CHAPTER 2

ABSTRACT ELEMENTS IN PHONOLOGY

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2.1. Abstraction in analysing data

Any scientific description involves an amount of abstractness. When the chemist classifies water, snow, ice and steam as "water", he ignores their temperature and state, and considers only one feature to be relevant: the chemical composition H_2O. This is the **distinctive feature** serving as the label of the category, while their being liquid or solid or falling in flakes are considered **redundant features**, being of secondary importance.

Abstractness in phonology means that we suppose the existence of segments that are more or less different from the surface (i.e. from phonetic facts).[1]

2.2. The phoneme and its allophones

Let us take the example of English /l/ to discuss phonological abstraction. The two kinds of L-sound, Clear-L and Dark-L are both articulated as lateral sonorant consonants, but

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[1] At all levels of language we find this duality of concrete vs. abstract: physically realizable, concrete data (allophones, morphs, word forms) versus their abstract equivalents (phonemes, morphemes, lexemes). Compare:

Concrete	↔	**Abstract**
sound, allophone	↔	phoneme
morph, allomorph	↔	morpheme
word form, syntactic word	↔	lexeme

- Clear-L, phonetically [l] *(leg)*, is pronounced with the tongue body in neutral position;
- Dark-L, phonetically [ɬ] *(belt)*, is velarized: the back of the tongue is raised towards the velum (the [o] position).[2]

These are the phonetic facts. But what does the phonologist say? How do we analyse this state of affairs?

2.2.1. The standard solution

The distribution of Clear-L and Dark-L is complementary. They are allophones, the realizations of an abstract category, a phoneme, which we represent as /l/. Any phoneme is an abstraction compared to the actual sounds. You cannot pronounce a phoneme:[3] you can only pronounce an allophone, either Clear-L or Dark-L. The phoneme is, perhaps, more than a sound; it is the sum of its allophones: /l/ = [l] + [ɬ]. The actual sounds (= allophones) are derived from the phoneme by means of rules. The standard solution is an "L-Darkening Rule":

(1) **L-Darkening Rule**

/l/ → [ɬ] / __ ⎧(#)C⎫ = the phoneme /l/ is pronounced "dark" (= velarized) when followed by a consonant in the same or in the next word, or by a pause.
⎩ ‖ ⎭

[l] / elsewhere = the phoneme /l/ is "clear" (= not velarized) elsewhere.

2.2.2. Alternative solutions

(a) Let us point out that we could have chosen Dark-L to be the basic alternant of this phoneme, saying that underlyingly all English L's are dark, and they become clear by an "L-Clearing Rule" when followed by a vowel.

(2) **L-Clearing Rule**

/ɬ/ → [l] / __(#)V = the phoneme /ɬ/ is pronounced "clear" (= unvelarized) when followed by a vowel in the same or the next word.

[ɬ] / elsewhere = the phoneme /ɬ/ remains "dark" (=velarized) elsewhere.

Rules (1) and (2) are equally logical and scientifically correct. It is arbitrary which allophone we choose to represent the whole phoneme, i.e. in which direction we abstract away from the phonetic data. It is for practical reasons (simpler typography!) that we normally choose Clear-L to be the basic alternant, and speak of L-Darkening rather than L-Clearing.

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[2] In some positions English /l/ had become so "dark" (= so much like an [o]) that it was historically absorbed in the previous *a* or *o*, and disappeared from pronunciation, remaining only in spelling as a silent letter: *talk, walk; folk, yolk* and *half, calves, balm, Holmes, Stockholm*. Note that the consonant following this "absorbed" silent L is always noncoronal.

[3] We often get round this problem by pronouncing the name of the alphabetic letter which the phoneme is normally spelt with, so we say "the L phoneme", or "the Double-U phoneme" for /w/, the "voiced TH phoneme" for /ð/; or we use traditional names like "yod" for /j/ or "schwa" for /ə/.

(b) It would be equally logical to use a third symbol for the phoneme, one which is neither clear nor dark, for example capital /L/, and say that the abstract (and therefore unpronounceable!) phoneme /L/ is realized in two ways, either as Clear-L or as Dark-L, according to its position. This is probably closer to psychological reality: when learning English (either as mother tongue or later), people do not lexicalize L as clear or dark, but store a general L in their mental lexicon,[4] and pronounce it as clear or dark as appropriate. Of course certain L's will always turn up as clear (before a vowel inside the word, *leg*), others always as dark (before a consonant, *belt*), while final L's will alternate *(tell me – tell it)*, but this does not weaken the argument. This "general L" is less specified than its allophones, being unspecified for clearness or darkness, having only the characteristics "lateral sonorant consonant".

This leads us to turn round our previous statment (2.2.1) that a phoneme is more than a sound; actually, a phoneme is less than a sound, because it has fewer features – just like, say, a mammal is less than a horse, or H_2O is less than snow, ice, etc. The higher the category, the less specified and more abstract it is.

(c) A different solution is offered by **Generative Phonology**. This approach says that any variant can be taken as the underlying one if, by applying the right rules in the right order, we can **derive** the required surface pronunciation. The rules will then "map" the underlying form of words onto their surface form, that is, they convert phonemes into speech sounds.

The derivation in (3) shows L-darkening (as well as other rules: Aspiration and Unstressed Vowel Reduction, to make the picture more complete).

(If a sound is affected, the changed sound is written under its starting form. The rules appear between the two horizontal lines. n.a. = not applicable.)

(3) Generative derivation: an example

Spelling:	*leg*	*belt*	*tell us*	*tell me*
Underlying Represent. (=UR)	leg	belt	ˈtelʌs	ˈtelmi
L-Darkening	*n.a.*	ɫ	*n.a.*	ɫ
Aspiration	*n.a.*	*n.a.*	tʰ	tʰ
Unstr'd Vowel Reduction	*n.a.*	*n.a.*	ə	*n.a.*
Surface Representation (=SR)	[leg]	[beɫt]	[ˈtʰeləs]	[ˈtʰeɫmi]

As we see, the L-Darkening Rule applies to *belt* and *tell me* (but not to *leg* or *tell us*, where the /l/ is before a vowel). The Aspiration Rule applies to the /t/ of *tell* (but not *belt*, where it is final). The Unstressed Vowel Reduction Rule applies to *us* (but not to *me*, because final /i/ is never reduced to /ə/).

[4] Interestingly, this is exactly what English spelling does: it uses the same letter *L* for both variants.

2.3. Natural classes

Consider the distribution of English [h] (the glottal fricative) and [ŋ] (the velar nasal).[5]

(4)	**Before vowels __V**	**Before consonants __C**	**Word-finally __#**
[h]	**h**am, **h**istorical, be**h**ave	NEVER	NEVER
[ŋ]	NEVER[6]	ba**n**k, a**n**ger, Hu**n**garian	si**ng**, belo**ng**, to**ng**ue

If we follow the principle of complementary distribution, we'll have to say that [h] and [ŋ] are allophones of one phoneme! This is counter-intuitive and ought to be avoided. We may point out that [h] and [ŋ] are not similar enough to be allophones of one phoneme – but this might sound vague and impressionistic, for what is "similar"? To put it more precisely, we say that they do not form a **natural class**: they do not share any feature which would not be shared by other sounds. Their only common feature is that they are both consonants; but that is not unique to them, as there are many other consonants. The allophones of a phoneme must exclusively share at least one distinctive feature (or feature-combination) not shared by other sounds. In the case of [l] and [ɬ] this feature was [+lateral], since no other sounds share this manner of articulation. The sounds [h] and [ŋ] do not satisfy this "**exclusive similarity**" requirement, so they must be analysed as two distinct phonemes even though they are in complementary distribution.

2.4. Neutralization

There are cases where two phonemes behave like allophones. Consider English /s/ and /ʃ/. These are phonemes, producing minimal pairs: ***s****o* – ***sh****ow*, *mas**s*** – *mas**h***, *par**c**el* – *par**t**ial*, *(uni)ver**s**al* – *(contro)ver**s**ial*, etc. But there is one position in which their appearance is predictable: at the beginning of a word when followed by a consonant (the "initial-preconsonantal" position):

(5) Distribution of /s/ and /ʃ/

Position		**[s]**	**[ʃ]**
initial-preconsonantal (not *r*)	#__$C_{\text{not } r}$	stub	*NEVER*
initial-preconsontl. before *r*	#__r	*NEVER*	shrub

The symbolization "#__$C_{\text{not } r}$" means "before any consonant except /r/": in this position only /s/ can occur *(stub)*, because there are no English words beginning with /#ʃt-/, /#ʃm-/, etc. On

[5] Remember that orthographic *h* is silent before a consonant or word-finally, so words like *John, Sarah, shah, Noah* do not have [h] (BEP 4.41).

[6] There are words in which [ŋ] is before a vowel, but these are all made up of free stem plus suffix, so they do not belong here, e.g. *sing#er* [ˈsɪŋə], *slang#y* [ˈslæŋi]. A real irregularity is *hangar* /ˈhæŋə/.

the other hand, when the second consonant is /r/, only /ʃ/ can occur *(shrub)*, because there are no English words beginning with /#sr-/. This is complementary distribution. In this position /s/ and /ʃ/ do not contrast: their opposition is **neutralized**.

Here are some further examples of neutralization.

- /n/ and /ŋ/ are phonemes *(sin ↔ sing)*, but are neutralized before velars (/k, g/), where only /ŋ/ can appear *(bank, anger)*.
- /s/ and /z/ are phonemes *(seal ↔ zeal, rice ↔ rise)*, but are neutralized word-finally after an obstruent consonant, with which they have to agree in voicing (*backs* /s/ but *bags* /z/).
- /ʊ/ and /u:/ are phonemes *(look ↔ Luke, pull ↔ pool)*, but are neutralized word-finally, where only /u:/ can appear *(bamboo, menu, continue)*.[7]

Neutralization means that two phonemes suspend their contrast in a particular position. In this **neutralizing environment** the two sounds behave like allophones.

The /s/ – /ʃ/ problem is different from the /h/ – /ŋ/ problem because [s] and [ʃ] are really similar sounds, forming a natural class: they (and only they) are the voiceless alveolar fricatives of English. How can we answer the problem of their behaviour?

2.4.1. The taxonomic handling of neutralization

In introductory courses and practical dictionaries the **taxonomic** (or "phoneme-inventory") approach is followed (BEP 2.18). This is based on minimal pairs: if two sounds contrast in at least one minimal pair in the language, they are declared to be phonemes of that language, and are represented as phonemes in all other words. This is the "once a phoneme, always a phoneme" principle. Because [s] and [ʃ] do contrast elsewhere *(so–show)*, they are different phonemes (separate members of the phoneme inventory of English, the "taxonomy"); and they are analysed as such even in those neutralizing environments where they do not contrast. A [ʃ] sound always represents an underlying /ʃ/, so *shrub* is transcribed as /ʃrʌb/ (as if a contrasting */srʌb/ was possible).

This representation is logical, but it pretends that the /s/ ↔ /ʃ/ contrast is valid everywhere, even though in certain places it remains "unexploited" by the language. Such a solution is **surface-oriented**: it says that *shrub* is pronounced with /ʃ/ simply because it is represented in the lexicon with /ʃ/. This gives the wrong impression that it is an **accidental gap** in the lexicon of English that no words begin with /sr-/ and no words begin with /ʃ/+other consonant. The taxonomic approach then, can be criticized because it **misses a generalization**.[8]

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[7] Similar neutralizations from Hungarian:

- *n* and *ny* are phonemes *(kén* 'sulphur' ↔ *kény* 'whim'*)*, but are neutralized before *ty, gy*, where only *ny* can be pronounced: *hangya* [hanygya] 'ant', *pinty* [pinyty] 'finch'.
- *o* and *ó* are phonemes *(kor* 'age' ↔ *kór* 'illness'*)*, but are neutralized word-finally, where only *ó* can appear: *olló* 'scissors'.

[8] Hung. 'szem elől téveszt egy általánosítást'.

2.4.2. The generative handling of neutralization

We can handle the *stub/shrub* problem in a generative framework by assuming /s/ to be the underlying phoneme in all word-initial consonant clusters, so *shrub* would be UR //srʌb//. (We shall include in double slants //...// those UR forms that are different from the usual transcription.) Now we have to introduce a rule turning this UR /s/ into [ʃ] before /r/. This is the **S-Cluster Adjustment Rule**. It is not different from allophonic rules (e.g. L-Darkening) because it has no exceptions.

(6) S-Cluster Adjustment Rule

/s/ → [ʃ] / #__r *shrub* //srʌb// → /ʃrʌb/

A sample derivation involving this rule appears below:

(7) Generative derivation of words beginning with /s/ or /ʃ/ + Consonant

Spelling:	*so*	*show*	*stub*	*shrub*
U. R.	soʊ	ʃoʊ	stʌb	srʌb
S-Cluster Adjustment	*n.a.*	*n.a.*	*n.a.*	ʃ
S. R.	[soʊ]	[ʃoʊ]	[stʌb]	[ʃrʌb]

This mapping correctly expresses that in *stub/shrub* the /s/ ~ /ʃ/ choice is predictable (= rule-governed), as it is in allophonic rules. The generative approach recognizes that contrast can be locally determined, i.e. it is valid in some places but not in others.

2.5. Lexical representation: the problem of Vowel Shift

Lexical representation means the string of phonemes with which a word (or morpheme) appear in the lexicon, the mental "dictionary" of speakers. For example, *coach* is represented lexically as 3 phonemes, /k–oʊ–ʧ/. Allophonic detail is not included, namely that this /k/ is aspirated, this /oʊ/ is clipped, and this /ʧ/ is preglottalized, because all this is predictable.

2.5.1. The taxonomic handling of Vowel Shift

Many stems are pronounced in two forms, with a tense vowel and with a lax one: *gr**a**ve ~ gr**a**v-(ity)*. This is called Vowel Shift[9]. What could be their lexical representation? The /eɪ/ ~ /æ/ alternation cannot be regarded as allophonic alternation, since – as shown in (8b) – the same vowels are elsewhere opposed, producing minimal pairs.

[9] See BEP 8.17-19 for details.

(8) Vowel pairs in Vowel Shift and in minimal pairs

Vowel pairs	*(a) in Vowel Shift*	*(b) in minimal pairs*
/eɪ/ ~ /æ/	gr**a**ve – gr**a**v-ity	cape ↔ cap
/i:/ ~ /e/	m**e**tre – m**e**tr-ic	feel ↔ fell
/aɪ/ ~ /ɪ/	t**y**pe – t**y**p-ic-al	mile ↔ mill
/oʊ/ ~ /ɒ/	s**o**le – s**o**l-itude	road ↔ rod

Once a phoneme, always a phoneme, says the taxonomic school: in that approach Vowel-Shift must be regarded as alternation between phonemes, that is, **allomorphic alternation**, which assumes that these stems simply have two different lexical representations (just like *foot–feet* or *teach–taught*), from which the speaker chooses the appropriate form. But while *foot* and *teach* are really irregular, the vowel-shifting stems like *grave* behave quite predictably. So once again we see that the taxonomic approach is logical and disciplined, but it misses a generalization by treating *grave–gravity* the same way as *foot–feet* or *teach–taught.*

2.5.2. The generative handling of Vowel Shift

The way Vowel Shift is presented at a practical level (so in BEP) is actually a generative solution, suggesting that in *grave~grav-* the vowel is some abstract element which is realized as /æ/ in a laxing environment *(grav+ity, grav+itate)*, but as /eɪ/ elsewhere *(grave, grav#est, grave#ly, grave#ness)*. Let us symbolize this abstract vowel as //A//.

(9) Abstract Vowel Realization Rule in Vowel-Shift

//A// → /æ/ / in a laxing environment (Trisyllabic Laxing, Laxing Suffix, etc.)
→ /eɪ/ / elsewhere

There are four such abstract vowels, symbolized with letters of the alphabet (very much as it happens in English spelling!), in capitalized form. The absract vowels each have two "daughter" phonemes. They are listed in (10), with their properties. You will note that the properties are very vague if they are to embrace both "daughters" of the abstract phoneme.

(10) **lexically =UR**	**phonemically = SR**	**properties of the abstract vowel**
//grAv//	/greɪv/ ~ /græv-/	//A// = front, nonhigh/high?
//mEtr//	/mi:tər/ ~ /metr-/	//E// = front, nonlow?
//tIp//	/taɪp/ ~ /tɪp-/	//I// = nonback, nonmid?
//sOl//	/soʊl/ ~ /sɒl-/	//O// = back, nonhigh?

In this approach *cape, favourite, basic* have lexical /eɪ/, and *cap, parody, matter* have lexical /æ/, because they do not undergo Vowel Shift; their vowel is stable (= non-alternating). Stems

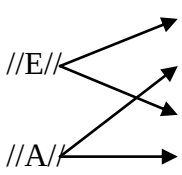
with alternating vowels, like *grave, nation, vain* have lexical //A//, so //grAv//, //nAʃən//, //vAn//.[10]

(11) Nonabstract and abstract vowels – an example

spelling	UR	SR	
cape, favourite, basic	/eɪ/	/eɪ/	– nonalternating stems
cap, parody, matter	/æ/	/æ/	– nonalternating stems
grave, nation, vain } gravity, national, vanity }	//A//	/eɪ/ ~ /æ/	– alternating stems

This solution has a weakness: the abstract vowels //A, E, I, O// listed above do not have well-definable features that would distinguish their "daughter phonemes" on the basis of exclusive similarity (see 2.3 above). For example, the abstract element //A// in the lexical representation of *grave, nation, vain,* etc., has the daughter phonemes /eɪ/ and /æ/, of which [æ] is a low vowel, while the diphthong [eɪ] starts with mid [e] and ends with high [ɪ]. Unfortunately these properties cross over with the daughters of abstract //E//, namely /e/ and i:/ (the lexical representation of *metre–metric, severe–severity,* etc.). The diagram below shows that the vowel-height of the abstract vowels //A// and //E// cannot be specified exclusively, since their realizations cross over:

(12)



/i:/ *metre* — high vowel
/eɪ/ *grave* — mid-high vowel
/e/ *metric* — mid vowel
/æ/ *gravity* — low vowel

We must conclude that the abstract "vowels" in (10) are too vague and too cross-positioned to be proper phonological segments. They are useful as morpho-phonological abbreviations expressing the working of Vowel Shift in that stem.

Another solution would be to arbitrarily pick one "daughter" to be the underlying segment (say, /eɪ/ for *grave*) and turn it into the other when necessary (so *gravity* would be UR //greɪvəti// → SR /ˈgrævəti/); but the problem with this would be that there are cases like *basic* /ˈbeɪsɪk/ (and not */ˈbæsɪk/), *obesity* /oʊˈbiːsəti/ (and not */oʊˈbesəti/), where Vowel Shift fails to take place without apparent reason. These are called "**lexical exceptions**" because their sound shape does not explain their not undergoing a rule. They show that the rule is not a real phonological one, because a pronological rule (like L-darkening) never has any exceptions.

All in all, Vowel Shift has to be regarded as an 80 per cent reliable **morpho-phonological tendency**. True, the spelling usually has the same vowel-letter for the alternants, so

[10] An analogous Hungarian example is provided by stable vowels such as *gyár ~ gyárak* 'factory/ies' (lexical /a:/), *nyak ~ nyakak* 'neck/s' (lexical /ɔ/), as opposed to stem-internal shortening vowels such as *nyár ~ nyarak* 'summer/s' (lexically an abstract vowel, perhaps /A/).

the letters *a, e, i, o* act practically like abstract underlying segments – but the existence of lexical exceptions undermines the phonological status of Vowel Shift.

Study this table carefully:

(13) Various types of alternation

Example	Type of alternation	Do they ever contrast?	Do they have exceptions?	Is the choice predictable by rule?	UR
[l]~[ɬ] leg~felt	allophonic	**NO**	**NO**	yes, everywhere	/l/
[s]~[ʃ] stub~shrub	phonological	yes	**NO**	yes, in a particu-lar position	/s/~/ʃ/
[eɪ]~[æ] grave~gravity	morpho-phonological	yes	yes	80 % certainty, but has lexical exceptions	//A// ? /eɪ/~/æ/
[ʊ]~[iː] foot~feet	morphological	yes	all these are exceptions	no	/ʊ/~/iː/

2.6. Representations and rules

The phonology of a language is made up of representations and rules. By **representations** we mean the phoneme strings of the words and morphemes in the lexicon; by **rules** we mean the transformations that turn these underlying representations into surface pronunciation. This chapter was about making representations more abstract in order to deprive them of unnecessary (because predictable) detail. The predictable detail is furnished ("fleshed out") by the rules, as shown in (17).

- Column (a) gives the actual pronunciation in a fairly "narrow" phonetic script.
- Column (b) gives the traditional taxonomic analysis (= Gimsonian transcription). Here only allophonic (= subphonemic, non-neutralizing) rules are needed.
- Column (c) gives a more abstract lexical representation, which has to be mapped onto the surface by various phonological rules, including the allophonic rules under (b). The unusual-looking transcriptions enclosed in double slants //...// in column (c) are not incorrect, they are just more abstract than the taxonomic-Gimsonian transcriptions in column (b). The derivation goes from (c) through (b) to (a).

If we use surface-close representations (as in the Gimson system), we need few rules; if we use more abstract ("impoverished") representations, we need many rules. The advantage of the more abstract representation is having a single underlying form for alternants of a given morpheme. Observe for example, that *atom* and *atom-(ic)* have a single underlier in Column (c) even though they are pronounced differently.

(14) Phonetic, taxonomical, and abstract-lexical representations

(a) Phonetic *Actual pro-nunciation*	**(b) Taxonomical Surface-close represent.** (explicit, rich, phonetic) **only alloph. rules needed**	**(c) Abstract Lexical representation** (implicit, poor, phonological) **phonological rules needed**
bank [bæ̃ŋk]	**/bæŋk/** – vowel nasalized bef. nasal	**//bænk//** – Nasal Place Assimilation /n/ → [ŋ]
bang [bæ̃ŋ]	**/bæŋ/** – vowel nasalized bef. nasal	**//bæng//** – Nasal Place Assimilation /n/ → [ŋ] – Postnasal-Final G-Drop /g/ → ∅
kissed [k^{h}ɪst]	**/kɪst/** – aspiration	**//kɪs+d//** – Voice Assimilation /d/ → [t]
each [iʔʧ]	**/i:ʧ/** – pre-voiceless clipping – preglottalization	**//i:ʧ//**
beer [bɪ:]	**/bɪə/** –smoothing of broken diph.	**//bi:r//** – Pre-R Breaking /i:/ → [ɪə] – R-Dropping /r/ → ∅
atom [ˈætəm]	**/ætəm/**	**//ætɒm//** – stress assignment – Unstressed Vowel Reduction /ɒ/ → [ə]
atomic [əˈt^{h}ɒmɪk]	**/əˈtɒmɪk/** – aspiration	**//ætɒmɪk//** – Stress fixed by suffix *-ic* (atómic) – Unstressed Vowel Reduction /æ/ → [ə]
gravity [ˈgrævəti]	/ˈ**grævəti**/	**//greɪvɪtɪ//** – stress assignment – Trisyllabic Laxing /eɪ/ → [æ] – High Vowel Tensing /-ɪ/ → [-i] – Unstressed Vowel Reduction /ɪ/ → [ə]

We have shown that an abstract representation, which needs complex rules to map it onto the surface, is more economical and often more insightful than the "rich" (i.e. surface-close) representations used in introductory textbooks and practical dictionaries.

END OF CHAPTER 2