does not make phonology react in any way, precisely because phonology cannot parse it.
      - phonology does not react on #s or omegas
      - #s and omegas only provoke an effect when phonology makes explicit reference to them
      - anything and its reverse may happen in presence of a # or of an omega:
        # may provoke the strength or the weakness of word-initial consonants
      - this is counterfactual:
        it is not true that morpho-syntactic divisions induce arbitrary effects. On the contrary, the effects observed are stable cross-linguistically.
        If there is a specific effect on consonantal strength word-initially, this context provokes strength, not weakness.

   2. non-sleepers
      - a non-diacritic will ALWAYS provoke an effect, not just when a phonological process makes specific reference to it.
      - precisely because it can and hence will be understood and parsed by phonological computation.
candidates for non-diacritic boundaries

a. melodic primes
   1. melodic primes
   2. syllabic constituents
b. melodic primes are out of business
   morpho-syntax and melody are absolutely incommunicado, in both directions
   1. phonology-free syntax
      Zwicky & Pullum (1986)
      morpho-syntactic processes are never conditioned by melody: "move the verb, but only if it begins with a labial" is unheard of.
      Non-melodic properties of phonology may influence morpho-syntax:
      - size: happi-er vs. *beautifull-er, minimal word constraints, heavy NP shift
   2. melody is not a carrier of morpho-syntactic information
      - absence of evidence
      floating pieces of melody such as German-style umlaut have always a lexical origin.
      - nobody has ever proposed melodic items as the output of translation
        [I am aware of one single exception: Lass 1971: # = obstruenicy]
   c. the only viable candidate for the output of translation is syllabic space
      whatever the representation of syllabic space in your theory, have a look at what kind of prediction it makes when it is inserted as a carrier of morpho-syntactic information.

lessons

a. interface design has always been done in absence of a modular/cognitive background – but translation has always been practised.
   ==> there must be something to it.

b. phonological theories have not taken seriously the arbitral award of the interface in the past:
   1. had structuralists seriously evaluated the consequences of morpho-syntactic information incarnating as phonemes (i.e. including in the middle of morphemes), they would have concluded that
      - phonemes are not the correct carriers of morpho-syntactic information
      - there must be some other units in phonology
   2. had SPE taken the consequences of hash marks seriously (Pyle 1972), it would have been obvious that
      - segments are not the correct carriers of morpho-syntactic information
      - there must be some other units in phonology
   3. had autosegmentalists taken the diacritic issue seriously,
      - representational intervention would have remained local
      - only bottom-up constructions would have qualified

c. ==> the interface is a good counsellor:
   it makes phonological theories progress – but they have to listen to the message.
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