

Phonetics in phonology: why Jakobson, Trubetzkoy, Martinet and others had to live in sin

1. Living in sin and how to achieve redemption

One aspect of Saussure's (1916) distinction between *Langue* and *Parole* is the fact that phonetics belong to the latter and are absent from the former: no phonetics in phonology (see for example Anderson 2021: 42ff). The quotes under (1) illustrate his view.¹

- (1) "Language, in a manner of speaking, is a type of algebra consisting solely of complex terms.
[...]
[L]anguage is a form and not a substance. [...] This truth could not be overstressed, for all the mistakes in our terminology, all our incorrect ways of naming things that pertain to language, stem from the involuntary supposition that the linguistic phenomenon must have substance." Saussure (1959 [1916]: 122, italics in original)

"Not only can the science of language do without the other elements of language, but it is only possible if the other elements are excluded." Saussure (1972 [1916]: 31, my own translation, the translation in the 1959 English edition being incomplete)

In Saussure's view, *Langue* is the study of form as well as of the correlations entertained by its units (phonemes) – and of nothing else. On the other hand, *Parole* studies, among other things, the phonetic substance by which units of form manifest themselves outside the mind/brain. Saussure's position is summarized in the opening sentences of Hjelmslev (1947):

- (2) "Ferdinand de Saussure may in many respects be considered the founder of the modern science of language. He too was the first to call for a structural approach to language, i.e. a scientific description of language in terms of relations between units, irrespective of any properties which may be displayed by these units but which are not relevant to the relations or deducible from the relations." Hjelmslev (1947: 69)

Ever since Saussure introduced this view, though, structuralist and generative practice imbues phonological items with phonetic properties.

It is shown below that with very few exceptions, structuralists and especially the Prague School accepted that phonemes (later on distinctive features) have phonetic content, even though they were acutely aware of the fact that this violates the first commandment of structuralism and makes them live in sin, as Jakobson (1949) puts it. First consider the epigraph to his article under (3).

¹ Original quotes:

"La langue est pour ainsi dire une algèbre qui n'aurait que des termes complexes [...] *[L]a langue est une forme et non une substance.* On ne saurait assez se pénétrer de cette vérité, car toutes les erreurs de notre terminologie, toutes nos façons incorrectes de désigner les choses de la langue proviennent de cette supposition involontaire qu'il y aurait une substance dans le phénomène linguistique." Saussure (1972 [1916]: 169, italics in original)

"Non seulement la science de la langue peut se passer des autres éléments du langage, mais elle n'est possible que si les autres éléments n'y sont pas mêlés." Saussure (1972 [1916]: 31)

(3) Epigraph

"As phonemes are linguistic elements, it follows that no phoneme can be correctly defined except by linguistic criteria, i.e. by means of its function in the language. No extra-lingual criteria can be relevant, i.e. neither physical nor physiological nor psychological criteria." Jakobson (1949: 318)

This sounds like a perfect application of Saussure's doctrine. But two pages later when Jakobson introduces the breakdown of phonemes into distinctive features, he wonders whether this move may be sin:

(4) "In dissociating the phoneme into distinctive features we isolate the ultimate linguistic constituents charged with semiotic value. When determining their specific essence, do we slip from the linguistic level into physical or physiological criteria and sin thereby against the epigraph of this paper?" Jakobson (1949: 320f)

As we will see in section 3.3, Jakobson's answer on the following page is positive: yes we are sinning, and there is no way to avoid sin because otherwise different phonemes could not be distinguished.

My goal is to show that

- most structuralists indeed lived in sin, and that
- they were forced to do so because nobody had thought of the instrument that relates phonological to phonetic items: spell-out.
- R. Jakobson handed the sin down to generative phonology, where, freed from structuralist misgivings under the new persuasion, it appeared in a more radical guise (due among other things to the elimination of the phoneme).

Spell-out is the idea that (in production), phonetic correlates of phonological items come into being only post-phonologically when the speaker accesses a look-up table relating phonological and phonetic items ($\alpha \leftrightarrow [\epsilon]$). What drove structuralists into sin is the question how phonemes (or distinctive features) could be recognized or even talked about if they had no phonetic properties: it would be impossible to know which one is which. Given spell-out, phonological units are indeed identified by their phonetic correlates – but not in the phonology.

The article also shows that structuralists by and large, and foremost the Prague school, chose sin, but there were also righteous structuralists: Baudouin de Courtenay and Louis Hjelmslev, later on in early generative times representatives of Stratificational Grammar (Sidney Lamb, David Lockwood), Erik Fudge, Galina Vasilyevna Voronkova and Mikhail Ivanovich Steblin-Kamenskij. Section 6 discusses the work of the authors mentioned in the post-Hjelmslevian period, knowing that there are surely other names to be added. All stubbornly refused the presence of phonetics in phonology. Spell-out was prefigured by Hjelmslev, Stratificational Grammar and Fudge: phonological units are unnamed entities whose association to phonetic correlates is arbitrary.

The phonetic content of phonological items was handed down from structuralist to generative times in perfect continuity, Roman Jakobson being the connecting link with his student Morris Halle. Thus generative phonology has lived in sin since day one, or rather, it has embraced what was sin in the older conviction: the commandments of Saussure having no governance anymore, Morris Halle and further generativists could sin without being sinners. The accommodation of phonetics in the phonology therefore took a more radical guise: unlike structuralists, they were not doing something that they knew they should not but had to, but rather they did it wholeheartedly and as an axiom of their theory. As we will see in section 5.2,

SPE actually considers alphas, betas and spell-out, but rejects this option. Dresher & Hall (2020) argue that the criterion used by Halle (1959) to organize features into a contrastive hierarchy (minimizing the number of features) ultimately led to the elimination of contrast and the phoneme in SPE, and that another criterion (phonological processing) would have produced generative phonology in a different guise: a road not taken. The rejection of alphas and spell-out by Chomsky & Halle (1968) is another road not taken, and as we will see similar concerns regarding the simplicity of grammar played a role.

Spell-out (which appears in various guises in the literature, see section 2.1) is a cornerstone of Substance-Free Phonology (SFP) that is shared by all versions of this approach: it is precisely the instrument that enables phonology to be substance-free. The founding article of SFP bears *substance abuse* in its title (Hale & Reiss 2000). Apart from the pun regarding the modern American use of the word, *substance* is purposefully chosen in reference to the Saussurian dichotomy *form* vs. *substance*. Hale & Reiss (2000) thus plead for reinstantiating this Saussurian distinction: no phonetics in phonology. Therefore they call their approach Neo-Saussurianism (Hale & Reiss 2000: 162, 2008: 169).

But Charles Reiss and Veno Volenec also see themselves walking in the footprints of the generative tradition where they believe that phonological units were substance-free (Reiss & Volenec 2022: 15f). This is not the case. What SFP is really continuing, or rather, bringing back from oblivion is, besides the original Saussurian position, the heritage of the structuralist mavericks Baudouin de Courtenay and Louis Hjelmslev, and later on in generative times of the other righteous phonologists mentioned. The article thus concludes that SFP finally makes good on Saussure's promise, due to spell-out, which is the instrument allowing for redemption that the structuralist sinners were waiting for: if you know you are sinning, you try to find a way back to the righteous. The generative performing agents of structuralist sin were not hoping for redemption, though, since the official narrative was (or is) that they broke with structuralist commandments: they imbued phonology with phonetics without any consciousness of wrongdoing.

Since Saussure's *Cours* appeared in 1916, there are countless publications on the relationship of phonology and phonetics, running under the heading of *form* vs. *substance*. On the pages below, only primary sources are discussed, i.e. authors who make statements, not authors who dwell on what other authors have said (with the exception of Martinet 1946 and Hintze 1949 in section 4.2.2, who comment on Hjelmslev). A reviewer says that the article is written by a working phonologist for other working phonologists, rather than in a historiographic perspective where external history (who wrote which letter to whom, what is the difference between various editions or manuscripts of a given writing, has the author contradicted himself in other writings, who first noted that some author was first in saying something, and so on) may outweigh linguistic content.² The reviewer is right: the present article is about linguistic content only. It aims at unravelling the position of SFP in the intellectual history of the field, and thus at having the past bear on the present and the future. It

² To take just one example: the fact that Saussure did not write the book that is published as the *Cours* under his name (his students Ch. Bailly and A. Séchehaye did, based on their lecture notes) is irrelevant for the argument. The only relevant thing is that this book has the content it has and had the influence on 20th century linguistics that it had. It is just as irrelevant whether Bailly and Séchehaye faithfully wrote down Saussure's thoughts, or were sloppy, or overinterpreted what they were taught, or introduced their own ideas, or betrayed their master. There is a literature on this kind of question, also fueled by the comparison with Saussure's original manuscripts (Godel 1957) and the appearance of new original documents in 1996 during construction work in his family house. The pages below have no ambition at all to find out or to examine what Saussure thought, whether he really thought what is published in the *Cours*, or whether he maybe thought one thing and its reverse at different points in his life, which is a common situation for scholars. What is relevant for the argument is only what is said in the *Cours*, and how it bore on the further development of phonology.

is meant to be a contribution to our understanding of who is who in the current landscape of the field.

Another issue with the secondary literature I have come across is that it does speak to the specific issue pursued here, i.e. whether there is phonetics in phonology, even in case it is explicitly concerned with the relationship of phonology and phonetics. A case in point is Tobin's (1988) paper entitled *Phonetics versus Phonology: The Prague School and Beyond*. The author goes through a number of quotes from Trubetzkoy and Jakobson and also mentions other secondary literature. But nothing in the quotes, or Tobin's own assessment of the topic, speaks to the subject matter of the present article. It is thus perfectly possible to write a paper about the phonetics - phonology relationship (in structuralism) without asking the question whether phonological items have phonetic properties. The main concern of Tobin is the abstract nature of phonological units, as compared to the physical reality of phonetic items. Tobin's conclusion is given at the outset of his paper: "[t]hus, we may view Prague School phonology as a natural extension of Saussurian phonology" (p. 53). While this is not a counterfactual statement (there is a sense in which Prague protagonists developed Saussure's view), it is irrelevant and misleading for the argument in the present article, as it leaves the reader under the impression that the phonetics - phonology relationship is the same in both cases. We have seen under (4) that it is not, and that R. Jakobson was perfectly aware of this fact.

Tobin (1988: 67, note 1) provides a list of secondary literature on the subject matter of his article. I have not read all items mentioned, but it may be that the yield for the argument to be discussed below is about the same as the one of Tobin's own article. It is indeed for Vachek (1966: 41-43) for instance, who discusses the relationship of phonetics and phonology in Prague school linguistics. He first notes that "Trubetzkoy and Jakobson drew a very sharp line between the two, classifying phonology as a component part of linguistics, while phonetics was assigned a far less respectable status as a mere auxiliary discipline of linguistics" (p. 41f). After discussion and a quote from Bohumil Trnka, Vachek concludes "that the status as separate sciences of both phonology and phonetics cannot be doubted but that their mutual relation is certainly much more complex than the radical line drawn in the early thirties was likely to reveal" (p. 43). Vachek does not mention that what he calls a radical line of division is a view whereby phonological units do have phonetic properties, and that this was recognized to be a sin by Jakobson.

To conclude, the reader will not encounter a balanced report on how authors interpret what the primary phonologists said; rather, the latter are given the word, to see how they viewed the question of phonetics in phonology, and to better understand why different authors and theories did or did not allow for phonetically imbued phonology. An analysis of the plethora of secondary literature on form vs. substance is also precluded by space restrictions: such a project requires another article, whose goal and perspective would be quite different. This being said, broad historiographic sources (Newmeyer 1986, Koerner 2002, Anderson 2021) will appear here and there, providing background information.

Section 2 starts by describing spell-out as conceived in SFP, as well as consequences that define the workings and properties of the approach. The issues introduced will echo in the review of structuralist and generative positions as the article unfolds. Structuralist sinners and the reasons why they chose to live in sin are discussed in sections 3.1-3.4: Kruszewski, Trubetzkoy, Jakobson and Bloomfield. Section 3.5 is about a common ingredient of their view, the *Lautvorstellung* "imagination of a sound", which today would be called an acoustic target. Section 3.6 is about chain shifts and the labelling of phonemes with capital letters in structuralism, showing that phonological units were fully endowed with phonetic content. Section 4 is about the righteous structuralists, Baudouin de Courtenay and Louis Hjelmslev, as well as two critics of the latter, Hintze and Martinet. Rejecting Hjelmslev's incarnation of the absence of phonetics in phonology, the appearance of Martinet in this section completes the list

of Prague School protagonists who have all gone down the road of sin. Section 5 reports the generative position on the subject matter of the article: in section 5.1, it is shown how Roman Jakobson handed down structuralist sin to his student Morris Halle and thus to generative phonology. That sin stands, which unchallenged to the present day (with exception taken by SFP) was set in stone in SPE, where the righteous alternative was considered and rejected (section 5.2). Section 6 is about righteous voices in early generative times, and the vivid reaction against them by representatives of the new theory. Finally, section 7 discusses the view on structuralist and generative sin in SFP.

2. Substance-free Phonology

2.1. Spell-out

Introduced by Hale & Reiss (2000), Substance-Free Phonology is just what its name says it is: the idea that phonology operates without any reference to phonetics, and without knowing that the units manipulated will at some point be pronounced and have a phonetic existence. Thus phonological primes are units whose only purposes are

1. to express contrast
2. to allow for phonological computation

It follows that no name can be given to phonological primes since their only identity is to be distinct from others. Greek letter symbols α, β, γ used to refer to them are just a crutch for our convenience, arbitrarily chosen and interchangeable: whether alpha names the phonological item whose phonetic correlate is labiality ($\alpha \leftrightarrow \text{labiality}$), or beta ($\beta \leftrightarrow \text{labiality}$), or banana ($\gamma \leftrightarrow \text{labiality}$), is irrelevant.³

Phonological primes are eventually pronounced and therefore have a phonetic correlate. In production, phonetic categories come into being when the output of phonology is transmitted to phonetics. This implies a modular setup whereby phonology and phonetics are ontologically distinct computational systems working on distinct vocabulary (Fodor 1983 followed by, among many others, Coltheart 1999, Gerrans 2002, Jackendoff 2002, Carruthers 2006: 3ff, Reiss 2007, Boeckx 2010, Robbins 2017).

The transmission is effected through a look-up table containing a list of spell-out instructions where phonological items are matched with phonetic items, just like in a language dictionary (where e.g. English *dog* is matched with French *chien*). This is shown under (5) below. Note that the symbol used for matching items of distinct vocabularies is $\leftrightarrow$ in post-phonological spell-out, purposefully the same that is used when morpho-syntactic items are translated into phonological items upon post-syntactic spell-out, which is just as arbitrary and involves the exact same kind of look-up table (e.g. in English, *past tense* $\leftrightarrow$ *-ed*). That is, intermodular communication uses only one mechanism, whatever the modules (Scheer 2014, 2020, 2022).

³ This is true for phonological units below the skeleton, i.e. representing place and laryngeal features. The situation of items at and above the skeleton (i.e. projections of sonority) is different: here labels are not arbitrary or interchangeable. That is, an onset is an onset and has cross-linguistically stable properties (it hosts consonants): it could not be called a nucleus. The distinction between items below and at / above the skeleton, as well as its interpretation in SFP, is discussed in Scheer (2022). It need not concern us here: the argument regarding phonetics in phonology, also historically since Saussure's *Cours*, has never concerned syllable structure.

- (5) spell-out instructions:
 substance-free melodic primes associated with their phonetic correlates
- | | | |
|----------|-------------------|------------|
| α | $\leftrightarrow$ | palatality |
| β | $\leftrightarrow$ | occlusion |
| γ | $\leftrightarrow$ | velarity |

This list-based translation appears in various guises in the literature: as cue constraints in the BiPhon model (Boersma & Hamann 2008, Hamann 2011), as phonetic interpretation (Harris & Lindsey 1995: 46ff, Gussmann 2007: 25ff, Cyran 2014), as transduction in Hale & Reiss (2008: 109-118), or in its incarnation used here, post-phonological spell-out (Scheer 2014, 2019, 2022).⁴

The phonetic correlates under (5) are articulatory properties for expository reasons. In the BiPhon model (Boersma & Hamann 2008), the vocabulary of the phonetic computational system is acoustic: the auditory continuum is expressed as an auditory spectral mean along the ERB scale (Equivalent Rectangular Bandwidth). That is, spell-out associates for example $s \leftrightarrow 20,1$ ERB. This reads "s is realized with a spectral mean of 20,1 ERB". The discrete ERB value thus defines the acoustic target of the pronunciation to be realized. The computation carried out in the phonetic module then creates slight variation around this target.

In the discussion below, we will meet the idea that production involves an acoustic target in the guise of the structuralist notion *Lautvorstellung* "imagination of a sound" (section 3.5).

2.2. Computation

Given spell-out, a regular palatalization expressed with classical substance-laden primes under (6)a identifies as (6)b in the substance-free setting, where α , β and γ have the phonetic correlates under (5).

- (6) palatalization
- | | | |
|----|--|-----------------|
| a. | $k, g \rightarrow \text{ʃ}, \text{dʒ} / __ i, e$ | substance-laden |
| b. | $\beta, \gamma \rightarrow \beta, \gamma + \alpha / __ \alpha$ | substance-free |

Note that phonological computation is arbitrary: it may add or remove primes (associate or dissociate in an autosegmental structure) in any way, and the trigger may be anything or its reverse. Thus any segment may be turned into any other segment in any context (Hale & Reiss 2008: 162-171). Danesi (2022) discusses in detail how primes and their phonetic correlates are established based on the alternations found in a language, and how substance-free computation works given these settings.

2.3. There is nothing wrong with being lazy

In practice, there is nothing wrong with using substance-laden labels when talking about phonology, provided it is understood that this is merely shorthand for (6)b. Chemists talk about *water* when they mean H₂O, and *black holes* are neither black nor holes, but astronomers are happy to use this term. Phonologists also talk about, say, *cat* in various degrees of explicitness: *cat* in spelling, [kæt] in IPA; syllable structure may be added to that, as well as the featural makeup of segments.

⁴ Note that all authors quoted agree that there is a form of spell-out translating the output of phonology into phonetic categories, but that this does not mean that all of them believe that phonology is substance-free. Harris & Lindsey (1995) for instance (as well as other representatives of Government Phonology where phonological primes are Elements) do not.

It may thus be understood that substance-laden features are in fact alphas, betas and gammas, but that it is more convenient to talk about their phonetic correlates when referring to them. In fact much of the SFP literature does exactly that (sometimes without making laziness explicit, though). That is, phonologists are merely lazy, trying to facilitate communication when using substance-laden labels to talk about phonology, just as chemists are lazy when talking about *water*. The difference is that every chemist knows that *water* is not the real object they are talking about, while phonologists are not aware of their laziness: they believe that the phonological item they talk about really has phonetic properties. One goal of SFP is to raise phonologists' awareness that they are lazy.

2.4. No naturalness (in phonology)

Phonology has no clue how its product will eventually be pronounced, or indeed that it will be pronounced at all: this follows from the fact that phonological primes α , β , γ are substance-free. A direct and necessary consequence is that no phonetic constraint can bear on phonology. This means, in turn, that naturalness has no business in phonology. On the question of naturalness in the phonological literature and its status in SFP, see Chabot (2021).

The mainstream view going back to the 19th century is that phonology is responsible for naturalness, i.e. the observation that the overwhelming majority of phonological patterns and processes make sense phonetically speaking. Thus a palatalization of the kind shown under (6)a ($k, g \rightarrow \text{ʃ}, \text{dʒ} / __ i, e$) will be called a natural process, while English velar softening where the output of palatalization is s ($k \rightarrow s / __ i$ as in *electri[k]* - *electri[s]-ity*) will be regarded as suspicious, also because it does not occur morpheme-internally (*king* is not pronounced $[\text{siŋ}]$) and is only triggered by class 1 suffixes (Kiparsky 1982: 40f). Finally, there are processes that are called crazy rules (Bach & Harms 1972) because they make no phonetic sense: $i \rightarrow u / d __$ found in Kashaya Pomoan (Pomo, California) is a case in point (Buckley 2000, 2004).

The only possible definition of naturalness is phonetic: something is natural because the phonetic properties of an item influence the phonetic properties of another item (palatalization is assimilation: front vowels make non-front velars more front).

If there is no phonetics in phonology, there is no way phonology could possibly be held accountable for naturalness, or its absence. If phonology is made of α , β , γ , it is not even possible to talk of anything being natural or unnatural. Thus the substance-free statement (6)b $\beta, \gamma \rightarrow \beta, \gamma + \alpha / __ \alpha$ may refer to the perfectly natural palatalization (6)a, but could as well describe the reverse unnatural event $\text{ʃ}, \text{dʒ} \rightarrow k, g / __ i, e$, or the crazy Kashaya Pomoan rule. The SFP literature discusses a number of formal (i.e. substance-unrelated) properties that restrict what computation can do,⁵ but these do not bear on the fact that any segment may be turned into any other segment in any context. Therefore phonology is just as happy to compute natural rules as it is to compute suspicious or crazy rules.

Naturalness in sound patterns surely exists, but has nothing to do with phonology. Its only source is phonetics, and it arises because phonological processes have phonetic precursors, which at some point are phonologized. Phonetic precursors are always natural since they are phonetic, and phonology inherits them (e.g. Bermúdez-Otero 2015).

⁵ Based on Odden's (1988) empirical observation that vowel deletion may be triggered ("delete a vowel only if flanking consonants are identical") or blocked ("delete a vowel unless flanking consonants are identical") by the identity of adjacent consonants, Reiss (2003) elaborates on the exact definition deciding whether two segments are identical or non-identical. Among other patterns that seem to be absent from the record (p. 323ff), he observes that there do not appear to be cases where non-identity is calculated over a subset of features, such as for instance vowel deletion blocked when one of the place features of the flanking consonants is different (but not when a manner feature is). Another formal restriction is Danesi's (2022: 447) No Ex Nihilo Hypothesis: "[p]honological computation cannot manipulate primes that are absent from the representation of the target and the trigger."

In section 3.6 below, we will come across an example of naturalness, chain shifts restoring the equilibrium of vowels in phonetic space, which structuralist analysis takes to be a consequence of a phonological reaction against an imbalanced system. This phenomenon also has a phonetic rationale, vowel dispersion, which by SFP standards is the only viable explanation.

2.5. Two schools in SFP: primes are emergent or universal and innate

All versions of SFP agree on the workings of spell-out described in the previous section. There are two competing views on other properties of spell-out, though. They concern the question whether phonological primes and their association to phonetic correlates is universal and innate, or rather emergent upon L1 acquisition. This is illustrated under (7) below where the latter view appears under (7)a, the former under (7)b. The take under (7)a is also referred to as Radical SFP (Odden 2022).

(7) two schools in SFP

	phonology	mapping	phonetics
	α	$\longleftrightarrow$	[x]
	β	$\longleftrightarrow$	[y]
	γ	$\longleftrightarrow$	[z]
	phonological primes present at birth?		associations present at birth?
a. SFP except Concordia	no		no
b. Concordia	yes		yes

The view under (7)b is taken by authors working (or formerly working) at Concordia University in Montreal, i.e., where Hale and Reiss found their academic home. In this view, both primes and their association to phonetic categories are genetically coded and present at birth: there is a universal set of around 20-30 substance-free primes (α , β , γ) from which L1 learners draw items when building their system, and which are associated to specific phonetic categories (Hale *et al.* 2007: 647f, Volenec & Reiss 2018, see also Hale & Reiss 2000, 2008, Reiss 2017, Volenec & Reiss 2022).

In the relevant literature, this is often referred to as the idea that there is a universal and innate list of distinctive features such as [labial], [voice] etc. But it is important to note that this is just a shortcut, or laziness in the sense of the section 2.3: what representatives of the Concordia view mean is that there is a universal and innate list of alphas, betas and gammas that are universally and innately associated to specific phonetic correlates. The phonological items themselves do not have any phonetic property: "[labial]" is merely shorthand for "the phonological item associated to labiality."

All other representatives of SFP, declared as such (Blaho 2008, Odden 2006, 2022, Samuels 2011a,b, 2012, Scheer 2014, 2022, Iosad 2012: 6ff, 2017, Chabot 2019, 2021, 2022, 2023, Danesi 2022) or under a different heading (Boersma 1998: 461ff, 2011, Boersma & Hamann 2008, Hamann 2011, 2014, Mielke 2008, Carvalho 2002, Drescher 2014, 2018), hold that primes are emergent, i.e. absent at birth, and that their association with phonetic categories is learned during first language acquisition. Overviews of this landscape are proposed by Scheer (2019) and Samuels *et al.* (2022).⁶

⁶ A third approach combines the two views (Scheer 2022): sonority and its phonetic correlates are universal and innate, while place and laryngeal properties are emergent. Like vocal language (sonority, place and laryngeal properties), sign language divides into three types of distinctions: movement, handshape and location (e.g. Sandler & Lillo-Martin 2006: 111-245). In this setting, the phonetic correlates of sonority, prominence or perceptual

2.6. Arbitrariness of association

In the emergentist view, the association of a phonological prime with a phonetic correlate is arbitrary. Any phonetic category may in principle be associated to any prime: there are no cross-linguistically stable or innate associations. The symbol $\leftrightarrow$ materializes the arbitrary character of the association just like at the upper interface of phonology, where any morpho-syntactic property may be associated to any phonological item: there is no cross-linguistically stable or innate association at this interface either.

At both interfaces, the associations are language-specific, learned during L1 acquisition, stored in long-term memory and subject to diachronic evolution. That is, the association *past tense* $\leftrightarrow$ *-ed* is in place in English, but arbitrary in the sense that in another language *past tense* may be associated to another phonological item. The same holds for spell-out instructions at the phonology-phonetics interface, e.g. for $\alpha \leftrightarrow$ labiality.

3. Structuralist sinners

The goal of this and the following section is to evaluate the attitude of structuralists regarding the question whether phonetic content is present in phonology. Phonological units in structuralism are foremost phonemes, later on distinctive features introduced in 1928 by Jakobson *et al.* (1928) (not yet under the name of distinctive features: the authors talk about correlations that are made of binary oppositions⁷) and worked out in Jakobson (1939) (see for example chapters five and six of Anderson 2021).

What is substance-free in SFP are phonological primes, i.e. distinctive features or unary primes (such as Elements |A|, |I|, |U|). Although it does not make sense to say that phonemes are substance-free (because they decompose into primes), the discussion below evaluates whether they are substance-laden or substance-free in structuralist writings.

The question is thus whether for structuralists the label of a phoneme referred to as /E/ is just laziness in the sense of section 2.3, or really indicates that the unit at hand is a mid front unrounded articulation *in the phonology*.

3.1. Kruszewski

Baudouin de Courtenay (1895: 7, note 1) acknowledges that the distinction between sound (German *Laut*) and phoneme (German *Phonem*) is due to his student Mikołaj Kruszewski (both being Polish, they worked at the University of Kazan in Russia, and are referred to as the Kazan school, see Radwańska-Williams 2021, Anderson 2021: 69ff). He adds that his understanding of the phoneme has changed over time, originally leaning on the one introduced by Kruszewski (1881) when he coined the word phoneme.

Kruszewski defines the phoneme as follows, in a few words only and without further elaboration:

salience, may be modality-unspecific: Sandler (1993: 253) says that "some kind of movement is necessary for a well-formed sign, just as a vowel, or, in its absence, some other sonorous element, is necessary for a well-formed syllable in spoken language. It has also been noted that movement is perceptually salient, just as vowels are perceptually salient in spoken language."

⁷"A phonological correlation consists of a series of binary oppositions defined by a common principle that can be thought of independently of each pair of opposing terms" Jakobson *et al.* (1928: 33, my own translation). Original: "Une corrélation phonologique est constituée par une série d'oppositions binaires définies par un principe commun qui peut être pensé indépendamment de chaque couple de termes opposés."

- (8) "I propose using the term 'phoneme' to refer to the phonetic unit (i.e., that which is phonetically indivisible), as opposed to 'sound' – the anthropophonic unit." Kruszewski (1881: 14, note 1, my own translation)⁸

Kruszewski's idea is to separate what humans produce (sound, referred to as the anthropophonic unit) and what the phonetic identity of these sounds is: this identity is phonetically atomic, i.e. cannot be further divided. The idea that the variation produced by pronunciation is the expression of a single unit, the phoneme, will have an important offspring (see section 3.5).

But for now let us note that the phoneme enters the scene in an explicitly phonetic guise: it is entirely made of phonetic substance.⁹

3.2. Trubetzkoy

Representatives of the Prague school leave no doubt that phonological units do bear phonetic content. This is because, they argue, phonemes are identified by their phonetic properties. How would you know which phoneme is which other than by their phonetic characteristics?

In his *Grundzüge*, Trubetzkoy is explicit on that: in the quote under (9), the distinctiveness of the phonemes at hand is based on the phonetic property of voicing which, Trubetzkoy says, must therefore characterize phonemes in the phonology.

- (9) "As regards phonology, it is clear that it must make use of certain phonetic concepts. For instance, the claim that in Russian the contrast between voiced and voiceless obstruents is used to differentiate between words, belongs to the field of phonology. [...] Despite their fundamental independence, a certain amount of contact between phonology and phonetics is therefore inevitable and absolutely necessary." Trubetzkoy (1969 [1939]: 14)¹⁰

Trubetzkoy tries to have his cake and eat it too, though: yes phonological units have phonetic content, but sure phonology and phonetics are fundamentally independent. It is just the word *fundamental* and its interpretation that saves Trubetzkoy from schizophrenia. This is the consciousness of sin tempting Trubetzkoy and others into a contradiction: there is no explanation how phonology could be independent of phonetics, while accommodating it. Being thus conscious of his sin, Trubetzkoy continues the quote under (9) by saying that maybe there is phonetics in phonology, but just a little, only what is strictly necessary. Note that the meaning of the crucial word in the quote below, *Anfangsteile* in the original German text, is entirely obscure (literal translation: *beginning (or initial) pieces*).¹¹

⁸ Original: "Mit dem Namen Phonem schlage ich vor die phonetische Einheit (d. h. das, was phonetisch untheilbar ist) zu benennen, zum Unterschied vom Laute – der anthropophonischen Einheit."

⁹ This is the origin of the phoneme in the meaning it has had ever since. The word *phoneme* as a term in linguistics is older, though, as the historiographic literature reveals: Mugdan (2011) traces it back to a presentation by Antoni Dufriche-Desgenettes to the Société de Linguistique de Paris in 1873, of which only an indirect (and anonymous) review reporting the introduction of this term exists, in the *Revue critique d'histoire et de littérature* 7.1, page 368. This review explains that the new term is handy since it refers to all consonants and vowels, i.e. what today would be called a segment.

¹⁰ Original: "Was die Phonologie betrifft, so muß sie selbstverständlich von gewissen phonetischen Begriffen Gebrauch machen. So gehört z. B. die Behauptung, daß der Gegensatz zwischen stimmhaften und stimmlosen Geräuschlauten im Russischen zur *Wortunterscheidung* verwendet wird, in den Bereich der Phonologie. [...] Somit ist ein gewisser Kontakt zwischen der Phonologie und der Phonetik trotz ihrer grundsätzlichen Unabhängigkeit unvermeidlich und unbedingt notwendig." Trubetzkoy (1939: 17, emphasis in original)

¹¹ It is unclear what the initial pieces, or maybe stages, of phonological and phonetic description could refer to: what would then be non-initial pieces / stages thereof? To explain, Trubetzkoy adds *Elementenlehren* in brackets,

- (10) "But only the introductory sections [German Anfangsteile] (i.e., the sections on the base elements) of a phonological and a phonetic description should take each other into account. Here, too, the limit of what is absolutely necessary should not be overstepped." Trubetzkoy (1969 [1939]: 14)¹²

What Trubetzkoy says expresses the doctrinal body of the Prague School defined in the nine theses published (unattributed) in the first issue of the *Travaux du Cercle Linguistique de Prague*. Here is a piece of thesis Nb. 2:

- (11) "Subjective acoustic-motor images are elements of a linguistic system only insofar as they fulfill a function of differentiating meanings within that system. The sensory content of such phonological elements is less essential than their reciprocal relationships within the system (structural principle of the phonological system).

[...]

The phonological system must be characterized, i.e., the repertoire of the simplest and most significant acoustic-motor images in a given language (*phonemes*) must be established." Cercle Linguistique de Prague (1929: 10f, my own translation, italics in original)¹³

Thus the phonetic content of a phoneme is "less essential" than the correlations it contracts with other phonemes. But it exists. Also note that the set of phonemes of a language is defined as the list of "acoustico-motor images" (on which more in section 3.5).

3.3. Jakobson

The quotes under (3) and (4) have shown Jakobson's (1949) consciousness of sin against the Saussurian insight. The latter quote ends with a question mark: when we determine the "specific essence" of distinctive features, are we sinning against Saussure? The answer appears on the following page: yes we are, and there is no way to avoid the sin.

which the English translation renders as "(i.e., the sections on the base elements)". Here as well, it is fully mysterious what the German word means, and the poor translator has made a choice that does not mean anything either. Whatever the exegetic effort, it may be doubted that we will be able to ever understand what Trubetzkoy meant with *Anfangsteile* and *Elementenlehren*.

¹² Original: "Dabei dürfen aber nur die Anfangsteile der phonologischen und der phonetischen Beschreibungen (die Elementenlehren) aufeinander Rücksicht nehmen, und auch da darf die Grenze des unbedingt Notwendigen nicht überschritten werden." Trubetzkoy (1939: 17)

¹³ Original: "les images acoustico-motrices subjectives ne sont des éléments d'un système linguistique que dans la mesure où elles remplissent, dans ce système, une fonction différenciatrice de significations. Le contenu sensoriel de tels éléments phonologiques est moins essentiel que leurs relations réciproques au sein du système (principe structural du système phono- logique). [...] Il faut caractériser le système phonologique, c'est-à-dire établir le répertoire des images acoustico-motrices les plus simples et significatives dans une langue donnée (*phonèmes*)." Cercle Linguistique de Prague (1929: 10f, italics in original)

- (12) "And now to return to our starting point: since phonemes are linguistic elements, they are subject to a strictly linguistic analysis which must *specify* all the underlying oppositions and their interrelations. The specific property of any opposition, the phonic nucleus utilized semiotically, must be exactly identified. Otherwise even a rudimentary listing of the phonemes of a given language becomes a *scientifically* insoluble problem.

[...]

Only in resolving the phonemes into their constituents and in identifying the ultimate entities obtained does phonemics arrive at its basic concept." Jakobson (1949: 322, italics in original)

Note that "the phonic nucleus" (where *phonic* means phonetic) of an opposition is its *nucleus*, i.e. its most intimate property. This is not being lazy: phonetics are really an essential property of the phoneme, says Jakobson.

Trubetzkoy's and Jakobson's argument for the presence of phonetic content in phonemes is thus that in its absence, it would be impossible to know which one is which phoneme: "the phonic nucleus" is "utilized semiotically", i.e. to distinguish phonemes.

This argument is sound, but Trubetzkoy's and Jakobson's conclusion that therefore the pronunciation must be in-built into the phoneme is faulty: spell-out was not on their radar. The association of phonological and phonetic items as under (5) in a spell-out dictionary allows phonologists to recant sin. Spell-out identifies phonological items by how they are pronounced, yet without placing the pronunciation in the phonology. Jakobson's (and Trubetzkoy's) redemption hinged on spell-out, which makes good on Saussure's promise.

3.4. Bloomfield

Leonard Bloomfield describes how those acoustic properties that are distinctive are bundled by the listener and in their acoustic shape constitute what is called a phoneme:

- (13) "Among the gross acoustic features of any utterance, then, certain ones are distinctive, recurring in recognizable and relatively constant shape in successive utterances. These distinctive features occur in lumps or bundles, each one of which 'we call a phoneme. The speaker has been trained to make sound-producing movements in such a way that the phoneme-features will be present in the sound-waves, and he has been trained to respond only to these features and to ignore the rest of the gross acoustic mass that reaches his ears." Bloomfield (1933: 79)

While distinctive features were introduced in 1928 by Jakobson *et al.* (1928), they did not run under this name then (see note 3). Bloomfield uses the term distinctive feature already in 1933, and says they are the building blocks of phonemes. There is no doubt that Bloomfield really means that acoustic properties are present in the phoneme: acoustic features are "recurring in recognizable and relatively constant shape in successive utterances". They are thus portions of the acoustic signal. In production, Bloomfield says, the speaker has learned to articulate in such a way that "phoneme-features will be present in the sound-waves".

3.5. Sin in the definition of the phoneme: Lautvorstellung

Twaddell (1935) reviews different ways in which the phoneme is defined in the literature of his time (see Anderson 2021: 376ff). He classifies the approaches into two groups: those contending that the phoneme is a mental or psychological item (what today would be called cognitive), and those arguing that it is a physical reality.

The latter goes back to the definition by Kruszewski (1881) (recall section 3.1). The relevant observation is that speech sounds have infinitely variable pronunciations, but still represent the same object: the p in *path* has millions of different phonetic realizations, but still is a "p" for both the speakers and the perceivers. "It is the recognition of this sameness, this effective unity, which has found expression in the term 'phoneme' as a unit of spoken language" (Twaddell 1935: 5). Twaddell further explains that the phoneme is a creature of the increased instrumental accuracy of phonetic investigation:

- (14) "In many ways, this concept of unity is not recent; its apparent newness is a product of the increased accuracy of phonetic observation which has accumulated evidence of almost infinite variety in the actual 'sounds' of speech (as articulations and sound-waves). [...] Before accurate phonetic observation had established the objective variety of the sounds of speech, there was obviously no necessity for such a distinction; earlier students could say 'sound' and mean both the objective articulatory and acoustic phenomenon on the one hand, and the structural unit on the other." Twaddell (1935: 5f)

The competing mentalist idea is well described by the German word *Lautvorstellung* "the imagination of a sound" found for example in Baudouin de Courtenay (1929: 39) or Trubetzkoy (1929), who uses *Phonem* and *Lautvorstellung* synonymously:

- (15) "Unlike *phonetics*, which is a natural science concerned with the *sounds* of human *speech*, *phonology* deals with the phonemes or *Lautvorstellungen* of human *language* and is therefore part of linguistics." Trubetzkoy (1929: 39, emphasis in original, my own translation)¹⁴

Lautvorstellung also appears as *Psychophon* (as opposed to *Physiophon*, Benni 1929: 35f), *image articulatoire et auditive* "articulatory and auditive image" (Sommerfelt 1971 [1928]: 199) or as *images acoustico-motrices* "acoustico-motor images" in the definition of the doctrinal body of the Cercle Linguistique de Prague in 1929, see the quote under (11). Twaddell (1935: 8f) quotes still more authors going by this definition of the phoneme, and interestingly not a single source is written in English.

What this means is that the cognitive unit *phoneme* consists of a phonetic target: the auditory and articulatory image of the pronunciation that was intended by the speaker. This intended pronunciation then experiences a number of distortions when put to use, creating the phonetic variation observed. The task of the listener is to reconstruct what was intended from the variable acoustic signal.¹⁵

The idea that a phonological unit is externalized thanks to an acoustic target is taken up in much modern work, including the literature discussed in section 2.1. It is an exact instantiation of the spell-out mechanism (5), except that the acoustic target was misplaced by Trubetzkoy and colleagues: since they had not thought of a spell-out mechanism, the only possible locus of the acoustic target was in the phoneme itself. That is, the phoneme *is* the *Lautvorstellung* = the acoustic target. With a spell-out mechanism, the phonological unit

¹⁴ Original: "Im Gegensatz zur *Phonetik*, die eine Naturwissenschaft ist und sich mit den *Lauten* der menschlichen Rede befaßt, hat die *Phonologie* die Phoneme oder *Lautvorstellungen* der menschlichen *Sprache* zum Gegenstand und ist demnach ein Teil der Sprachwissenschaft."

¹⁵ The idea that the tension between intended and actual pronunciation plays an important role in phonology has a modern offspring: in Natural Phonology, this is the very definition of phonology: "Phonology is the study of the categorical discrepancies between speech as it is perceived and intended, and speech as it is targeted for actuation" Donegan & Stampe (2009: 1). According to Ohala (1981) and much subsequent work, sound change is initiated when listeners fail to undo the distortions that acoustic and articulatory artefacts introduce into the acoustic signal when they attempt to reconstruct the pronunciation that was intended by the speaker.

(phoneme or feature) is exempt from any acoustic target. Rather, the acoustic target is the phonetic item into which the phonological unit is translated (through a look-up list).

The conclusion is the leitmotif of this article: most structuralists, here those of the Prague School, had to live in sin because they had not thought of phonology and phonetics in terms of a modular structure where both systems are related by a spell-out mechanism.

3.6. Chain shifts

The basic building blocks of structuralist analysis are phonemes. A substantial concern of structuralism is how exactly linguists can determine the set of phonemes and their relationship (correlations), given the phonetic surface. This was called the discovery procedure, or phonemic analysis (e.g. Hockett 1942: 20f, Drescher 2009: 13-19). But the literature is less loquacious explaining how a phoneme becomes a phonetic realization upon speech production.

Structuralism is known for the large amount of slack that was allowed between phonemes and their phonetic realization. Or rather, for the lack of ambition to determine which allophone deserves phonemic status. Thus in a language where [e] and [ɛ] are in complementary distribution, will the phoneme be /e/ or /ɛ/? Structuralists would not bother with this question and rather say that the phoneme is /E/, i.e. a vowel located in the area of /e/ and /ɛ/. It is not useful to be more precise regarding its phonetic properties since apart from its correlations with other units, the only important thing for a phoneme is to be different from other phonemes, here from /O/, /I/, /U/, /A/ in a 5 vowel system.

How much [e] or [ɛ], if any, is there in a structuralist phoneme referred to as /E/? Is E chosen to substantiate the phoneme at hand because of its phonetic essence, a front mid unrounded vowel? Or are the phonetic properties used to characterize phonemes just shorthand for naming phonological items that do not have any phonetic properties? In other words, is this merely a case of laziness in the sense of section 2.3? If so, could a five vowel system /A E O I U/ (16)a just as well identify as /α β γ δ ε/ (16)b? That is, is the phonetic content of the former a mere artefact and could be done away with if linguists were less lazy?

(16) 5 vowel system

a. substance-laden phonemes

I	U
E	O
A	

b. substance-free phonemes

α	ε
β	δ
γ	

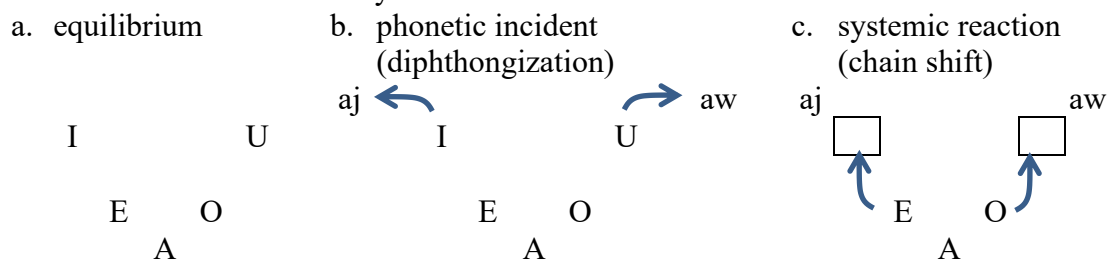
The answer is no: structuralist phonemes are located in the vocalic triangle and thus have a phonetic anchor. By contrast, alphas and betas have no location in any phonetic space: their arrangement on the phonetic triangle under (16)b to parallel (16)a is nonsense. There is no way in which α is any more front, back, round or high than β etc. Alphas and betas as well as the phonological computation that manipulates them have no clue that phonetic substance exists, and that they will eventually end up being pronounced.

Saussure's perspective, again, is fully substance-free. Given the quote under (17), he disagrees with the presence of any phonetic content in phonemes. The only thing that makes the identity of a phoneme, its only property, he says, is its distinctiveness with respect to other phonemes.

- (17) *"The characteristics of the unit blend with the unit itself. In language, as in any semiological system, what distinguishes a sign is everything that constitutes it. It is difference that creates character, just as it creates the value of the unit."* Saussure (1972 [1916]: 168, italics in original, my own translation, the translation in the 1959 English edition being inaccurate)¹⁶

A central idea that was introduced by structuralism and makes a good deal of its identity is that phonemes are arranged in systems, which produce systemic pressure: they strive for equilibrium. Chain shifts (Gordon 2011) such as the Great Vowel Shift that occurred at the end of the Middle English period (e.g. Krug 2017) are typical illustrations of systemic action: given a symmetrical system in equilibrium (18)a, the initial spark is a change in the pronunciation of a phoneme or of a set of phonemes caused by some phonetic or other factor, here the diphthongization of high vowels under (18)b. Once the phonetic space is thus vacated, neighbouring phonemes move to occupy it: under (18)c, E and O raise to I and U, respectively. That is, they change their pronunciation because they are phonetic neighbours: Martinet (1955) calls this movement a drag chain or pull chain (see Anderson 2021: 218ff).

(18) chain shift: structuralist analysis



On the structuralist analysis, chain shifts occur in the phonology: the items involved are phonemes, and the evolution observed is caused by a systemic reaction. The phoneme labels necessarily note phonetic content that is present in the phonology: E and O need to "know" that they are mid and therefore move in order to fill in the vacancy left behind by their phonetic neighbours I and U. A does not move into the position of I or U because it is not phonetically adjacent.

Also note that on the structuralist analysis, phonemes change labels when their pronunciation is changed: E raises to occupy blank phonetic space, and as a result becomes I. This also shows that the phonological identity of phonemes is determined by the way they are pronounced.

In a substance-free perspective where the phonological identity of phonemes has nothing to do with how they are pronounced, the chain shift under (18) involves five phonemes, whose pronunciation changes over time, as under (19). Their labels cannot change because they do not have any: a given phoneme, say β under (19), is pronounced [e] before, [i] after the shift.

¹⁶ Original: *"les caractères de l'unité se confondent avec l'unité elle-même. Dans la langue, comme dans tout système sémiologique, ce qui distingue un signe, voilà tout ce qui le constitue. C'est la différence qui fait le caractère, comme elle fait la valeur de l'unité."* Saussure (1972 [1916]: 168, italics in original)

(19) chain shift: substance-free analysis

before the shift			after the shift		
α	$\leftrightarrow$	[i]	α	$\leftrightarrow$	[aj]
β	$\leftrightarrow$	[e]	β	$\leftrightarrow$	[i]
γ	$\leftrightarrow$	[a]	γ	$\leftrightarrow$	[a]
δ	$\leftrightarrow$	[o]	δ	$\leftrightarrow$	[u]
ε	$\leftrightarrow$	[u]	ε	$\leftrightarrow$	[aw]

The shift is caused by the same mechanism that was identified by the structuralists, but has nothing to do with phonology or phonemes. The description of the facts refers only to phonetic items: how phonemes are *pronounced*, how a blank spot is created in *phonetic* space, and how the *pronunciation* of other phonemes changes in order to rebalance the distribution of phoneme *pronunciations* in the *phonetic* space.

The number of phonemes and their correlations have not changed over time: the only thing that has changed is their pronunciation, creating an unequally populated phonetic space.

The structuralist idea of self-equilibrating systems was based on the observation that given the articulatory (and acoustic) space defined by buccal anatomy, vowel and consonant systems place individual vowels/consonants in such a way that they equally occupy this space. That is, the distance between vowels (or consonants) is maximized and their distribution is symmetric. A number of asymmetric systems notwithstanding, this is confirmed by modern typological reviews, e.g. Lass (1984), Clements (2003, 2009), Hall (2011). Following the structuralist model, these authors devise phonology-internal mechanisms to account for the observation.

An extra-phonological alternative is dispersion, a phonetic rationale based on perception, learnability or other non-phonological mechanisms. The most popular perception-based approach holds that optimizing the articulatory space by maximizing distance and phonetic dissimilarity among segments enhances perceptibility (Liljencrants & Lindblom 1972, Lindblom 1986, Schwartz *et al.* 1997, Johnson 2000). Vaux & Samuels (2015: 573) argue that dispersion is due learnability: "[a] system that is easier to learn (e.g., one whose members are more dispersed in perceptual space) is predicted by our model to become more common cross-linguistically over evolutionary time than its less learnable competitors."

Grammar or UG have nothing to do with the self-equilibration of systems via dispersion: phonology is just as happy with a dispersed i-a-u system as it would be with an undispersed i-e-a or y-ə-o system. If phonology is substance-free, the self-equilibrating virtue of segment inventories in the phonetic space has nothing to do with phonology or grammar: it is a purely phonetic event due to functional factors.

This section was to show that typical structuralist labels of phonemes such as E are not just shorthand. That is, the label E is not chosen out of laziness, but rather describes what is held to be the true phonetic content of the phoneme. Thus on this common structuralist take, phonetic content is present in the phonology.

4. Righteous structuralists

4.1. Baudouin de Courtenay

There are also structuralists who deserve grace: Baudouin de Courtenay and Louis Hjelmslev (see chapters four and seven of Anderson 2021 for background information).

At the outset of his book on alternations, Baudouin de Courtenay (1895) provides some "explanation and definition of terms", among which the phoneme:

- (20) "The phoneme = a uniform concept belonging to the phonetic world, which arises in the soul through the psychological fusion of impressions obtained by pronouncing one and the same sound = psychological equivalent of the speech sound. The uniform concept of the phoneme is linked (associated) with a certain sum of individual anthropophonic concepts, which are, on the one hand, articulation concepts, i.e., concepts of completed or ongoing physiological articulation processes, and, on the other hand, acoustic ideas, i.e., ideas of the results of those physiological processes that have been heard or are in the process of being heard." Baudouin de Courtenay (1895: 9, my own translation)¹⁷

Thus the phoneme is the "psychological equivalent of the speech sound", built in the soul upon exposure to phonetic input. The phoneme is *associated* with articulatory and acoustic values. This is an exact description of the workings of spell-out under (5): the phonological item is *associated* with phonetic correlates, but has no phonetic content itself.¹⁸ Baudouin de Courtenay does not dwell on how exactly the association converts phonological into phonetic items, though.

4.2. Hjelmslev

4.2.1. Algebra, unnamed entities, arbitrary association

Baudouin de Courtenay is not explicit on what the essence of phonemes is, i.e. how they should be called. Recall from section 3.3 that this was the stumbling block that made Jakobson (1949) give in to sin. Louis Hjelmslev makes good on this: echoing Saussure's algebra mentioned under (1), under (21) he describes the theory ("such a science") that he will be introducing by its name on the following page: glossematics (units of which are glossems).

- (21) "Such a science would be an algebra of language, operating with unnamed entities, i.e., arbitrarily named entities without natural designation, which would receive a motivated designation only on being confronted with the substance." Hjelmslev (1969 [1943]: 79)

Phonemes have no natural designation and are therefore unnamed, or arbitrarily named entities: exactly what alphas, betas and gammas convey under (5). They receive a motivated designation only when "confronted with the substance": while this is not very informative, Hjelmslev is more explicit in an early article entitled "On the relationship of phonetics with linguistics", published in a phonetics journal:

- (22) "Form is completely independent of substance, and the relationship between form and substance is entirely arbitrary and purely conventional." Hjelmslev (1938a: 215, my own translation)¹⁹

¹⁷ Original: "Das Phonem = eine einheitliche, der phonetischen Welt angehörende Vorstellung, welche mittelst psychischer Verschmelzung der durch die Aussprache eines und desselben Lautes erhaltenen Eindrücke in der Seele entsteht = psychischer Aequivalent des Sprachlautes. Mit der einheitlichen Vorstellung des Phonems verknüpft sich (assoziiert sich) eine gewisse Summe einzelner anthropophonischer Vorstellungen, welche einerseits Articulations- Vorstellungen, d. h. Vorstellungen vollzogener oder in Vollziehung begriffener physiologischer Articulationsarbeiten, andererseits [sic] aber akustische Vorstellungen, d. h. Vorstellungen gehörter oder im Gehörtwerden begriffener Resultate jener physiologischer Arbeiten, sind."

¹⁸ The quote opens with "The phoneme = a uniform concept belonging to the phonetic world", which appears to place the phoneme in phonetics. This is contradicted by what follows, though. It may be doubted that we will be able to understand this (apparent) inconsistency from hindsight.

¹⁹ Original: "Die Form ist von der Substanz ganz unabhängig, und das Verhältnis von Form und Substanz ist ein ganz arbiträres und rein konventionelles."

The relationship of phonological (form) and phonetic (substance) items is thus arbitrary and conventional. This is exactly how spell-out instructions (5) work, and what is implied by Baudouin de Courtenay's association: an alpha can be associated to any phonetic correlate. Recall from section 2.4 that there is no way to even talk about anything being natural or unnatural in the phonology if phonological items are alphas and betas, precisely because they have no intrinsic phonetic content and may be associated to any such content.

Hjelmslev (1938b: 140) in fact crafted a better term than alphas and betas to refer to phonological units: *cenemes* (or *cenematemes*), from Greek χενός "empty". They are opposed to *pleremes* (or *plerematemes*), from Greek πλήρης "full", which are phonetic items.

The basic argument used by Hjelmslev to show that Saussurian form is distinct and independent from substance is the fact that substance is interchangeable:

- (23) "Danish when spoken, Danish when written, Danish when telegraphed by means of the morse code, Danish when signalized by means of the international flag code of the navies, is, in all these cases, essentially one and the same language, and not essentially four different languages. The units of which it is composed differ from one of these cases to another, but the framework of relations between these units remains the same." Hjelmslev (1947: 69f)

Hjelmslev (1938a: 215) concludes that "sound therefore is not part of the essence of language" (my own translation, original: "Die Laute gehören also nicht zum Wesen der Sprache"), not any more than writing, the morse code or the flag code. Or sign language, which he mentions in the list of interchangeable and arbitrary vehicles of language when making the same argument in 1938 (Hjelmslev 1938a: 213). How come, then, is the vocal modality the only one found cross-linguistically (except in case of physical impairment: deaf speakers use sign language)? Hjelmslev correctly points out that this is merely because the vocal modality is the most efficient way to externalize (it allows communication over a distance greater than the visual or any other modality, and it permits exchange in the dark) – but still an anatomic accident making use of organs made for another purpose.²⁰

- (24) "The fact that all peoples throughout history have preferred to express themselves through sounds cannot be explained by the nature of language. It is to be explained by human nature. The fact that language can be expressed most naturally and conveniently through sounds is a consequence of the anatomical and physiological constitution of humans. It has often been pointed out that humans, as anatomical beings, do not possess speech organs; the so-called speech organs are, by nature, digestive and respiratory organs that have only incidentally and without any organic necessity proved to be particularly suitable for the purposes of speech manifestation. However, it seems that linguists have accepted this truth merely as a witty joke, without seriously drawing the necessary conclusions from it." Hjelmslev (1938a: 215, my own translation)²¹

²⁰ While all versions of currently entertained SFP share the Saussurian idea that there is no phonetics in phonology, the modality independence of language bears on the debate between the two views on spell-out discussed in section 2.5. The Concordia-based approach holding that features and their association to phonetic correlates are universal and innate is at pains to explain how sign language could exist if vocal phonetic correlates such as labiality, voicing etc. are universal and innate: deaf signers have no access to vocal phonetics and do not use labiality etc. By contrast, the competing emergentist approach is equipped for externalization in any modality: what is universal and innate is the ability to build phonological units based on sensory input, whatever its kind.

²¹ Original: "Die Tatsache, daß alle Völker zu allen Zeiten ihre Sprache vorzugsweise durch Laute manifestieren, ist nicht durch die Natur der Sprache zu erklären. Sie ist durch die Natur des Menschen zu erklären. Daß die Sprache am natürlichsten und am bequemsten durch Laute manifestiert werden kann, ist eine Folge von der

Finally, regarding the work of Hjelmslev, the following quotes about the independence of form and substance, and thus the fact that they need to be independently investigated, are worthwhile.

- (25) "Let us first consider language. It can be regarded [...] as a pure form, defined independently of its social realization and material manifestation." Hjelmslev (1942: 32, my own translation)²²

"linguistics describes the relational pattern of language without knowing what the relations are. Hjelmslev (1947: 75)

"Thus, considerations we have been led to entertain in the foregoing, in direct consequence of Saussure's distinction between form and substance, lead us to recognize that language is a form and that outside that form, with function to it, is present a non-linguistic stuff, Saussure's 'substance' – the purport. While it is the business of linguistics to analyze the linguistic form, it will just as inevitably fall to the lot of other sciences to analyze the purport. From a projection of the results of linguistics on the results of these other sciences will come a projection of the linguistic form on the purport in a given language. Since the linguistic formation of the purport is arbitrary, i.e. not based on the purport but on the particular principle of the form and the consequent possibilities of realization, these two descriptions – the linguistic and the non-linguistic – must be undertaken independently of each other.

[...]

just as the various special, non-linguistic sciences can and must undertake an analysis of the linguistic purport without considering the linguistic form, so linguistics can and must undertake an analysis of the linguistic form without considering the purport that can be ordered to it in both planes." Hjelmslev (1969 [1943]: 77f)

4.2.2. Critics: Hintze

Hjelmslev's true instantiation of Saussure's doctrine triggered a host of reactions, typically from representatives of the Prague school who, as we saw in sections 3.2 and 3.3, answer with a frank *yes* the question whether phonetics should be present in the phonology.

Hintze (1949) wrote an article entirely devoted to defending the Prague school position, and thus to refute Hjelmslev's view. He makes two points: Trubetzkoy's and Jakobson's discussed in section 3.2 and 3.3, and another one regarding correlations among phonemes. The former is expressed under (26): you cannot even talk about phonemes if you are unable to name them according to their phonetic properties.

anatomisch-physiologischen Konstitution des Menschen. Oft genug hat man die Aufmerksamkeit darauf hingelenkt, daß der Mensch als anatomisches Wesen keine Sprachorgane besitzt; sind doch die sogenannten Sprachorgane von Natur aus Verdauungs- und Respirationsorgane, die sich nur nebensächlich und ohne irgend eine organische Notwendigkeit für die Zwecke der Sprachmanifestierung als besonders geeignet erwiesen haben. Diese Wahrheit haben aber die Sprachforscher, wie es scheint, lediglich als einen geistreichen Witz hingenommen, ohne im Ernst die notwendigen Konsequenzen davon zu ziehen."

²² Original: "Considérons d'abord la langue. On peut la considérer [...] comme une forme pure, définie indépendamment de sa réalisation sociale et de sa manifestation matérielle."

- (26) "The fact that the relations we wish to use as the basis for describing a form are linked to the respective substance category follows from the fact that terms are necessary for describing and formulating the relation, which are themselves clearly defined by the substance category." Hintze (1949: 91f, my own translation)²³

The other argument is about Hjelmslev's point that the substance which externalizes language is interchangeable (23). All structuralists agree that phonology is about phonemes, which have two core properties: they carry distinctiveness and enter into privileged relationships with each other, thereby creating a phonemic system (see section 3.6). The relationships (called correlations) are always defined by phonetic properties. Thus the correlation of voicing relates all voiceless phonemes to all voiced phonemes of a language, the correlation of palatality all palatal to all non-palatal phonemes, etc. In diachronics, the idea was then that what is subject to evolution is not the phonetic sound or the phoneme, but rather the correlation. This was introduced by Fourquet (1948) in his analysis of Grimm's Law where Indo-European p,t,k first aspirated (> p^h,t^h,k^h) and then spirantized (> f,θ,χ) in Common Germanic, while voiced b,d,g become voiceless (> p,t,k). Thus on Fourquet's analysis, the evolution targeted the voicing correlation.

Hintze (1949: 95-100) argues that if a language may be externalized by interchangeable substances, correlations cannot, because they have a phonetic definition. In the quote under (27), Hintze uses *relations* to refer to correlations.

- (27) "This creates a reciprocal dependency between linguistic form and substance, with the inevitable consequence that it is impossible to even establish relations without implicitly taking substance into account. Establishing relations 'without knowing what the relata are' is only possible in the case of strictly logical relations; however, since linguistic relations are non-logical in nature – they are linguistic in nature – a purely relational description of linguistic form, as structuralist linguistic research has set itself the task of doing, is not possible without taking linguistic substance into account." Hintze (1949: 105, my own translation)²⁴

Since phonemes were broken down into distinctive features by Jakobson *et al.* (1928), they are the units that unite the two terms of a correlation: p,t,k share [-voice], while b,d,g share [+voice]. It is these features that carry the opposition and are subject to diachronic evolution.

That substance is also interchangeable in correlations may be seen when looking at the only non-vocal modality that native speakers use. Sign language also has distinctive features and is also subject to diachronic evolution, which will surely not involve voicing or palatality, but phonetic units specific to this modality: handshape, location and movement (e.g. Sandler & Lillo-Martin 2006). The voicing correlation of, say, American English will thus be expressed using the feature [voice] by vocal speakers, but using some sign-specific feature by speakers who use American Sign Language: in both cases, the same language, American English, is externalized.

²³ Original: "Dass die Relationen, die wir der Beschreibung einer Form zugrunde legen wollen, an die jeweilige Substanzkategorie gebunden sind, folgt daraus, dass zur Beschreibung und Formulierung der Relation Begriffe notwendig sind, die selbst durch die Substanzkategorie in eindeutiger Weise bestimmt sind"

²⁴ Original: "Dadurch tritt die sprachliche Form in ein wechselseitiges Abhängigkeitsverhältnis zur Substanz, was zur unausweichlichen Folge hat, dass schon die Aufstellung der Relationen unmöglich ist, ohne dass die Substanz implizit berücksichtigt ist. Eine Aufstellung von Relationen, 'ohne zu wissen, was die Relata sind', ist nur bei streng logischen Relationen möglich; da die sprachlichen Relationen aber nichtlogischer Natur – eben sprachlicher Art – sind, ist auch eine rein relationelle Beschreibung der sprachlichen Form, wie sie die strukturalistische Sprachforschung sich als Aufgabe gestellt hat, nicht möglich ohne die Berücksichtigung der sprachlichen Substanz."

4.2.3. Critics: Martinet

In a review of the original Danish edition of Hjelmslev's *Prolegomena* (Hjelmslev 1969 [1943]), André Martinet (1946) concludes that it is not possible to eliminate phonetics from phonology:

- (28) "We appreciate the value of many of his [Hjelmslev's] suggestions. But we wonder whether it is possible to agree with the author when he proposes completely disregarding both the phonetic and semantic aspects." Martinet (1946: 19, my own translation)

"There is no doubt that the complete elimination of substance gives linguistics a much more 'scientific' character, even 'algebraic', as Hjelmslev goes so far as to say. But one may rightly ask whether this resolutely abstract character is truly the one that is appropriate for linguistics if we want it to be well suited to its subject matter." Martinet (1946: 36, my own translation)²⁵

While Martinet offers a detailed description of the content of the book, he is rather curt regarding the arguments that motivate his conclusion. I could only identify one,²⁶ concerning diachronic evolution, which Martinet suggests occurs in the phonetic substance and therefore does not fit phonological units expunged of phonetics:

²⁵ Original: "On apprécie la valeur de beaucoup de ses suggestions [les suggestions d'Hjelmslev]. Mais on se demande s'il est possible de suivre l'auteur lorsqu'il propose de faire complètement abstraction de la substance, phonique et sémantique."

"Il est certain que l'élimination totale de la substance donne à la linguistique un aspect beaucoup plus « scientifique », « algébrique » va même jusqu'à dire Hjelmslev. Mais on peut à bon droit se demander si cet aspect résolument abstrait est celui qui convient réellement à la linguistique si l'on veut que celle-ci soit bien adaptée à son objet."

²⁶ Martinet also makes the following point: "Hjelmslev therefore fails to convince us that it is possible to establish units of expression without resorting, to a certain extent, to phonetic substance." Martinet (1946: 38, my own translation, original: "Hjelmslev donc ne nous convainc pas qu'il soit possible de dégager les unités d'expression sans avoir recours, jusqu'à un certain point, à la substance phonique"). In order to decide whether two phonetic items represent the same phoneme, Hjelmslev (1969 [1943]: 74) devised the commutation test: if in a given word, a phonetic item is substituted by another phonetic item but speakers will still perceive the same word, both phonetic items are variants of the same phoneme (Dresher's 2011: 252 example: [p^h] substituted by [p] in *pin*). Otherwise they represent different phonemes ([p^h] substituted by [b], producing *bin*).

Martinet (1946: 37f) doubts that this can be done without reference to phonetic substance: the /p/ of French *pelle* "shovel" and French *prendre* "to take" are the same because we can take one and put it into the other word, which will then be understood just like if it were pronounced with its own p. But what if we substitute the onset p of *pelle* with the coda p of *cap* "cape"? It is not clear, Martinet says, that if the phonetic recording of onset [p] were replaced with the phonetic recording of coda [p] in the sound track of a film, the spectator would still perceive *pelle*. Martinet's argument is thus that Hjelmslev's general substance-free method of deciding which phonetic items represent the same phoneme may be inoperative in some cases, where substance needs to be called on in order to make a decision. If Martinet were right, this would merely mean that Hjelmslev's commutation test is not waterproof. There are different means of establishing phonological units based on the phonetic continuum, though: distributional analysis using minimal pairs.

But anyway this discussion is off the mark for the issue of whether or not phonological items have phonetic properties: it is about how to establish phonemes, not whether they have phonetic properties. If Martinet is right, phonetic substance may be needed in order to identify phonemes, but they could still be devoid of phonetic properties.

- (29) "However, if it turns out that the seeds of linguistic evolution lie in substance rather than form, the establishment of the 'algebraic' structures of glossematians will have left us ill-prepared for the necessary examination of diachronic reality." Martinet (1946: 36f, my own translation)²⁷

This argument is quite surprising, since Martinet does not mention the fact that the phonetic origin of sound change is a central lesson taught by Saussure: "it is speech that causes language to evolve" (my own translation, original: "c'est la parole qui fait évoluer la langue" Saussure 1972 [1916]: 37). Saussure himself is the voice of the neogrammarians: "[t]he real reason for the change in usage is nothing other than ordinary speech" (my own translation, original: "Die eigentliche Ursache für die Veränderung des Usus is nichts anderes als die gewöhnliche Sprechfähigkeit" Paul 1920 [1880]: 32). In modern terms, the initiation of sound change occurs when a specific phonetic precursor which is contained in the pool of variation inherent of the phonetic signal is promoted to grammatical status (phonologization or, more generally, grammaticalization) (among many others, see Ohala 1989, Garrett & Johnson 2013).

Martinet's objection thus smashes in open doors and can hardly be levelled against the idea that phonology is devoid of phonetics.

5. Sin handed down to generative phonology

5.1. Jakobson > Halle

It was shown that the Prague school considers that phonetic content is a necessary ingredient of the phoneme. This view is put down in its founding statement (the 9 theses), and major representatives endorse it: Trubetzkoy, Jakobson, Martinet. There is no point in talking about sin regarding the generative approach since this theory emerging in the 1950s does not abide by Saussure's commandments. Quite to the contrary, the generative paradigm was installed in fierce opposition to structuralist thinking, at least in the showcase: the new theory was supposed to do a tabula rasa with respect to the old theory (but in fact there was much continuity, see e.g. Goldsmith 2008). In this context, one narrative is that Morris Halle (1957) went down to the LSA arena to slay the strongest structuralist dragon, the phoneme (again more of a social than a phonological feat, see Anderson 2000).

Be that as it may, the tie between structuralist and generative phonology was Roman Jakobson, Morris Halle's teacher. The transition and, regarding distinctive features, the transmission was carried out in two books co-authored by Jakobson and Halle: *Preliminaries to speech analysis. The distinctive features and their correlates* (Jakobson *et al.* 1952) and *Fundamentals of Language* (Jakobson & Halle 1956).²⁸ Newmeyer (1986: 32) believes that "Roman Jakobson probably exerted a greater influence on transformational grammar than any other linguist. [...] Together [with Morris Halle] they developed the theory of generative phonology."

Jakobson inculcated the Prague School view to Morris Halle and thus generative phonology which, as said, was unfettered by Saussurian freight anyway. The subtitle of Jakobson, Fant & Halle (1952), *The distinctive features and their correlates*, sounds promising in the Saussurian sense: phonological features and their phonetic correlates appear to be separated. But in fact this is not the case: the features have phonetic content themselves which

²⁷ Original: "Or, s'il se révèle que c'est dans la substance, plus que dans la forme, que se trouvent les germes de l'évolution linguistique, l'établissement des structures 'algébriques' des glossématiciens nous aura fort mal préparé à l'examen indispensable de la réalité diachronique."

²⁸ Under the title *Phonology in relation to phonetics*, Jakobson & Halle (1968) is an (almost) identical reprint of Part I of Jakobson & Halle (1956: 3-51).

then, the authors argue, has other phonetic correlates. The quotes under (30) illustrate this view using [grave] vs. [acute].

- (30) "For example, as far as language uses an autonomous distinctive opposition of gravity and acuteness, we examine the acoustical correlates of the linguistic values in question and the articulatory prerequisites of these stimuli." Jakobson *et al.* (1952: 11)

Caption of a figure showing sagittal sections of the articulatory apparatus:

"Fig. 5. Grave vs. acute and compact vs. diffuse phonemes. X-ray photographs of the production of Czech vowels and constrictives: Horizontal pairs illustrate the articulatory correlates of the opposition grave vs. acute. In the articulation of the grave member of the opposition (left), the front cavity (black area) is larger while the pharynx and lips are more contracted than in the corresponding acute (right)." Jakobson *et al.* (1952: 49)

Thus the phonological objects [grave] and [acute] bear acoustic content and have acoustic (page 11) as well as articulatory correlates (page 49). Note that the phonological object [grave] has acoustic correlates distinct from graveness, i.e. large front cavity, contracted pharynx and lips. Therefore an interpretation whereby Jakobson *et al.*'s (1952) system is merely a case of laziness is precluded: laziness is using the phonetic correlates of a phonological unit when talking about it. Had Jakobson *et al.* been in this case, the acoustic correlate of their phonological unit would have been what they use in order to refer to it, i.e. graveness. Since this is not the case, "grave" is not just shorthand for alpha: rather, it *is* a phonetically imbued phonological unit, which has some acoustic correlates that are instantiated.

Jakobson & Halle (1956: 8ff) contrast what they call inner and outer approaches to the phoneme. Their own, the inner approach, follows Bloomfield's view discussed in section 3.4. Thus under (31), the authors take over his idea that "distinctive features are present in the sound waves". Also, their approach "locates the distinctive features and their bundles within the speech sounds."

- (31) "For the connection and delimitation of phonology (especially phonemics) and phonetics, the crucial question is the nature of the relationship between phonological entities and sound. In Bloomfield's conception, the phonemes of a language are not sounds but merely sound features lumped together. [...]

The speaker has learned to make sound-producing movements in such a way that the distinctive features are present in the sound waves, and the listener has learned to extract them from these waves. This so-to-speak inner, immanent approach, which locates the distinctive features and their bundles within the speech sounds, be it on their motor, acoustical or auditory level, is the most appropriate premise for phonemic operations, although it has been repeatedly contested by outer approaches which in different ways divorce phonemes from concrete sounds." Jakobson & Halle (1956: 8)

What Jakobson & Halle mean when they call their approach *inner* is thus the Prague school idea that phonetic properties are present in the phoneme.

What they call outer approaches to the phoneme are "attempt[s] to locate the phoneme outside the uttered sounds" (Jakobson & Halle 1956: 12). On the following page, they oppose the idea that the relationship of phonemes and phonetic qualities is random or arbitrary, since that "threatens the objective value of phonemic analysis."

- (32) "The belief that the choice among phonemes to which we assign the sound might, upon occasion, be made arbitrarily, even at random, threatens the objective value of phonemic analysis. This danger may, however, be avoided by the methodological demand that any distinctive feature and, consequently, any phoneme treated by the linguist, have its constant correlate at each stage of the speech event and thus be identifiable at any level accessible to observation." Jakobson & Halle (1956: 13f)

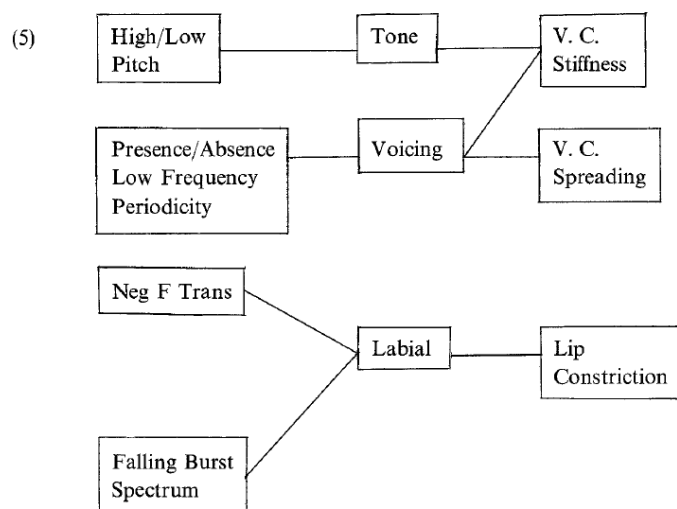
Among the outer approaches competing with theirs, they count Baudouin de Courtenay's ("still surviving", p.11) and Hjelmslev's. Echoing Saussure, they call the latter *algebraic* and of course reject it (as much as, via the algebraic hint, Saussure):

- (33) "Each venture, however, to reduce language to its ultimate invariants, by means of a mere analysis of their distribution in the text and with no reference to their empiric correlates, is condemned to failure." Jakobson & Halle (1956: 15)

The transition with structuralism having been made by adopting the Prague school view through the mediation of Roman Jakobson, the phonetic content of phonological units (now distinctive features, rather than the phoneme) was set. As far as I can see, it was never challenged in the generative literature, where Jakobson's acoustically defined features gave way to an articulatory definition in SPE (Chomsky & Halle 1968).

In a retrospective, Halle (1983) faithfully reports the view of Jakobson *et al.* (1952), as reported under (30): phonological features that have phonetic content (middle column under (5) in the quote under (34) below) are related to acoustic (left column) and articulatory (right column) correlates.

- (34) "Considerations of this nature were much in our minds thirty years ago when Jakobson, Fant and I were working on *Preliminaries to Speech Analysis*, and it was these considerations that led us to draw a sharp distinction between distinctive features, which were abstract phonological entities, and their concrete articulatory and acoustic implementation. Thus, in *Preliminaries* we spoke not of 'articulatory features' or of 'acoustic features,' but of 'articulatory' and/or 'acoustic correlates' of particular distinctive features. The model we had in mind was, therefore, of the type represented by the block diagram in (5), where the abstract distinctive features constitute the link between specific articulatory and acoustic properties of speech sounds.



" Halle (1983: 94)

Thus nothing has changed: Morris Halle confirms in 1983 that the generative doctrine continues the Prague school, where distinctive features have phonetic content.

5.2. SPE considers and dismisses spell-out: another road not taken

Following discussion with structuralist positions in the 1950s and 1960s (see section 6.1), the generative take on phonology was defined in *The Sound Pattern of English* (SPE, Chomsky & Halle 1968). In a section called *Phonological and phonetic representation* (p. 164ff), the authors introduce phonetic distinctive features and phonological distinctive features, which they say have unfortunately been confused since distinctive features were introduced.

- (35) "We have used the term 'phonetic distinctive features' for the universal physical scales that determine the rows of the phonetic matrices. Correspondingly, we may use the term 'phonological distinctive features' to refer to the categories that label the rows of the phonological matrices. Unfortunately, the discussion and development of the theory of distinctive features has been confused by the use of the term 'distinctive feature' in both senses." SPE: 169

Phonetic features are made of a phonetic label (called a *phonetic scale*) and an integer, the latter indicating the label's strength for a given segment: thus /n/ may be [1 nasal] or [3 nasal] depending on context.

- (36) "A phonetic feature specification consists of a 'phonetic scale' (called a 'phonetic feature') and an integer indicating the position of the phonetic segment in question along this scale.¹ The phonetic scales form a predetermined universal set, namely, the '(phonetic) distinctive features.'

note 1

[...] Thus, the phonetic distinctive features are absolute in one sense, namely, they are universals, independent of any particular language and providing the basis for phonetic representation in every language." SPE: 164

As shown by the quote, phonetic distinctive features are universal, drawn from a predetermined set. Interestingly, phonetic features are called *distinctive*, just like phonological features. This is in line with the generative dismissal of contrast (see section 6.1), which by structuralist standards exists only in the phonology: in its absence, "distinctive" refers broadly to anything that makes things different, here phonetic properties that have been chosen from the universal set of phonetic features.

An interesting question of course is how these phonetic properties are picked from the phonetic continuum. On p. 298, the authors say that anything that is "clearly an independently controllable aspect of the speech event" will be a phonetic feature: talking about labio-velar consonants in Yoruba that are produced with a "special clicklike suction", they say that "[s]ince clicklike suction is clearly an independently controllable aspect of the speech event, the data just cited establish suction as a separate phonetic feature, regardless of the fact that apparently in no language are there contrasting pairs of utterances that differ solely in this feature."

In a section called *Phonetic and phonological representation* (p. 295ff), Chomsky & Halle then ask what phonological features may look like, given the universal set of phonetic features. They conclude that the labels of phonological features are the same as those of the phonetic features.

- (37) "we propose that each item in the lexicon be represented as a two-dimensional matrix in which the columns stand for the successive units and the rows are labeled by the names of the individual phonetic features." SPE: 296

This is the result of a discussion where the authors consider alphas and betas (here A, B) in an earlier chapter:

- (38) "It might be proposed, in the light of the distinction between phonological and phonetic distinctive features, that the two sets be absolutely unrelated – that in cases such as (1) [phonetic features in a feature matrix] and (2) [phonological features in a feature matrix] above, for example, the rows be labeled entirely differently in the phonological and phonetic matrices. Thus in (1) we would have the phonetic features 'consonantal,' 'vocalic,' etc., as before, but in (2) we would have the phonological features A, B, and so on. Only the phonetic features would now be 'substantive' ; the phonological features would be without physical content and would provide an arbitrary categorization." SPE: 169

Then immediately preceding the decision (37), they also consider the spell-out that is needed for alphas and betas to be converted into phonetic items:

- (39) "The phonological features cannot be chosen arbitrarily, for the phonological component would then have to include a huge number of ad hoc rules of the type
- | | |
|------------------|------------|
| [+A, -B, -C, +D] | → [hʌt] |
| [-A, -B, -C, +D] | → [rʌt] |
| [-A, +B, -C, +D] | → [əlɪps]" |
- SPE: 295

It is unclear why A, B, C, D, which clearly represent phonological features, are converted into whole words, rather than into segments, but that does not need to concern us here: what is relevant is that Chomsky & Halle consider spell-out based on alphas and betas, by what they call *ad hoc rules*.

The authors reject this option for four reasons. First, *ad hoc rules* are an unnecessary complication: given the universal set of phonetic features, all languages would have to have the same instructions. This would be redundant and could not help representing the difference between languages. Such redundancy can be avoided by directly giving phonological features the label of phonetic features:

- (40) "for example, we would have rules providing that [αA] → [avocalic], [αB] → [αconsonantal] [...]. But every grammar will have to have exactly these rules; hence they do not contribute in any way to the choice among grammars and can just as well be eliminated from all grammars. To eliminate them means, simply, to use the names of the phonetic features to label the categories in the first place." SPE: 169

This argument rests on the idea that there is a fixed universal set of phonetic features, which is not self-evident. Voronkova & Steblin-Kamenskij (1975 [1970]) argue against this idea, which is reminiscent of the position taken by the Concordia school of SFP: there is a set of universal and innate (phonological) features, whose phonetic correlates are also universal and innate. The alternative entertained elsewhere in SFP is that features and their phonetic correlates are emergent (see section 2.5).

The second argument shown under (41) below is about language acquisition, which Chomsky & Halle use to motivate identical phonetic and phonological features. This identity

facilitates the task of the learner, they argue, who does not need to bother with (distributional) analysis in order to discover the phonological items that need to be stored in the lexicon: the child has the universal set of phonetic features at birth and merely needs to detect their phonetic values in the acoustic signal in order to know what is phonological and lexical.

- (41) "We think, then, that there may be good reason to limit the class of phonological matrices in terms of the set of universal phonetic features. For the linguist or the child learning the language, the set of phonetic representations of utterances is a given empirical fact. His problem is to assign a lexical representation to each word, and to develop a set of grammatical (in particular, phonological) rules which account for the given facts. The performance of this task is limited by the set of constraints on the form of grammars. Without such constraints, the task is obviously impossible; and the narrower such constraints, the more feasible the task becomes. Among the formal conditions is the one that we have just outlined, namely, that each lexical entry consists of a phonological matrix in which the rows are labeled by names of phonetic features along with a set of categories to which the formative in question belongs." SPE: 170

The third argument is about what today are called natural classes:

- (42) "Moreover, if we represented lexical items by means of an arbitrary feature notation, we would be effectively prevented from expressing in the grammar the crucial fact that items which have similar phonetic shapes are subject to many of the same rules." SPE: 295

The question is why we would like or need to express natural classes in the grammar. For Chomsky & Halle, the only possible origin of sound patterns lies in the phonology: they do not consider the logical possibility that they may also have phonetic causes, which are then only administered by the phonology (see section 2.4). We will see in section 6.4 below how Postal (1968) expands on this issue.

Finally, the fourth argument is shown under (43) below.

- (43) "Recall that the phonetic features constitute a fixed and restricted set, independent of any particular language. Thus, our decision to restrict phonological categories to those that can be labeled by phonetic features amounts to an empirical hypothesis concerning the number of possible categories of a phonological matrix. It reflects the hypothesis that beyond the categorization given by the features which are associated, ultimately, with phonetic values, all categorization applies to the formative [= the morpheme] as a whole and not to its separate (successive) parts. [...] We expect, to put it loosely, that there will be rules applying to segments specified in terms of categories very closely tied to phonetic features and rules applying to full lexical items; but rules of other sorts will necessarily be more complex, given the framework we are adopting. This becomes a significant claim as soon as an evaluation measure is fixed. If true, it is a formal property of language that would be missed if phonetic and phonological features were strictly dissociated." SPE: 169f

In my understanding (helped by the insights Elan Dresher shared when I asked him for advice), the argument is based on the fact that in SPE a feature matrix is made of two distinct types of features: phonetic features which co-define individual segments of a morpheme, and features like [+lateral] that define entire morphemes only, i.e. not individual segments. This is the formal property of language that Chomsky & Halle refer to which, they argue, would disappear if phonology were only made of alphas and betas: [+labial] would be [+A] and

[+latinate] would be [+B]. The two would be indistinguishable. Chomsky & Halle do not exclude that individual segments may also be marked by [+latinate]-type features and then be targeted by computation ("rules of other sorts"). These will however add extra complexity to the grammar, which may be disfavoured by an evaluation measure, discussed in the following section (pp. 172-176) and whose precise contours is "far from definitive" (p. 175). The reasoning is thus what was called a *potential argument* at the time: one relying on premises that may not be correct, but in case they are produce the argument.

If this is the correct interpretation, the question arises in which way [+labial] and [+latinate] are better candidates for representing the formal property of language at hand: how are they distinct in kind? Are they any more intrinsically distinct than an alpha and a beta? Grammar must somehow know that [+labial] refers to a given segment, while [+latinate] is a property of the whole morpheme. The same would be true if phonological units were alphas and betas: grammar would need to know that alpha defines a segment, but beta the morpheme.

To conclude, the crucial decision made by Chomsky & Halle is the explicit rejection of spell-out (what they call *ad hoc rules*). This obliterates any interpretation of their view whereby Chomsky & Halle are merely lazy in the sense of section 2.3: they only use phonetic labels to refer to phonological items for convenience, when in fact these items are devoid of any phonetic content. Such an interpretation may be fueled by wordings such as "the rows [of a feature matrix] are *labeled* by the names of the individual phonetic features" (emphasis added) under (37): "labeled" may be construed as a lazy way of referring to a substance-free item. In the same way, on p. 297 Chomsky & Halle say that "[t]his does not mean that the phonetic features into which the phonological features are *mapped* must also be binary" (emphasis added). Mapping could be understood as a spell-out operation relating a substance-free phonological feature to a substance-laden phonetic feature.

These interpretations are impossible, though, since Chomsky & Halle explicitly reject any kind of spell-out: the identity of phonetic and phonological features that they conclude on is for real, since substance-free phonological items cannot exist without a later conversion into phonetic items. Therefore it is not just labels that are used for something else in the phonology: rather, the actual phonetic features are present in the phonology, and nothing is mapped on anything. The same phonetic features occur in the lexical recording through all phonological operations into phonetics, where they become gradient, rather than binary.

Dresher & Hall (2020) discuss Halle's *Sound Pattern of Russian* (Halle 1959) where features are organized into a contrastive hierarchy. This was abandoned in further generative development, as indeed contrast was. Dresher & Hall show that if Halle had used phonological processing for establishing the hierarchy, rather than the wish to use as little features as possible (simplicity), generative phonology may have evolved in a different direction where contrast would have been maintained and used to account for phonological processing. Dresher & Hall's article is about this road not taken.

Taking over the Saussurian and Hjelmslevian view on the identity of phonological units is another road not taken, this time in SPE. Chomsky & Halle consider but dismiss alphas and spell-out, for reasons where simplicity also plays a role: to them, spell-out is redundant and an unnecessary complication (40); the task of the child is simplified when phonological and phonetic units are identical (41).

Clearly Chomsky & Halle (1968) were not concerned with what would later run under the label of modularity (Fodor 1983), although the recognition of separate computational systems using proprietary vocabulary was introduced in Chomsky's *Logical Structure of Linguistic Theory* (LSLT; written in 1955-1956 but only published as Chomsky 1975) and put to use in the inverted T model in *Aspects* (Chomsky 1965) (more on that in section 6.3.2). Had they taken modularity seriously, there would have been no way to have the same vocabulary in

both phonetics and phonology, and spell-out would not have been a redundant and unnecessary complication, but rather a crucial condition on phonetics and phonology being separate computational systems (just as spell-out, i.e. Vocabulary Insertion, at the syntax-phonology interface is, including in SPE: 163).

That a generative phonology with alphas and spell-out is possible has been shown by SFP since its inception. Representatives of Concordia in particular argue for a phonology that is close to SPE, except with alphas and spell-out. A price that Chomsky & Halle were not prepared to pay is the elimination of naturalness from phonology (42).

6. Righteous voices in early generative times

6.1. Generative radicalization

After having discussed the generative position on the presence of phonetics in phonology in the previous section, let us now look at the broader context of the exchange with structuralism. Starting with Chomsky's (1951) Masters thesis, generative phonology was built during the 1950s and 1960s (Anderson 2021: 403ff). It faced what Postal (1968: ix) calls the entrenched dominant view in the United States. Generative phonology took issue with a number of tenets of the dominant theory, especially regarding two points: on the one hand the phoneme and more largely contrast (Dresher & Hall 2020), which were referred to as *autonomous phonemics* (or Chomsky's 1964: 75ff *taxonomic phonemics*) by their generative contenders who denied their existence; on the other hand, the idea of rewrite rules (Hockett 1954, Halle 1962), which at that point were shared by syntax and phonology on the generative side (this is why the theory was called transformational).²⁹

Both issues relate to the question of phonetics in phonology. Without the phoneme, phonology lacks units that can be defined independently of phonetic properties, that is as structuralist relations (here: contrast). The only alternative for the makeup of phonological units is then phonetic content. Rewrite rules operate in the phonology, where they transform a lexical item into a phonetic one. This can only work if the type of objects manipulated is the same: phonological items must be phonetic in kind since phonetics is the output of the transformation. A /p/ can be transformed into an [f], but there is no way to even talk about a putative transformation of an alpha into an [f].

The alternative is made perfectly explicit by contemporary Stratificational Grammar (Lamb 1966a) and Fudge (1967), on which more below: if contrast is relevant, the units of phonology must be phonemes, which in turn must be bare of phonetic content and therefore identify as alphas and betas (Hjelmslev's unnamed entities). From this it follows that the transition from phonology to phonetics cannot be rewrite rules: it makes no sense to transform an alpha into a [p]. This is why phonological units are related to phonetic items by spell-out, which appears as *realization* in Stratificational Grammar (an alpha is *realized* as [f]), and as *articulatory rules* in Fudge (1967).

Representatives of the then-new generative view constantly appeal to Roman Jakobson as the godfather of phonetically imbued phonological items. Their view on the presence of phonetics in phonology is radicalized with respect to Jakobson and the Prague school, though,

²⁹ Some of the debate among structuralists and generativists is by Householder (1965) and Chomsky & Halle (1965) in the first issue of the *Journal of Linguistics* in 1965. Householder mainly discusses Chomsky's contribution to the 9th International Congress of Linguists, eventually made into Chomsky (1964). Paul Postal (1968) wrote a book entirely devoted to dismissing autonomous phonemics; the preface provides an informed overview of the debate and literature regarding the controversy among structuralists and generativists on this topic. And of course there is a sizeable historiographic literature on the question (e.g. Newmeyer 1986: 31-35, Encrevé 2000, Koerner 2003, Anderson 2021: 403ff).

for the reasons mentioned: the absence of contrast and the phoneme, as well as the transformational take on the relationship of phonology with phonetics, which enforces an absolute reliance on the phonetic vector all through.

Therefore, the parties opposing Louis Hjelmslev and the one that righteous phonologists face in generative times are quite different in kind. Hjelmslev could argue to be true to the structuralist reference Saussure, who was respected by everyone around. And his opposing party was aware that they were sinning against the foundational statement of the theory that they held themselves to represent. This doctrinal ballast was removed from the shoulders of generativists who could wholeheartedly sin without being sinners. Thus the environment was arguably quite a bit rougher for a righteous phonologist in early generative times than it was before.

But still some upheld the Saussurian torch in the generative blizzard.³⁰ Below three cases are discussed: Voronkova & Steblin-Kamenskij (1975 [1970]), Erik Fudge and representatives of Stratificational Grammar such as Sidney Lamb and David G. Lockwood. The vivid reaction of the generative party is a good measure of how crucial the presence of phonetics in phonology was for generative theory.

6.2. Voronkova & Steblin-Kamenskij (1975 [1970]): against distinctive feature bundles

Representatives of the Leningrad school, Voronkova & Steblin-Kamenskij (1975 [1970]) take issue with distinctive features, specifically with the identity of phonetic and phonological features that SPE has staged (37). The authors argue that distinctive features are either phonetic, in which case they cannot occur in the phonology, or phonological, which means that they have no business in phonetics. But they cannot be both phonetic and phonological (in all quotes below DF refers to distinctive features):

- (44) "A very convenient substitute, however, has been devised for the description of phonemes themselves. Elements observed on the physical plane are regarded as elements of the functional plane (that is, bundles of DF). Thereby physical reality is attributed to the functional plane, and the structure of the functional plane is attributed to physical reality." p. 76

"since DF are physical characteristics, they must be regarded as independent of the oppositions into which phonemes enter. But since they constitute the phonological content of a phoneme, they must be regarded as existing only in these oppositions." p. 79

"if DF were really elements which composed phonemes, that is, if they were a functional reality, then they would not be accessible to direct observation as physical reality; and, conversely, once they are accessible to direct observation as physical reality, then they are genuinely physical, and in no way functional reality." p. 79

Voronkova & Steblin-Kamenskij also call into question the grouping of phonetic properties into a matrix made of phonetic features:

³⁰ There are surely other phonologists to be added to this list, which I have not identified due to my insufficient knowledge of the plethora of structuralist literature. Many thanks to a reviewer, who pointed out Voronkova & Steblin-Kamenskij (1975 [1970]) to me.

- (45) "However, although these features are physical reality, it does not follow that the grouping of them into bundles is physical reality. On the contrary, the grouping of them into bundles is clearly not even objective reality, but simply a convenient way of describing the differences between phonemes." p. 80

The authors insist on the Saussurian view whereby only relations among phonemes define phonemes: "[b]ut what is the phonological content of a phoneme if it is not the way this phoneme is opposed to the other phonemes in different conditions?" (p. 86) and conclude as follows: "[t]hus if the arguments presented in this article are true, the thesis 'the phoneme is a bundle of DF' has been disproved" (p. 89).

6.3. Stratificational Grammar

6.3.1. Strata (levels), entities without labels, realization

On page two of the book *Outline of Stratificational Grammar* where this theory is introduced by its founder Sidney Lamb, the author makes the Hjelmslevian inheritance explicit.³¹

- (46) "The concept of stratification in language is by no means original with me, nor are many other features of this system, which is no more than the result of adding a few extensions and refinements to a synthesis of Hjelmslev's glossematics (1943) and one of the standard versions of American structural linguistics. The present formulation differs from earlier ones mainly in recognizing more strata and in that it provides a more precise specification of the relationships on which the concept of stratification is based." Lamb (1966a: 2)

Lockwood (1985) makes explicit that Stratificational Grammar endorses the basic Saussurian insight whereby linguistic structure is made of relationships.

- (47) "Initially, stratificational theory was an outgrowth of some of the more sophisticated Neo-Bloomfieldian work of the period centering around the 1950's. In the course of the theory's development, however, it has been receptive to many ideas which originated in European schools of linguistics, and has striven to develop a synthesis which incorporates the best of several views while retaining a fundamental coherence of basic outlook. The most fundamental of such ideas is undoubtedly the notion that linguistic structure consists solely of relationships, which derives in particular from the glossematic theory of Louis Hjelmslev (1961) and can ultimately be traced back to Saussure's dictum that 'in language there are only differences ... without positive terms' (Saussure 1959:120)." Lockwood (1985: 109)

The heritage from the American side is about what were called levels (rather than strata³²): based on the description of native American languages, the ambition of American structuralism was to build a fully-fledged grammatical statement of a language from scratch, i.e. from the raw data that reach the ear of the fieldworker. The so-called discovery procedure of grammatical structure, then, is strictly feed-forward: only recorded or previously constructed information can feed linguistic analysis (Aronoff 1980, Scheer 2011: §61). Thus observable data are made of sound alone; the corresponding units are called phones. The analysis of phones establishes a higher order phonemic level, whose basic units are phonemes. Phonemes cluster together as morpho-phonemes, which are the building blocks of the morpho-phonemic level of

³¹ Work in Stratificational grammar includes Lamb (1966b,c), Lockwood (1969, 1985) Makkai & Lockwood (eds.) (1973) and Lockwood's (1972) textbook.

³² Lamb's strata have nothing to do with strata known from Lexical Phonology.

analysis. Finally, morpho-phonemes build clauses at the clausal level. Each level is thus independent of the next higher level (*Level Independence*).

Strata are distinct levels of linguistic organization. According to Lamb (1966a: 1), the number of strata may vary across languages, but all languages have at least four of them: phonemic (phonemes), morphemic (morphons), lexemic (lexons) and sememic (sememes) (Lamb 1966a: 20). The two extreme strata (and only these) are related to the real world: "semology is related to meaning and phonology to speech, while grammar is intermediate between the two" (Lamb 1966a: 1).

There are two types of relations: tactic among items of a given stratum, and realizational among items of neighbouring strata. Thus items of, say, the lexemic stratum are *realized* by items of the next lower stratum, morphemes: in English, the lexon *past participle* is realized by two morphemes, *-ed* and *-en* (Lamb 1966a: 5). In the same way, morphons are realized by phonemes, which are in turn realized by phonons (phonetic items). Realization of units of one stratum in another is called spell-out (section 2.1): a list-based translation of one vocabulary into another.

The consequence of strata made explicit under (48) speaks to the presence of phonetics in phonology:³³

- (48) "A stratum differs from its neighbors with regard to its elements and their combinations. The elements of a stratum [...] are obviously unique to that stratum." Lamb (1966a: 21)

In the chapter on Stratificational Grammar of his manual of Phonology, Sommerstein (1977: 73) adds: "in SG [Stratificational Grammar] a unit on one stratum cannot be composed of units on another stratum." As a byproduct of American structuralist and Hjelmslevian levels, Stratificational Grammar thus upholds the Saussurian absence of phonetics in phonology.

Finally, under (49) Lockwood (1972) makes explicit that Stratificational Grammar follows Hjelmslev's unnamed entities (see also Lamb 1966a: 57f). In a given stratum, a number of items exist (phonemes express contrast), but the labels used to refer to them have no linguistic status: they are arbitrary and exist only for mnemonic reasons, as Lockwood puts it, that is, out of laziness (section 2.3).

³³ It may be of interest to note that privative (or unary) features appear in Stratificational Grammar, when the founding statement of this view on primes is usually taken to be Anderson & Jones (1974) (of which implementations are then seen in Dependency Phonology, Particle Phonology and Government Phonology, later privative features were also adopted in mainstream feature theory, e.g. Hall 2007). Stratificational Grammar implements features (called components), but based on markedness considerations (the unmarked term does not need to be mentioned) is outspokenly against their binary nature. Thus Lockwood (1969: 300) writes (see also Lockwood 1972: 209): "[p]erhaps not so well-known is the fact that stratificational theory also makes use of marking, and has done so in phonology for a number of years. This fact becomes clear when one realizes that the phonons of stratificational phonology, unlike the roughly equivalent Jakobsonian distinctive features, are single-valued rather than binary. (Lamb has variously used the terms UNARY, 1965:44, and SINGULARY 1966a:553. [here: Lamb 1966b]) This means that while a binary distinctive feature has to be indicated both as present in the first place, and as having a plus or a minus value in the given case, a phonon is either present or absent. The recent development in transformational phonology, using the distinction marked vs. unmarked with only the marked having a 'cost' (Postal [1968], 166), can be seen to a certain extent as the adoption of the phonon concept by the transformationalists."

- (49) "[T]he entities discussed here are points in the total network of relationships, and their labels are assigned as a matter of convenience, having no status in the theory whatsoever. In the stratificational system of relationships to be detailed in later chapters, these labels are simply added at various points in the total network of relationships as reference points to aid the linguist in discussing this system. When all necessary relationships are properly represented, the internal structure of the language will be resolved into these relationships, as only they have a status in the theory. The only 'entities' which are not just points in the linguistic network are the conceptual and phonic correlations, which connect to the linguistic system but lie outside it. Labels placed within such a system make no contribution to its content, but they do contribute to its readability, and this is their primary justification." Lockwood (1972: 26)

"In this case, each line in the graphic representation will have to be assigned a label, which may be either mnemonic or arbitrary, and this label will be used to symbolize the line in the algebraic representation." Lockwood (1972: 61)

Of course, the absence of meaningful labels for phonological items also precludes the presence of phonetics in phonology. The only place where items have phonetic properties is phonetics, where phonons occur.

6.3.2. Levels, strata, modules: different words for the same insight

The modern reader of the Stratificational Grammar literature (or a synthesis thereof, such as Sommerstein 1977) who is familiar with Chomskyan and Fodorian modularity (Fodor 1983 and the references mentioned in section 2.1) will be unable to miss the match.³⁴ The heart of modularity is that there are different computational systems which use distinct sets of vocabulary and therefore need an interface (spell-out, Vocabulary Insertion) in order to communicate (domain specificity). This is precisely expressed by Lamb under (48) in his own terms: strata rather than modules, elements rather than vocabulary, realization rather than spell-out.

The internal organisation of language in terms of distinct computational and functional systems that are specialised in morpho-syntax, phonology and semantics is made explicit in one of the earliest generative documents, Chomsky's (1955-56) *Logical Structure of Linguistic Theory*, published only in 1975 (see Scheer 2011: §623). In the structuralist environment of the time, Chomsky holds that the basic units that language is made of are levels.

- (50) "[T]he theory of linguistic structure [is], essentially, the abstract study of 'levels of representation'.

[...]

A linguistic level is a system L in which we construct unidimensional representations of utterances. Thus a level has a certain fixed and finite 'alphabet' of elements, which we will call its 'primes.' Given two primes of L we can form a new element of L by an operation called 'concatenation,' symbolized by the arch $\wedge$. Thus if a and b are (not necessarily distinct) primes of L , we can form $a\wedge b$ and $b\wedge a$ as new elements of L . Concatenation is essentially the process of spelling, where primes are taken as letters. Given the element $a\wedge b$ and the prime c , we can form a new element $(a\wedge b)\wedge c$." Chomsky (1975 [1955-56]: 105)

³⁴ The literature on Fodorian modularity does appear to have missed the match, though: Stratificational Grammar or Sidney Lamb are left unmentioned in Fodor (1983) for example.

Levels are thus computational systems which each operate on a specific vocabulary and produce suites of vocabulary items associated with a hierarchical structure that reflects their concatenative history. This is precisely the description of a Fodorian module: a domain-specific computational unit that works only on its own proprietary vocabulary. The quote also describes what is known today as the basic minimalist engine, Merge ($\wedge$). Stratificational Grammar arrives at the same conclusions: each stratum has its own proprietary vocabulary that does not occur on other strata, and there is stratum-internal computation (tactics). The existence of a relationship among strata / levels, i.e. of interfaces, is also common to LSLT and Stratificational Grammar: realization in the latter, as under (51) in the former.

- (51) "A linguistic level is not determined completely by the statement that it is a concatenation algebra. We must also specify its relations to other levels (i.e., the conditions of compatibility between levels)." Chomsky (1975 [1955-56]: 106)

The modular conception that was laid out in LSLT was progressively developed. Chomsky & Miller (1963: 306f) make the explicit statement that syntax and phonology are distinct computational (input-output) systems (see Newmeyer 1986: 172f, 198f). Modularity eventually took the guise of the inverted T model in *Aspects* (Chomsky 1965: 15ff), has become the cognitive reference for the generative architecture of grammar especially after the publication of Fodor's (1983) generalization to the cognitive system, and to date is consensual in generative quarters.

All this is of note here since, as we will see below, by the late 1960s representatives of generative grammar argue against Lamb's strata and strata-specific vocabulary because generative phonology, having inherited sin, uses the same phonetic vocabulary for both phonetics and phonology. That is, they deny what was called the autonomous phonemic level (i.e. phonemes and contrast) and therefore were left with only the morpho-phonemic level: this level was distinct from the phonetic level, they admitted, but both were running on the same phonetic vocabulary – a contradiction in terms given LSLT and Fodor's modularity. Those who did that (e.g. Kiparsky and Postal) did not know yet that they were in fact arguing against the generative standard to come: LSLT and Fodor (1983) were not published yet. They could have been aware that levels / strata are the basic building blocks of the architecture introduced in *Aspects*, though.

6.4. Postal's campaign against Stratificational Grammar

Postal's (1968) book is entirely devoted to showing that there is no such thing as autonomous phonemics. More than half (pages 33-228 for a total of 326 pages) is about Stratificational Grammar, the discussion opening with a section entitled *Failure of the Stratificational Defence of Autonomous Phonemics*. In the preface, Postal sets the scene:

- (52) "We review a fundamental argument against autonomous phonemics which was first developed by M. Halle, survey similar kinds of cases, and consider an attempt by advocates of so-called 'Stratificational Grammar' to avoid the negative conclusions of Halle while maintaining the basic tenets of autonomous phonemics. It is concluded that this attempt is a necessary failure. More importantly, however, discussion of these topics leads to an account of the Naturalness Condition, which is, it is claimed, a fundamental constraint governing the relations between phonetic and phonological structure. It is shown how stratificational phonemics violates this condition and how its conceptual foundations are chaotic." Postal (1968: xi-xii)

Postal motivates the presence of phonetics in phonology by what he calls the *Naturalness Condition*, which he ascribes to Roman Jakobson. He believes that this condition is a "fundamental fact about human language" – a *fact* that is among the most important of Jakobson's contributions. Here again the authority and mentorship of Jakobson in generative quarters clearly appears.

- (53) "The Naturalness Condition is concerned with a fundamental fact about human language – the emphasizing of which fact is among Roman Jakobson's most important contributions. Namely, the relation between phonological and phonetic structures is a *natural* one. We can today interpret this insight as claiming that the categorization of lexical items given by phonological structure, i.e. required to represent morphemes in the dictionary, required to state morphophonemic and phonological rules, needed to state constraints on sequences of phonological elements, needed to state phonological universals, etc., is not, from the point of view of phonetic structure, an arbitrary code. Rather, this representation is *closely related* to the representations needed to state the phonetic properties of the various sequences which represent individual lexical items." Postal (1968: 56, emphasis in original)

Postal then repeats the argument based on language acquisition that appears in SPE (see (41)): if phonological and phonetic items are identical, there are no phonemes that the child needs to discover through the analysis of the phonetic material, thus the mapping from phonetics to phonology is one-to-one (except for boundaries, the reason for the restriction to "a great deal" under (54)) and the child has an easy life.

- (54) "in terms of language learning, when a child has determined the phonetic representation of a form, he has thereby determined a great part of its phonological structure. Unfortunately, this contribution of Jakobson's has tended to be obscured by his involvement with the artificial view of autonomous phonology." Postal (1968: 56)

Postal ascribes the incomplete recognition of Jakobson's insight to his involvement with the dark side of the force, i.e. autonomous phonemics. Poor Jakobson is thus a sinner on all sides: against the Saussurian commandment by allowing for phonetics in phonology, as much as against the generative perspective, by not having professed the complete identity of phonology and phonetics. But luckily for him, the new persuasion is willing to forgive past misguided practices.

Postal (1968: 57) undertakes a *reductio ad absurdum*, imagining "a situation in which morphophonemic representation was a perfectly arbitrary code. [...] The most natural notation for them [the items of this representation] would be arbitrary integers." This leads Postal to echo the argument based on natural classes that was made in three lines in SPE under (42):

- (55) "Classes of these symbols which were relevant for various types of morphophonemic rules would not have phonetic realizations which shared any phonetic properties beyond those due to chance. That is, if for example there is a rule which deletes certain morphophonemes, say, 1, 14, 16, 19, 23, before another morphophoneme (i.e. which says that in this position these morphemes have null phonetic representations), one will find that the phonetic properties of the phonetic representatives of 1, 14, 16, 19, 23, share no properties in excess of those determined by chance. Hence, 1 for example might be represented phonetically by glottalized velar fricatives, 14 by high front rounded vowels, 16 by [m]; 19 by rounded apical dental plain stops; 23 by a palatal lateral." Postal (1968: 57)

Postal (1968: 58) concludes that "it is immediately evident that [...] situations like that described in the early part of this paragraph are clearly impossible in real languages". He did not know about crazy rules brought to the fore by Bach & Harms (1972) (see section 2.4), or about crazy *phonologically active classes*, as Mielke (2008) prefers calling natural classes that are not natural. One of these, the Sanskrit *ruki* rule named after its four triggering segments, was well known at the time Postal wrote, though.

On the conceptual side, like SPE under (42) and most generative endeavours up to the present day, Postal assumes that the origin of naturalness observed in phonetics cannot be anything other than phonological. The logical possibility that naturalness is only a phonetic property to which phonology does not contribute anything and whose existence it ignores (section 2.4) is not envisioned.

6.5. How do you measure abstractness when comparing alpha to beta, or alpha to [p]?

The opening sentences of Kiparsky's article *How abstract is phonology?* which eventually led to the emergence of Lexical Phonology (and its modern heirs) (Scheer 2011: §§139ff), are in (56).

- (56) "What is the form of morphophonemic representations? How far removed are they from the phonetic or phonemic surface?" Kiparsky (1973 [1968]: 5)

The purpose of the article is to first measure the distance between items recorded in the lexicon (morphophonemic representations) and items occurring on the surface (phonemic, i.e. after the application of all rules, or phonetic, i.e. in pronunciation), and then to assess what this distance may, or ought to be. The larger the distance, the more abstract is phonology; the smaller it is, the more concrete the phonology.

It is immediately obvious that there is nothing to be measured when an alpha in the lexical recording is compared to a beta (produced by rule application based on alpha) after the last phonological rule has applied (phonemic surface).³⁵ In the same way, nothing can be measured at all when an alpha is compared to a [p], labiality or whatever other phonetic item. An alpha is not more or less distant from a beta, or from a [p]: it does not make sense to talk about distance between these items because they do not belong to the same type of vocabulary.

Kiparsky's endeavour thus requires that items recorded in the lexicon and items appearing on the (phonemic or phonetic) surface both be written in a vocabulary that allows us to calculate their distance. This vocabulary is phonetic in kind. Kiparsky (1973 [1968]: 6) says that surface [ŋ] may be /ng/ lexically: in his view this is abstract, but not arbitrary, as would be a lexical origin /ō/ for [ŋ]. He argues that the two pre-generative approaches to phonology that he has identified either do not allow for abstract relationships (the Prague school and American structuralism, which he calls fully concrete), or allow for arbitrary relationships, which is the case of the Hjelmslevian view, "defended by Lamb (1966[b]), Fudge (1967) and, apparently, Householder (1965)" (p. 5), which he calls fully abstract ("[t]he writings of Hjelmslev may be interpreted as setting forth a similar position" p. 5).

According to Kiparsky, then, generative phonology, rooted in Sapir and Jakobson, is a

³⁵ This is shorthand: in fact, phonological primes are not turned into other primes (only segments are): just like [+labial] is not turned into [+coronal], alphas do not become betas. Rather, primes combine and an alpha may receive a beta from context (assimilation), or may lose a beta due to context (dissimilation) or to syllabic position (lenition). An abstractness calculus could then measure complexity: the greater the difference between the number of primes in the lexical recording compared to the output of computation, the more abstract the derivation. I am not sure what degree of abstractness this would produce, though, for example regarding the SPE derivation of *righteous* [ˌraɪtʃəs], which originates in /rixɪt+i+əs/ (Chomsky & Halle 1968: 234). But anyway, the complexity measure of abstractness based on non-phonetic primes was not on Kiparsky's agenda.

synthesis of the best of two worlds.

- (57) "The third alternative, taken by linguists such as Sapir, Jakobson (1948), and Chomsky and Halle (1968), in a sense combines the ideas underlying fully concrete morphophonemics and fully abstract morphophonemics. Adopting a term used by Lamb, we can call this general approach process morphophonemics. [...] This conception of morphophonemics incorporates the main virtues of both of the others without the main faults of either. Like fully abstract morphophonemics, it recognizes that there is an underlying phonological pattern which is not necessarily identical to the phonetic pattern (e. g., superficial [ŋ] may function like /ng/), which fully concrete morphophonemics is forced to deny. On the other hand, it recognizes that this pattern, while abstract, is not arbitrary, but in general related to the phonetic level ([ŋ] is hardly likely to function as /ö/ or /p/ or /l/), a relationship which fully abstract morphophonemics throws overboard." Kiparsky (1973 [1968]: 5f)

The presence of phonetic content in phonology is thus a prerequisite for Kiparsky's project to measure abstractness. It is also the decisive property that distinguishes the new generative approach from the preceding fully abstract view represented by Hjelmslev. In this context, it is of note that Kiparsky explicitly mentions Jakobson (1948) (where the author admits to be a sinner against Saussure) as a forerunner of generative phonology.

6.6. Levels (today's modules) have nothing to do with the vocabulary they use

The issue of phonetics in phonology also crops up in the guise of linguistic levels (see section 6.3). Under (58), Kiparsky (1973 [1968]) defends generative phonology ("process theories" are those which use rewrite rules) against the objection that morphophonemic forms (that is, the lexical recording of morphemes) are defined by phonetic vocabulary and thus not distinct from the phonetic level: *cat* identifies as /kæt/, but should not since the units of the morphophonemic level must not be phonetic in kind.

- (58) "Another objection is that process morphophonemics is somehow logically inconsistent and springs from a confusion of linguistic levels. It seems that underlying this objection is the not very clearly formulated idea that a linguistic level is necessarily a set of representations in some distinct alphabet of symbols. What apparently raises uneasiness is the fact that in generative phonology and in other process theories, morphophonemic forms are represented in a phonetic alphabet, which has led to the idea that the morphophonemic level is thereby not kept distinct from the phonetic level. The fallacy here lies in assuming that a level must be defined by the symbols which appear in its representations. There is no inconsistency or contradiction in representing morphophonemes by phonetic categories if the levels are formally defined by the structure of the grammar, rather than by a set of symbols. In a generative grammar, the morphophonemic representation is defined as the input to the phonological component, and the phonetic level is defined as the output of the phonological component. There is absolutely no confusion between the two." Kiparsky (1973 [1968]: 7)

It is not entirely clear whose critique Kiparsky echoes: he only talks about "another objection", and is not sure what its motivation is ("What apparently raises uneasiness..."). It may be assumed that he refers to Lamb (1966b) since in the preceding paragraph Kiparsky discussed Lamb's objection that rewrite rules were introduced only because they existed in diachronic phonology.

Kiparsky addresses the putative objection blaming the confusion of levels by explaining that there is nothing wrong with using the same phonetic vocabulary in phonetics and in the lexical recordings of morphemes. That is, there is nothing wrong with the presence of phonetics in phonology.

Writing in 1968, Kiparsky may not have known about the fact that in LSLT (which was published only in 1975), Chomsky precisely defined levels in terms of the vocabulary they use (see (50)). This was also the definition of levels later on when Fodorian modularity became the backbone of the generative architecture of grammar. Thus by modern standards, given that Kiparsky did not consider phonetics and morphophonemics as instances of the same computational system, his phonetic units at both levels are a modularity violation.

6.7. Fudge on alphas, betas and spell-out

As indicated by the title of his paper *The nature of phonological primes*, Fudge (1967) inquires into the basic building blocks of phonology. He argues that the generative answer to the question, phonetically defined features, is inadequate due to the mismatch that may occur between the phonological behaviour of primes (their relations in the structuralist sense) and their alleged phonetic specifications: This leads him to conclude that phonological primes are alphas and betas (actually: A, B, 1, 2, etc., see below).

Under (59) below, Fudge argues that phonological primes cannot be auditory (i.e. acoustic) or articulatory in kind: they must belong to another level and are just as abstract as morphological or syntactic items. This is thus in defence of the phoneme and what generativists call autonomous phonemics.

- (59) "If neither the auditory nor the articulatory features are basic to the phonological component of a grammar, then it is obvious that we need a further level to handle the basic elements, which must fulfil the following conditions:
(a) They must be completely abstract" Fudge (1967: 3)

"Although they are closely connected with sound, it must be clearly borne in mind that the phonological elements are in themselves no less abstract than those of the syntactic and morphological levels: the actual articulation consequent upon the selection of a given phonological element is of secondary importance in the systemic context, and may in fact vary considerably between speakers. A similar statement may be made about the acoustic and auditory effects of such articulations. It is thus dangerous and misleading to say that either articulatory or auditory features ARE the phonological elements, unless they correlate so closely that no facts of language are obscured by treating them as if they were the same." Fudge (1967: 4, emphasis in original)

It follows from this view that the abstract phonological items at hand need to be referred to by alphas and betas, in explicit reference to Hjelmslev's units.

- (60) "In our Mandarin example, Tone 3 as a basic phonological element is simply Tone 3, and has absolutely no properties which are even remotely phonic – actual phonic properties only come in at the systematic phonetic levels." Fudge (1967: 7)

"To emphasize that phonological elements are in themselves not phonic in any way, we will replace the phonetically-reminiscent labels of Table 5 by the completely neutral labels A, B, 1, 2, a, b, (i), (ii)," Fudge (1967: 10f)

"Actually our labels correspond almost exactly to Hjelmslev's CENEMES (Hjelmslev, 1939: 271-272) or GLOSSEMES OF EXPRESSION (Hjelmslev, 1961: 100)." Fudge (1967: 12, emphasis in original)

Since these phonological units with neutral labels appear as phonetic items on the surface, Fudge sets up what he calls articulatory rules, which are the exact same thing as post-phonological spell-out introduced in section 2.1.

- (61) "Articulatory rules. These convert the strings of phonological elements selected by the syntactic component of a grammar of the language into 'ideal articulations';

[...]

1. A → Front of tongue highest

[...]

3. 1 → Tongue high

[...]

6. b → Lips rounded

" Fudge (1967: 11f)

Note that the output of articulatory rules are "ideal articulations", which today would be called acoustic targets (see section 2.1), and also appear in the guise of structuralist *Lautvorstellung* (section 3.5).

The article closes on the paragraph shown under (62) where Fudge advises generativists to burn their phonetic boats, a metaphor that has had some posterity.

- (62) "The logical conclusion of this is that phonologists (above all, generative phonologists) ought to burn their phonetic boats and turn to a genuinely abstract framework. By so doing they will escape the fate of not only falling between two stools (the result of attempting to handle systematic phonemic and systematic phonetic levels in the same terms), but also ending up sitting in the very place which they have expended such strenuous and well-justified efforts to avoid." Fudge (1967: 26)

7. Aftermath

Reiss & Volenec (2022) start their article on the innateness of phonological features by situating themselves within what they report as the generative tradition:

- (63) "Following a long tradition in generative phonology, we take features to be abstract mental units that have a lawful but highly indirect relation to phonetic substance." Reiss & Volenec (2022: 15)

The statement that features are "abstract mental units that have a lawful but highly indirect relation to phonetic substance" is a correct description of Halle's position (34) (and would be subscribed to by all structuralist sinners), but does not speak to the question whether phonological units have phonetic content: "highly indirect" can mean a number of things. In Reiss & Volenec' own view, the answer is no, they do not. Reiss & Volenec are representatives (and Charles Reiss one of the founders) of SFP, whose *raison d'être* is the claim that there is no phonetics in phonology. Really no phonetics, not even a little tiny bit. All versions of SFP subscribe to (5): substance-free phonological units (alphas, betas, gammas) are associated to phonetic correlates through a translational (spell-out) mechanism (5). Halle's (1983) phonological units are imbued with phonetic substance, though. Therefore, like all other generative incarnations of distinctive features since Halle *et al.* (1952), they are incompatible with SFP.

Reiss & Volenec's statement under (63) is also a correct description of SFP, since a "highly indirect relation to phonetic substance" could also refer to spell-out. After having quoted Halle's (1983) text under (34) as well as other views from the generative literature along the same lines, Reiss & Volenec say that they walk in the footsteps of this generative tradition:

(64) "Continuing this tradition and sharpening its main claim about the neural reality of features, we adopt the cognitive-neuroscience framework proposed by Gallistel and King (2009).³⁶" Reiss & Volenec (2022: 16)

This is not the case, though: their work is head-on opposed to the Prague school > Halle *et al.* (1952) > generative phonology lineage. That's the whole point of SFP. Rather, the tradition they and SFP represent is the one craved by the righteous: Baudouin de Courtenay, Saussure, Hjelmslev, Lamb, Lockwood, Fudge. This view was fought by the structuralist establishment since day one, albeit in a way that aimed at creating the illusion of instantiating it (have your cake and eat it too). The sin was admitted only occasionally, and then wholeheartedly embraced since it was thought that there is no alternative. The Saussurian view then went extinct in generative times when the structuralist view on the matter was radicalized, and reappeared only in 2000 when Mark Hale and Charles Reiss published their article on *substance abuse* (Hale & Reiss 2000), which founded SFP.

8. Conclusion

The goal of this article has been to show that the reason why the righteous were dismissed and the field (structuralist and generative alike) engaged in sin was that either nobody had thought of spell-out (5) (structuralists), or spell-out was explicitly dismissed (generativists). Spell-out is a true way of having your cake and eating it too, though: yes, phonological units may be referred to by phonetic properties (so everybody knows which one is which), but these properties are absent from the phonology. The righteous Baudouin de Courtenay, Hjelmslev, Lamb (along with other representatives of Stratificational Grammar) and Fudge set up the full programme of what today is called SFP.

Baudouin de Courtenay (section 4.1) says that the phoneme is the "psychological equivalent of speech sound", that it is associated to a phonetic (articulatory and acoustic) correlate, and that it is emergent.

Hjelmslev (section 4.2) views linguistics as an algebra of language (referring to Saussure's algebra). For him, phonemes are "unnamed entities, i.e., arbitrarily named entities

³⁶ Gallistel & King (2010) (rather than 2009, I think) work out what could be the general workings of Fodorian modularity in the cognitive system and its relation to the brain. Among other things, the authors are concerned with memory, learning and computation. The latter especially relates to phonology.

without natural designation". They are therefore called *cenemes* (from Greek *κενός* "empty") and "receive a motivated designation only on being confronted with the substance." The relationship of phonological and phonetic items is arbitrary and conventional. In Hjelmslev's view, phonology has no clue that there is phonetics, or that it eventually will be externalized in phonetic terms: "linguistics describes the relational pattern of language without knowing what the relata are." Finally, externalization by the vocal modality is accidental: any other modality (e.g. sign language) will do.

According to Lamb (and other representatives of Stratificational Grammar, section 6.3.1), language is organized in different computational systems, strata (today called modules), which work on their own specific vocabulary. The phonological stratum is made of phonemes which, following Saussure, are unnamed entities whose only linguistic content is their relationship with other phonemes. The labels assigned to them only exist in order to be able to talk about them. There is computation among units of a given stratum, called tactics, and communication among strata is done through realization: a phoneme is realized as some phonetic item.

Fudge (section 6.7) excludes that acoustic or articulatory properties could be present in phonology: "[i]t is thus dangerous and misleading to say that either articulatory or auditory features ARE the phonological elements". He "emphasize[s] that phonological elements are in themselves not phonic in any way" and therefore refers to them as A, B, 1, 2, a, b etc. in explicit reference to Hjelmslev's *cenemes*. These units are transformed into phonetic items by spell-out, which he calls articulatory rules.

Spell-out has two crucial properties (see section 2.1): it is list-based (rather than a computation: there is no algorithm transforming an input into an output), and the relationship between the items of the two distinct vocabularies associated by a spell-out instruction is arbitrary. As far as I can see, the former property is made explicit by none of the righteous, although it echoes in their writings. I could find the latter property explicitly mentioned only by Hjelmslev (see (22)): "the relationship between form and substance is entirely arbitrary and purely conventional." Elsewhere it remains implicit. This notwithstanding, all righteous authors have set up a spell-out mechanism, which is inescapable once alphas and betas are recognized as the units of phonology.

In conclusion, despite the voice of righteous Cassandras, the field was pushed into sin because its protagonists did not think of (structuralists) or considered but dismissed (generativists) a workable alternative to having phonetic content in the phonology. It is to the credit of SFP that this gap is now closed: spell-out finally allows us to make good on Saussure's promise.

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