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Kognice
Brno
22-24 September 2011

this handout and some of the references quoted at
www.unice.fr/dsl/tobias.htm

INTERMODULAR COMMUNCATION THROUGH THE LEXICON: NO BIG BROTHERS

(1) purpose
   a. to show how intermodular communication is currently conceived of in (generative) linguistics.
   b. to argue against translation by computation, i.e. against Big Brothers: "bidomain-specific" computational systems (Jackendoff 1992 and following).
   c. instead, to argue for translation through a **lexical access**: translation is non-computational.
   d. to see whether there are parallels elsewhere in the cognitive system.

1. Modularity

(2) the mind is made of specialized computational systems
   a. Franz-Josef Gall (1758-1828), phrenology
   b. implicit in the Turing - von Neumann model that underlies the so-called cognitive revolution of the 50s-60s (Gardner 1985)
   c. Chomsky & Halle's (1968) description of the phonological rule system:

> "The rules of the grammar operate in a mechanical fashion; one may think of them as instructions that might be given to a mindless robot, incapable of exercising any judgment or imagination in their application. Any ambiguity or inexplicitness in the statement of rules must in principle be eliminated, since the receiver of the instructions is assumed to be incapable of using intelligence to fill in gaps or to correct errors." Chomsky & Halle (1968:60)

   d. modern and explicit incarnation: Fodor (1983) and following

(3) competing model of the mind: connectionism
   a. Rumelhart *et al.* (1986) and following
   b. issues:
      – parallel, instead of serial computation
      – colourless (content-free) computation: computation is all-purpose, rather than (domain) specific
      – consequence: computation is non-symbolic
      – non-distinction between storage and computation: rule-list fallacy
      – reductionsim (eliminativism): there is no mind, the brain is the only relevant entity
   c. in linguistics: "Cognitive" Linguistics, Langacker (1987) and following, see e.g. Taylor (2002) for an overview.
   d. overview literature:
      Pinker & Mehler (eds.) (1988), Dinsmore (1992), Pylyshyn (1999), Rumelhart (1989), Stillings *et al.* (1995:63ff), Thagard (2005:111ff)

(4) core properties of cognitive modules according to Segal (1996:145)
   a. **domain specificity**
   b. **informational encapsulation**
   c. obligatory filtering
   d. fast speed
   e. shallow outputs
   f. limited inaccessibility
   g. characteristic ontogeny
   h. dedicated neural architecture
   i. characteristic patterns of breakdown

(5) how do we identify modules?
   a. **domain specificity**
   b. **informational encapsulation**
   c. based on pathologies: double dissociation

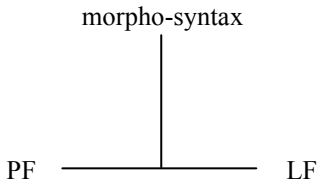
(6) how much of the mind is modular?
   a. Fodor (1983, 2000 etc.):
      1. the mind has a non-modular core
      2. this core is made of central systems: teleological etc.
      3. these are impenetrable for human intelligence: don't even try
      "the more global […] a cognitive process is, the less anybody understands it" (Fodor 1983:107)
   b. lower vs. higher cognitive functions
      (only) lower cognitive functions are modular in kind: perceptual systems and language.
   c. this line of thought is goes back to Descartes: I know that I have a mind (soul) that is distinct from my body, but I will never be able to know how it works and what it is made of.
      Also Chomsky
      [e.g. Chomsky 1984:6f, 23f, Chomsky 1995b:2f, chapter 4 of Chomsky 1975 is called "Problems and mysteries in the study of human language"]
   d. opposite take: massive modularity
      1. the mind is modular through and through
      2. Sperber (1994, 2001)
      3. evolutionary psychology: Pinker (1997), Plotkin (1998)
      4. in linguistics: Smith & Tsimpli (1995:164ff, 1999)
   e. an outgrowth of the idea that modularity is not restricted to perceptual systems (or lower functions) is its application to higher functions, and namely to social interactions and culture:
      Cosmides & Tooby (1992a,b), Hirschfeld & Gelman (eds.) (1994) and following.
   f. overviews
      Stainton (ed.) (2006:3ff), Samuels *et al.* (1999)

(7) a related topic: is the mind (are modules) the result of Darwinian adaptation?
   a. NO: Hauser *et al.* et al. (2002), Hornstein (2009) etc.
   b. YES: Pinker & Jackendoff (2005a,b), evolutionary psychology (Barkow *et al.* 1992)

(8) domain specificity requires translation
   a. a direct consequence of the fact that different modules speak different languages (of the mind) is their inability to understand each other. Modules can only parse objects that belong to their own language, i.e. which are part of the domain-specific vocabulary that they are designed to process.
   b. "'Mixed' representation[s] should be impossible. Rather, phonological, syntactic and conceptual representations should be strictly segregated, but coordinated through correspondence rules that constitute the interfaces." Jackendoff (1997:87ff)

2. Modularity in language

(9) the standard model: inverted T
   a. three independent and domain-specific computational systems:
      1. (morpho-)syntax = the concatenative system, whose output is interpreted by
      2. phonology (PF) = assigns a pronunciation
      3. semantics (LF) = assigns a meaning
      Chomsky (1965:15ff)



(10) **phonology vs. the rest**
   a. if we go by domain specificity,
      the major ontological gap in language is between phonology and the rest.

Vocabulary used in syntax, morphology, semantics:	phonology:
number	
person	labiality
gender	friction
animacy	voicing
quantification	occlusion
aspect	

   b. Jackendoff's (1987, 1992, 1997) Representational Modularity
      (called Structure-Constrained Modularity today, Jackendoff 2002:218ff)

> "The overall idea is that the mind/brain encodes information in some finite number of distinct representational formats or 'languages of the mind.' Each of these 'languages' is a formal system with its own proprietary set of primitives and principles of combination, so that it defines an infinite set of expressions along familiar generative lines. For each of these formats, there is a module of mind/brain responsible for it. For example, phonological structure and syntactic structure are distinct representational formats, with distinct and only partly commensurate primitives and principles of combination. Representational Modularity therefore posits that the architecture of the mind/brain devotes separate modules to these two encodings. Each of these modules is domain specific.
> […] The generative grammar for each 'language of the mind,' then, is a formal description of the repertoire of structures available to the corresponding representational module." Jackendoff (1997:41)

c. Chomsky (2000)
"The phonological component is generally assumed to be isolated in even stronger respects: there are *true* phonological features that are visible only to the phonological component and form a separate subsystem of FL [the Faculty of Language], with its own special properties." Chomsky (2000:118, emphasis in original)

d. Late Insertion = segregation of phonological vocabulary
while up to Government & Binding (80s), morpho-syntactic computation was done on the basis of complete lexical information that included syntactic, morphological and semantic features as much as phonological material (sealed suitcases), Late Insertion is the idea that phonological material is absent from morpho-syntactic computation

3. Zoom on the communication between morpho-syntax and phonology

(11) derivational and representational communication

a. since Chomsky *et al.* (1956:75) where cyclic derivation is introduced, both are operative in generative grammar.

b. representational: **translation**
a morpho-syntactic object is translated into a phonological object
example for the translation of morphemes: in Czech, the morpho-syntactic object
- <number = plural>
- <person = 3>
- <verb class = X>
is translated into phonological vocabulary and appears in the linear string as
-ou (oni krad-ou etc.)

c. derivational: cyclic derivation, today called phase theory
==> nothing is translated, but the output is impacted
[[[A] B] C] is interpreted successively from inside out:
1st round: [A] is interpreted (by PF and LF)
2nd round: [AB] is interpreted (by PF and LF)
3rd round: [ABC] is interpreted (by PF and LF)

==> hence [[[A] B] C] and, say, [[A] BC] produce different results

"[ ]" is called a phase and the distribution of phases over syntactic structure is a currently debated question.

d. **we will only look at representational communication**
- domain specificity marshals representational communication
- encapsulation is relevant for derivational communication (and phase theory has modified the picture quite a bit, but this is another story…)

4. History of translation and its violation in generative phonology

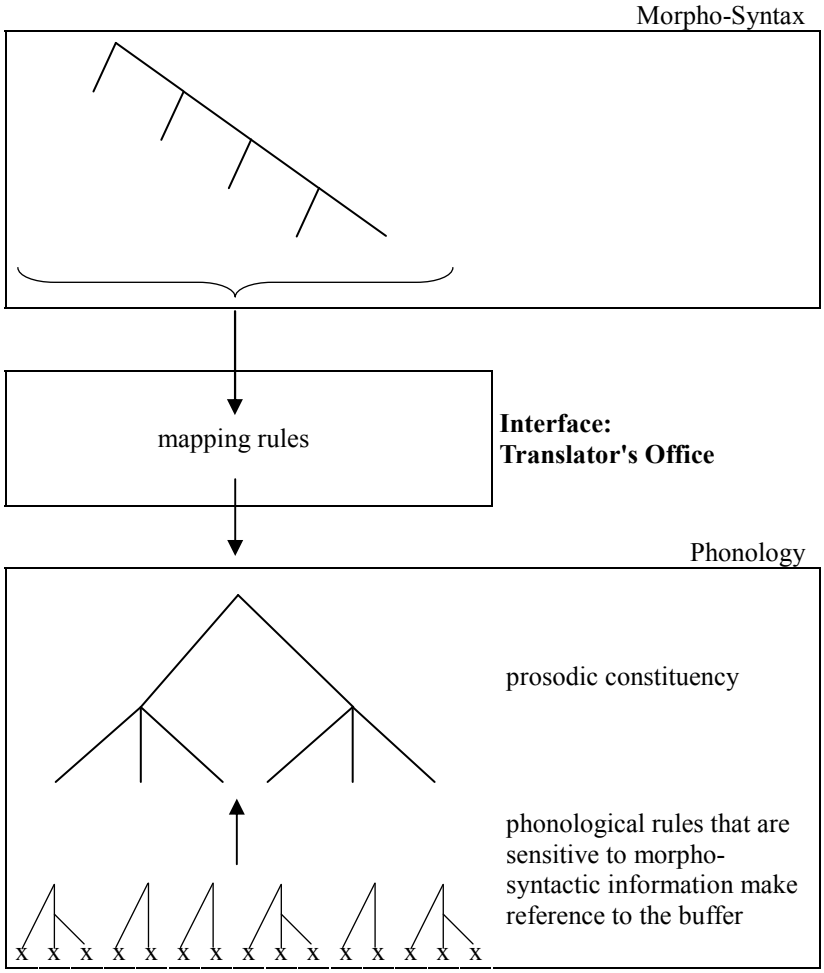
(12) definition
domain specificity and hence modularity is violated when phonology makes reference to **untranslated** morpho-syntactic information

(13) SPE
[The Sound Pattern of English, Chomsky & Halle 1968]
a. boundary information
there is a translation procedure: **non-morphemic** morpho-syntactic information is translated into so-called boundaries #
- <root = krást>
- <number = plural>
- <person = 3>
- <verb class = X>
==> result of translation: krad # ou

compare for example class 1 vs. class 2 affixes in English:
párent = bare root, penultimate stress
parént-al = root + class 1 affix, penultimate stress
párent # hood = root + class 2 affix, root stress (stress assignment blocked)
b. but there is also reference to untranslated information:
labelled brackets
$[[\text{electric}]_{\text{Adj}}\ \text{ity}]_{\text{Noun}}$
- brackets are aliens: non-parsable by the phonology
- labels (Adj. etc.) are untranslated information

(14) 80s: Prosodic Phonology
Selkirk (1981 [1978], 1984), Nespor & Vogel (1986)
a. emerged from the conflict with the so-called Direct Syntax approach that proposes to make direct reference to untranslated morpho-syntactic information, hence to
==> abandon translation altogether
Kaisse (1983, 1985, 1990), Chen (1990), Odden (1987, 1990), Pyle (1972), Rotenberg (1978), Clements (1978)
==> the conflict was decided in favour of Prosodic Phonology in the mid-80s.
b. domain specificity is called Indirect Reference
[but strangely enough, no reference is made to modular theory]
==> the architecture is perfectly modular:
1. phonological computation makes reference only to translated information
2. translation is done in **modular no-man's land** (neither morpho-syntax nor phonology)
3. translation is **computational**: mapping rules are RULES, i.e. carry out a computation in its own right.

(15) general architecture of Prosodic Phonology



(16) Optimality Theory (OT): massive violation since the 90s
[Scheer 2011:§523]

a. constraint-based mapping with ALIGN: translation is done IN the phonology, and this is a permanent violation of domain specificity.
b. so-called interface constraints: a modern version of Direct Syntax
c. sometimes modularity as such, in language and elsewhere in the mind, is declared wrong: Burzio (2007)
d. OT has roots in connectionism, and hence a scrambling trope: one of its founders, Paul Smolensky, was also at the forefront of the development of PDP:
e.g. Smolensky (1987)

(17) current minimalist syntax has created a monster: PF
[Chomsky 2000 and following]
a. empty (narrow) syntax, pump up PF: clean syntax, dirty phonology?
b. PF used to be coextensive with "phonology", or "phonological computation"
c. it has now become an agora for all kinds of operations that have got nothing to do with phonological computation.
==> one of them is a strong modularity offender: PF Movement
[Embick & Noyer 2001 and following]
PF Movement moves items along the syntactic tree, but the movement is triggered by phonological properties.

5. Core properties of translation

(18) partial homology
Jackendoff (2002)
a. translation is selective: only a subset of the properties of the sending module is made available to the receiving module.

> "Correspondence rules perform complex negotiations between two partly incompatible spaces of distinctions, in which only certain parts of each are 'visible' to the other." Jackendoff (1997:221)

> "The overall architecture of grammar consists of a collection of generative components G_1, …, G_n that create/ license structures S_1, …, S_n, plus a set of interfaces I_{jk} that constrain the relation between structures of type S_j and structures of type S_k. […] Typically, an interface I_{jk} does not 'see' all of either S_j or S_k; it attends only to certain aspects of them." Jackendoff (2002:123)

b. the amount of structure that is visible for interface processors in a given module may be small or big, and this is unpredictable: the translational channel between two modules may have a more or less narrow "information bottleneck" (Jackendoff's 2002:229 term).
c. well supported in language:
morpho-syntax and melody are incommunicado in both ways

(19) translation is arbitrary
Jackendoff (2002)
a. which pieces of the structure of the sending module are translated cannot be predicted.
b. well supported in language:
the mapping puzzle (Scheer 2011): all efforts at finding cross-linguistic patterns of translation have been by and large vain. That is, phonologists could not come up with natural classes of boundaries.

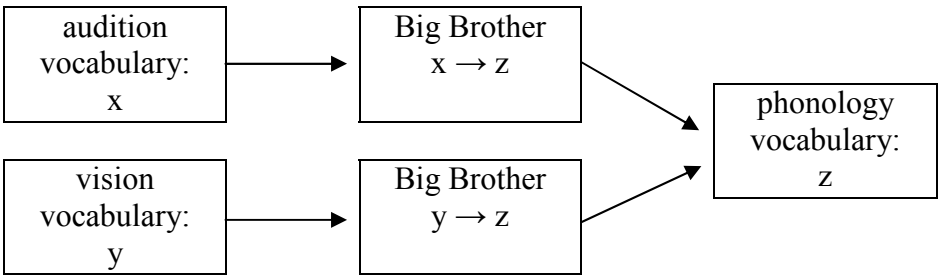
(20) modules receive variable inputs, but produce a uniform output
   a. many-to-one
      modules may draw on information that comes from a range of other modules
      1. example: in perception, phonology is fed at least by acoustic-phonetic and visual information.
         ==> McGurk effect (McGurk & MacDonald 1976, Ingleby & Azra 2003)
      2. The circuitry of visual stimuli that reach grammatical processing appears to be different from auditory stimuli, but processed by the auditory cortex (Calvert & Cambell 2003).
      3. interestingly, the McGurk input into the phonological module appears to be the complementary set of what morpho-syntax can provide: melodic primes.
   b. one-to-many
      the output of a given module may be used as the input to a range of other modules
      audition
      provides information for a number of very different modules: sound is processed by
      - all-purpose audition (e.g. the perception of sound that is produced by animals)
      - voice recognition (the identification of humans according to their voice)
      - auditory affect perception (emotion detector)
      - perception of linguistically relevant phonetic material
   c. consequence
      variable input vocabularies that are all mutually unintelligible must be translated into the proprietary vocabulary of the receiving module.

6. Computational translation (in general)

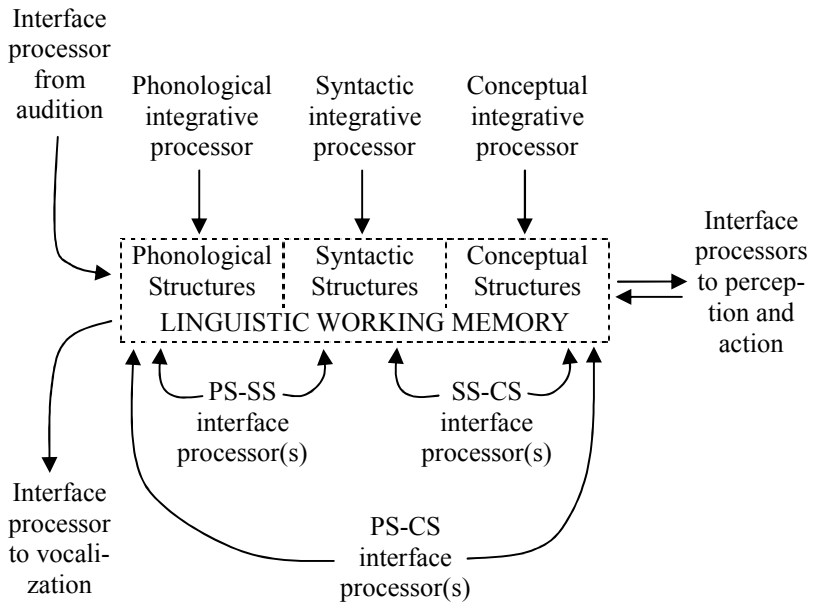
(21) computational translation
   a. translation has always been conceived of as computational
      - readjustment rules (SPE)
      - mapping rules (Prosodic Phonology)
      - correspondence rules (Jackendoff)
      all are a computation in its own right, i.e. distinct from either the sending or the receiving module.
   b. **Big Brother**
      translation by computation requires the Translator to have access to both the vocabulary of the sending and the vocabulary of the receiving module.
      ==> violation of domain specificity
   c. Jackendoff (2002:229) tries to discuss away this contradiction with the help of the word "bi-domain specificity": interface modules are domain-specific like all others, but they are super-modules and therefore can be specific to two domains.
      ==> contradiction in terms

(22) which status do computational devices have that do translation?
   a. ==> they can only be modules, since there is nothing in modular theory that carries out computation apart from modules.
      ==> but they cannot be modules because they violate domain specificity.
   b. in Jackendoff's model (where modules are called processors):
      1. inferential processors (Fodor's central systems)
      2. integrative processors (Fodor's modules)
      3. interface processors
      integrative processors are related by interface processors.

(23) reduction of variable inputs to a uniform output
   a. no trouble for computational translation: on their input side, modules have a Big Brother for each different vocabulary that they are fed with.
   b. example [audition, vision] → phonology

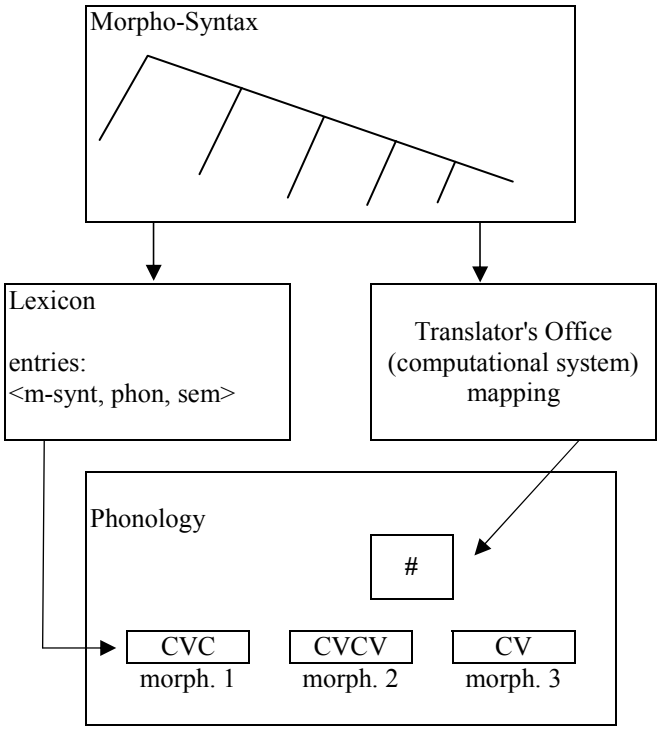


(24) modular structure of language according to Jackendoff
(reproduction of chart from Jackendoff 2002:199)



7. Computational translation (in language)

(25) translation in generative interface thinking
Two Channel



(26) mixed lexical and computational translation
a. lexical translation
morphemic information is transformed into phonological material through a lexicon:
- <number = plural>
- <person = 3>
- <verb class = X>
==> morpheme injected into phonology: -ou
b. computational translation
non-morphemic (boundary) information is transformed into phonological objects by a computational process:
párent = bare root, penultimate stress
parént-al = root + class 1 affix, penultimate stress
párent # hood = root + class 2 affix, root stress (stress assignment blocked)

(27) linearisation
a. is a complicated and debated problem
e.g. Kayne's (1994) Linear Correspondence Axiom (LCA), Richards (2004, 2007), Bobaljik (2002), Embick & Noyer (2001, 2007) and Embick (2007).
b. somebody must decide the linear order in which objects that represent morphemic and non-morphemic information are pieced together.
==> what is for sure is that the input to phonological computation is a linearly orderd string: linearisation is done prior to phonology.

8. One-Channel Translation (i.e. only lexical)

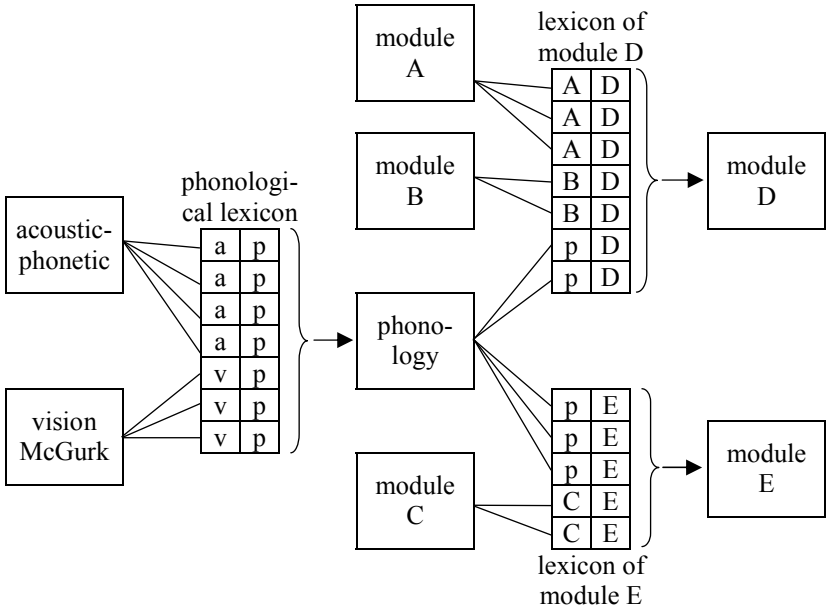
(28) Michal Starke's idea
(but no quotable text available)

(29) translation bears the signs of **lexical** activity
a. arbitrary relations of an input and an output
b. refusal to obey cross-linguistic lawful behaviour

(30) other arguments for lexical translation
a. Big Brothers violate domain specificity
b. economy / Occam's Razor: lexical translation uses the resources of modular theory that are needed anyway.
Modularity knows only
1. modules
2. lexica
3. eventually central systems

(31) reduction of variable inputs to a uniform output
a. instead of having a number of Big Brothers, modules have a proprietary Lexicon on their input side.
b. this Lexicon has variable inputs (i.e. written in the distinct vocabublaries of the different inputs), but a uniform output, i.e. only into the phonological vocabulary.
c. in this perspective, lexical entries are pairs of arbitrarily associated items which belong to two different domains.

(32) intermodular communication through lexical access



(33) well-known problem of translation by computation: all-powerfulness
Jackendoff defends all-powerful translation against the critique of overgeneration, i.e. the fact that unconstrained transmission of information allows for the description of existing as much as non-existing interface activity.

> "correspondence rules are conceptually necessary in order to mediate between phonology, syntax, and meaning. It is an unwarranted assumption that they are to be minimised and that all expressive power lies in the generative components. […] In other words, correspondence rules, like syntactic and phonological rules, must be constrained so as to be learnable. Thus their presence in the architecture does not change the basic nature of the theoretical enterprise." Jackendoff (1997:40)

(34) lexical translation constrains translation: anything is not possible

a. anything that reaches phonology must originate in the lexicon.
Hence boundary information must qualify for being stored in the lexicon

b. **morpho-syntax has no bearing on phonological computation**
==> explanation
for the fact that morpho-syntax NEVER alters phonological computation: computational instructions cannot be its output. By contrast, there is nothing wrong with that in principle if translation is computational.

c. **diacritics are outlawed**
the output of the translation of boundary information are necessarily pieces of the proprietary phonological vocabulary: only such vocabulary can be stored in the lexicon.
==> diacritics are outlawed
this is a valuable benefit since the output of translation of boundary information has always been diacritics: "+", "#", "ω", "φ" etc.
==> diacritic-free Interface is the gist of Direct Interface: Scheer (2008, forth).

d. **morpho-syntax has no bearing on morpheme-internal phonology**
however linearisation works, the linear input string to phonology is made of pieces that represent morphemic as well as non-morphemic information. Since both have the same origin – the lexicon –, boundary information must have exactly the same linear identity as morphemes: it must incarnate as identifiable pieces of the linear string.
   1. ==> there is no linear requirement when translation is computational: prosodic constituency does not have any linear identity (it is a tree structure erected over morphemes)
   2. ==> explanation
   of the observation that morpho-syntax has no bearing on morpheme-internal phonology: only edges may be modified.

9. Conclusion

(35) do
1. the properties found in language-internal intermodular communication and
2. the interface mechanisms that linguists develop
have any echo elsewhere in the mind?

a. prime candidates for modular workings are lower cognitive functions:
"perceptual systems + language"
==> is there production anywhere else? Perceptive systems don't produce…
==> linguistics and linguistic interfaces are traditionally production-oriented
b. is there any parallel to linearisation elsewhere? [a production issue]
c. is there any parallel to phase theory elsewhere? [another production issue]
I.e. the attempt to derive a chunk that is too big (for working memory) into smaller pieces, that are
1. embedded (every piece is included in the following piece)
2. computed one-by-one
d. recursion in the mind
Hauser, Chomsky & Fitch (2002) hold that only language has it (and that this is the only ingredient of language that is specific to language).
==> there is recursion in vision for example – but is this the same kind of recursion?

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