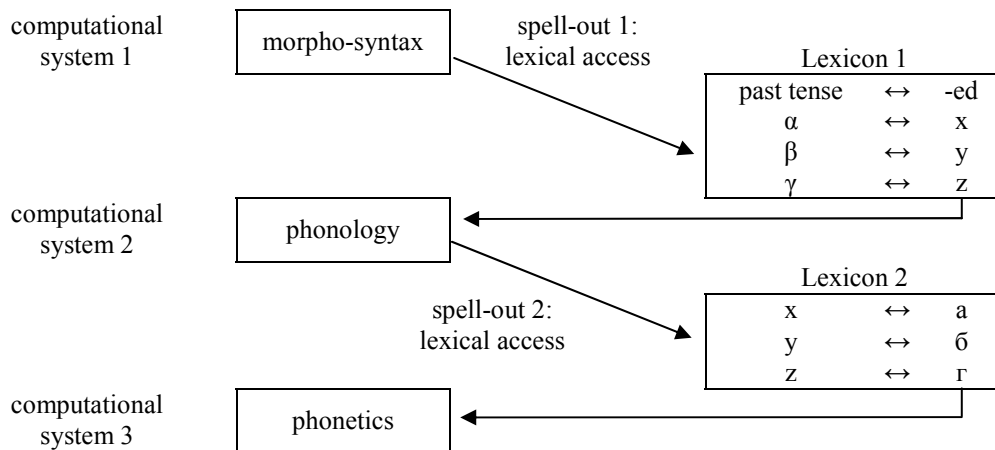


## PHONOLOGY, ITS TWO INTERFACES AND WHY ANIMALS DON'T HAVE IT

- (1) purpose
  - a. to define a consistent place for phonology in a modular architecture of grammar
  - b. critical question: intermodular communication.  
==> Spell-Out  
==> applied to both the higher and the lower interface
  - c. benefit if all interfaces respond to the same logic: linguistic-internal matters and competing theories are refereed by extra-linguistic constraints, in our case those imposed by cognitive science and modularity.
  - d. this perspective is in line with minimalist and biolinguistic tenets:  
grammar-internal properties are shaped and explained by extra-grammatical, more generally cognitive constraints, typically relating to the interface(s) (**third factor** explanations, see Chomsky 2005).  
See also intermodular argumentation: Scheer (2008b, 2009b, 2010)
  - e. based on this grammar-internal reasoning, expand to the larger picture discussed in the biolinguistics literature: animals appear to have all faculties required to run phonology – but no animal does. Why?
- (2) more specifically, I will try to convince you
  - a. of One-Channel Translation  
(the upper) Spell-out (= translation) is not computational but goes through a lexical access.  
==> no readjustment (SPE), no mapping rules (Prosodic Phonology)  
Scheer (2012a)
  - b. that there is only one chunk-defining device: phases (cycles etc.)  
representational chunk-definers have to go (hash marks, the Prosodic Hierarchy)  
**Modular PIC**  
Scheer (2011:§§778, 794, 2012a:§307), D'Alessandro & Scheer (to appear), Scheer (2012b)
  - c. that the lower interface works exactly like the upper interface:  
post-phonological Spell-out  
==> translation to phonetics is **arbitrary**  
Scheer (2014)
  - d. that animals don't have phonology because they have nothing to externalize  
(rather than because of accidental non-convergence in a single animal species of physical and cognitive abilities that are required for phonology)

- (3) fragment of grammar involving phonology



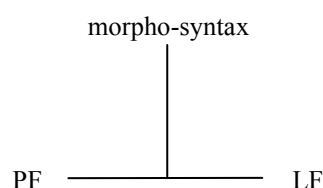
## 1. Modularity in Cognitive Science

- (4) general description  
the mind (and ultimately the brain) is made of a number of **computational systems** that are
- specialized in a specific task
  - non-teleological
  - symbolic
- Fodor (1983), Coltheart (1999), Gerrans (2002)  
[competing model: connectionism, but no time to delve into that: Rumelhart *et al.* (1986) and following, in linguistics: "Cognitive" Linguistics, Langacker (1987) and following, see e.g. Taylor (2002) for an overview.]
- (5) core properties of cognitive modules according to Segal (1996: 145)
- domain specificity** ==> **translation**
  - informational encapsulation** ==> **no look-back: PIC**
  - obligatory filtering
  - fast speed
  - shallow outputs
  - limited inaccessibility
  - characteristic ontogeny
  - dedicated neural architecture
  - characteristic patterns of breakdown
- (6) modules are **domain-specific**
- they work with a specific symbolic vocabulary that is distinct from the vocabulary of other modules.  
==> different languages of the mind
  - for example, the input to visual and auditory computation is made of distinct items, which will be unintelligible by modules that they do not belong to.
  - That is, an auditory input to the visual system will provoke no reaction at all: the data are simply ignored since they cannot be parsed.
  - ==> every module can only parse items that belong to its own proprietary vocabulary.

- (7) modular computation
  - a. based on their domain-specific input vocabulary, modules perform a computation whose output is structure.
  - b. for example, syntactic computation (whose central tool is Merge in current minimalism) takes as its input features such as gender, number, person, tense etc., and outputs hierarchized syntactic structure, i.e. trees.
- (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)
  - c.  $\implies$  intermodular communication must rely on translation of items from one vocabulary into another.
- (9) how do we identify modules?
  - a. **domain specificity**
  - b. **informational encapsulation**
  - c. based on pathologies: double dissociation

## 2. Modularity in language

- (10) 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)



- (11) **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<br>syntax, morphology, semantics:              |  | phonology:                                    |
| number<br>person<br>gender<br>animacy<br>quantification<br>aspect |  | labiality<br>friction<br>voicing<br>occlusion |

- 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. Core properties of translation

- (12) translation is **selective**

partial homology, information bottleneck

Jackendoff (2002)

- a. 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  $G_1, \dots, G_n$  that create/ license structures  $S_1, \dots, S_n$ , 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)

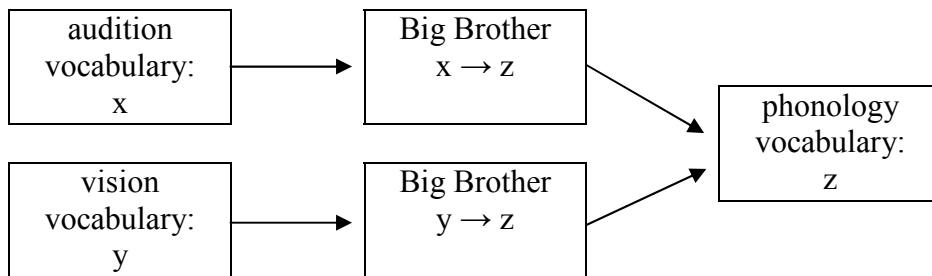
- b. the amount of structure that is visible for interface processors in a given module may be small or big, and this is unpredictable: the translational channel between two modules may have a more or less narrow "information bottleneck" (Jackendoff's 2002: 229 term).
- c. well supported in language: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

- (13) 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.
- (14) 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.**

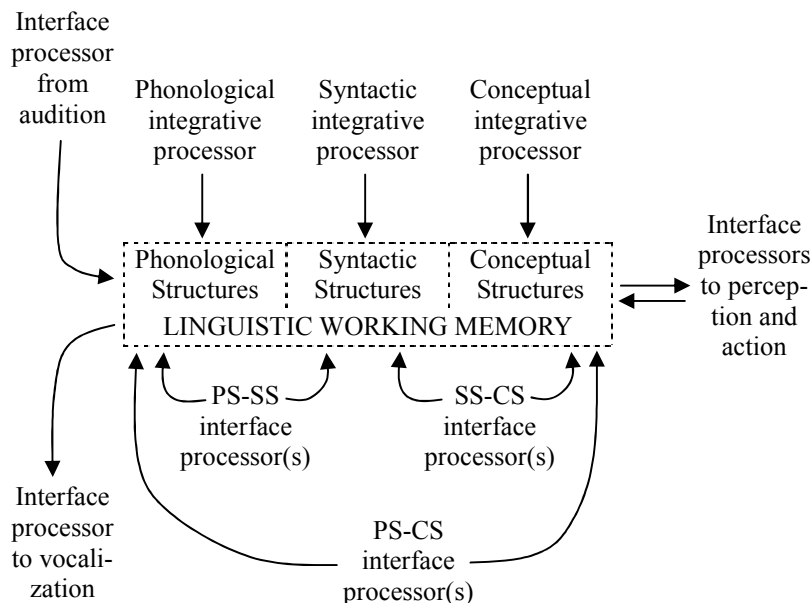
#### 4. Computational translation (in general)

- (15) 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

- (16) which status do computational devices have that do translation?
- $\implies$  they can only be modules, since there is nothing in modular theory that carries out computation apart from modules.  
 $\implies$  but they cannot be modules because they violate domain specificity.
  - in Jackendoff's model (where modules are called processors):
    - inferential processors (Fodor's central systems)
    - integrative processors (Fodor's modules)
    - interface processors
 integrative processors are related by interface processors.
- (17) reduction of variable inputs to a uniform output
- no trouble for computational translation: on their input side, modules have a Big Brother for each different vocabulary that they are fed with.
  - example [audition, vision]  $\rightarrow$  phonology



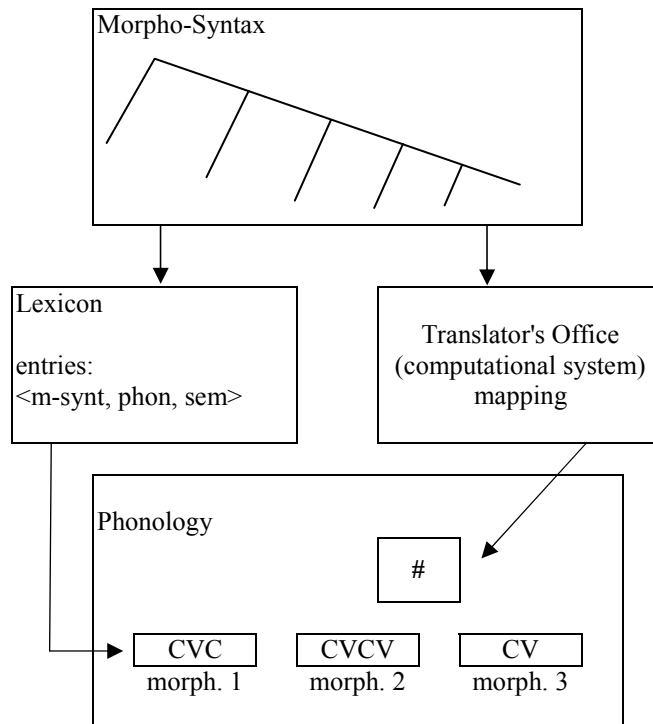
- (18) modular structure of language according to Jackendoff  
 (reproduction of a chart from Jackendoff 2002: 199)



## 5. Computational translation (in language)

(19) translation in generative interface thinking

### Two Channel



(20) mixed lexical and computational translation

a. lexical translation

morphemic information is transformed into phonological material through a lexicon:

- <number = sg>

- <person = 3>

==> morpheme injected into phonology: -s

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)

(21) major difference

both lexical and computational translation insert an item into the phonological string, but

a. lexical translation

the origin of that item is the lexicon: there is **a lexical access**

==> **morphemic information** (vocabulary insertion)

b. computational translation

the origin of that item is not the lexicon: there is **no lexical access**

==> **boundary information** (i.e. non-morphemic: #, ω etc.)

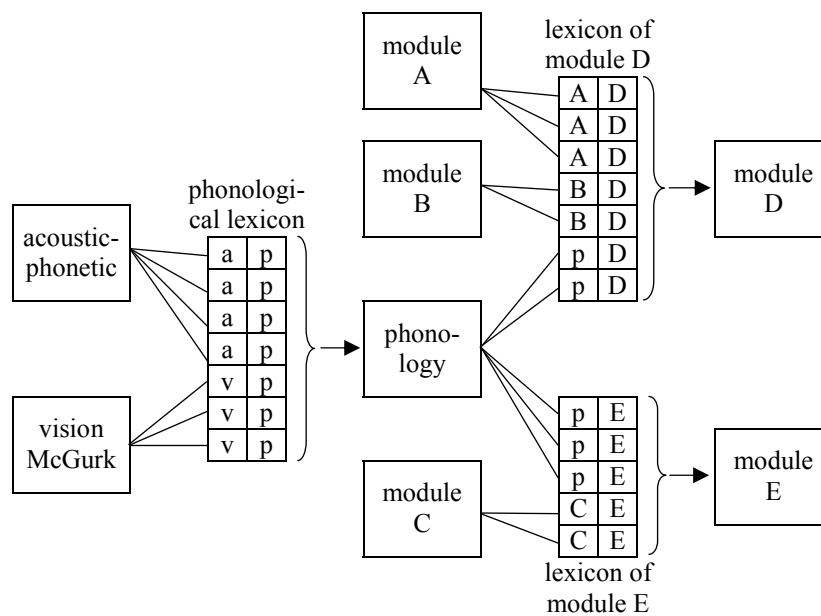
- (22) linearisation
  - a. is a complicated and debated problem
    - e.g. Kayne's (1994) Linear Correspondence Axiom (LCA), Richards (2004, 2007), Bobaljik (2002), Embick & Noyer (2001, 2007) and Embick (2007).
  - b. somebody must decide the linear order in which objects that represent morphemic and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

## 6. One-Channel Translation (i.e. only lexical)

- (23) Michal Starke's idea (but no quotable text available)  
introduction in Scheer (2012a)
- (24) translation bears the signs of **lexical** activity
  - a. arbitrary relations of an input and an output
  - b. refusal to obey cross-linguistic lawful behaviour
- (25) 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
- (26) 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 vocabularies 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.



(27) intermodular communication through a lexical access



(28) 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)

(29) 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 (2008a, 2012a).

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.

## 7. How many chunk-defining devices?

### 7.1. Goal #1: updating chunk definition in phonology

(30) chunk definition in phonology

- a. how are phonologically relevant chunks of the linear string defined?  
[A phonologically relevant chunk is a domain of phonological computation.]
- b. since SPE, there are two competitors:  
[Scheer (2011:§423, 2012a:§99, 2012b)]
  1. representationally: #s in SPE, units of the Prosodic Hierarchy since the 80s  
phonological theory associated: ProsodicPhonology
  2. procedurally: cycles, today phases  
phonological theory associated: Lexical Phonology

(31) phase theory has radically modified the landscape

(but this went by and large unnoticed in phonological quarters):

- a. since Lexical Phonology, post-lexical phonology is supposed to be non-cyclic.  
==> at and above the word level, chunk definition is ONLY representational, i.e. done by the Prosodic Hierarchy.
- b. phase theory obliterates this idea: it defines phonologically relevant chunks above the word level.  
[to the extent that it has any impact in phonology at all]
- c. ==> phase theory takes over the function of the Prosodic Hierarchy  
==> the Prosodic Hierarchy is redundant and has to go

(32) independent reason #1 to believe that the Prosodic Hierarchy has to go:  
it is redundant

- a. reaction/adaptation of the established Prosodic Hierarchy to phase theory:

**prosodic islands**

Prosodic islands make **prosodic constituency isomorphic with phases**: FIRST a phase defines the chunk, THEN this chunk is translated into phonological representations in the form of a unit of the Prosodic Hierarchy.

==> **abandon of THE fundamental claim of Prosodic Phonology: non-isomorphism.**

Dobashi (2003), Piggott & Newell (2006), Kratzer & Selkirk (2007), Ishihara (2007) and Kahnemuyipour (2009). Elordieta (2008:274ff) offers an informed survey.

- b. theory cannot afford to do the same labour twice:  
if prosodic and phase structure are exactly identical and isomorphic, Occam commands to get rid of one of them. Since
  - phases are independently needed in syntax
  - the Prosodic Hierarchy has no other purpose in phonology than introducing morpho-syntactic information $\Rightarrow$  prosodic constituency has to go.  
This argument is typically made by protagonists of DM:  
Pak (2008:42ff), Samuels (2009a:284ff), also Seidl (2001).

(33) independent reason #2 to believe that the Prosodic Hierarchy has to go:  
just like #, it is made of diacritics:  $\omega$ ,  $\varphi$  etc.  
In a modular environment, diacritics do not qualify since computational systems (modules) can only understand, parse and process their own proprietary vocabulary.  
Scheer (2008a, 2011:§402, 2012a:§93, 2012b)

- (34) conclusion
- a. phase theory is the only chunk-defining device.
  - b. a case of intermodular argumentation (Scheer 2008b, 2009b)  
[stronger evidence than regular intra-modular arguments]  
shaping phonological by morpho-syntactic theory.

## 7.2. Goal #2: adapting phase theory to the demands of phonology

- (35) phonologically relevant chunks are smaller
- a. as it stands, phase theory is unable to describe all phonologically relevant chunks, which are often smaller and more diverse than what phase theory can delineate today.
  - b. in order to meet the ambition of goal #1, phase theory needs to be made more flexible.
  - c. this demand coincides with the syntax-internal evolution of phase theory:  
since Chomsky's initial take (CP, vP, perhaps DP), there is a constant trend to grant phasehood to smaller and smaller chunks (den Dikken 2007:33 provides an overview, also Scheer 2011:§773).
  - d.  $\Rightarrow$  goal: make phase theory more flexible so that smaller and more diverse chunks can be described.
  - e. another case of intermodular argumentation  
shaping morpho-syntax by demands of the PF-interface.  
 $\Rightarrow$  this is the minimalist/biolinguistic way to go.

## 7.3. Modular PIC

- (36) workings of phase theory as it stands:
- a. phases themselves do not define phonologically relevant chunks.
  - b. only the PIC, i.e. its freezing/opacity effect makes phase boundaries visible in phonology.
  - c. **phases and PICs are isomorphic:**  
every phase triggers a PIC, and every PIC is due to a phase.

(37) trivial empirical fact:

not every phase has a phonological effect (is visible in the phonology).

(Scheer 2009a,b)

- a. e.g. t-flapping in (relevant varieties of) English, which applies **in all syntactic environments alike** provided the /t/ is word-final and intervocalic (e.g. Nespor & Vogel 1986:46f, 224ff).
- b. at issue  
a white owl  
invite Olivia  
at eleven  
just the other night a racoon was spotted in our neighbourhood  
a very dangerous wild cat escaped from the zoo
- c. but there are of course phase boundaries within the domain of application of t-flapping.
- d. ==> phase boundaries are ignored altogether by t-flapping.
- e. this is true for many other external sandhi phenomena:  
==> **phonology only exceptionally cares for phase boundaries.**

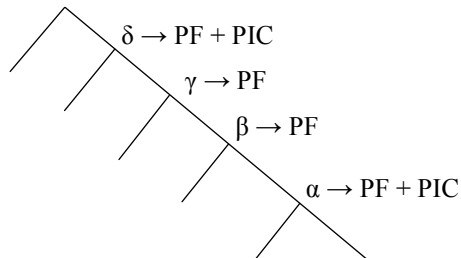
(38) Modular PIC

D'Alessandro & Scheer (forth), Scheer (2011:§§778, 794, 2012a:§307)

- a. the **phase skeleton** is defined in syntax  
= phasehood: which nodes are phase heads, i.e. trigger spell-out to PF?
- b. in a given language, there is only one phase skeleton.  
There may be cross-linguistic variation: different languages have different phase heads (Gallego 2009, 2010).
- c. phases exist independently of the PIC
  - 1. some phases are endowed with a PIC at PF
  - 2. other phases are not: there is spell-out, but no effect  
==> phonologically vacuous application of spell-out (phases)  
==> the PIC is phase-specific
- d. for a given phase, the **PIC is module-specific**  
Phases which leave no footprint in phonology may well have a syntactic motivation for being armed with a PIC *in syntax*.  
For example, this is the case of vP in t-flapping varieties of English: there is good syntactic reason to assume the existence of a phase endowed with a PIC in syntax, but the same phase has no effect in phonology, hence there is no PIC associated to this phase *in phonology*.
- e. two loci of variation
  - 1. cross-linguistic parameterisation of phasehood
  - 2. within a given language, it is decided for every phase whether or not
    - it is associated to a PIC in syntax
    - it is associated to a PIC at PF
    - it is associated to a PIC at LF

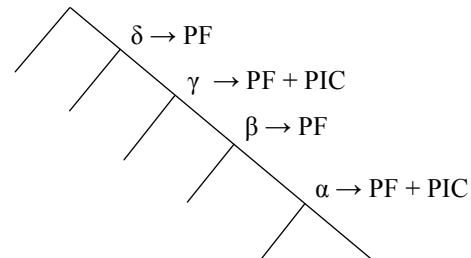
(39) language A

- a. phase heads  $\alpha$  and  $\delta$  are endowed with a PIC at PF
- b. phase heads  $\beta$  and  $\gamma$  trigger vacuous spell-out at PF



language B

- a. phase heads  $\alpha$  and  $\gamma$  are endowed with a PIC at PF
- b. phase heads  $\beta$  and  $\delta$  trigger vacuous spell-out at PF



(40) the global picture

- a. the impact of morpho-syntactic divisions on phonology may be
  - 1. language-specific (Gallego 2009, 2010)
  - 2. chunk-specific: class 1 vs. class 2 morphemes (Lexical Phonology)
  - 3. size-specific: lexical vs. post-lexical phonology (Lexical Phonology)
  - 4. process-specific
    - the same boundary impacts a given phonological process, but not others.
    - E.g. English: word-stress is strictly bound by the word, but t-flapping ignores the word boundary.
  - 5. NEW: module-specific
    - not really new in fact: there is a body of literature arguing for asymmetric spell-out at LF and PF.
    - Marušič (2005), Marušič & Žaucer (2006), Felser (2004), Matushansky (2005), den Dikken (2007), Megerdooian (2003) and Caha & Scheer (2008).
  - 6. NEW: phase-specific
- b. sure, many sources of variation weaken phase theory.
  - But we are only recalling what is firmly established
  - 1. empirically
  - 2. in interface theory

(41) **to sum up: Modular PIC**

Ingredients

- a. PIC-defined spelled-out chunks are invisible for syntactic computation
- b. PIC is also active at PF
- c. PIC-defined spelled-out chunks may be invisible for phonological computation [PIC at PF].

## 8. The modular view of the phonology-phonetics interface: Post-phonological Spell-Out

(42) some relevant references

- a. a classical GP tenet: phonetic interpretation
  - Harris & Lindsey (1990, 1995: 46ff), Harris (1996), Gussmann (2007: 25ff)
- b. Boersma (1998), Hamann (2014)
- c. more elaborate version of the items below: Scheer (2014)

### 8.1. Properties of post-phonological Spell-Out

- (43) two distinct computational systems?
- are phonology and phonetics are two distinct computational systems?
  - if they are not, there is no interface in the first place, and hence no point in applying the workings of the other interface.
  - the question whether phonetics is just low-level phonology, rather than ontologically distinct, is the subject of a long-standing debate.
  - coming from connectionism (Smolensky 1988), OT is genetically endowed with a **scrambling tropism** that blurs or does away with modular contours, on both ends of phonology: morphological and phonetic constraints are typically interspersed with phonological constraints in the same constraint hierarchy, and characteristics of two domains (phonology-phonetics, phonology-morphology) often co-occur in the formulation of constraints.
  - The alternative view that upholds a modular distinction between phonology and phonetics is also represented in the literature, though (see the overview in Kingston 2007).
  - we proceed on the assumption that phonology and phonetics are
    - two distinct computational systems
    - two distinct modules
    - with two distinct vocabularies
    - hence that can communicate only through translation
- (44) consequence
- there must be a **spell-out** operation that converts the output of phonology into units of the phonetic vocabulary.
  - as was shown, modular spell-out has a number of properties that then must also apply to its post-phonological instantiation, and which entail a number of consequences:
- (45) the phonology-phonetics interface conceived of as

### post-phonological Spell-Out

i.e. the spell-out of the result of phonological computation (phonological structure) as vocabulary items of the phonetic module.

#### Post-phonological spell-out has four core properties

- (46) #1
- Lexical access: list-type conversion
- the match between phonological structure and phonetic exponents thereof is done through a **lexical access**. That is, the conversion is list-type, or one-to-one: a phonetic item X is assigned to a phonological item A.
  - the dictionary-type list in question is hard-wired, i.e. stored in long-term memory and not subject to any influence from (phonological or any other) computation. It does undergo diachronic change, though.

(47) #2

No computation

- a. the difference between list-based and computational conversion is the absence of an input-output relationship in the former: the two items of the correspondence are not related by a computation that transforms one into the other.
- b. nothing is said about the nature and the size of the phonological structure A and its phonetic exponent X.
  1. Namely, there is no segment-based implicit: the phonological units that are screened by the spell-out mechanism may comprise one or several timing units (x-slots).
  2. Basic autosegmental principles apply: only those melodic items that are associated to timing/syllable structure are transmitted to the phonetics (i.e. floating melody is not). This property of the spell-out mechanism is universal.

(48) #3

The match is arbitrary

- a. recall that a fundamental property of translation is the arbitrariness of the two items of distinct vocabularies that are related.
- b. this follows from the fact that translation is list-based: like in a multilingual dictionary, there is no reason why "table" has the equivalent "stół" in Polish, "Tisch" in German or "udfirk" in some other language.
- c. a consequence of arbitrariness is what Kaye (2005) calls the "**epistemological principle of GP**"
  1. the only means to determine the phonological identity of an item is to observe its (phonological) behaviour. Its phonetic properties will not tell us anything.
  2. That is, in case spell-out "decides" to have a given phonological structure pronounced by a rather distant phonetic exponent, its phonetic properties may be opposite to its phonological identity and behaviour.
  3. For example, if an /u/ is pronounced [i], it will not palatalise despite its being front phonetically. Relevant examples are discussed below.

(49) #4

Conversion is exceptionless

- a. a basic criterion for classifying alternations as morpho-phonological, allomorphic, phonological, analogical, lexical or phonetic is the presence of exceptions.
- b. the whole notion of exception makes only sense when both alternants are related by computation: an exception is an exception to an expected result, i.e. the application of an algorithm that transforms X into Y.
- c. if, say, *electric* and *electricity* are two distinct lexical items, it does not make sense to say that *antique* - *antiquity* is an exception to the k - s-ity pattern: there is no such pattern in the first place.
- d. hence talking about exceptions supposes computation. Since the match of phonological structure and its phonetic exponent does not involve any computation, it must be exceptionless.
- e. this is indeed what we know from the morpho-syntax - phonology spell-out: there is no variation, there are no exceptions in the assignment of phonological material to morpho-syntactic structure.
- f. ==>  
what that means is that among all alternations found in language, only those that are exceptionless can possibly be due to post-phonological spell-out.

- (50) exceptionlessness = phonetic proximity  
The idea that exceptionlessness and "proximity" to phonetics are strongly related is a long-standing insight:
- a. exceptionless alternations are often called
    1. "low level",
    2. "surface palatalization" (in Polish) or,
    3. quite aptly (for bad reasons though), "late".
  - b. This expresses the view that on the route towards phonetics, exceptionless alternations are rather close towards the phonetic end.
- (51) "late": inside vs. outside of phonology
- a. the literature in question  
continues to place the processes and hand *in* the phonology: "late" means "towards the end of the application of ordered rules" in SPE.
  - b. in the present modular approach
    1. "late" means "outside of the phonology"
    2. the alternations in question arise **during post-phonological spell-out**.

## 8.2. Some issues addressed by post-phonological Spell-Out

- (52) #1  
how much of the alternations that we observe on the surface is exactly the result of phonological computation?
- a. answers
    1. SPE: big is beautiful  
close to 100%, including "alternations" like *eye - ocular* or *sweet - hedonistic*  
Also with a modern offspring: Hale & Reiss (2008)
    2. since the 70s  
constantly decreased, in order to constrain the generative power of SPE:
      - the abstractness debate (internal revision): Kiparsky (1968-73) and following
      - Natural (Generative) Phonology
    3. small is beautiful  
very little labour is left for phonology  
typical for Government Phonology, worked out and theorized by Gussmann (2007).
  - b. outsourcing  
how do alternations work that are not the result of phonological computation?
    1. no computation
      - distinct lexical entries (electri[k]c - electri[s]ity)
      - post-phonological spell-out
    2. non-phonological computation (grammatical)
      - allomorphy (the root has two allomorphs, *electri[k]-* and *electri[s]-*)
      - post-phonological spell-out (e.g. so-called surface palatalization in Polish)
    3. non-phonological computation (non-grammatical)  
analogy
  - c. post-phonological spell-out shows that there is life after all phonological computation is done, and how this life is organized.



(53) an example:

shifting labour from phonological computation to post-phonological spell-out (phonetic interpretation)

a. in Polish, [ɛ] behaves in three different ways

1. palatalizing e                      lot - loci-e      "flight Nsg, Lsg"
2. non-palatalizing e              lot - lot-em      "id. Nsg, Isg"
- rak - rak-iem      "crab Nsg. Isg"
3. post-velar e in recent loans      kelner "waiter", kemping "camping"

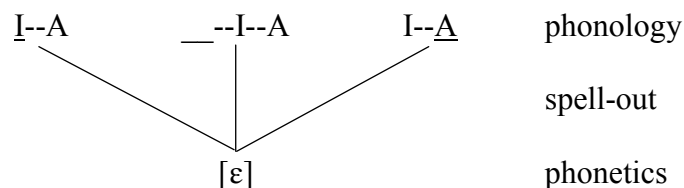
b. classical analysis (Rubach 1984)

1. one-to-one match between phonological behaviour and phonetic substance:
  - any item that is phonologically [+front] (or [-back]) palatalizes
  - only items that are phonologically [+front] (or [-back]) palatalize
2. consequences
  - palatalization is only triggered by [+front] (or [-back]) items
  - in case a phonetically [+front] (or [-back]) item fails to trigger palatalization, it cannot be [+front] (or [-back]) by the time the palatalization process applies.
3. ==>
  - Isg -em is /ɣm/ (where /ɣ/ is a back unrounded vowel, distinct from /ɔ/ through roundness).
  - rule ordering:
    1. palatalization (/ɣm/ has no effect)
    2. context-free transformation of /ɣm/ into /ɛm/ by *phonological computation*
  - hence there is an additional vowel in the inventory of Polish, /ɛ/, which is absolutely neutralized

c. Gussmann (2007: 56ff)

1. there are three phonologically distinct [ɛ]'s
  - palatalizing e (lot - loci-e "flight Nsg, Lsg"):      I--A
  - non-palatalizing e (lot - lot-em "id. Nsg, Isg"):      --I--A
  - post-velar e in recent loans (kelner, kemping):      A--I
2. which all bear the palatal agent I, though in different function (no automaticity of palatalization in presence of the palatal agent)
3. the "surface neutralization" occurs during post-phonological spell-out (phonetic interpretation), rather than *in* the phonology (by phonological computation).

d. summary



(54) #2

virtual length

- a. the length of phonologically long vowels and phonological geminates may be marked in the phonetic signal by duration, but also by other means: there is no reason why phonological length should always be flagged by duration.  
Virtually long items do not betray their length by phonetic cues related to duration, but by other properties that can be read off the signal.
- b. vowel length has been found to be expressed by

1. ATRness in French  
Rizzolo (2002)
2. vowel reduction
  - Semitic (Lowenstamm 1991, 2011)
  - Ge'ez (Old Ethiopian) (Ségéral 1996)
  - Kabyle Berber (Bendjaballah 2001, Ben Si Saïd 2011, 2014)
3. stress  
in Apulian dialects of Italian (Bucci 2013a,b)
- c. phonological geminates have been found to be expressed by
  1. the length of the preceding vowel
    - German (Caratini 2009)
    - Cologne dialect of German (Ségéral & Scheer 2001)
    - English (Hammond 2007)
  2. the (non-)inhibition of a preceding vowel-zero alternation  
Somali (Barillot & Ségéral 2005)
  3. aspiration  
English (Ségéral & Scheer 2008)
  4. preaspiration  
Icelandic and Andalusian dialects of Spanish (Curculescu 2011)
- d. examples from English
  1. agma  
[ŋ] is /ng/:
    - it occurs only after short vowels
    - it does not occur word-initially  
Gussmann (1998), Dressler (1981) for German
  2. distribution of short/lax vs. long/tense vowels in English  
short/lax vowels occur in closed syllables, hence the phonetically simplex t in *city* must be a geminate. *NOT* an ambisyllabic consonant.  
==> ambisyllabicity is the analysis of people back in the 70s where it could not be conceived that a phonetically simplex consonant is related to two skeletal slots.  
The unbreakable rule was a one-to-one mapping between x-slots and phonetic duration.  
Hammond (1997)

(55)	a. English agma	b. length = non-reduction	c. length = shortness of the preceding vowel
after phonologi- cal computation	$\begin{array}{c} x \ x \\ \diagdown \diagup \\ n \ g \end{array}$	$\begin{array}{c} x \ x \\ \diagdown \diagup \\ a \end{array}$	$\begin{array}{c} x \ x \ x \ x \ x \\   \   \ \diagdown \   \\ c \ i \ \quad t \ y \end{array}$
spell-out	↑	↑	↑
phonetic expo- nent	[ŋ]	[a]    [ə]	[t]

(56) #3

laryngeal realism and the identification of spread-glottis languages though VOT  
Iverson & Salmons (1995), Honeybone (2005), Harris (2009)

- a. it is fairly consensual today that there are two distinct systems of laryngeal, or voice-related oppositions: what is traditionally called a voice vs. voiceless contrast may in fact involve two distinct sets of primes,
  1.  $[\pm\text{voice}]$  vs.  $[\pm\text{spread glottis}]$  in feature-based systems
  2. L- or H-active systems in monovalent approacheshence there are two types of languages: voicing and aspiration.
- b. the standard answer in the literature is that this may be decided by looking at the VOT of word-initial pre-vocalic plosives (e.g. Harris 2009).
- c. in recent work, Cyran (2012, 2014) has argued that a well-known peculiarity of voicing in external sandhi that is found in South-West Poland (so-called Cracow voicing, or Poznań-Cracow voicing) is not the result of phonological computation.
- d. he shows that it may be derived by simply assuming that the Warsaw-type system is L-based (true voicing), while the Cracow-type system is H-based. When injected into the same computational system, these opposite representations produce the surface effect observed.
- e. a consequence of Cyran's analysis is that there cannot be any cross-linguistically stable phonetic correlate for H- or L-systems.
  1. these systems may not be identified by spectrograms, VOT or any other property contained in the phonetic signal: Warsaw and Cracow consonants are phonetically identical.
  2. the only way to find out which type of laryngeal opposition a surface voice-voiceless contrast instantiates is to observe its behaviour.
  3.  $\Rightarrow$   
This is what is also predicted by post-phonological spell-out: phonetic correlates of phonological structure are arbitrary.

(57) #4

how much slack ought to be allowed between the phonological identity of a segment and its pronunciation?

- a. we know that the same phonetic object may have distinct phonological identities across languages:  $[\varepsilon]$  may be
  1. I.A,
  2. A.I or
  3. I.A(using GP representations where the head of the expression is underscored).  
But may it also be
  4. I alone?
  5. A alone?
  6. or even U alone?
- b. intuitively, there must be limitations on how things can be pronounced, since otherwise a three vowel i-a-u system could in fact be flip-flop where  $[i]$  is the pronunciation of A,  $[a]$  of U and  $[u]$  of I.
- c. the arbitrariness of post-phonological spell-out enforces a counter-intuitive position, though: yes, flip-flop is indeed a possible situation.

(58) confirmation of counter-intuitive arbitrariness

a. South-East British posh girls

1. Uffmann (2010) reports that in the speech of this group,

"vowels are currently shifting quite dramatically, with back/high vowels fronting and unrounding, and a counter-clockwise rotation of most of the remainder of the system, leading not only to vowel realisations that are quite distinct from traditional Received Pronunciation, but also, at least for some speakers, to near-merger situations (e.g. /i:-u:, ey-ow, e-æ/)."

(Uffmann 2010)

See also Henton (1983), Harrington *et al.* (2008).

Hence posh girls will pronounce "boot" as [biit].

2. BUT this [ii] is still /uu/ phonologically: it produces a back glide

external sandhi gliding in English (e.g. Broadbent 1991)

see [j] it

do [w] it

posh girls

d[ii w] it

b. "r"

1. in some languages the sonorant "r" is pronounced as a uvular fricative [ʁ, ʁ̥] or trill [R]. French, German, Norwegian and Sorbian are cases in point.
2. In these languages, like all other obstruents [ʁ] undergoes final devoicing (if present in the grammar), and voice assimilation.
3. Phonologically, however, it "continues" to behave like a sonorant: only sonorants can engage in a branching onset, but the uvular fricative or trill does so jollily.
4. When looked at through the lens of post-phonological spell-out, there is nothing wrong with this situation: for some reason the languages in question have decided to pronounce the phonological item /r/ as a uvular. This does not change anything to its phonological properties or behaviour.

c. "exotic" segments: ingressive, clicks etc.

1. surface-bound classical phonological analysis takes these articulatory artefacts seriously and may implement a specific melodic prime, [±suction] in Halle (1995: 8ff)
2. in the perspective of post-phonological spell-out, ingressive and clicks are but funny pronunciations (garden varieties as Jonathan Kaye would say) of regular phonological objects that occur in other languages as well.
3. but of course it must be secured that there are enough distinct phonological representations for all items that contrast in such a language.

### 8.3. Why post-phonological Spell-Out is not cyclic

- (59) if
- a. Spell-Out is the only way modules can communicate
  - b. the upper Spell-Out is cyclic ==> inside-out interpretation  
then the lower Spell-Out should be cyclic as well, shouldn't it?  
==> alas, there is nothing remotely resembling cyclicity when phonology is converted into phonetics
- (60) reason: phonological structure does not define any chunks
- a. cyclicity is not a necessary ingredient of Spell-Out. It follows from the existence of arboreal, chunk-defining structure in morpho-syntax.
  - b. recall that according to Modular PIC there is only one chunk-defining mechanism in grammar: cycles (phases).
  - c. hence domains of phonological computation are defined **outside of phonology**, by the upper Spell-Out.  
And what is thought of as a phonology-internal chunk-defining structure, the Prosodic Hierarchy, does not exist.
  - d. finally, in CVCV there are no trees (deforestation) at all, including syllabic and infrasegmental representations.
  - e. in absence of trees (infrasegmental, syllabic, prosodic), there is nothing in phonology that could give rise to cyclic spell-out:  
cycles cannot exist without arboreal, chunk-defining structure.

## 9. Phonology: where is it, who has it and what is it made of?

- (61) what do biolinguistics and animals have to do with interfaces and Spell-Out?
- a. idea developed below:  
even if there were an animal species that had all physical and cognitive abilities to perform phonology, it still couldn't have phonology because there is nothing to be externalized:  
no computational system that combines pieces (Merge), no Spell-Out, no phonology
  - b. BUT this does not mean that phonology lies outside of grammar.
- (62) biolinguistic ideas  
(Hauser *et al.* 2002, Hornstein 2009: 4ff) etc.
- a. the emergence of the Language Faculty in the human species is not the result of selective adaptation (Darwinian selection).
  - b. rather, it is a by-product of "one or two" spontaneous genetic mutations.
  - c. FLN vs. FLB  
[Faculty of Language in the Narrow sense vs. in the Broad sense]
    1. FLB  
based on pre-human cognitive capacities  
==> PF (phonology), LF (semantics)  
==> shared with animals
    2. FLN  
result of "one or two" genetic mutations  
==> narrow syntax, i.e. Merge and Phase  
==> specific to humans

(63) phonology: where is it?

If grammar is FLN, phonology lies outside of grammar.

- a. Chomsky uses the vocabulary item "ancillary" to characterize phonology.
- b. Hornstein (2009: 4ff) for example does not even mention the classical inverted T: his biolinguistically shaped horizon ends before PF and LF are in sight.
- c.  $\Rightarrow$  the inverted T still exists and the three endpoints are still Fodorian modules – only are PF and LF not located in grammar anymore.
- d. [except of course if there is only "one route to externalisation", i.e. if the LF branch is eliminated (integrated into narrow syntax) and there is no inverted T anymore in the first place. See Chomsky (2013).]

(64) phonology: who has it?

- a. human phonology is "based" on cognitive mechanisms that are shared by animals and humans.
- b. hence animals could in principle have phonology: there is no genetic hurdle.

(65) phonology: what is it made of?

Questions

- a. so why animals don't have phonology?
- b. what does "based on" exactly mean?
- c. is human phonology the result of a specific modification based on primate-shared cognition, which primates could in principle follow but for some reason did not / do not?

(66) phonology: what is it made of?

Answers: Samuels (2009b, 2011a,b)

- a. Samuels (2009b: 356ff) distinguishes cognitive prerequisites of two kinds
- b. performance:  
how are auditory categories learned, how is speech produced?
  1. vocal imitation and invention
  2. neurophysiology of action-perception systems
  3. discriminating the sound patterns of language
  4. constraints imposed by vocal tract anatomy
  5. biomechanics of sound production
  6. modalities of language production and perception
- c. competence  
mentioned by Yip (2006a,b):
  1. Grouping by natural classes
  2. Grouping sounds into syllables, feet, words, phrases
  3. Calculating statistical distributions from transitional probabilities
  4. Learning arbitrary patterns of distribution
  5. Learning/producing rule-governed alternations
  6. Computing identity (total, partial, adjacent, non-adjacent)Samuels' own:
  7. Exhibiting preferences for contrast/-rhythmicity
  8. Performing numerical calculations (parallel individuation and ratio comparison)
  9. Using computational operations: search, copy, concatenate, delete
- d. "virtually all the abilities that underlie phonological competence have been shown in other species." Samuels (2009b: 355)

- e. "a wide range of animal species are capable of the tasks in (2a–i), though it may be the case that there is no single species (except ours) in which all these abilities cluster in exactly this configuration – in other words, it may be that what underlies human phonology is a unique *combination* of abilities, but the individual abilities themselves may be found in many other species." (Samuels 2009b: 358)

(67) returning to the question Who has it?

- a. Samuels' conjecture  
anybody / any being who has the full set of the above listed performance and competence items.
- b. ==>  
animals don't have phonology because no animal species has the full set of abilities that characterizes human phonology.
- c. if they did, they would have human phonology.  
==> so why don't they?
- d. and the reason why no animal species has the full set is bad luck: the pathways of evolution haven't produced such a species, except one, the human.

(68) so phonology is accidental?

- a. there are two evolutionary accidents that were necessary to produce language:
  - 1. the one-or-two genetic mutations ==> result: morpho-syntax (Merge)
  - 2. the grouping of all animal-based abilities concurring to produce phonology
- b. is the emergence of both in the same species really accidental?
- c. could we imagine that accidental mutations and groupings of phonology-ingredients had produced two species
  - 1. one of which has morpho-syntax (Merge) but no phonology
  - 2. the other having phonology but no morpho-syntax

?

==> both species would walk around with their high-end equipment but neither would speak.

(69) another answer

- a. that does not sound plausible.  
Rather, there is a causal relationship between
  - the existence of Merge and
  - the existence of phonology

==> the latter is a product of the former and exists for obvious functional reasons: if there is no externalizing system, the new high-end language technology is of no use.
- b. So:  
the question why animals didn't develop the full set of performance and competence abilities that define human phonology?  
is a non-question:
  - 1. they could (have), since all that is required is pre-human cognition
  - 2. but they didn't / don't because there is no reason for them to do so: they don't have Merge
- c. if by evolutionary accident they did, they still would have no phonology since their abilities would lie waste, failing to have any input.
- b. **animals don't have phonology because they have nothing to externalize.**

(70) really?

- a. animals actually do communicate and do externalize sound-meaning associations.  
Animals do have the linguistic Sign (association of sound and meaning, Martinet's first articulation). What they don't have is grammar, i.e. concatenation and resulting compositional meaning (Martinet's second articulation).
- b. hence it's not because they don't have anything to externalize that they don't have phonology,
- c. but because they don't have the human-specific FLN to externalize.
- d. ==>  
the externalization mechanism was adapted to the specific (computational, concatenational) needs of the FLN system.
- e. ==> phonology is not just any externalization
  - 1. its properties depend on the properties of the concatenational system
  - 2. which are transmitted by Spell-Out
- f. phonology adapts to morpho-syntax  
this is the reverse adaptational movement of what is promoted by minimalism, where a basic explanatory principle is the adaptation of the properties of FLN to the interfaces, i.e. to the demands of phonology.  
==> we face a dialectic come and go, rather than an adaptational one-way.

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